MANAGING FOR EXCELLENCE:

ANALYSIS OF WATER AND WASTEWATER UTILITY MANAGEMENT SYSTEMS

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INTRODUCTION

EPA's Office of Water is working with wastewater and water utilities to promote the adoption of innovative management system approaches to ensure organizations are sustainable into the future. This effort is an important part of EPA's overall effort in collaboration with industry to ensure that the Nation's water and wastewater infrastructure is sustainable through more effective utility management. Effective utility management contributes to infrastructure sustainability by institutionalizing management systems and other innovative approaches which can lead to reduced infrastructure costs and improved performance across a full range of utility operations.

As part of this effort, profiles of eight leading utilities were prepared to document the types management systems in place at these utilities, the drivers to implement those systems, costs and benefits, successes and challenges, and roles that various stakeholders can and do play in the process of developing and implementing the system. Drawing on information from eight profiles, analyses were conducted to explore trends, common themes, or other insights that emerged from the profiles. This material helped to set the stage for a 2-day conversational meeting with water and wastewater utility managers, water sector trade associations, and EPA on ways to promote sustainable management approaches by utilities.

This report includes the Cross-Cutting Analysis and eight utility profiles. The Cross-Cutting Analysis aims to identify commonalities among current management practices of leading utilities. The analysis draws largely from the profiles which were based on interviews with utility managers and research.

The utilities profiled were identified as industry leaders through informal peer consultation. As recognized leaders, EPA invited the utilities to participate in the profiling process and each one voluntarily agreed to discuss and share information about their management practices. Each utility reviewed their profile for accuracy and completeness.

The Cross-Cutting Analysis that follows is divided into six sections covering an Overview; Management System Development Efforts; Performance and Benefits Measurements; Drivers for Change to Management Systems; Barriers and Challenges to Management Systems; and Management System Resource Requirements. The utility profiles are presented in the eight appendices.

I. Overview of Utilities

The eight utilities profiled provide water, wastewater, or combined services. A cross-section of utilities was chosen to represent a wide range in size, budget, type of services provided, geography, and management initiatives undertaken. These utilities were identified as leaders in the industry for their sustainable management approach through progressive management systems.

The following table highlights the distribution of characteristics among the utilities profiled (presented in order of average MGD).

Utility	Geography	Water / Wastewater	Average Wastewater Flow	Average Water Flow	Residential Population Served
Orange County Sanitation District	West	Wastewater	238 MGD	-	2.1 million
Santa Clara Valley Water District	West	Water	-	217 MGD	1.7 million
San Diego Metropolitan Wastewater Department	West	Wastewater	180 MGD	-	2.2 million
Seattle Public Utilities	Northwest	Water	-	140 MGD	1.3 million
Charleston Commissioners of Public Works	Southeast	Combined	37 MGD	50 MGD	200,000 / 400,000
Madison Metropolitan Sewerage District	Midwest	Wastewater	41 MGD	-	318,000
Eugene Public Works Department, Wastewater Treatment Division	Northwest	Wastewater	38 MGD	-	220,000
Shelby, N.C. Environmental Services Division	Southeast	Combined	3 MGD	3 MGD	19,000

Infrastructure

In profiling such a diverse collection of utilities, infrastructure characteristics are varied. Some utilities provide wastewater collection and water distribution and therefore have extensive piping systems, whereas others are wholesalers that only control main lines. For example, Seattle Public Utilities manages a wastewater collection system (but King County manages the wastewater treatment), and on the other side, Madison has wastewater treatment, but local municipalities maintain the collection system. For many of the utilities, the original assets are 80-100 years old, but much of the infrastructure has been replaced or upgraded in the last several decades. In just a few utilities, treatment plants are relatively new (10 or fewer years old), but most piping is significantly older.

Governance

All of the utilities have some type of oversight through a board, city council, or city mayor/manager, however there is a range of the degree of autonomy and control of utility functions, particularly with respect to budget and rate setting. Utilities' governance and organizational structures can generally be characterized in two ways.

First, there are those utilities that are divisions of a larger city department or agency. In these utilities, business support functions, such as planning, human resources, and finance are typically separate divisions that fall outside the organizational boundary of the utility. These utilities manage to given or adopted budgets. For instance, the Eugene Wastewater Treatment Division is part of the larger Public Works Department and therefore shares resources and functions with other parts of the Department.

Second, there are utilities that are an autonomous entity of local government with their own business support functions and budget setting processes. For example, Santa Clara Valley Water is a relatively autonomous wholesaler with a Chief Operating Officer responsible for most of the agency's functions.

II. Management System Development Efforts

A. Types of Management Systems and Other Formal Initiatives

The eight utilities profiled have collectively implemented (or are in the process of implementing) the following management systems or other formal initiatives.

- ISO 14001 Environmental Management Systems (EMS)
- National Biosolids Partnership EMS
- Optimized Asset Management Plans and Programs
- Capacity, Management, Operations, and Maintenance (CMOM) Programs
- Strategic Business Plans
- Balanced Scorecard
- APWA Accreditation Program
- QualServe
- Partnership for Safe Water
- Bid-to-Goal
- Pay-for-Performance

The management systems and other formal initiatives can be loosely grouped and described in the following manner.

Strategic Planning Systems and Tools (e.g., Strategic Business Plans)

Several of the utilities have adopted strategic business plans and unifying business strategies that define a "balanced" set of high-level organizational goals, priorities, and strategies across key management outcome areas (such as financial, customer, operational, and environmental performance).

Formal Management Systems (e.g., EMS, Asset Management)

All of the profiled utilities have adopted environmental management systems (EMS) and/or asset management systems. While focused on different outcomes and utilizing a different set of tools, both provide mechanisms for setting objectives, routinely collecting and analyzing data, making improvements in desired areas, and checking for adjustments and improvements over time (i.e., they embrace an explicit "plan, do, check, act," continual improvement management approach).

Best Practices Implementation (e.g., APWA Accreditation, QualServe)

Several utilities have adopted and/or are benchmarking against best practices for the industry. Benchmarking provides a comparison to peer utilities across the country that can help in setting objectives and targets. Best practice initiatives provide for operational efficiencies and means for achieving identified improvements. Best practices are often adopted under management system standard operating procedures. Some best practice initiatives, like the program sponsored by APWA, also include a formal accreditation component.

Beyond Compliance Performance Programs (e.g., Partnership for Safe Water)

At least one utility is participating in the Partnership for Safe Water, which defines beyond compliance performance targets for drinking water quality.

Employee Incentive Programs (e.g., Pay-for-Performance)

Several utilities have implemented programs that seek to reward employees for achievement of organizational objectives and targets defined in strategic business plans and/or management systems.

Service Level Definitions and Agreements (e.g., Bid-to-Goal)

Several utilities have developed definitions and agreements about service level provision. This is done through a program like Bid-to-Goal, in which a public service agreement is developed, or through defining service levels as part of asset management or EMS planning.

The following table lists the management systems and other formal initiatives undertaken at each of the utilities profiled.

Utility	Systems and Initiatives
Charleston	ISO 14001 EMS, CMOM, Partnership for Safe Water, Balanced Scorecard (under consideration)
Eugene	ISO 14001 EMS, APWA Accreditation, Balanced Scorecard (under consideration)
Madison	Strategic Planning Initiatives, Asset Management, National Biosolids Partnership EMS
Orange County	Asset Management, National Biosolids Partnership EMS, Unifying Strategies
San Diego	ISO 14001 EMS, Strategic Business Plan, Bid-to-Goal, Pay-for-Performance
Santa Clara	Asset Management, ISO 14001 EMS, Balanced Scorecard/Strategic Planning, Assessments Using the Malcolm Baldrige National Quality Program Criteria
Seattle	Strategic Business Plan, Asset Management, formal EMS (for one treatment plant)
Shelby	ISO 14001 EMS

B. Implementation Approaches

Utilities have employed a variety of approaches to implementing, expanding, and/or integrating management systems and other formal initiatives.

Enterprise Wide Fenceline

Strategic plans and asset management tend to be enterprise-wide from the start. For example, Seattle's strategic business plan and asset management program cover the entire utility, including all divisions. Environmental management systems, like the EMS developed by the Charleston Commissioners of Public Works, can also include the entire enterprise.

Strategic planning is usually enterprise-wide because it is typically a top-down effort initiated at the highest level within an organization or is being driven by multiple divisions pushing for alignment between operations and initiatives. For example, Orange County middle managers were the force behind development of organization-wide Unifying Strategies (strategic plan) that are designed to balance priorities across areas and provide more consistency and clarity between initiatives.

Asset management is typically enterprise-wide because financial and capital decision-making structures often fall outside specific operational divisions. However, some utilities have addressed the collection of data for an asset management program one business unit or facility at a time.

Business Unit Fencelines

While some of the utilities had EMSs covering specific divisions and others were covering all operations, most of the utilities took an incremental approach implementing ISO EMS by starting with one business unit or facility and rolling out to other units over time. The following are examples.

- Charleston first developed an ISO 14001 EMS for the Water Distribution Division and eventually expanded the program to cover all of the divisions. Initially, separate ISO registrations were maintained for the different divisions. In 2002, all of the EMSs were incorporated together under one ISO registration.
- Shelby implemented an ISO EMS for wastewater treatment and then expanded to include the water system. One certification now covers the entire Environmental Services Division.
- San Diego implemented ISO EMS for three main operational divisions. They maintain separate EMSs and ISO certifications for their Operations & Maintenance Division as of 1999, Environmental Monitoring & Technical Services Division as of 2002, and Wastewater Collection Division as of 2004.

For Charleston and Shelby, the expanded fenceline approach resulted in one EMS covering all operations; while for San Diego, it resulted in three separate EMSs with distinct fencelines.

- Shelby and Charleston have found that having a single EMS provides for better unification and alignment between the goals and objectives of the different business areas. Managers also cited audit and management review efficiencies as a benefit.
- San Diego managers indicated that they have not yet seen enough advantage to unifying and including the business support divisions. There are not many environmental aspects and impacts in business support divisions. Also, there are discrete operations, aspects and

impacts, objectives and targets between the three different divisions that are covered. For San Diego, alignment between different divisional objectives happens in the Strategic Business Plan.

Utility managers cited several advantages of starting with one business unit and expanding the EMS fenceline, regardless of whether the result was one or several distinct systems.

- This approach allows the organization to "test it out" in a smaller venue, requiring less resources and fewer people to buy-in to the system.
- This approach also provides a way to demonstrate early success, which makes rolling out to other units easier in that others are more likely to get on board when the benefits and advantages of the system can be demonstrated.
- Utilities taking this approach were able to leverage procedures and tools developed in one division or unit as they implemented in additional divisions. Managers found that the same level of effort was not required for each new unit added. For example, Shelby took two years to implement an EMS for the wastewater program, but only six months for the water program.
- Utility managers noted the need to make sure systems and procedures will work for other divisions or business units, as it can be hard to take on another unit's systems and procedures.

Organizations implementing a National Biosolids Partnership EMS (Orange County and Madison) are required to include the "entire biosolids value chain" from pretreatment, treatment, and final use, thus essentially requiring the EMS fenceline to cover all aspects of biosolids management for an entire wastewater treatment division or department. However, since the fenceline for the NBP EMS program is drawn around biosolids management, final water effluent treatment processes and endpoints are not addressed.

Expanding Scope

Many of the utilities that have implemented an EMS or asset management have sought to expand the scope of outcomes or areas for improvement covered by their management system efforts. Utility managers expressed a sense that their management systems could be improved by expanding the scope by addressing additional areas for performance improvement such as financial management worker health and safety, human resources, and security. To help address this, several utilities are expanding their management systems to include efforts such as Balanced Scorecard or formal enterprise-wide strategic business planning, to help fill gaps in existing management systems.

- For example, both Eugene and Charleston are considering Balanced Scorecard as a way to expand current management systems to address other areas for improvement.
- Orange County implemented a National Biosolids EMS and developed an Asset Management Strategic Plan before developing the Unifying Strategies.

Systems Leading to Strategic Planning

Several of the organizations that have engaged in strategic business planning or developing unifying business strategies, notice a change in thinking from technical based problem solving to more strategic analysis and planning with the introduction of formal management systems. As the utilities became more invested in management systems, they found a need to develop broad strategies for aligning between different divisions and management systems. Many of the utilities interviewed indicated that future management system investments would head in the direction of

broadening outcomes covered by the management systems, increased alignment between systems and outcomes, and more enterprise-wide strategic planning.

Management System Hierarchy

Utilities that are implementing multiple management systems and initiatives typically have connected these through some form of management system hierarchy. Strategic business plans that define high-level organizational goals, priorities, and strategies for achieving them tend to sit at the highest level of the management system hierarchy. Strategic business plans are usually supported by some form of management system, such as EMS and asset management, that provide a continual improvement framework. However, a hierarchical end-state does not suggest a sequence of development, such as a strategic business plan preceding specific management systems. In fact, several utilities started with management systems which led to the formation of a broader based planning framework.

- For example, Seattle's management system hierarchy includes a twenty-year comprehensive plan that provides long term direction setting; a three-year strategic plan that sets the agency's objectives and targets in line with the comprehensive plan; and specific management systems to support the objectives and targets of the strategic plan. Each cascading level of management planning tool has a distinct set of measures that supports the objectives and targets at that level and above.

Employee Incentives

Several utilities have also linked the achievement of identified goals and objectives from EMS, asset management, and strategic business plans to employee incentive programs. This helps turn broad, organizational goals into tangible targets for employees and provides incentives for achieving those targets.

- For example, under San Diego's Pay-for-Performance program, employees receive monetary compensation (bonuses) for achievement of targets in their unit.

C. Key Attributes of System Effectiveness

Irrespective of the particular systems deployed, these utilities tended to share a set of common management system characteristics. In general, a sustainable management system enables the utility to meet the current needs of the community without compromising the ability to meet the needs of future generations. Beyond this, there are several specific attributes of management systems, as follows.

Continual Improvement

The most fundamental change utilities identify as they improve their management systems is the adoption of an explicit "plan, do, check, act" systems approach. This continual improvement framework is the backbone of many management systems such as EMS and asset management and drives utilities to more explicitly set objectives and targets, develop organizational strategies in response, measure performance, and close the loop by adjusting strategies in response to performance. All of the utilities profiled had a management system or systems built on the continual improvement framework.

Effective Balancing of Priorities Among Multiple Outcome Areas

Utilities have found a need to deploy management approaches that will allow them to effectively manage and integrate priorities across a range of management areas. In particular, agencies believed that their organization could "over steer" in one management outcome area in the absence of systems that balance priorities. These outcome areas can include capital improvement priorities, customer service levels, employee health, safety, and motivation, environmental performance, financial performance, and operational performance. Utilities have utilized a variety of strategic business planning tools, as well as "triple bottom line" sustainability frameworks to address this need. The following are some examples of frameworks that arrange utilities overarching goals.

- As part of the asset management program, Seattle requires a Project Development Plan (PDP) be conducted to apply triple bottom line analysis to compare the net present value of multiple project options. Factors in the PDP analysis include capital costs, full life cycle operation costs and benefits, social costs and benefits, and environmental costs and benefits.
- Several utilities use (or are considering) the Balanced Scorecard or a modified / tailored scorecard. For example, San Diego's Strategic Business Plan has the following framework.
  - Systems Operations and Maintenance
  - Capital Asset Management
  - Fiscal Management
  - Customer Service
  - High Performing Work Team
- Santa Clara's Balanced Scorecard is based on the Business Results category from the Malcolm Baldrige National Quality Program Criteria:
  - Products and Services
  - Customers
  - Financial
  - Human Resources
  - Organizational Effectiveness
  - Leadership and Social Responsibility
- Orange County's Unifying Principles have a similar, but unique organizing framework.
  - Environmental stewardship
  - Business principles
  - Workplace environment
  - Wastewater management
- Shelby's EMS program encompasses broad objectives and targets, including capital improvement programs and security efforts, such that the EMS acts as the primary planning tool to balance priorities.

Measurement

The profiled utilities bring a strong focus to measurement, establishing explicit, systematic measurement strategies built on the development of concrete objectives and targets connected to long-term organizational health as well as short-term operational consistency and efficiency. Consistent with a continual improvement culture, these utilities focus on regular review of objectives and targets typically presented in a summary, visual format with clear expectations for follow-up action as needed. (Significant further information on and examples of measurement is presented in Section III.)

Capital Investment Strategy

Many of the utilities have adopted optimized asset management strategies. These strategies, and associated management systems, seek to deploy risk based asset decision-making tools to efficiently allocate capital for long-term investments. These frameworks typically require justifying capital projects based on full life-cycle costs and draw on asset condition assessments and established service levels to evaluate the benefits and costs of higher or lower levels of investment.

- For example, Orange County relied on their asset management plan to successfully build a case for a 31 percent rate increase, which was approved by the governing board.
- Santa Clara maintains an Infrastructure Capital Asset Management Toolkit which includes a database that provides a 40 year funding forecast for anticipated replacement and overhaul, based on the estimated useful life of the assets. They also prepare and maintain annual, and 3 year and 15 year rolling maintenance plans which are initially based on the 40 year forecast but are revised based on a risk assessment that considers the actual condition of assets and their maintenance history. This allows priority setting for maintenance work and near term forecasting of anticipated maintenance costs for budgeting and rate setting purposes.
- Seattle used its asset management system to identify assets that could be most efficient (on a triple bottom line, life-cycle cost basis) to run to failure rather than perform preventative maintenance.

Environmental and Ecological Performance

The profiled utilities have tended to bring an explicit focus to environmental performance that goes beyond compliance with applicable standards to position the utility as a steward of water and other natural resources. The use of environmental management systems or their functional equivalent has been the driving force behind improvements in these areas which include more holistic water resource management, water conservation, solids and effluent reuse, materials recycling, and energy efficiency.

- Watershed Stewardship is embedded in Santa Clara's mission and Santa Clara has Board Policies and a Watershed Operations that balances flood protection, environmental benefits, and costs. Providing a "net positive" impact on the environment is integral to the mission and vision of "Getting Greener, Cleaner, and Leaner."
- Several utilities with EMSs, such as Eugene, have reduced vehicle fuel consumption, increased paper recycling, and reduced chemical use.
- Orange County is increasing their water reclamation to recharge local aquifers.
- Seattle has encouraged water conservation through incentive rebates for water efficient appliances and public education.

Employee and Community Involvement

Many of the profiled utilities had increased emphasis on participation by employees and communities (including customers) in setting objectives and targets and developing strategies to address them. Community input, obtained through surveys or public processes has been particularly directed at establishing customer service and environmental performance levels. Through their EMSs, several utilities, such as Charleston and Madison, have utilized community advisory committees to improve regular communication with the public.

Employee involvement often takes the form of cross-functional teams used during the planning and checking phases of the continual improvement cycle. Almost all of the profiled utilities have established some form of cross-functional team to support the management systems. A key facet of these teams is the ability to help break down organizational silos, providing a forum for different divisions and business units to work together. Such teams, and other forms of employee involvement, ensure that the management system becomes a regular part of doing business and not a series of documents left on a shelf. Many of the utilities indicated that the adoption of the management systems has lead to more employee empowerment and ownership, as employees are directly engaged (and at times directly rewarded for) generating improvement ideas that are forwarded to management.

D. Key Tools

Looking across the profiled utilities, there appears to be a set of underlying and similar set of tools and techniques utilized as part of their management systems.

Service Levels

Several of the profiled utilities have developed explicit service levels or standards. These levels act as the backbone for measurement efforts and help guide capital and programmatic investment decisions under asset management.

- For example, San Diego's Bid-to-Goal agreement with the local community establishes explicit service levels and provides a basis for comparing operations against private sector benchmarks.
- Orange County's core measures and targets for service levels articulate priority areas for investment and attention.
- Seattle is currently defining service needs through a written survey of customers' preferences.

Benchmarking

Most of the profiled utilities have used benchmarking to identify best practices and/or compare their performance in key areas to other utilities. This information forms the basis for establishing and/or revising performance targets and can aide the utility in defending performance or justifying the need for performance improvements and associated expenditures.

- Charleston participated in the QualServe Performance Indicators Survey in 2004.
- Seattle participated in an Australian based asset management benchmarking process.
- The Eugene Public Works Department, including the Wastewater Treatment Division, received APWA Accreditation in 2004.

Despite the widespread use of benchmarking, there are varying opinions about the value of benchmarking. Several utilities observed they see *performance* benchmarking as having limited value given the high degree of operational and community circumstance variability among utilities. Several utilities, however, indicated that *process-oriented* benchmarking was much more useful. Overall, many utilities felt that benchmarking (performance or process) within the U.S. water and wastewater utility industry did not fully reveal best practices for many functions. For utility specific processes, many utilities look overseas to Australia and New Zealand for best practices. Other utilities suggested looking to other industries for best practices. For example, to

identify top customer service, one utility recommended comparing performance to L.L. Bean's telephone service rather than to the utility industry.

Life-Cycle Costing

Several of the profiled utilities with optimized asset management systems are beginning to consider life-cycle costing to ensure decisions regarding projects and programs are evaluated over the lifetime of the project or program. Costs include initial development and construction costs, annual maintenance costs, social costs, and environmental costs. Benefits are also evaluated over the life of program/project.

- Seattle is one example where this practice has already been implemented for all capital programs. Seattle has a system that requires proposed capital projects to identify alternatives and compare the Net Present Value of each option based on life-cycle cost, and triple bottom line costs and benefits.

Auditing

Most of the profiled utilities use either internal and/or external auditing as part of their continual improvement process. Audits provide a rigorous review of operations and performance to manage system objectives and targets.

- To receive ISO EMS certification, Eugene, Shelby, Charleston, and San Diego completed external audits, and to maintain certification they receive periodic "surveillance" audits.
- Eugene's APWA process included an onsite evaluation by a panel of public works officials.
- Through the NBP EMS process, Madison and Orange County completed both internal audits and external third-party audits.
- Seattle conducts annual internal environmental performance audits.
- Santa Clara conducts internal and external audits to maintain ISO certification for its Capital Programs Services Division and Watershed Operations. Also, Santa Clara's Board of Directors has initiated an external Comprehensive Performance Audit of the District and incorporated the use of the Malcolm Baldrige National Quality Program Criteria as part of the audit.

III. Performance and Benefits Measurements

A. Measurement Systems

There is significant overlap of measures used at the utilities profiled, especially in areas related to environmental regulatory compliance, budgets and rate setting, and core operational services. This suggests that there is a solid core of what these utilities believe is important to pay attention to as well as to improve performance over time. There is also some similarity in the measurement systems employed. Most of the utilities profiled also have a series of core measures, that are typically enterprise wide and beyond the scope of any one management system, as well as measures that are specific to the management systems, such as EMS objectives and targets.

There are also many examples of measures that were used by only one or a few of the utilities. This diversity of measures results from a number of factors, including the varying approaches the utilities are taking in establishing management systems, organizational missions, and governance

structures. As well, many of the unique measures among the utilities reflect specific challenges dependent on climate, geography, mission, or community expectations.

Core Measurements

Most utilities have "core" measurements, indicator reports, or management dashboards that are usually enterprise or division wide, beyond the scope of any individual management system or program. These periodic (often quarterly) management measurements are usually reflected in or built into annual reports.

- Seattle's quarterly Performance Indicator Report corresponds to its Strategic Business Plan goal areas setting approximately 50 indicator targets to track over time. The report also includes easy-to-recognize achievement or failure symbols to rate the goal area.
- Eugene uses its bi-annual core measures as "exceptions reporting" aligned with the agency's mandate and regulatory responsibilities to flag major organizational or compliance problems. Around 50 measures cover its major departments and programs, such as labs, maintenance, operations and biosolids.
- Orange County develops monthly reports to board committees structured around the "triple bottom line" economic, social, and environmental performance indicators.
- Santa Clara is currently developing a 'CEO dashboard' to track key performance measures quarterly. Included in the CEO's dashboard are 23 key vision and mission index measures composed of leading indicators and lagging measures of results and outcomes.

Management System Measurements

All of the utilities have measures for specific management systems or initiatives to report program implementation progress and success. Management system measures tend to be operational-level measures.

- For Eugene, the EMS measurements track progress against targets specific to the EMS objectives, such as 'reduce fuel consumption by 10 percent' and 'reduce total solid waste by 15 percent'.
- San Diego tracks cost savings and avoided costs from resource and recycling savings recognized in their EMS.
- Orange County monitors capital replacement avoided costs identified by their asset management system.
- For their EMS, Charleston uses a monthly operating report to measure (among others), water turbidity, disinfectant chlorine use, and preventive and corrective maintenance.
- Madison tracks biosolids metals loading and classification, return frequency for fields receiving biosolids, and increasing employee and contractor awareness of their NBP EMS.

Balancing Tradeoffs

Measurement systems can be used to achieve an effective balance and explicitly manage the tradeoffs among service levels, operating and capital costs, and business risks. A number of utilities have used their measurement systems as a framework for addressing this balance with explicit service levels set and associated performance measures established. Measurement systems can be helpful not only for internal utility management, but also for educational tools for governing bodies, customers, and communities.

Measurement Evolution

For most utilities, the implementation of a formal management system and/or strategic plans led to increased measurement in terms of the number of measures, the rigor of evaluation, and the response to the measures. In many cases, except for annual reports, a limited number of performance measurements were in place before the utilities introduced management systems. Management systems and strategic business plans often led utilities to either identify core measures for the first time, or significantly change their existing core measures.

Governance Impact on Measurement

An organization's governance structure and procedures often determines what gets measured, particularly with respect to rates and budget setting processes.

- Eugene's Wastewater Division is part of a larger city public works utility and as such, does not control functions like human resources, budgeting, or engineering. Therefore, Eugene's Wastewater Division does not emphasize measurement of these functions.
- Santa Clara sets its rates cooperatively with its wholesale customers, through annual open public hearings and presents options for customer service and capital improvement levels. Santa Clara relies heavily on its asset management measurement system to build the business case for rate levels.

Mission Related Measurement

Organizational priorities drive utilities to tailor measurement approaches. For example, utilities may incorporate measurement system frameworks that directly reflect their organization's mission.

- Orange County's mission statement ("…to protect public health and the environment by developing, integrating, and implementing fiscally responsible solutions to wastewater, water reclamation, and watershed protection issues") drives Orange County to organize their Level of Service into the triple bottom line concept. A two-page report identifies key performance indicators and targets arranged by financial, environmental, and social aspects.
- Seattle's mission statement ("…protect public health and balance our social and environmental responsibilities to the citizens and community, while providing cost effective serves to our ratepayers") pushes Seattle to work toward incorporating triple bottom line ideas into their core measures. Already, they have instituted such accounting for project evaluation.

Situation Specific Measurement

All of the utilities employ some unique measures that are situation specific. For example, while almost all of the utilities had measures for water conservation, the utilities located in the arid southwest have also established measures and measurement systems for water reclamation. Utilities located close to populations tended to have more measures for nuisances, such as odor control.

B. Measures

Although the profiled utilities use different measurement organizing frameworks and have developed many unique measures, the measures utilities employ can be organized into six

general areas: Assets and Infrastructure; Customers and Community; Employees; Environment; Finance; and Business Operations.

Assets and Infrastructure

All of the utilities profiled have some measures related to assets and infrastructure. Common measures include asset maintenance tracking and asset performance measures, such as the ratio of planned maintenance to critical maintenance.

Those organizations that have engaged in optimized asset management have developed robust measurement systems in this category. The overarching goals for those utilities is meeting current and future customer, environmental, and regulator service levels at the lowest possible life-cycle cost in a sustainable manner and at an acceptable risk. Desired outcomes in this category focus substantially on understanding critical asset conditions, ensuring planned maintenance and replacement activities occur consistently and reliably, and maintaining a deliberate and disciplined CIP process.

Examples of measures related to optimized asset management include:

- percent of maintenance activities performed by target dates;
- percent of scheduled asset inspections (e.g., CCTV pipe review) completed;
- asset replacement levels as a percent of goal (e.g., miles of sewer main replacement); and
- number of CIP projects completed on time and within budget.

Customers and Community

Most of the profiled utilities have developed measures for customer and community outcomes related to reliability, responsiveness, quality, cost effectiveness, and predictability. Some of the utilities are also striving to better involve communities in the decisions that affect them and more explicitly reflect community values and priorities in decision making. Utilities, such as Madison and Orange County, who are participating in the National Biosolids EMS, have been required to develop programs and goals for proactive public participation. Local situations, as well as local community values and concerns can affect specific customer measures established by utilities.

Examples of common customer measures include:

- complaint number, type, and response times (e.g., odor/taste/aesthetics and pressure drinking water concerns and odor concerns with wastewater treatment plants and/or biosolids management);
- percent achievement of taste and odor goals;
- number of customers with service outages of certain duration;
- response times for service outages and spills;
- permit and connection hook up request processing times;
- number of combined and sanitary sewer backups;
- service fee/rate annual percentage increases;
- affordability indexes (e.g., annual residential bill relative to median and/or poverty income level); and
- benchmarking rates to other communities.

Examples of measures for those utilities that are focused on increased community involvement include:

- citizen participation rates; and
- timeliness of public access to information.

Employees

Many of the utilities profiled are striving to be "world class" and recognize they must have a world class workforce. Key outcome areas focus on employee safety, competence, and motivation, with an emphasis on generating a more adaptive and flexible workforce and ensuring the potential loss of critical skills due to workforce trends is addressed through appropriate succession planning. Management systems and other initiatives may influence which measures are used. Environmental management systems require that utilities emphasize employee training and competence. Best practice and benchmarking programs such as QualServe and APWA Accreditation also emphasize worker health and safety.

Examples of safety measures include:

- safety severity rates (e.g., number of days of time lost per 100 full time employees);
- safety frequency rates (e.g., number of claims opened per 100 full time employees); and
- sick leave as a percent of total hours worked.

Competence measures tend to focus on the level of training activity, including such measures as:

- training hours per employee; and
- training compliance rates.

Motivation is addressed in a variety of ways including:

- hiring process satisfaction surveys;
- employee satisfaction measures (derived through surveys);
- percentage of vacant positions; and
- overtime as a percent of total hours worked.

Environment

All of the profiled utilities view environmental regulatory compliance as a given and necessary baseline operating condition while striving to improve environmental performance across a broad range of areas. Other typical environmental areas that receive attention include resource conservation and enhancement activities; materials recycling; nuisance conditions such as odor; and energy conservation. However, the specific measures used by any given utility vary depending on local conditions and drivers.

Common compliance measures include:

- water quality, effluent limits, and solids contaminants;
- number/severity of sewer overflows; and
- number/severity of notices-of-violations and/or fines imposed.

Unique resource conservation and enhancement activity measures include:

- linear feet of habitat improved;

- water conservation savings;
- area with natural drainage systems in use; and
- in-stream flows.

Most of the utilities are undertaking some form of recycling efforts, including:

- recycling rate metrics for such items as paper, as well as biosolids and effluent reuse rates.

Nuisance conditions, most typically odor, are measured through complaint rates.

Energy use is often segmented by type (natural gas, electricity, etc.) and functional use (e.g., treatment plant, transportation fleet, etc.) compared to energy generation by type (methane capture, hydropower, etc.).

Finance

All of the utilities profiled have measures that consider organizational financial performance. The range of measures depends largely on the degree of financial autonomy the organization has. Those utilities whose organizational structures include finance and planning typically include measures focused on long-term debt, asset values, operations and maintenance expenditures, and operating revenues.

Example measures include:

- debt-equity ratio;
- percent of revenue used for debt service;
- bond rating;
- percent of cash funding the CIP; and
- year-to-date capital expenditures.

Utilities that are a division within a larger public department tend to concentrate on overall budget performance and measure annual variance from adopted budgets.

Business Operations

All profiled utilities track some form of primary business operations measures. The type of measures tracked depends primarily on the type of operations and services provided.

Example measures include:

- treatment cost per account;
- treatment cost per million gallons;
- average cost of selected service jobs;
- percentage of new water service installations completed within targeted timeframe;
- service disruption rates (e.g., unplanned less than four hours per 1000 customers);
- percent of emergency responses within targeted timeframes;
- percentage of water losses due to system leaks;
- non-revenue water as percent of total water use;
- long-range supply availability (e.g., number of years until forecasted average annual water demand equals firm yield from current and planned supply sources); and

- planned maintenance ratios (in hours and in cost)

C. Management System Benefits

The benefits of management system adoption are significant and vary from quantifiable cost savings and estimated cost avoidance to less tangible outcomes such as improved community relations and customer satisfaction. While some utilities can demonstrate year-to-year measurable performance improvement benefits of the management systems, in many cases utility managers were reluctant to make a direct causal link between the implementation of the management systems and performance improvement (i.e., the management system was not the only source of improvements). However, most of the utilities have seen measurably improved performance that coincided with the implementation of their management systems. In addition, objectives and targets for further performance improvement for recently implemented systems indicate many areas of anticipated benefits.

Following are examples of benefits identified from measured performance improvement, coincidental improvement, and anticipated improvement.

Assets and Infrastructure

- Seattle reported saving $150 million in three years due to avoided capital replacement requirements.
- Orange Country saved over $30 million after developing its asset management strategic plan and reorganizing capital improvement priorities.
- Santa Clara's asset management system identified cost discrepancies between their treatment plants (for example, up to 12 times the maintenance cost for solids treatment) and plans to significantly reduce costs through process changes and efficiencies.
- Eugene's targets for increasing planned maintenance on their pump stations is anticipated to decrease needs for more costly corrective maintenance.
- San Diego meets consent decree requirements of no more than 60 sanitary sewer backups in a calendar year by achieving targets for sewer main cleaning (tracked by miles cleaned).

Customers and Community

- San Diego targets first response to sewer spills is less than 30 minutes, 100 percent of the time. Tracking this measure helps the utility understand performance and make timely corrective action to improve performance when needed.
- Orange County is targeting its management system to drive air emissions-related health risk reductions to employees and the community by 60 percent.
- Shelby's EMS objectives include a project designed to address low pressure in the system.

Employees

- Orange County targets 45 training hours per employee per year. The anticipated benefit is better trained employees by systematically targeting their management efforts and setting objectives and targets in this area.
- San Diego aims to develop a high performing work team, optimizing both productivity and job satisfaction. To support this, San Diego tracks measures for overtime usage, injury/illness incident rates, workers' compensation claims, department hours in training, performance evaluations, and supervisor initiated rewards.

Environment

- San Diego reduced total sewer spills by 65 percent in four years and reduced sewer spills from 11.5 to 4 per 100 miles of sewer main during the same period.
- San Diego increased water conservation from 19 MGD in 2000 to 25 MGD in 2004.
- San Diego aims to increase use of reclaimed water from 10 percent in 2001 to 50 percent of treated flows by 2012.
- San Diego has yearly cost savings on recycling of $4,500.
- Orange County plans to improve the regional watershed by collecting and treating 150 percent more dry weather urban runoff over seven years and by increasing its water reclamation seven-fold to 70 MGD within seven years.
- Orange County aims to beneficially reuse 100 percent of biosolids.
- The following table illustrates some of the most notable environmental performance improvements from Eugene's EMS.

Goal	Annual Target	2000	2001	2002	2003	2004	Percent Change
Janitorial Supplies	9.3 tons	13.3	12.9	11.6	7.3	1.2	91%
Vehicle Fuel	9,872 gals.	10,969	10,635	9,604	8,277	9,368	15%
Solid Waste to Landfill	9.3 tons	n/a	n/a	10.9	9.6	7.2	34%
Sulfur Dioxide Emissions	2.060 lbs.	n/a	n/a	13,733	n/a	41	99%
Paper Products	1.2 tons	1.8	1.3	1	0.6	0.8	56%

- Eugene reported that evidence of its EMS driven performance helped downgrade a federal audit to an inspection, avoiding a costly multi-day on-site visit.
- Eugene has achieved $18,000 in electrical power savings plus $28,500 in utility credits.
- Madison has a greater range of cost-effective application options by meeting "high quality" biosolids standards through lowered metals concentrations.
- Shelby has experienced a decrease in compliance inspection frequency.
- Shelby plans to more closely monitor water tanks to reduce water waste and prevent overflows.

Finance

- Orange County aims to fully cover its operations and maintenance costs with user fees.
- Orange County limits borrowing to not exceed capital improvement expenses, thereby saving excess interest.
- Seattle measures the percent of total operating revenue used for debt service (payment of principle and interest on debt) and aims to stabilize this percentage at approximately 40 percent through the year 2009.
- Seattle tracks the debt to assets ratio, which has risen since 1997, and aims to stabilize the rate over the next 5 years. Seattle also aims to increase the percentage of cash funding of CIP to over 20 percent by 2009.
- In the Division's informal bond rating review, Eugene's EMS generated a positive reaction.

Business Operations

- Orange County projects 2004-2005 savings of $1.45 million dollars by reengineering its disinfection process.
- San Diego attributes to its EMS yearly cost savings on SSO response avoidance of over $200,000.
- Shelby has several EMS objectives designed to reduce stoppages and overflows in the system due to the build up of fat, oil, and grease.
- Seattle estimates its asset management program has lowered annual operations and maintenance costs by 8-10 percent

Improved Decision-Making and Resource Utilization

In addition to measurable benefits, utility managers cited as a key benefit improved decision-making and resource utilization resulting from management systems helping to better set and balance priorities. Several utilities believed that the real benefit from management systems was in better resource utilization overall. For example, while a utility might spend more in the operating budget (for instance on employee training and/or information technology) to run an asset management program, it may reduce the capital budget. One utility offered an articulation of overall benefit as "delivering a defined level of service at the lowest life cycle cost" (where life cycle cost takes into account triple bottom line costs and benefits).

Organizational Learning

A significant benefit of implementing management systems has been improved organizational flexibility and organizational capacity building. In particular, the culture change and access to information through the standardization, centralization, and documentation of data and information resources enables agencies to tackle additional initiatives.

- Through the implementation of the EMS, much of Eugene's Wastewater Division was compliant with the standards for the APWA accreditation. In particular, the improved documentation, as well as implementation of management practices under the EMS, resulted in the APWA accreditation being a relatively minor task for the Wastewater Division. The Division was able to gather information needed for the APWA accreditation in a few weeks when it took other divisions in the Public Works Department an average of six months.
- Charleston believed that their EMS builds a foundation to implement other management systems or initiatives and make changes within the organization. Charleston found that EMS implementation puts a structure in place such as an organized documentation system that makes implementing other programs easier.
- Santa Clara's increased understanding of their asset value and replacement projections in relation to maintaining service reliability assist in making the case for budgeting expenditures.

Increased Understanding of Organizational Vision and Goals

Prior to management system implementation, several utilities reported a proliferation and confusion among various work plans and initiatives. This frustrated employees and did not provide the organization a clear sense of direction or understanding of goals.

- Eugene's EMS provided a consistent and cohesive management framework where employees throughout the department understand the organization's vision, benefits, and goals.

- San Diego EMS benefits employees by bringing ownership to processes and operations that empowered staff to know they are being managed by a system rather than a personality.
- Madison's EMS implementation has led to greater employee knowledge of the reuse program and its relationship to other aspects of the District's operation. The continual improvement policy has made projects and initiatives more structured with employees committed to achieving goals set forth under the EMS.
- Santa Clara employees appreciate the better scheduled work plan rather than corrective maintenance fire drills.

IV. Drivers for Change to Management Systems

There are a number of drivers for utilities to implement management systems, including the following.

Systematic Management Approach

Most of the utility managers interviewed mentioned they sought a more systematic management approach through a formalized management system.

- Prior to the documented management system, much institutional knowledge was contained in the minds of the management and employees that have been with the utilities several decades or more. Most of the profiled utilities expect significant staff turnover (due to retirements) over the coming years and believed they are at risk of losing a significant amount of "tribal knowledge" critical to the effective operation of their organizations. Utility managers felt the need to have a formalized management system to document roles and responsibilities, standard operating practices, and other important procedures. EMSs, in particular, were cited as management systems that provide the documentation and structure to support these needs.
- Additionally, utility managers looked to formal management systems, such as EMS and strategic business plans, to provide a consistent and cohesive management framework where employees throughout the organization would understand the organization's vision, benefits, and goals.

Competition from Private Operators

Many of the utility managers cited the possibility of privatization in their districts as one of the reasons for investing in management systems. Certain utilities have felt the need to establish a clear standard of service against which privatization proposals could be compared, such as establishing explicit service levels, performance measurement, and clearly documented activity and procedures. This enables the utility to demonstrate it is "well run" by showing continual improvement and by benchmarking against other utilities.

- Managers sought structured management systems such as EMS and asset management as a way to establish a clear performance baseline and document performance improvement over time.
- Managers highlighted that lowest cost is not the only factor affecting the bottom line for public utilities. Other factors such as environmental stewardship weigh into consideration in the service they provide. Management system documentation and performance measurement provide mechanisms for presenting how environmental, social, and other factors affect

bottom line considerations, thereby creating an objective basis for comparability between public and private utilities.

Financial Improvement

Most profiled utilities cited financial improvements as key motivators for management system change. Anticipated (and realized) improvements included more stable and predictable rates, lower life cycle infrastructure repair, replacement, and maintenance costs, improved debt position; and reduced public health and environmental liabilities.

- Optimized asset management, in particular, was often seen as an effective way to identify and document current and future capital investment needs, and to analyze and determine lowest life-cycle costs for assets while providing desired services levels.

Reduced Risk and Liability

Many managers indicated that reducing public health and environmental liabilities was a motive in changing management systems.

- Both optimized asset management and EMS require organizations to identify and prioritize high risk areas and develop plans for minimizing the health and environmental liabilities associated with those risks over time.
- Utility managers indicated that reducing risks not only supported the achievement of desired environmental and public health outcomes, but could also lead to economic benefit in the form of better bond ratings and avoided costs (e.g., prevented sanitary sewer spills).

Customers and Community Responsiveness

Many profiled utilities engaged in enhanced management system efforts to increase customer and community responsiveness. Certain of these utilities faced actual or potential limitations on their operational activities in the face of community concerns, while others believed an explicit and systemically managed customer service effort would create a stronger basis for rate justification and responding to privatization proposals.

- Utility managers indicated a need to systematically address areas such as customer response time, spill and service outages, customer and community complaints, and public information requests.

Other External Pressures

- Several utility managers indicated that there were no explicit external social factors driving implementation of management systems for the utilities, but acknowledged that the culture and environmental consciousness of the community they reside in may have had an indirect effect.
- Utilities in EPA's Region 4 (Charleston and Shelby) cited an implicit pressure to implement EPA's Capacity, Management, Operations, and Maintenance (CMOM) program as an external driver to invest in formal management systems.

V. Barriers and Challenges to Implementation

Utilities identified several barriers and challenges to management system implementation, including the following.

Lack of Management Capacity

An important area of challenge to implementation was the strain on management capacity and capabilities that management systems change represents. Specifically, several utilities suggested that new tools and management systems require a different skill set than many managers currently have and, therefore, are pushing the limits of some managers' abilities. In particular, there is a new focus on team work and collaboration (especially between "silos") that some managers struggle with. Furthermore, some managers struggle with the diffusion of responsibility that management systems introduce. While management initiatives often empower many employees, managers can view this as a loss of power. Santa Clara suggested that an organization needs 4-7 years of concentrated effort on culture change before full management systems or initiatives can be put into place. Such changes are not likely to be a linear process and utilities have taken several different approaches. For example, Eugene hired a management coach to act as an internal organizational development training resource. Although culture change was recognized as a mid- to long-term undertaking, management system implementation can (and usually does) occur concurrently with culture change. While culture change and management system implementation can happen at the same time, it may take several years for the management system to operate optimally. Some utilities suggested that, because the industry has traditionally been managed around silos (that is in separate divisions or responsibilities), career advancement has been based on expertise within a silo. As a result, there are few senior managers with a broad view of the whole utility enterprise, while management system efforts require a view across the silos to be effective.

Long-Term Versus Short Term Decision Making

Utilities also identified the challenge of tension between short-term demands and perspectives taken by elected officials who operate on 4-year election cycles and a long-term decision-making view (e.g., 20 year asset planning time horizon). Several utilities believed it was important to stress that such local political pressure can come in a variety of forms. These include the ability to justify rate increases, the ability to effectively respond to privatization proposals, and the ability to objectively demonstrate utility performance.

Inadequately Communicating Purpose and Vision of the Management System

Many of the utility managers found that more communication of the purpose, goals, benefits, and overall vision of the management system was needed during the implementation stage than originally anticipated. Utility employees were often resistant to change due to a lack of understanding of the concept and reasoning behind the management system being implemented.

Culture Change Resistance

Management systems require a significant cultural change that meets resistance on a variety of fronts such as flavor of the month mentality and "if it ain't broke don't fix it" mentality.

- One utility manager estimated that roughly half of the system development and implementation effort was addressing culture change within the organization.
- Another utility manager indicated that gaining acceptance from employees at all levels was difficult. Many had the mentality of "Things are going well. Why do we need this?"

- Another stated that the highest level supervisors resisted accepting their role in the management system because of a perceived loss of power under the new system.
- Some managers have expressed concern that the gap analysis conducted with management system efforts may identify major flaws that can create a mismanagement stigma.

Initial Development Hurdle

There is a high initial development hurdle with limited immediate benefits. Utilities have experienced one to two year initial development timeframes (sometimes even longer) during which only limited benefits have been realized, while at the same time very sustained focus, commitment, and effort must be maintained. External assistance has often been needed to educate utility staff and lead initial efforts, and staff resources must either be reassigned or newly acquired to support development efforts.

Uncertainty of Mid- to Long-Term Benefits

Uncertainty remains regarding magnitude of mid- to long-term benefits (only limited benefits documentation has taken place). As a result, the potential long-term motivator to overcome the initial development cost hurdle is too muted to be fully effective.

Resistance Due to Previous Initiatives

Several utility managers cited multiple, previous attempts at other management initiatives as a barrier to implementation.

- At several utilities, employees expressed resistance and skepticism, viewing the management system as just another of many ideas that management thought they should try for a while and would eventually disappear. Utility managers expressed a need to demonstrate commitment to the management system and convey that the system is not just a short term initiative that will be replaced by something else.
- One utility manager also cited a tendency to change direction during the implementation phase as a major barrier. Certain managers felt the need to constantly make adjustments during the implementation phase. As a result, the constant change caused disorder, confusion, and resentment among employees. The utility manager mentioned that it would have been beneficial to develop a single framework, apply it for a year, and then make manageable, necessary changes.

Difficult language

Management systems are laced with unfamiliar jargon causing confusion and making communication challenging. Several of the utility managers interviewed particularly cited ISO 14001 EMS language as a barrier to implementation.

Documentation

Several utility managers indicated that enhanced documentation is often seen as burdensome and adding limited value.

- In many cases, the barrier to implementation was a lack of existing documentation for operating procedures and control points required. Utility managers indicated that creating the documentation was a large effort.

- In at least one utility, getting the documentation organized was also difficult because much of the implementation was electronic and a number of employees were not used to using computers.

Enhanced or New Data collection and Analysis

Utility managers indicated that having an existing computerized maintenance management system (CMMS) is very helpful in starting an asset management program. Most utilities profiled had CMMS, asset inventories, and/or many of the tools for asset management, even if not referring to them as part of an asset management program.

While all utilities already collect substantial data as part of regulatory requirements and ongoing operations, implementing management systems often requires collecting additional data or using existing data in new ways. This can require upgraded information systems and/or staff training for the analysis.

Barriers to Ongoing Implementation

- Ongoing audit costs were cited as a barrier to ongoing system implementation. However, most utility managers found that this barrier diminished over time, as the benefits of the management system became more obvious.
- At one utility which has implemented and become certified to an ISO 14001 EMS, the manager indicated that one of the barriers for ongoing implementation is the expectation among employees that all decisions will be made for environmental reasons. There currently tends to be an overemphasis on environmental considerations within the organization even when it is not the most pressing factor in influencing a decision; there is a perception in the organization that the EMS goals guide all management decisions when in fact they are one consideration.

VI. Management System Resource Requirements

The resources required to implement and maintain management systems for water and wastewater utilities vary by organization. There is, however, a rough correlation between the size of a utility and the cost to develop a formal management system. Substantial resources, both in terms of outside consulting assistance and internal staff time, are required to launch a new management system. Utility managers profiled suggest that the pay back period is generally 12 to 24 months. The following are examples of the resource investments into management systems made by several of the participating utilities.

- Orange County has spent $500,000 so far in developing their asset management plan. The utility anticipates spending another $2 million on consultants and almost $8 million in staff time over a period of seven years to fully implement asset management.
- San Diego Operations & Maintenance Division spent $200,000 in labor and $160,000 for consultants in implementing an ISO 14001 EMS.
- San Diego Wastewater Collections Division spent $211,000 in labor and $90,000 in consultant costs implementing an ISO 14001 EMS.
- Madison implemented an NBP EMS in approximately two years using a half-time employee as the main coordinator with training and technical support provided by the National Biosolids Partnership (at a dollar value of approximately $15,000).
- Charleston invested 1,675 hours of employee time implementing an ISO 14001 EMS.

- Eugene spent approximately $100,000 in labor and $20,000 on a consultant to implement an ISO 14001 EMS.
- Seattle hosted an asset management specialist from Hunter Water, Australia for six months to implement the program.
- Shelby estimates initial EMS implementation costs for the wastewater operation included approximately $15,000 in staff time and $10,000 for travel and internal audit training over the course of a one-year period.
- Santa Clara committed three full time utility staff and spent $600,000 on consultant costs over one year to implement the asset management program.

Nearly all of the utilities interviewed used some form of external assistance during the implementation or pre-implementation stages of their management systems.

- Most of the utilities hired consultants to identify baseline conditions for the utility and areas for improvement through assessments such as gap analysis.
- Seattle brought a specialist from Australia to launch and set up their asset management program for the first six months.
- Shelby did not use consultants, but relied instead on staff who received state-sponsored monthly training for one year on EMS implementation.

To support implementation, utilities generally assigned 0.5-1 full time employee and a committee or core group of staff working on the management system.

In most of the cases, after the implementation was complete, there was a significant reduction in the overall staff time devoted to the management system. For nearly all of the utilities, once their management system was in place, the effort and full-time employees needed to maintain the system became absorbed into normal operations. Overall for the utilities, the staff time and operational requirements needed to maintain the system was absorbed by the efficiency and costs savings achieved. Once the management system is fully in place, utility managers tend not to view it as an “extra” cost, but rather as a way of doing business.

APPENDIX A: CHARLESTON COMMISSIONERS OF PUBLIC WORKS (SOUTH CAROLINA)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the City of Charleston, South Carolina Commissioners of Public Works (CPW) Water and Wastewater Divisions and its management systems and initiatives, including International Organization for Standards (ISO) certified Environmental Management System (EMS), Partnership for Safe Water (PSW), and Capacity, Management, Operations and Maintenance (CMOM).

Utility Overview

The City of Charleston, South Carolina Commissioners of Public Works provides water and wastewater service for Charleston, Berkeley, and Dorchester Counties surrounding the city of Charleston, South Carolina and covering roughly 425 square miles. The water operations serve approximately 400,000 residential customers and over 5,000 commercial/industrial customers, and the wastewater treatment operations provide service to about 200,000 residential customers.

The water division operates one treatment plant with a maximum flow capacity of 118 million gallons a day (MGD) (average 50 MGD) and roughly 1,500 miles of water distribution infrastructure. Charleston's first water treatment facilities were built in 1904 and the original building itself is still used today. Additional water processing equipment was last added in the 1960's. Overall, the water infrastructure is a relatively old system with some original water mains from 1876. The mains are operational, having been relined with cement. CPW's water treatment is a conventional process with enhanced coagulation, filtration, disinfection, chlorine dioxide, corrosion control and chlorine treatment. CPW also applies water residuals from the treatment process to a non-harvested forested area to grow oak and pine trees. The forested area is part of the CPW property and not harvested or used for any specific purpose.

The wastewater division operates two treatment plants with a combined permitted flow capacity of 36.5 MGD and average flow of 21 MGD, as well as 525 miles of infrastructure. The original wastewater infrastructure is also over 100 years old. A new section and treatment system was added in 1969. CPW's wastewater treatment is a conventional activated sludge process with chlorine disinfection. Wastewater sludge is disposed in a subtitle D landfill.

Charleston CPW's FY 2003 operating budget was approximately $67 million with a total capital expenditure of $5 million. The water and wastewater divisions together consist of approximately 442 employees. CPW is considered a municipal corporation with a five member board consisting of 3 elected officials from the City of Charleston. The remaining two officials are the Mayor of Charleston and a member of the Charleston City Council. CPW must receive approval from the Charleston City Council when procuring debt, but all other activities are autonomous from the City of Charleston and the City Council.

Management System Development Efforts

Charleston CPW's primary management system initiative is an ISO 14001 certified Environmental Management System (EMS) and a Capacity, Management, Operation and Maintenance (CMOM) program is secondary. CPW also has implemented Partnership for Safe Water (PSW) for its

water treatment facility, QualServe Benchmarking, and is in the process of examining the Balanced Scorecard. These management systems and initiatives are described in greater detail below.

Environmental Management System

CPW first developed an ISO EMS for the water distribution operations, which was certified in 1999. This first EMS was a pilot that was expanded to the Hanahan Water Treatment Plant, the Plum Island Wastewater Treatment Plan, and then eventually utility-wide, covering 12 different operational units. Initially four separate ISO registrations were maintained for the divisions, but in 2002 the EMSs were incorporated under one ISO registration.

For CPW, the EMS has provided a structure for defining responsibility and holding people accountable to targets and objectives. In addition, the management system has increased connectivity within the agency, which helps drive continual improvement.

Capacity, Management, Operation and Maintenance (CMOM)

Charleston CPW has implemented a CMOM program that is highly integrated with the ISO EMS for wastewater collections. CPW had fully developed the EMS before launching the CMOM program and believes that significant effort was saved in CMOM development by having the EMS in place first. The intent of the CMOM program is to prevent sewer system overflows and this is accomplished through best management practices, such as diligent maintenance, preventive maintenance, proper staffing and equipment, emergency response, planning, documentation, and effective system evaluation.

Partnership for Safe Water

Charleston CPW became of member of Partnership for Safe Water (PSW) in 1996. PSW is aligned with the EMS by its identification as a voluntary requirement under the EMS requirements. CPW has also incorporated the PSW performance targets into EMS objectives and PSW technical guidelines into EMS operational controls for meeting designated drinking water targets.

QualServe Benchmarking

Charleston CPW has participated in a QualServe benchmarking survey. This survey, which examines five performance areas (organizational development, customer relations, business operations, water operations, and wastewater operations), through a series of 54 measures, provided CPW with an understanding of their performance relative to their peers. CPW has used the benchmarking information to identify opportunities for improvement and inform goal setting processes.

Balanced Scorecard

Charleston CPW has been examining the Balanced Scorecard, but has not yet implemented a scorecard. CPW has completed approximately 75 percent of the components, but the Balanced Scorecard is not yet tied together in a comprehensive fashion. Given Balanced Scorecard's corporate orientation, CPW is unsure of the Balanced Scorecard's effectiveness for the water and wastewater divisions and does not believe it will have the same transformational effect for the agency as EMS did.

Drivers for Management Systems Change

Charleston CPW's drivers to implement an EMS were largely internal. One of the primary drivers was to avoid the possibility of a privatization take-over of the utility. Even though CPW never directly faced the possibility of privatization take-over, the agency wanted to establish a quantified level of service demonstrating best-in-class efficient operations to force an objective comparison in the event of a privatization proposal.

There were also economic factors pushing the utility toward EMS implementation, including curbing increasing rates, controlling expenses, optimizing revenue, and reducing liabilities and risk. Public health and environmental liabilities were also considerations.

The main driver for implementing the Capacity, Management, Operations and Maintenance (CMOM) program was the potential for EPA to approve national CMOM program requirements, supported by guidance on CMOM implementation by EPA Region 4.

The primary drivers for participation in the Partnership for Safe Water were to ensure public health protection through treatment optimization, to receive recognition for beyond-compliance reporting, and to take advantage of technical resources provided by the Partnership.

System Resource Requirements

Charleston CPW's resource requirements for EMS development and implementation are estimated to be approximately $100,000 in internal staff time. The staff involved in the EMS development consisted of one EMS Manager, a 12 member steering committee, and six local site teams. No third party consultants were used.

The initial certification cost was $22,000 with two auditors over a four day period on-site. The costs for the ongoing surveillance audits are approximately $18,000 a year.

Management System Challenges to Implementation and Effective Attributes

The biggest challenge for Charleston CPW in the initial phase of implementing the EMS was changing leadership and inconsistent direction setting. CPW had more than one project leader struggle to implement the management system in an effective team-oriented and communicative way. Additionally, in part due to the changes in project leadership, there was a tendency to change directions during implementation. The constant change during the implementation phase caused disorder, confusion, and, at times, resentment among employees. CPW believes, in retrospect, it would have been beneficial to develop a single framework, apply it for a year and then make manageable changes.

For success in implementing EMS, Charleston CPW stressed the need to push EMS on the frontline through communication, training, organization, and exposure. It is essential to establish a team concept and recruit people from various levels of the organization to implement EMS. It is also important to demonstrate a commitment to the program and convey that it is not just a short term initiative that will be replaced by something else. CPW created buy-in from employees through highlighting the environmental benefits of EMS and communicating that it is a world-wide initiative that is globally recognized.

Measures of Performance

EMS Measures

For 2005, Charleston has set nine EMS objectives for wastewater operations and 13 EMS objectives for water supply operations. The wastewater objectives cover five environmental aspect areas: inflow and infiltration (I & I); easement maintenance and inspection; air release valve inspection and maintenance; wastewater tunnel operation; and energy use. Charleston has five objectives related to I & I with the remaining aspects having one objective each. The water supply objectives cover ten environmental aspect areas: drinking water treatment/disinfection; security and emergency preparedness; maintenance; laboratory services; sedimentation flocculation rapid mix; chemical storage; solids handling and disposal; low\high service pumping; and finished water storage. The wastewater objectives and targets focus largely on future-oriented (capital) improvement projects (such as better capacity management), while water supply objectives reflect a mix of future-oriented projects and maintaining or improving basic day-to-day operations (e.g., maintaining turbidity performance levels and maintaining a specified preventive to corrective maintenance ratio).

Overall, Charleston's objectives and targets cover a very broad scope of activities – from capacity management and energy on the wastewater side to treatment and security on the water supply side – and are reflective of the EMS acting as an umbrella for managing Charleston's major improvement projects. The objectives and targets also explicitly reflect Charleston's incorporation of the CMOM and Partnership for Safe Water programs into its EMS. For example, Charleston has an EMS objective for turbidity removal process built on PSW requirements. The objectives and targets further reflect Charleston's linkage of a wide variety of improvement projects to environmental performance (e.g., security enhancements at the water treatment plant).

Tables I and II provides a sample of objectives, targets, and performance records for wastewater treatment and water supply operations, respectively.

Table 1: Wastewater Collection Division EMS Objectives and Targets

Aspect Item	Specific Negative Impact (Enter a brief description)	Objective	Target/Performance Indicator	Performance Record
Inflow & Infiltration (I & I) *(Significant Aspect)*	Loss of natural resources through energy use	Reduce the amount of I & I entering the system and exfiltration leaving the system through pipe repairs with little land & utility disturbance.	Conduct a study on the rehabilitation of sewer mains and laterals that pass through brick arch storm drains in the peninsula city by Sept. 1, 2005. *Assigned to Senior Construction Operations Supv.*	WWCD Monthly Operating Report; Final Cross-Connection Pipe Repair / Rehabilitation Study Recommendation Report
Inflow & Infiltration (I & I) *(Significant Aspect)*	Loss of natural resources through energy use	Establish a formal methodology for prioritizing and planning rehabilitation initiatives through	Develop WWCD's requirements and criteria for selecting an asset management software package based on current and future needs with a recommendation by Oct. 31,	WWCD Monthly Operating Report; Final WWCD Asset Management Program Recommendation Report, 2005

Aspect Item	Specific Negative Impact (Enter a brief description)	Objective	Target/Performance Indicator	Performance Record
		integration of all available tools, and development of additional tools.	2005. *Assigned to Senior Technical Supervisor.*	
Energy Use (Pump Stations)	Depletion of natural resources used to generate energy / Shorten life of equipment	Reduce electrical usage & costs associated with pump station operations.	Perform an electrical usage pilot study to seek ways for reducing electrical costs associated with pump station operations by Oct 31, 2005. *Assigned to Senior Pump Station Operations Supv.*	*WWCD Monthly Operating Report; Final Energy Management Pilot Report*
Wastewater Tunnel Operations *(Significant Aspect)*	Potential for widespread Sanitary Sewer Overflows (SSOs)	Replacement of deteriorating Tunnel System.	Phase II construction completion Oct. 2005; Phase III design completed by Feb. 2005, and construction to begin Feb. 2005; Phase VI Master Plan to be completed by Jan. 2005, and design scheduled to be completed by Feb. 2006. *Assigned to WWCD Superintendent. Admin.*	WWCD Monthly Operating Report; Final Design Plans; Completed Installation/Construction; Status Reports

Table II: Hanahan Water Treatment Plant EMS Objectives and Targets

Aspect Item	Specific Negative Impact (Enter a brief description.)	Objective	Target/Performance Indicator
Drinking Water	▪ Potential for regulatory non-compliance. ▪ Potential for unsafe drinking water.	Comply with voluntary AWOP and PSW finished water turbidity requirements.	Maintain performance level of 95% of finished water turbidity compliance samples equal or <0.1 NTU.
Security/Emergency Preparedness	▪ Potential for terrorism. ▪ Potential for vandalism. ▪ Potential public health issues.	The Distribution System Pressure Monitoring Project-Phase II is designed to increase the number of water distribution system pressure monitoring points via the SCADA system.	The Distribution System Pressure Monitoring Project-Phase II will install Pressure Transmitter at Station 66 and Station 33.
Maintenance	▪ Improperly done or neglected maintenance degrades the integrity and operability of plant	Through use of the MP2 computerized maintenance management system (CMMS) track	Using the CMMS, track, record, and report all preventive and corrective maintenance manhours. Continue to maintain a

Aspect Item	Specific Negative Impact (Enter a brief description.)	Objective	Target/Performance Indicator
	equipment. ▪ Potentially may increase risk of pollution. Potential public health and safety issues.	preventive and corrective maintenance manhours to help increase overall maintenance efficiency.	performance level of 70% preventive maintenance verses 30% corrective maintenance based on a running YTD average for the year 2005 recorded monthly by Dec 2005.
Solids Handling and Disposal	▪ Potential regulatory non-compliance for residuals disposal. ▪ Potential regulatory non-compliance for NPDES discharge. ▪ Disruption of continuous treatment and disposal capability.	Project is designed to provide an alternative means for handling and disposal of treatment plant residuals. It will provide opportunity to decrease land application site loading rates, thus extending site life.	The Solids Handling Mechanical Dewatering Project is scheduled for completion by March 2006.

Core Measures of Performance

In addition to its EMS objectives and targets, Charleston utilizes a series of operationally-oriented "core measures" tracked by individual departments. For water supply operations, the core measures cover water production (e.g., daily flow), water quality (e.g., turbidity, lead, and copper), treatment activity (e.g., filter performance and disinfectant residual), maintenance (e.g., maintenance man hours, PM:CM ratios), and other measures including, for example, a recycling report. For wastewater treatment, core measures cover similar areas including: treatment performance; maintenance activity; biosolids production; and effluent quality. Several of the core measures have a specific link to Charleston's EMS implementation and the EMS objectives and targets. For example, both water supply and wastewater treatment maintain core measures related to EMS training activities. Other links include turbidity measures and planned maintenance to critical maintenance ratios for water supply operations.

To supplement its direct, internal measurement activities, Charleston has also participated in the QualServe benchmarking survey. As mentioned above, this survey, which examines five performance areas (organizational development, customer relations, business operations, water operations, and wastewater operations), through a series of 54 measures, provides participating utilities with an understanding of their performance relative to their peers. Charleston has used the benchmarking information to identify opportunities for improvement and inform establishing targets associated with their operationally-oriented core measures.

Key Management System Benefits

Charleston has experienced benefits on multiple fronts resulting from their management system efforts. Overall, Charleston believes its organization has substantially increased its ability to plan proactively and consistently execute its operational activities. Key organizational benefits cited by Charleston include:

- Planning has become more systematic and focused with better goal setting and clearer accountability while employees have obtained a much clearer sense of organizational direction and a heightened awareness of the operations' environmental impacts;
- Increased effort and improved performance in tracking legal requirements has resulted in improved communication to field operation staff on compliance obligations and associated procedures;
- Operational improvements have become more proactive and progressive, with new Standard Operating Procedures in place promoting operational consistency and providing additional benefits for the consistency and effectiveness of training and addressing potential regulatory concerns;
- More emphasis on employee training and development, with annual planning conducted to establish set training schedules;
- Documentation has improved with fewer and more concise documents in use which are better organized, easier to locate, and purged on a regular schedule helping to eliminate problems associated with outdated document use; and
- Emergency planning and response placed on an enhanced footing with procedures in place to facilitate emergency response and communications and post incident reviews facilitating continual improvement.

In addition to these organizational benefits, Charleston's EMS objectives and targets derive directly from efforts to improve environmental performance. Anticipated benefits derived in this context include: reduced potential for wastewater leaking into the environment; reduced energy use; reduced Sanitary Sewer Overflows; consistent compliance (and beyond compliance performance) with biosolids, wastewater effluent, and drinking water standards; reduced potential for hazardous chemical spills\releases and less exposure in the event of a spill\release; increased life of treatment residuals land application sites; and reduced potential for an inadequate supply of drinking water.

APPENDIX B: CITY OF EUGENE PUBLIC WORKS DEPARTMENT (OREGON)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the Eugene Public Works Department's Wastewater Division and its management systems, including an International Organization for Standards (ISO) certified Environmental Management System (EMS), American Public Works Association (APWA) Accreditation, and consideration of a Balanced Scorecard program.

Utility Overview

The City of Eugene, Oregon Public Works Department's Wastewater Division provides wastewater service through an intergovernmental agreement with the Metropolitan Wastewater Management Commission (MWMC). The service area includes the cities of Eugene and Springfield, and the unincorporated River Road and Santa Clara areas of Lane County, OR. The Wastewater Division serves roughly 225,000 residential and 39 industrial customers. The wastewater treatment system consists of one wastewater treatment plant with 48 pumping stations and approximately 770 miles of pipeline.

The original wastewater treatment facilities were constructed between 1900 and 1910 and an additional expansion occurred during the 1960s. In 1984, the Eugene/Springfield Regional Water Pollution Control Facility, the current wastewater treatment facility, began operation replacing the old sewage plants operated by the two cities of Springfield and Eugene. The regional wastewater treatment facility is a conventional activated sludge treatment plant with pretreatment, primary treatment, secondary treatment, and disinfection stages. The facility has a peak flow design of 175 million gallons per day, and on an annual average, the facility currently treats 38 million gallons of wastewater per day. The treated wastewater is discharged into the Willamette River.

The Eugene Wastewater Division faces a need to expand maximum capacity to 270 million gallons per day to conform to five-year event wet weather requirements and upgrade treatment processes to meet more stringent effluent limits (such as for nutrient reduction and temperature control). Eugene estimates the cost of the expansion and upgrades at $144 million over the next twenty years.

The Wastewater Division is also exploring different opportunities for expanding the use of reclaimed water and the addition of tertiary treatment (filtration). The Division is currently using reclaimed water for cooling water, wash down, landscape irrigation, and for the biosolids belt filter press among other processes.

Biosolids from the wastewater treatment processes undergo an anaerobic digestion process with the digested sludge pumped six miles to an offsite biosolids management facility with 25 acres of facultative storage lagoons, mechanical dewatering, and another 25 acres of air drying beds. The biosolids program applies biosolids to agricultural lands for grass crops, such as rye grass. The MWMC has also purchased a 600-acre plot for a "biocycle farm" for poplar trees. The Wastewater Division operates the farm and will use reclaimed water for irrigation and application of biosolids for fertilizer and soil conditioning. The hybrid poplars will be harvested in ten years, with the expectation that the harvest of trees will provide revenue to help offset operational expenses. The Division is also currently examining options for carbon sequestration credits for the biocycle farm.

The Wastewater Division's FY 2005 operating budget is just over $11.5 million and its capital budget is approximately $2.7 million. The Wastewater Division provides operation and maintenance services for wastewater treatment and monitoring and industrial permitting under the City's stormwater services, but maintenance of the sanitary sewer collection system, administration of the capital program, and engineering are conducted out of separate divisions. The Eugene Public Works Department consists of approximately 415 full-time employees with about 79 full-time employees in the Wastewater Division.

The Eugene Public Works Department is operated through the Eugene City Council and City Manager. The City Council develops legislation and policies and the City Manager oversees the personnel and operations and carries out the City Council's directions. The Metropolitan Wastewater Management Commission (MWMC) governs the regional wastewater program which serves the greater Eugene/Springfield metropolitan area. Included in this program is the Eugene/Springfield Water Pollution Control Facility which is operated and maintained by the Wastewater Division of Eugene's Public Works Department under an intergovernmental agreement. The MWMC is made up of seven Commissioners: the City of Eugene appoints three members, the City of Springfield two, and Lane County two members for a total of seven. One appointee from each jurisdiction is an elected official, the others are lay representatives. The meetings of the Commission are held once per month, and are open to the public.

The process for wastewater rate review requires the Wastewater Division to propose operations and maintenance and capital improvement plan budgets to the MWMC. These proposals are reviewed by the regional commission, approved and ratified by each of the governing bodies, and sent back to the regional MWMC for implementation. The budget and financial processes of the MWMC are managed by the City of Springfield, also under an intergovernmental agreement. The Wastewater Division has identified $144 million in capital improvement in a twenty-year facilities plan; the majority of the needs are front-loaded in the next 5-10 years. Eugene now estimates up to $30 million in capital outlays for 2006 and $20-$30 million per year for several years following, a significant increase from recent capital expenditures. The planned improvements include increased capacity for wet weather flows, nutrient removal for ammonia, and additional temperature and biosolids treatment. The Eugene Wastewater Division anticipates covering these costs largely with rate increases (28% rate increase last year and anticipated modest increases for another several years), loans from the State Revolving Fund, and the issuance of revenue bonds.

Management System Development Efforts

The Wastewater Division has developed an ISO 14001 Environmental Management System (EMS) and is considering implementation of the Balanced Scorecard. The entire Eugene Public Works Department has also received accreditation from the American Public Works Association (APWA) Accreditation Program. These management systems and initiatives are described in more detail below.

Environmental Management System

The Wastewater Division's ISO 14001 EMS was certified in September of 2001. The EMS covers the Wastewater Division, but none of the other divisions within the Public Works Department. The development and ongoing implementation of the EMS is currently restricted to activities under the control of the Division, with a "fence line" that includes the wastewater treatment plant, the biosolids processing facility, and 48 wastewater pumping stations. The EMS fence line does not

include the wastewater and stormwater collections systems, because the Wastewater Division does not have sole responsibility for those systems; the Maintenance and Engineering Divisions have significant operations and maintenance responsibilities for the collections systems.

The Wastewater Division's environmental policy goal, of which the EMS is a large part, is to continually improve its environmental performance and to provide sound stewardship of the environment consistent with the Division's mission.

APWA Accreditation

The American Public Works Association (APWA) Accreditation Program was designed to provide formal verification and recognition of public works agencies for compliance with the recommended practices set forth in the APWA's *Public Works Management Practices Manual*. The manual includes more than 400 recommended practices in 32 areas, covering management practices such as strategic planning and finance, as well as operational practices, such as solid waste and wastewater treatment.

The APWA Accreditation was a two-year process implemented for the entire Public Works Department that included phases for self assessment, improvement, and an onsite evaluation by a panel of public works officials from across the country. The panel found Eugene Public Works Department, including the Wastewater Division, to be in full or substantial compliance with all recommended practices and granted accreditation in 2004.

Balanced Scorecard

The Wastewater Division is evaluating the Balanced Scorecard because managers believe that the EMS does not sufficiently address financial and customer considerations in decision-making. For example, the Wastewater Division found it did not have a strong basis for balancing the cost of making an operational change or new capital investment with the benefit of meeting an environmental objective of the EMS. The Wastewater Division believes the Balanced Scorecard may provide a means to give consideration to developing people, improving efficiency, as well as understanding what customers want, where improvements can be made, and where money is being spent all at the same time. The Division hopes that Balanced Scorecard could be used to help further contextualize efforts such as the EMS, within larger organizational goals.

Asset Management

The Wastewater Division has many of the elements of a formal asset management system including an asset database, computerized condition assessment system, a replacement/repair review schedule, and a fund for asset replacement. While these elements could be more closely tied with top level strategic planning, the essential elements of a formal system exist.

Drivers for Management Systems Change

The drivers to implement the EMS for the Wastewater Division included both internal and external factors. Internal drivers included the desire to translate the community's environmental values and ethics into explicit and quantitative measures in order to establish standards for wastewater services that could be used in evaluating alternative service providers (i.e. private contract operations). Internal drivers also included the desire to develop a more systematic management approach based upon the continual improvement philosophy of the Plan, Do, Check, Act process that could lead to improved environmental performance, cost savings in terms of lower operational costs, and greater effectiveness in staff training. In September 1999, when the decision to pursue an ISO EMS was made, external drivers facing the Wastewater Division included the listing of spring Chinook salmon on the Willamette River as a threatened species under the Endangered Species Act, federal rules restricting sanitary sewer overflows, Clean Water Act provisions for improving water quality in "water quality limited" streams, and the availability of a new state "green permit" program for facilities that implement an EMS.

Prior to the EMS implementation, the organization observed the increasing trend in the United States of privatizing wastewater utilities. Although privatization was never raised for Eugene/Springfield in particular, the Wastewater Division wanted to take measures to ensure that if comparisons were made between public and private utilities, it would be able to clearly state the standards for expected environmental performance and demonstrate a high quality of service being delivered for its customers. The EMS was seen as a way to establish a clear performance baseline and document performance improvement over time thereby establishing an objective basis for comparability.

The EMS also incorporated the Division's desire to establish a more systematic management approach, have performance measures and metrics, and contribute to sustainability. Prior to implementing the EMS, the Wastewater Division worked with various organizational work plans and initiatives. Overall, employees were frustrated by these initiatives because they did not provide a clear sense of direction in terms of goals and desired outcomes, and were not integrated within an overall visible plan or process. The EMS has provided a consistent and cohesive management framework where employees throughout the department understand the vision, benefits, and goals.

In terms of social factors, there was no explicit community movement pushing for implementation of an EMS. The wastewater treatment facility is located on the edge of the city limits and resides in a mixed-use zoned area. Immediately surrounding the facility are residential areas to the south with a highway adjacent to the property on the north. The relationship to neighbors is relatively stable, with the primary feedback from neighbors related to about a dozen odor complaints a year. The Division has experienced very little community participation in board meetings and other activities open to the general public. However, the Division acknowledges that there is a strong sense of environmental consciousness in the Eugene community, with this social factor playing an indirect role in the implementation of EMS such as a general enthusiasm for environmental stewardship among employees.

The Wastewater Division participation in the APWA process was driven by the decision for the entire Eugene Public Works Department to commit to the program. The APWA program provided recognition and validation for the Wastewater Division's performance. The existing EMS substantially facilitated the Wastewater Division's conformance to the APWA best practices, since the majority of items on the APWA accreditation list were already in place and functioning.

The driver to consider the Balanced Scorecard program is primarily to enhance integration and coordination across all business functions of the Division, particularly around financial management, that the EMS does not sufficiently cover. As noted above, while the EMS is viewed as an effective management system and has been embraced by the organization, Balanced Scorecard is seen as a tool to formalize, institutionalize, and effectively balance a broader scope of utility management priorities.

Management System Resource Requirements

The Wastewater Division employed a combination of staff time and contractor resources for EMS development and implementation. The main cost for implementing EMS was staff time with roughly 5,000 hours invested over a two-year time period. The Wastewater Division estimates approximately $100,000 was spent on staff time, employee training, and materials. Much of the initial effort was locating records and information and creating an effective system for documentation. Although the Division considered this a necessary task regardless of the EMS, the EMS implementation served as an impetus for the documentation effort. The Wastewater Division spent another $21,000 on a consultant during the first two years of EMS implementation to identify where the program was and where they needed to be (i.e., to conduct a "gap analysis").

Since the implementation of EMS has been completed, there has been a reduction in the overall staff time spent on maintaining the EMS compared to the development stage. There have been no additional employees added to support the EMS and consultants are no longer used (except for required external, third party audits of the system). The operational efficiencies reached after the implementation of EMS has absorbed the staff time and effort needed to maintain the system. In effect, the EMS has generated no net increase in FTE operational requirements. The Wastewater Division spent $8,300 on the first certification audit, and approximately $3,000 annually on EMS surveillance (or maintenance) audits.

Management System Challenges to Implementation and Effective Attributes

The Wastewater Division found that one of the biggest challenges to implementation of ISO 14001 EMS was the language of the standards. Division managers found the language to be jargon-like and not intuitive to implement. This initially hindered understanding of the standards and created the perception that EMS was something not relevant to them and that it did not have high value. Another barrier to implementation was a lack of documentation for operating procedures and control points required for the implementation process. Moreover, getting the documentation organized was difficult because much of the implementation was electronic and a number of employees were not used to using electronic document control methods. In overcoming these initial barriers, communication throughout the Wastewater Division was essential. Having goals, targets, and benefits written out clearly and consistently, and explaining them to the organization allowed employees to understand the benefit of having a performance management system focused on environmental attributes.

Since implementation of the EMS, one of the barriers for ongoing implementation is the expectation among employees that all decisions will be made for environmental reasons. There currently tends to be an overemphasis on environmental considerations within the Division even when it is not the most pressing factor in influencing a decision; there is a perception in the Division that the EMS goals guide all management decisions when in fact they are just one

consideration. In this context, the Division has identified the need for an overarching management system to guide all operations. The Division believes, in hindsight, that it might have been beneficial to implement the Balanced Scorecard first and then fit EMS into it.

The Division identified key attributes of its EMS effectiveness to include:

- Keeping targets simple and meaningful;
- Creating a central place for information and documentation that is easily accessible;
- Communication throughout the organization so that all staff understands the objectives and how they can do their part; and
- Support from upper management.

Measures of Performance

Since beginning the EMS development process in 2000, the Wastewater Division has tracked a set of EMS measures that are established and updated each year. Prior to implementing the EMS, there were few "beyond compliance" measures in place, nor were measurement reports/tools coordinated. Management was largely focused on annual reports, discharge monitoring reports, the annual workplan, and reports to public works; all aimed toward narrow, singular purposes. The EMS formalized the "plan, do, check, act" approach and provided the first clear path toward coordinated, systematic measurement.

The EMS measures now establish targets for a series of Objectives and assign a Program Coordinator responsible for each Objective. Performance measures are maintained and compared over a series of years to measure ongoing performance. The following table represents the 2005 EMS objectives and targets.

2005 Objectives and Targets

REGISTERED TO ISO 14001:1996

Objective	Target
Reduce Consumption of Natural Resources Program Coordinator: Peter Ruffier	Improve the fuel efficiency of the Division's fleet (gasoline and diesel vehicles)
	Increase the amount of non-petroleum-based fuels by the Division's fleet
Reduce Power Consumption Program Coordinator: Dave Breitenstein	Reduce annual electrical power consumption of WPCF by 5% (Baseline 2000)
	Evaluate Enid and Willamette Towers Pump Stations calculated pump efficiency ratings and if less than 40% evaluate if a smaller motor horsepower should be used.
	Reduce annual electrical power consumption of BMF (measured as kwh/dry ton biosolids produced) by 5% (Baseline 2002)
Reduce Solid Waste Program Coordinator: Todd Anderson	Minimize quantities of non-recyclable wastes (Excluding grit truck waste and dewatering press screenings)
	Minimize recyclable wastes from solid waste disposal sent to landfill
	Reduce total solid waste (tons) by 15% based on cubic yards taken to landfill (Baseline 2002)
Improve Quality of Treated Wastewater Effluent Program Coordinator's: Bill Bennett / Tom Hans	Through a collaborative effort with Operations and Residuals staff meet ammonia permit limits 12mg/L monthly average and 22mg/L maximum daily from May 1, 2005 – October 31, 2005
Reduce use of Toxic Chemicals	Reduce annual use of chlorine, pounds per million gallons, by 2%. (Baseline 2004)
Program Coordinator: Donna Adams	Reduce the total number of products that ranked higher than a 3 per Zero Waste Alliance assessment by 5%. (Baseline 2004 ZWA Assessment Information)
Reduce Air Pollution Program Coordinator: Tom Mendes	Reduce Carbon Monoxide emissions (lbs) from the engine generator by 50% (Baseline 2003)
	Evaluate opportunities to reduce particulate emissions
Reduce Potable Water Use Program Coordinator: Greg Watkins	Reduce potable water use (gallons) by 15% (Baseline 2002)

The Division is still working on appropriately normalizing EMS targets and objectives so that the baseline is calculated by either typical years or annual figures. The targets are currently a mix of capital, equipment, or technology improvements and behavioral goals. The behavioral goals, such as improving recycling rates, are viewed as important not just in and of themselves, but because they engage employees directly in the improvement process and act, therefore, to maintain awareness of and effective participation in the Division's overall commitment to performance improvement. For example, in 2003, the Division set the target to reduce paper consumption by 30 percent and exceeded the target reducing paper consumption by 50 percent through creating a computer intranet system, printing double-sided documents, replacing paper towels with cloth towels, and holding information sessions for employees. The Division has found that successes, such as achieving the paper reduction target, foster ownership among employees in the overall performance process.

The Division also has a set of Core Performance Measures (established outside of the EMS process) that are reviewed quarterly by management. The Core Performance Measures were established after the EMS was put in place as an effort to recognize the division's primary duties. The Core Performance Measures from 2004 include measures related to Biosolids; Facilities; Industrial Source Control/Stormwater; Lab; Equipment Maintenance; Management Information System; Operations; Pump Stations; Sampling; and Stores. As a division of the Public Works Department, the Wastewater Division does not have sole responsibility or control over functions such as human resources, risk assessment services, financial services, or budgeting. For these functions that the Division does not control, the Division does not have measures.

Looking across the ten Core Performance Measure areas, there are a number of environmental performance related Core Performance Measures. These measures include:

- Compliance with biosolids permit and related regulations;
- Output of biosolids (land applied);
- Output of biosolids as percent of plant output;
- Percent of lagoon harvested biosolids composted;
- Percent of lagoon harvested biosolids land applied;
- Corrections required for errors/omissions during final lab review;
- Internal QA/QC Audit findings;
- Results of Annual Regulatory Performance Testing;
- Compliance with permit effluent limits and related permit requirements;
- Number of chemical leak incidents;
- Number of outstanding PSM internal audit findings;
- Performance as percent of permit limits for CBOD (10/25);
- Performance as percent of permit limits for NH3 (Ammonia) (12/NA);
- Performance as percent of permit limits for TSS (10/30);
- Number of complaints (citizen/customer); and
- Compliance monitoring samples collected.

Although there is an implied connection, the Core Performance Measures do not derive from, nor is their performance reflected back to the EMS. These measures are tracked separately by management. The Core Performance Measures were established after the EMS measures as a way to track and acknowledge significant day-to-day activity. The Core Performance Measures represent the utility's mandate and regulatory responsibilities and are used as "exceptions reporting" – it is expected that the organization will perform well on these basic principles and compliance oriented measures, and only exceptions to compliance are discussed. In addition, the measures provide a means to identify trends in performance, with an opportunity to be proactive and resolve problems before they become compliance issues. The measures were designed to be easy to measure using existing information.

The EMS does support the core objectives of the Wastewater Division and there are natural and inherent connections between the Core Performance Measures and the EMS objectives and targets. If something were deficient within the organization's basic performance, it is expected that the Core Performance Measures would reveal this (not necessarily the EMS). However, any corrective action taken could be reflected in an adjustment to the EMS.

The Division started to consider Balanced Scorecard as a good framework to balance the strong EMS measurements and Core Performance Measurements. However, management was

hesitant to introduce another initiative on the heels of EMS. Should the Division pursue the Balanced Scorecard approach, it is expected that additional measures may be added to the Core Performance Measures currently in place.

Key Management System Benefits

While having an EMS is generally seen as a positive financial investment, there are no explicit links between the EMS and financial measures. For example, while the Division performs well in comparison to the wastewater user rates of peer agencies (tracked internally), it is difficult to draw a connection between the EMS and user rates. In the area of capital funds, the EMS generated a positive reaction in the Division's informal bond rating review; however, there has been no explicit implication of a higher bond rating because of it.

The Wastewater Division has experienced numerous benefits from EMS implementation, including: measurable environmental performance improvement; costs savings; improved access to information and documents; increased employee understanding of organizational vision and goals, and organizational experience and understanding of the plan, do, check, act management cycle.

Measurable Performance Improvement

As described above, the Wastewater Division tracks performance against targets and establishes new targets each year for their performance measures under the EMS. The year-to-year measurable performance demonstrates the continual improvement benefits of the Division's EMS. The following table illustrates some of the most notable environmental performance improvements.

Goal	Annual Target	2000	2001	2002	2003	2004	% Change
Paper Products	1.2 tons	1.8	1.3	1	0.6	0.8	56%
Janitorial Supplies	9.3 tons	13.3	12.9	11.6	7.3	1.2	91%
Vehicle Fuel	9,872 gals.	10,969	10,635	9,604	8,277	9,368	15%
Solid Waste to Landfill	9.3 tons	n/a	n/a	10.9	9.6	7.2	34%
Sulfur Dioxide Emissions	2.060 lbs.	n/a	n/a	13,733	n/a	41	99%

Cost Savings

The Wastewater Division has experienced cost savings from operational efficiencies and environmental performance improvements as a result of the EMS. For the year 2001, the Wastewater Division savings from EMS included:

- Approximately $18,000 in electrical power savings, plus $28,500 in credits;
- Approximately $1,700 in paper use savings; and
- $2,800 from garbage disposal savings.

Improved Access to Information / Documentation

Another significant benefit of implementing an EMS for the Wastewater Division has been improved access to information through the standardization, centralization, and documentation of data and information resources.

For example, through the implementation of the EMS, much of the Wastewater Division was already compliant with the standards for the APWA accreditation. In particular, the improved documentation, as well as implementation of management practices under the EMS, resulted in the APWA accreditation being a relatively minor task for the Wastewater Division. The Division was able to gather information needed for the APWA accreditation in a few weeks when it took other divisions in the Public Works Department an average of six months.

Increased Understanding of Organizational Vision and Goals

As described above, prior to EMS implementation, the Wastewater Division worked with various improvement initiatives that started at various levels in the City organization. This frustrated employees and did not provide them a clear sense of direction or understanding of goals. The EMS has provided a consistent and cohesive management framework where employees throughout the department understand the organization's vision, benefits, and goals.

In addition, through its EMS, the Wastewater Division has been accepted into EPA's Performance Track program. Eugene has seen a benefit from this program with respect to reduced regulatory oversight. For instance, as a member of Performance Track, Eugene's annual pretreatment program inspection was downgraded from a full program audit to an informal review. This downgrade saved at least three days of staff time that would have been required to prepare for and participate in an audit.

Understanding of the Plan, Do, Check, Act Cycle

The management processes of plan, do, check, and act (PDCA) is based upon continual improvement and quality management principles. The ISO EMS standard is based upon the PDCA cycle, and requires explicit statements of performance measures that are capable of being monitored and quantitatively assessed. The understanding of this process, and the experience gained under the EMS in conducting performance measurement and following up with assessment and improvement, is a skill that can be transferred to other business functions and objectives.

APPENDIX C: MADISON METROPOLITAN SEWERAGE DISTRICT (WISCONSIN)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the Madison Metropolitan Sewerage District (MMSD) and its strategic planning initiatives, National Biosolids Partnership (NBP) Environmental Management System (EMS), and asset management program.

Utility Overview

The Madison Metropolitan Sewerage District (MMSD) provides wholesale wastewater services to 43 communities (villages, towns, cities, and local sanitary districts) in the Madison, WI area, with a residential population of approximately 318,000 and over 12,000 commercial and industrial customers. Major industrial users include a pharmaceutical plant, food processing plant, and several dairies, among others. The total service area of the District is approximately 175 square miles.

MMSD operates one treatment plant, the Nine Springs Wastewater Treatment Plant, which has an average flow of 41 million gallons a day (MGD) and a peak capacity of 140 MGD. The Nine Springs Wastewater Treatment Plant is an advanced secondary treatment facility. MMSD is also responsible for the operation and maintenance of 60 pump stations and 93 miles of interceptor collections sewers, which convey wastewater from the 43 municipal customers to the Nine Springs Wastewater Treatment Plant. Wastewater collection systems are owned and operated by the 43 communities and are connected to the metropolitan interceptor system. MMSD also receives and treats septic tank wastes from unsewered areas located primarily in rural Dane County. Treated wastewater is disinfected by ultraviolet irradiation and discharged into Badfish Creek and Badger Mill Creek.

All biosolids produced at the Nine Springs Plant are recycled to agricultural land as a fertilizer and soil conditioner through MMSD's "Metrogro" Program. The thickened and digested biosolids are pumped directly to loading facilities or to the Metrogro storage tanks. During winter, all biosolids are stored in the Metrogro storage tanks, which have a storage capacity of 19.5 million gallons. In 2004, biosolids were thickened to an average concentration of 5.5 percent.

MMSD has its own analytical laboratory for testing and monitoring the treatment process and the environment. Some of the lab monitoring is done as a requirement of MMSD's discharge permit, but much of it is performed voluntarily by MMSD to ensure that operations do not adversely affect the environment. The laboratory annually performs over 50,000 analyses on samples of industrial wastewater, influent to the plant, intermediate process samples, clean water, the streams receiving the clean water, the Metrogro biosolids product, the soils and plants from fields where Metrogro is applied, as well as groundwater and septage.

MMSD captures methane gas from the anaerobic digesters. In 2004, digester gas production averaged 629,000 cubic feet per day. Most of the digester gas is used to fuel two engine generators and a blower engine which provides air to the aeration tanks. An average of 16,416 kilowatt hours of electricity was generated each day in 2004; and the engine blower saved the purchase of an additional 7,047 kilowatt hours per day. MMSD supplements digester gas production with natural gas purchased from Madison Gas and Electric, to allow the engines to be run more efficiently. MMSD also takes advantage of the heat recovered from the engines to heat anaerobic digesters and most plant buildings.

MMSD was created in 1930 by state statute to protect the environment in the region of lakes and streams that comprise the upper Yahara River watershed. MMSD is a municipal corporation that is independent of the City of Madison government. MMSD is governed by a five-member commission appointed by the County Executive and approved by the County Board for 5-year terms. The MMSD commissioners are responsible for setting policy, ensuring fiscal responsibility, and establishing District directions.

MMSD's operating budget for FY2004 was $17.6 million. MMSD has 81 employees organized into three divisions: engineering, administration, and operations and maintenance.

Management System Development Efforts

Strategic Planning Initiatives

MMSD has engaged in many strategic planning initiatives since the early 1990s, and in 2002 published their "Vision, Goals, and Strategies" document which articulates the organization's mission statement, values and principles, vision, goals, and strategies. Strategies within the document are supported by the implementation and maintenance of environmental and asset management systems. For example, one of the primary goals is to "operate with costs consistently below the median of organizations of similar size and function." One of the strategies under this goal is to forecast financial needs with a 10-year horizon to help plan for long-term borrowing needs. Implementation of this strategy is supported by MMSD's investment in asset management tools and systems.

National Biosolids Partnership (NBP) Environmental Management System

MMSD has implemented an NBP Environmental Management System (EMS) for their biosolids program and was the fourth utility nationally to receive NBP EMS certification in 2004. The goal of the EMS is continual improvement for the biosolids division. MMSD is evaluating expansion of the EMS to include all of its operations.

Asset Management

MMSD continues to invest in asset management tools and systems. Asset management examines the need for maintenance and replacement of infrastructure through cost-benefit analysis and supports the development of MMSD's 20-year facilities plan. MMSD has had a computerized maintenance management system since 1998. In addition to tracking the maintenance activities and costs associated with each of the 8,500 assets included in the system, the software tool also helps to manage purchasing, inventory, and timekeeping. All of MMSD's assets are in the system, and MMSD has completed an asset condition assessment on all collection system components.

Drivers for Management Systems Change

One of the primary drivers for the implementation of the various management systems within MMSD was the potential of employee retirement of up to 65 percent of its 1995 workforce by 2010. This possible scenario put succession planning at high priority for the organization. Strategic planning and management systems were seen as tools to help prepare for anticipated turnover while continuing to provide a high-level of service. Furthermore, the management systems were seen as opportunities for MMSD to document management practices that have not explicitly been written out.

MMSD's primary driver for NBP EMS implementation for MMSD was to proactively highlight the quality of their biosolids and the sophisticated software management tools developed to manage the system to counter any negative public perceptions that might arise.

MMSD's driver for investment into asset management systems was to improve financial and capital asset investment decisions. More specifically, MMSD wanted to assure that it would meet service expectations and regulatory requirements at the least cost over time and be able to structure financing of asset additions and replacements to avoid major rate fluctuations.

Management System Resource Requirements

To date, MMSD has largely implemented management systems through investment of internal (staff) resources.

EMS Resource Requirements

The 2004 NBP EMS implementation was performed entirely in house for MMSD, with some training and technical support provided by the National Biosolids Partnership (at a dollar value of approximately $15,000). The implementation took approximately two years and MMSD assigned a half-time employee as the main coordinator and brought in different employees within the organization to complete different parts of the operation as part of normal work activity. In addition to staff time, the external EMS audit, which cost $19,350, has been the only additional expense for EMS maintenance. Overall, there were not many added costs, and MMSD considered the implementation as putting a different emphasis on the work already being done.

Asset Management Resource Requirements

The District began tracking the condition of its interceptor sewers in the mid-1990s. Each year ten percent of the system was televised and the information on the condition of each interceptor segment was recorded for ten different elements. This data has now been used to calculate a numeric score for each interceptor segment. All of this work was done by District staff.

In 2000 the District's engineering staff evaluated all seventeen of the District-owned pumping stations for capacity and physical condition as part of the "Collection System Facilities Plan." This plan prioritized replacement projects that were expected to be necessary over the next twenty years. The plan included elements of both an asset management plan and a CMOM capacity assurance plan. All of this work was done by District staff with $30,000 of assistance from the county regional planning commission. The computerized maintenance management system (CMMS) was purchased in 1998. Consulting services, software procurement, and District staff

time to plan and implement this system cost $1 million. All asset information was collected and input to the system by District staff.

A four-person team currently monitors the operation of the CMMS. The District's purchasing manager acts as the database administrator for the system. He is assisted by staff from the maintenance, information technology, and accounting areas. All four team members are active members of the software user group to ensure that upgrades to this product match District work flows and to maintain a working knowledge of the overall software system.

Management System Challenges to Implementation and Effective Attributes

The greatest barrier for MMSD during implementation of NBP EMS was gaining acceptance from employees. Many employees had the mentality of "Things are going well, so why do we need this?" In overcoming this barrier, managers cited the need to effectively communicate the vision of the performance management system to employees and conveying its importance.

A challenge MMSD encountered with asset management was performing comparative analysis of assets. Because MMSD is a special service district that does not maintain local sewer collections systems, performing comparative analysis for asset management proved to be challenging. Roughly two-thirds of the District's asset value is in the single treatment plant. Assigning the thousands of assets contained in the maintenance management system to asset groups to be used in an asset management initiative for the plant is a current challenge.

Measures of Performance

EMS Performance Measures

MMSD prepares a periodic biosolids management program performance report that provides summary information on a wide variety of activities associated with the biosolids management program and the EMS for biosolids. The report tracks performance relative to eleven voluntary goals established under MMSD's EMS. In the first year of EMS implementation in 2004, eight out of the 11 goals set by MMSD were met or exceeded. The following are a selection of goals reported in the MMSD 2004 Annual Metrogro Program Report and Management Review.

- Increase employee awareness of the EMS and associated activities
- Increase awareness of the EMS and associated activities
- Successfully complete the 3rd party verification process and receive verification by the end of 2004
- Begin work associated with development of alternative biosolids product(s)
- Achieve 100% compliance with all local, state and federal rules/regulations
- Maintain an accurate, up-to-date and easy-to-use GIS application for the Metrogro Program
- Meet the state regulatory definition of high quality sludge with respect to metals, the EPA Class B requirement for pathogen reduction, and the EPA requirement for vector attraction reduction
- Provide biosolids related training to equipment operators
- Meet specific return frequency benchmarks for fields receiving Metrogro applications in terms of phosphorous loadings
- Hold the variable portion of 2004 unit costs to an increase less than or equal to the rate of inflation

Convert the Metrogro database out of Oracle to its own SQL Server database by end of 2004 (Note: this goal was subsequently dropped after analysis showed that effort for conversion was significantly greater than the potential benefits of conversion.)

Core Performance Measures

MMSD prepares an Annual Report of the Commissioners that provides operations and performance information across the organization. The Report covers regulatory reporting requirements (e.g., effluent pollutant concentrations) and basic operations (e.g., daily average quantity of wastewater), as well as voluntary measures (e.g., water reuse), finances (e.g., costs by function), and internally focused management areas, such as human resources (e.g., hours of training) and operational improvements (e.g., engineering and construction projects completed).

The core measures also focuses explicitly on Metrogro operations as one of its core reporting areas, thus providing an explicit link between the EMS and core measures of the Annual Report. The Annual Report covers parallel measures to the EMS goals for Metrogro operations. For example, Annual Report metrics include:

- Biosolids quality average values for metals, nitrogen, phosphorus, potassium, and total solids compared to EPA limits;
- Number and results of water samples collected from private wells;
- Quantity of recycled biosolids;
- Biosolids acres applied; and
- Costs of biosolids program.

Key Management System Benefits

The biggest impact of EMS implementation has been improved employee knowledge of the reuse program and its relationship to other aspects of the District's operation. The continual improvement policy has made projects and initiatives more structured with employees committed to achieving goals set forth under the EMS. Systematic tracking and attention to biosolids quality ensures MMSD is producing "exceptional quality" biosolids product on a consistent basis. The management systems have supported achievement of 100 percent compliance with all discharge permit limits in 2004. They also supported MMSD achieving its goal of providing services in 2004 at a cost that was 35 percent lower than the national average for agencies of similar size. Goal areas suggest that MMSD anticipates continued improvements such as reduced biosolids program costs, additional biosolids application/product options, and improved community relations.

Additional benefits from EMS and asset management include improved documentation and continual improvement of the biosolids process. In particular, the CMMS provides recordkeeping and information storage for the District. This allows record sharing for all personnel, resulting in more efficient work flows for all work groups, especially maintenance, purchasing and accounting. The system has also resulted in improved purchasing practices to take advantage of price breaks at quantity levels to reduce purchasing costs.

APPENDIX D: ORANGE COUNTY SANITATION DISTRICT (CALIFORNIA)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the Orange County Sanitation District (OCSD) and its management systems, including Asset Management, a National Biosolids Partnership (NPB) certified Environmental Management System, and 'Unifying Strategies'.

Utility Overview

Orange County Sanitation District (OCSD) provides wastewater collection, treatment, biosolids treatment, and water reclamation services to 2.4 million people across more than 470 square miles. OCSD comprises nine former revenue areas joined into a single service district, forming the third largest wastewater discharger in the western United States. OCSD maintains and operates sewer service for 23 cities, including 12 trunk sewer systems, two treatment plants (one with an average flow of 87 million gallons per day (MGD) and the other with an average flow of 151 MGD for a total of 238 MGD), two discharge outfalls and two emergency weir outlets. OCSD operates and maintains 475 miles of collection interceptor and trunk lines and 17 pump stations. OCSD has annual revenues of $264.4 million with operating expenses totaling $117.8 million (FY04-05) and has 629 employees.

OCSD was formed in 1946 under the County Sanitation District Act of 1923, which replaced a joint outfall sewer organization owned by several sewerage agencies within Orange County. OCSD was formed to address the need for sewage collection, treatment, and disposal facilities that would be suitable for the expanding municipal areas in Orange County. Formation also facilitated public financing for sewer systems in Orange County, which the previous organization was unable to accomplish. A bond election in 1949 allowed OCSD to build treatment and disposal facilities serving the cities of Anaheim, Santa Ana, Fullerton, Orange and sanitary districts in Placentia, Buena Park, La Habra and Garden Grove. The 1949 bond election also financed the beginning of a network of trunk sewer systems throughout Orange County. OCSD formally took control of sewer management in 1954 when Plant No. 2 and Ocean Outfall No. 1 were constructed. Ocean Outfall No. 2 was subsequently constructed in the 1970s.

OCSD is currently undertaking the largest water reclamation project in the U.S. to process 70 MGD via microfiltration and reverse osmosis. The reclaimed water will be used for direct water injection for a seawater intrusion barrier to protect inland groundwater and also sent to inland recharge basins along the Santa Ana River for percolation and recharge via a 12 mile pipeline.

Under state law, user fees for wastewater facilities can be raised by the governing board absent of a protest of 50 percent of ratepayers. For OCSD, the governing board is made up of 25 mayors or appointed city council members representing all of cities and districts served. The board sets user fees on an annual basis with a 2/3 majority vote requirement to raise them.

OCSD has traditionally had very low rates, operating well under the state average. OCSD attributes two advantages to its ability to keep low rates. First, up until recently, OCSD operated with a 301 (h) ocean waiver which allowed for no secondary treatment. The board reversed this in 2002, and OCSD is moving to full secondary treatment by 2012. Second, management maintained financial reserves and an AA bond rating for many years, which has put the agency in an excellent financial condition.

However, in expectation of significant facility upgrades, including implementing secondary treatment and increased wet weather flow capacity, OCSD had a 31 percent rate increase in this past year and now projects 15 percent annual rate increases for the next five years. It is expected that the rate increases will eliminate $400 million in future capital borrowing and the associated interest costs.

Management System Development Efforts

OCSD has undertaken management systems initiatives in two main areas: Optimized Asset Management and the National Biosolids Partnership Environmental Management System. OCSD has also engaged in strategic planning activities and in 2003 created the Unifying Strategies.

Asset Management

A group of OCSD middle managers, frustrated by the lack of clear connectivity between several ongoing initiatives, began to suggest better integration in the organization to improve decision-making. In 2002, OCSD built the Strategic Plan for Asset Management that has thus far formed the basis for better integration within the organization.

Within the Asset Management Plan for 2005 are a series of annual, key performance indicators, which are organized around the triple bottom line areas: economic, environmental, and social. Social performance indicators focus on customers, neighbors and employees. Environmental performance indicators focus on air and water quality, biosolids, and other areas of operational performance. Economic performance indicators focus on rates, costs, and debt management.

OCSD has a cross-divisional Asset Management Steering Committee that meets once a week. Asset management drives two primary considerations at OCSD; 1) investment toward the lowest cost of ownership, and 2) the best plan in terms of stewardship. OCSD currently has 97,000 taggable assets in the organization with the intention to integrate the data in digital warehouses to draw all assets together. OCSD asset management efforts build on many years of investment in information management systems, such as GIS, a computerized maintenance management system, a laboratory information management system, and financial systems.

National Biosolids Partnership (NBP) EMS

OCSD has implemented an NBP EMS to guide environmental performance and interaction with the community regarding biosolids management. In 2003, OCSD was the first utility in the nation to receive NBP EMS certification. The NBP EMS was put in place to support the biosolids program's overarching goal of creating an economically viable, environmentally sound, and socially acceptable biosolids program by 2008. The EMS supports this goal by creating a system based on continual improvement, documentation, and building relationships with, and creating opportunities for participation by, interested parties.

Unifying Strategies

Both EMS and Asset Management efforts predate the Unifying Strategies, strategic planning initiative. First introduced in 2003, the Unifying Strategies provide the umbrella under which the EMS and Asset Management program sit. The Unifying Strategies act as a strategic alignment framework that ties the management plans and agency operations together in four broad areas: environmental stewardship, business principles, workplace environment, and wastewater

management. The Unifying Strategies are based on a strategic planning process that promotes continual improvement. The entire text of the Unifying Strategies is as follows:

- *Environmental Stewardship*: OCSD participates collaboratively in the protection of regional water resources for the benefit of the people we serve.
- *Business Principle*: OCSD makes every decision based on short and long-term environmental, societal and financial impacts (the triple bottom line).
- *Wastewater Management*: OCSD beneficially reuses and recycles water and other resources using safe and effective wastewater systems.
- *Workplace Environment*: OCSD provides and environment of partnership, growth, opportunity, responsibility and accountability.

OCSD is currently initiating a program management office for Unifying Strategies to better and more consistently communicate and report on the priorities identified within. OCSD's future expectations for improvement are to define and build toward long term sustainability.

Drivers for Management Systems Change

For approximately eight years, OCSD participated in benchmarking performance against seven peer utilities on the west coast of the United States. This benchmarking helped drive investment in asset management and the environmental management system by identifying key areas for performance improvement.

Another key driver to implement Asset Management at OCSD was the initiative taken by internal leaders within middle management to identify the need and lead the effort to implement such a management system. Middle managers within the organization took it upon themselves to develop a strategy for integrating operations across disciplines and improving business practices and performance within OCSD and decided upon asset management. A secondary influence was the accounting standards GASB34, which prompted the focus on looking at infrastructure differently.

OCSD initiated the NBP EMS partially in response to land application challenges in crowded Southern California. OCSD needed to implement a system that would ensure high quality biosolids and have credibility to drive community support for biosolids land application.

The Unifying Strategies system came about from internal needs to systematically address strategic planning tying various activities together, including the Asset Management system and EMS.

Management System Resource Requirements

Asset Management

OCSD has spent $500,000 over the past two years in developing their Asset Management Strategic Plan. The utility anticipates spending another $2 million on consultants and almost $8 million in staff time over a period of seven years to fully implement asset management. Until recently, there was one FTE and an asset management steering committee that met for an hour and half once a week committed to the system. OCSD does not view the costs as "extra," but

believes it is simply a system that provides a framework for better organizing activities that would have occurred regardless of asset management implementation.

OCSD had a significant number of information management systems in place and much of the information for the asset inventory existed before the asset management program was initiated. Therefore, the management system required more coordination and data improvement than resource and time intensive data collection or systems development.

NBP EMS

OCSD spent approximately $250,000 in NBP EMS implementation over a period of two years. NBP also provided OCSD contractor assistance and training workshops valued at $15,000 - $18,000 to support EMS implementation. The initial third party audit costs for the wastewater treatment facilities, composting, and land application equaled $28,300. OCSD spends $150,000 per year in maintaining the management system with 1.5 full-time employees assigned to the program.

Unifying Strategies Strategic Plan

OCSD Unifying Strategies was an initiative crafted by a group of managers through a short series of meetings and discussions centered on the need for greater management and performance integration across operations. Through these meetings the four principles outlining Unifying Strategies (cited above) were created connecting the asset management and EMS programs. Minimal resources were expended on the strategic plan and consisted of a few staff hours a week.

Management System Challenges to Implementation and Effective Attributes

For OCSD, the challenges to asset management implementation were largely around change management. As OCSD management reported, “50 percent of system development and implementation was culture change.” It was important to both educate the Board on asset management and to provide adequate internal and external communication.

Key Measures of Performance

Core Measures

OCSD’s primary measures are captured in three key performance measure areas, following the triple bottom line concept of Financial, Environmental, and Social. The 2005 Asset Management Plan is the first plan fully implementing the triple bottom line measures. The measures represent a snapshot of the organizational priorities and functions.

OCSD is beginning to use triple bottom line analysis to determine whether a project is worth the cost. OCSD has piloted the use of triple bottom line as an evaluation model for a project on odor control and is considering its broader use.

OCSD, in the context of its asset management strategic plan, developed a set of key performance indicators now used on a quarterly basis to drive utility performance. OCSD organized the performance indicators around the three sustainability “triple bottom line” categories: environmental; social; and financial. Environmental performance indicators are

broken out into six categories: compliance with effluent quality standards; reliable flow management; recycling of effluent; sustainable biosolids program; improved regional watershed; and protect air environment. Social performance measures focus on OCSD being a good neighbor and responsive to customers, providing timely and effective public access to information, and taking care of employees. Financial measures focus on debt position, user fee levels, and operational costs. See Table 1 for examples of OCSD performance measures.

Table 1: OCSD Performance Measures

Category	Indicator Area	Indicator	2005 Target Level of Service
Environmental	Effluent quality standards	Effluent total coliform bacteria after initial dilution, mpn	<1,000
Environmental	Manage flows reliably	Sanitary sewer spills per 100 miles	<2.1
Environmental	Effluent recycled	Treated effluent reclaimed, % (flow)	4% (10 MGD)
Environmental	Sustainable biosolids management program	Percent of biosolids beneficial reuse, Class "A/EQ"	60%
Environmental	Improve regional watershed	Per capita wastewater flow rate, gal./person/day	<105
Environmental	Protect air environment	Odor complaints, Treatment Plant No.2	5
Social	Good neighbor / Responsive to customers	Off site biosolids nuisance complaints	0
Social	Provide public access to information	Public Records Act requests within 10 working days	100%
Social	Take care of people	Training hours per employee	45
Economic	Exercise sound financial management	COP service Principal and Interest	< than O&M expenses
Economic	Exercise sound financial management	Annual user fees	Sufficient to cover all O&M requirements
Economic	Exercise sound financial management	Annual variance from adopted reserve policy	< 5%

For each performance indicator, OCSD has developed an annual "Target Level of Service" against which performance is measured. The indicators also provide a variety of direct links to its EMS for Biosolids. Both the environmental and social performance indicators categories have individual indicators that draw on OCSD EMS for Biosolids objectives and targets (e.g., number of off-site biosolids nuisance complaints).

Driven by its EMS for Biosolids, OCSD also maintains a set of goals and objectives specific to its biosolids value chain. In 2003\2004 OCSD had nine goals substantially focused on the utility's initial development and implementation of its EMS (e.g., one objective was for vendors to

complete and approve the written Biosolids Management Plans before the end of FY 04). For FY 2005 OCSD established 11 goals driving a mixture of further biosolids program implementation, direct operational improvement, and increased public participation and outreach (See Tables 2 & 3). OCSD also has established a direct link between its EMS for Biosolids and the Unifying Strategies: one of its FY-2005 EMS goals is to ensure EMS goals are appropriately integrated into the Unifying Strategies process; and it has developed two additional Unifying Strategies Biosolids-Related Goals.

Table 2: OCSD 2005 Biosolids EMS Goals

Biosolids EMS Goals	Anticipated Outcomes
Maintain 100% biosolids-related compliance with 40CFR503, local regulations, and OCSD NPDES permit.	
Develop minimum compliance standards checklist	
Inspect land application sites at least twice; in crop rotation and compost facilities at least once per quarter.	
Inspect at least 1% of biosolids hauling trucks per year.	
Create and implement a Contractor Oversight Evaluation System	

Table 3: OCSD 2005 Biosolids EMS Goals (Continued)

Biosolids EMS Goals	Anticipated Outcomes
Vendors will miss no more than 5% of their weekly loads for Good performance (less than 1% for Excellent performance).	
Ensure that Biosolids EMS goals are appropriately integrated into the Unifying Strategies' process.	
Pursue applicable Class A alternatives within current management contracts when viable opportunities are presented.	
Implement recommendations of the Long-Range Biosolids Management Plan which seeks market-driven, manufactured biosolids-based products for management options in order to create a more sustainable biosolids program.	
Create and implement South Kern Organics interested party participation and outreach plan.	
Fund, participate, and summarize biosolids-related research. Projects address scientific concerns regarding biosolids reuse (e.g., questions related to safety, characteristics, best management practices, and constituent and pathogen content) and future market development and expansion opportunities for biosolids-based products.	
Continue participation in and professional leadership within national, state, and local associations that promote good biosolids practices including acting as Chair of the Water Environment Federation's Residuals and Biosolids Committee, Tri-TAC (statewide wastewater treatment plant technical advisory committee) Land Committee Chair, and encouraging the use of biosolids Environmental Management Systems with sister agencies through presentations at state and national conferences.	

Key Management System Benefits

Although in the early stages of its enhanced management systems efforts, OCSD has documented several management system benefits. Most notably, OCSD estimates its asset management efforts to date have saved over $30 million in avoided infrastructure investments through reprioritizing and eliminating Capital Improvement Plan items. OCSD, in response to its Biosolids for EMS certification efforts, has experienced marked improvements in its relationships with parties interested in its biosolids land application activities. In addition to these early benefits, OCSD anticipates benefits (as indicated by its key performance indicators and EMS objectives and targets) across a wide spectrum of areas:

- Driving air emissions-related health risk reductions to employees and the community down by 60 percent.
- Improving employee training;
- Improving the regional watershed (e.g., by collecting and treating 150 percent more dry weather urban runoff over seven years and by increasing its water reclamation seven-fold to 70 MGD within seven years);
- Achieving 100 percent biosolids beneficial reuse, with a substantial portion (e.g., 60 percent) applied as Class A biosolids;
- Increasing public participation in and awareness of the biosolids management program:
- Maintaining high responsiveness to customer complaints and concerns (e.g., restoring collection service when interrupted within eight hours);
- Maintaining high responsiveness to community interests (e.g., process public access records requests within ten days); and
- Ensuring sound financial management of the utility (e.g., maintain annual variance from cash reserve policy at less than 5 percent).

APPENDIX E: CITY OF SAN DIEGO, METROPOLITAN WASTEWATER DEPARTMENT (CALIFORNIA)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the City of San Diego, California Metropolitan Wastewater Department and its management systems, including three division-level, International Organization for Standards (ISO) certified Environmental Management Systems (EMS) and department-wide strategic planning.

Utility Overview

The San Diego Metropolitan Wastewater Treatment Department (MWWD) provides wastewater and stormwater collections, wastewater treatment, biosolids processing, and water reclamation services to approximately 2.2 million residents in a 450 square-mile area. More than 1,900 industries and business in the MWWD service area have been identified as potential dischargers of prohibited wastes or toxic pollutants. The MWWD Wastewater Collections Division operates and maintains 84 pump stations and is responsible for 2,894 miles of sewer lines.

The MWWD Operations & Maintenance Division operates and maintains one wastewater treatment plant, two water reclamation plants, and a biosolids center. Total system wastewater average daily flow (ADF) is 285 million gallons per day (MGD).

- The Point Loma Wastewater Treatment Plant was constructed in 1963 and is the Department's main wastewater treatment plant, treating an average of 180 MGD with a maximum ADF capacity of 240 MGD. The Point Loma Plant has screening, grit removal, and advanced primary treatment processes. It is located on a 40-acre site on the bluffs of Point Loma. The Point Loma Plant outfall is a 12-ft diameter pipe, gravity-driven 4.5 miles to 320 foot deep ocean water.
- The North City Water Reclamation Plant treats wastewater generated by northern San Diego communities. It opened in 1996 and can treat up to 30 MGD ADF. The plant has secondary and tertiary treatment processes and provides reclaimed water to customers for irrigation, landscaping, and industrial use.
- The South Bay Water Reclamation Plant opened in May 2002 and relieves the South Metro Sewer Interceptor System and provides local wastewater treatment services (tertiary treatment) and reclaimed water to the South Bay and has a wastewater treatment capacity of 15 MGD ADF.
- The 39-acre Metro Biosolids Center began operating in 1998 and has capacity of 600 metric tons of biosolids per day. Stabilized liquid biosolids are piped 17 miles from the Point Loma Plant to the Metro Biosolids Center for dewatering, storage, and transportation. Undigested liquid solids are piped 5 miles from the North City Water Reclamation Plant where they are stabilized in anaerobic digesters and dewatered. Solids from the South Bay Water Reclamation Plant are returned to the wastewater system as waste activated sludge.

Modified Permit

In November 1995, the San Diego MWWD received a modified permit (also called a "waiver") from secondary treatment requirements of the Clean Water Act for the Point Loma Wastewater Treatment Plant. This modified permit was renewed in September 2002. Through a combination of factors, including industrial source control, advanced primary treatment of wastewater, a deep

ocean outfall, and comprehensive environmental monitoring, both the Environmental Protection Agency and the Regional Water Quality Control Board agreed that the Point Loma Plant fully protects the ocean.

Methane Gas Capture

Methane gas is removed from the digesters at the Point Loma Plant and is used to power two Caterpillar engines in the plant's Gas Utilization Facility. These two engines supply all of the plant's energy needs, making the Point Loma Plant energy self-sufficient. The plant sells the excess energy it produces to the local electricity grid, offsetting the energy costs at pump stations throughout the city. Methane gas is also captured from the digesters at the Metro Biosolids Center and converted to electricity and thermal energy.

Hydro Power

The Point Loma Plant also takes advantage of its location on a cliff's edge by operating a hydroelectric power plant driven by effluent dropping 90 feet into the Outfall. This additional power is also sold to the local energy grid.

Governance and Structure

Appointed by the Mayor and confirmed by the City Council, the Public Utilities Advisory Commission advises the Mayor, Council, City Manager and the Deputy City Manager in charge of utilities on matters related to public utilities which impact rate payers and residents of the City of San Diego. These utilities include the City's Water Department and Metropolitan Wastewater Department. The Commission is composed of representatives from each of the participating agencies (cities in addition to San Diego that feed into the wastewater treatment system). Budget rate setting decisions lie with the San Diego City Council. The City Council also must approve debt and bonds.

With over 1000 employees, MWWD is organized into seven divisions: Wastewater Collection, Environmental Monitoring and Technical Services, Engineering and Program Management, Services and Contracts, Information and Organizational Support, Operations and Maintenance, and Storm Water Pollution Prevention. MWWD's total operating budget for FY 2004 was $508.7 million.

Management System Development Efforts

San Diego MWWD has developed three division-level ISO 14001 certified environmental management systems (EMSs) for the operational divisions of the department—Operations and Maintenance, Wastewater Collection, and Environmental Monitoring and Technical Services (includes industrial pretreatment program and laboratory). In addition, MWWD has an overarching Strategic Business Plan.

Environmental Management Systems

The three MWWD EMSs were developed independently (albeit following somewhat similar templates) with separate fencelines tailored to each division's needs.

> The Operations and Maintenance Division EMS was ISO 14001 certified in 1999.

- The Environmental Monitoring and Technical Services Division EMS was ISO 14001 certified in June 2002, making it the first publicly owned laboratory in the nation to receive such certification.
- The Wastewater Collection Division EMS was ISO 14001 certified in 2004.

There are several divisions of MWWD that are not yet covered by an EMS, specifically the business support divisions such as human resources, information technology, and engineering. At this time, rather than attempt to implement a single department-wide EMS, MWWD aims to continue to approach each division separately.

Strategic Business Plan

Since Calendar Year 2000, the MWWD has implemented an organization-wide Strategic Business Plan (Plan). The Plan is based upon the Balanced Scorecard concepts. The Plan is updated annually and reflects a focused, on-going process of planning, execution, review, and adjustment of MWWD activities. The purpose of the Plan is to: 1) set department vision, goals, objectives, and action plans; 2) involve all levels of the organization in the Plan processes; 3) facilitate consistent, high-quality, and timely decision making; 4) develop priorities and allocate resources optimally; and 5) integrate all MWWD planning efforts, so as to maximize value and minimize redundancy.

The Strategic Business Plan provides the following organizational framework:

1. Vision—A result of Successfully Accomplishing the Mission: We are a recognized Wastewater Industry Leader, serving the public good through innovation and continual improvement.
2. Mission—Purpose of Existence: Provide the public with a safe, efficient, and cost-effective regional sewerage system that protects the environment, supplements our limited water supply, and meets regulatory standards.
3. Business Goals and Objectives:
    a. Systems operations and maintenance
    b. Capital asset management
    c. Fiscal management
    d. Customer service
    e. High performing work team

The three EMSs do not explicitly tie into the department-wide Strategic Business Plan. However, because the plan has a Balanced Scorecard-influenced approach and follows a similar “plan, do, check, act” framework, there are implicit connections to the EMSs. For example, EMS objectives and targets fall underneath and are generally supportive of high-level business goals and objectives in the Strategic Business Plan.

Other Management Initiatives

MWWD has developed an employee incentive plan called Pay-for-Performance, which utilizes a cash bonus payoff. Bonuses are based on savings attained by each division and achievement of goals. Each employee can receive bonuses totaling up to $1000 each year. In addition, the Operations and Maintenance Division and the Wastewater Collection Division have a Bid-to-Goal competitive program which makes available up to $3000 per employee based on achieving performance measures. Pay-for-Performance and Bid-to-Goal programs have provided an incentive for employees to achieve EMS objectives and strategic planning goals.

Drivers for Management Systems Change

The Operations and Maintenance Division was driven to implement the EMS due to the potential of a private contract operator taking over. The Division saw the EMS as a tool to produce a level of service with quantifiable public and economic goals that prove the utility's performance.

The Environmental Monitoring and Technical Services Division felt that many of the EMS elements were already incorporated into their existing processes, and the EMS was seen as another level of quality assurance. Having already completed EPA's National Environmental Laboratory Accreditation Program (NELAP) certification, the Division was encouraged to certify with ISO since it was relatively easy to complete.

One of the Wastewater Collection Division's drivers for EMS was an EPA Administrative Order. In calendar year 2001, EPA conducted a comprehensive, field-level audit of MWWD's Wastewater Collection Division. On April 5, 2002, as a result of the audit, EPA issued a comprehensive Administrative Order requiring updated procedures, information systems, organizational practices, and logistical support for the City's Municipal Wastewater Collections System. The standard operating procedures that the Wastewater Collection Division instituted in response to the Administrative Order essentially formed an EMS. The formalized EMS that followed in 2004 provided a structure of authority and document control for standard operating procedures to help comply with the Administration Order.

In addition, there was an internal management driver to improve performance across the organization, especially in the case where day-to-day activities were not documented. MWWD management believed employees respond better to a management system than to a person giving orders to do activities. By having a system with clear, documented operating procedures and quantified expectations, all employees know what they are supposed to do.

MWWD's primary driver for strategic planning was to support long-range planning and performance improvement across the Department in several key management areas (systems operations and maintenance; capital asset management; fiscal management; customer service; and high performing work team).

Management System Resource Requirements

For the Wastewater Collection Division management system, implementation costs totaled approximately $308,000 ($90,000 of which went to consultant costs). In addition, the Division estimates the implementation required 6,200 hours of staff time over a period of 30 months.

The Operations and Maintenance Division EMS required approximately $365,000, with $200,000 in staff time over 18 months. Initial EMS registration cost was $7,000 and ongoing surveillance audits cost approximately $5,000 annually.

The total cost to get the Environmental Monitoring and Technical Services Division EMS up and running through the first year (FY 2002) was approximately 2,225 hours of staff time and about $187,000 in consultant costs. Ongoing, the Division commits about 100 hours of staff time per year and the annual third-party audit cost ranges from $5,000 - $7,500.

Management System Challenges to Implementation and Effective Attributes

Culture change and change management were some of the most significant challenges to EMS implementation at MWWD. The Wastewater Collection Division faced resistance from the highest level supervisors in accepting their role in the management system. In fact, there was much greater buy in from employees than supervisors, likely because there was a perceived transfer of power from supervisors to employees. In addition, there were challenges to change the work ethic to follow the system, especially the documentation requirements.

The Operations and Maintenance Division faced change management challenges when the Division started going through the planning process. Employees were hesitant to consider further optimizing treatment chemicals. Employees were of the mentality that they were already optimizing chemicals and did not see the value in the EMS. However, the EMS eventually led to more streamlined hazardous materials storage lockers and improved containers. The EMS gave the structure, tools, and motivation to examine the situation. Even though it took some time to start seeing the benefits of the EMS, once employees saw the benefits in their daily work life it started to take hold. Another one of the earliest benefits of the EMS was in preparing for the first of the third-party audits, which "impressed the auditors and impressed the employees even more." In the end, however, one of most effective approaches to overcoming resistance to change was offering cash incentives to employees.

Measures of Performance

EMS Measures

In the Operations and Maintenance Division, each facility generates an annual report based on the unique equipment and processes at each plant. The reports are reviewed yearly for performance measures such as energy, water use, land use, NOx emissions, paper recycling, and manhole lid recycling. Objectives and targets are reviewed each year in an effort to trim down resource use to optimal levels.

The Laboratory Division recently relocated to a new facility and is revising objectives, targets and performance measure to fit the new situation.

The Wastewater Collection Division has a monthly EMS objectives and targets report divided into four business sections (administration and management, construction, main cleaning and maintenance, and sewer pump and interceptor operation and maintenance). The objectives cover nine EMS initiatives addressing air, land, water, resource use and waste stream impacts. The report sets out activities, a time frame, the EMS program element, and the responsible program coordinator for each objective. The Division tracks between four and eight objectives for each of the sections. The objectives range from regulatory compliance as well as beyond compliance activities and voluntary aspirations. Most performance metrics are measurable outcomes. The table below includes a sample of the Wastewater Collection Division EMS objectives, targets, and performance metrics from May 2004.

Section	Objectives	Targets	Performance Metrics
Administration and Management	Optimize existing recycling program	Expand recycling program to aluminum, plastics, and packing materials – Goal to reduce waste	Pounds of material/month recycled

		by 5%	
Construction	Erosion control and noise abatement	Maintain current levels of compliance and maintain post construction inspection	Number of non-compliances reported
Main cleaning and maintenance	Reduce air emissions	Reduce use of two-engine trucks and identify new technologies or work practices	Number of replaced trucks
Main cleaning and maintenance	Maintain preparedness and response time	Maintain current rate of <1% total call backs incident rate per total footage cleaned	Incident rate total calls backs per Division per total footage cleaned
Sewer pump and interceptor operation and maintenance	Determine and reduce chemical waste generation	Establish reduction target after baseline data complete	Waste generated per pump station

Core Measures

In addition to the EMS objectives and targets, MWWD has a quarterly Performance Indicator Report that reports on activities related to the Strategic Business Plan's five business goal areas (systems operation and maintenance, capital asset management, fiscal management, customer service, and high performing work team). For each of the five areas, there are a number of measures covering the organization's core business performance.

Based on EMS objectives and targets, the EMS directly contributes to all core measurement areas, except capital asset management. The table below illustrates some of the connections between performance indicators and EMS objectives and targets.

Business Goal Area	Performance Indicator Report Metric	EMS Objective
Systems operation and maintenance	Miles of sewer main replacement	Maintain and seek improvements for repair and replacement
Fiscal management	Electrical energy consumption	Maintain current energy saving initiatives
Customer service	HelpDesk response time	Increase staff customer service skills
High performing work team	Department hours in training	Maintain current work practices (enhance staff training)

Key Management System Benefits

MWWD has found the three EMSs and Strategic Business Plan provide significant, measurable benefits in the form of environmental and financial performance improvement, as well as organizational learning.

Measurable Performance Improvement

The Wastewater Collection Division estimated an EMS payback period of 1.5 years as indicated by the figures below.

- Collections Division EMS Startup costs: $308K

- Yearly cost savings on SSO response: $212.8K
- Yearly cost savings on recycling: $4.5K

In addition to the quantified cost savings, MWWD indicated the annual resource savings including the following.

- 410 cubic feet of landfill space reduction
- 36,900 kWh electricity
- 63,000 gallons water
- 153 trees
- 3,420 gallons oil
- 1,260 lbs air pollution reduction

The EMS also led to cost savings and further improved environmental performance. For example, the Division eliminated over-purchasing of reagents and chemicals, which provided benefit from an economic standpoint as well as environmental standpoint.

In addition, the EMS objectives and targets anticipate future measurable benefits. For example, EMS objectives point toward measurable benefits.

- Reduced fuel usage
- Reduced energy usage
- Reduced chemical usage (reduced chemical waste)
- Reduced natural resource construction materials usage
- Reduced paper usage
- Reduced landfill tipping fees and landfill space reduction (increased recycling)

Strategic planning goals also point towards anticipated, measurable benefits in the areas of systems operations and maintenance, capital asset management, fiscal management, customer service, and high performing work team. The following are a few examples of such anticipated benefits.

- Reduce the number of worker's compensation and industrial leave claims and associated costs
- Reduce the number of preventable vehicular accidents
- Achieve Occupational Safety and Health Agency safety incidents rates

Organizational Learning

For the Division's three EMSs, periodic management reviews, documentation, and internal and external audit activities drive improved performance to meet the reviewed objectives. In addition, internal audits build peer-to-peer learning among cross-divisional teams. Finally, the EMSs benefit employees by bringing ownership to processes and operations that empower staff to know they are being managed by a system rather than a personality.

APPENDIX F: SANTA CLARA VALLEY WATER DISTRICT (CALIFORNIA)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the Santa Clara Valley Water District to provide context for more detailed information on the Water Utility Enterprise, particularly focusing on the optimized asset management program.

Utility Overview

The Santa Clara Valley Water District (District) is the primary water resources agency for Santa Clara County (County), California. The District ensures there is enough clean, safe water for homes and businesses; works to protect residents and businesses from the devastating effects of flooding; and serves as the steward for the County's 700 plus miles of streams and creeks, its groundwater basins, and District-owned reservoirs. The District is unique in being a special district that is countywide and focused in many aspects of water resources management. To accomplish its mission during fiscal year 2005/06, the District is projecting $241 million in total revenues and other financing and $264 million in total net operating and capital outlays. The $264 million in outlays includes $23 million funded from reserves. At the end of fiscal year 2005/06, the District is projecting that $125 million will remain in reserves for specified purposes.

The Santa Clara Valley Water District operates three water treatment plants: Rinconada, constructed in 1967; Penitencia, constructed in 1974; and Santa Teresa, constructed in 1991. The majority of the distribution pipelines were constructed in the 1970's and 1980's with an average age of 20-30 years, however, the oldest of the pipelines are approximately 50 years old and the newest are eight to nine years old. The cumulative water treatment flow from the three treatment plants is 120 million gallons per day (MGD) (120 MGD is an approximate daily average over an average year. Treated water deliveries are seasonal – summer daily deliveries are often 190 - 200 MGD and winter deliveries are around 80 – 90 MGD) with a maximum capacity of 220 MGD.

The District's service area encompasses all of the County's 1,300 square miles and serves the area's 15 cities, nearly 1.8 million residents, and more than 200,000 commuters. The County's largest city, San Jose, was recently recognized by Readers' Digest as one of the cleanest cities in the United States, partially due to the District's management of water.

The District's core business, as clearly reflected in its mission statement ("*The mission of the District is a healthy, safe and enhanced quality of living in Santa Clara County through watershed stewardship and the comprehensive management of water resources in a practical, cost-effective and environmentally-sensitive manner*") is to provide residents with a clean and reliable supply of water and protection from flooding. To accomplish this, the District manages, captures, and stores local surface water in its reservoirs, recharges the groundwater basin, and imports water from the Sacramento/San Joaquin Delta. Once water is first treated at District facilities, it is distributed through pipelines to eight municipal and investor-owned water retailers for distribution to County residents and businesses. Additionally, private well owners and five water retailers pump water from the ground water basin that is managed by the District. Flood protection is provided through construction of capital projects such as channels and levees and through stream stewardship maintenance activities. The District is environmentally sensitive in how it plans and conducts its work. The District also strives to be a "Good Neighbor" by minimizing the unavoidable disruption to neighborhoods and residents caused by District work. The District also

works with local jurisdictions to make available reservoirs, trails, and open space for public use and enjoyment.

State Law (Santa Clara Valley Water District Act) outlines the structure, function, and operations of the District's Board of Directors (Board). The Board is composed of five elected Directors and two Directors appointed by the Santa Clara County Board of Supervisors. Although the District is a politically independent special district, the County Board of Supervisors also adopts the District's budget. The Board operates under a model of governance based upon the Policy Governance Model®. A unique feature of the District is that its Water Utility operations is managed as an enterprise primarily supported by water rates, while its Watershed Management operations is organized around the County's five main watersheds.

District employees are organized into three bargaining units: Mid-Management Association; Employees Association; and Engineers Society. The Employees Association is represented by the American Federation of State, County and Municipal Employees, AFL-CIO (AFCSME). Additionally, the District has "unclassified" employees who are "at will" employees. All executive level managers are unclassified employees.

Key Customer Groups and Markets, Customer Partnering and Communication Mechanisms:

Customers	Market Segment	Expectations	Partnering & Communication Mechanisms
Municipal & Industrial Water Users and Water Retailers	Treated drinking water & ground water	Clean, safe, reliable water supply at a reasonable cost, low groundwater pumping costs	Water Commission (advisory to the Board), personal meetings with treated water retailers, Water Retailer Committee.
Landscape Water Users	Water for landscaping irrigation purposes	Efficient water use, reliability, sufficient supplies, information on drought tolerant landscaping	Landscape Advisory Committee to the Board
Agricultural Water Users/Farmers/Growers	Bulk water for irrigation	Sufficient, reasonable cost water that is safe for irrigating crops for human consumption	Agricultural Advisory Committee to the Board
Private Well Owners	Groundwater	Quality, reliability, reasonable cost	Water rate hearings
Residents & Businesses in areas subject to flooding	Storm water & flood water drainage	Reasonable protection from flooding balanced with maintaining environmental/aesthetic values at reasonable cost	Flood Zone Advisory Committees to the Board, Water Resources Protection Collaborative
Neighborhood Residents Adjacent to District Facilities & Project Sites	Good Neighbor Program	Advance notification of disruptive work, minimizing noise, traffic conditions, dust, and other conditions related to District operations that would cause neighborhood concern	Community Meetings, Project Newsletters, surveys, Board Meetings
Environmental Organizations & Fish, Wildlife, & Ecosystems	Water and habitat for fish, wildlife, & plants	Water quality in streams, in-stream flows to maintain riparian habitat & fish passage and meet regulatory requirements, wetlands habitat protection & enhancement	Environmental Advisory Committee to the Board

Management System Development Efforts

Santa Clara Valley Water District has been involved in implementing a variety of management system initiatives. These include a district-wide Scorecard Performance Management System; optimized asset management for the water utility enterprise, ISO 9001/14001 for Watershed Operations, and ISO 9001 for the Capital Program Services Division. The District as a whole is also certified as a Green Business under the locally sanctioned Green Business Certification Program.

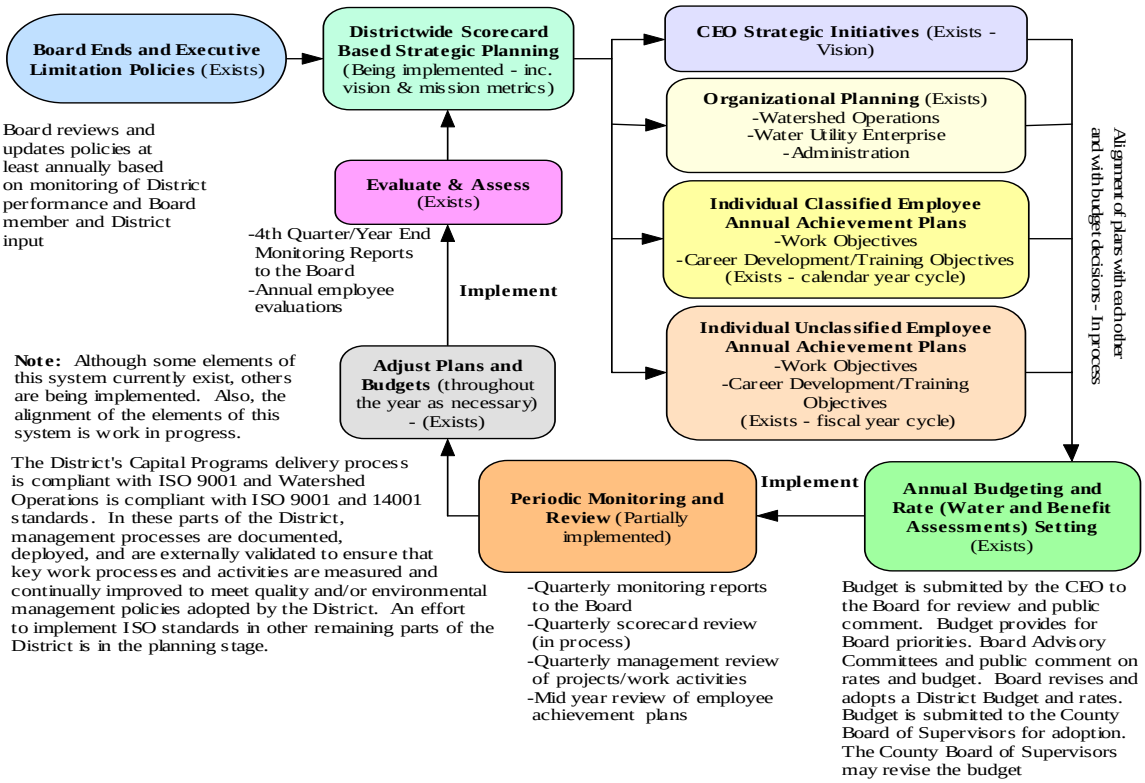
Scorecard Performance Management System

The District CEO has developed an enterprise vision ("*Getting cleaner, greener and leaner*") after consulting groups of employees. This vision statement describes the investment the District is making to:

- Manage water to meet strict regulatory standards;
- Increase its commitment to environmental stewardship; and
- Increase its cost-effectiveness.

The three elements of this vision statement: cleaner, greener and leaner are incorporated into the District's Scorecard Performance Management System to help define the vision, measure progress, and provide a basis for assessment and improvement.

The diagram below shows the overall framework for how the District aligns work activities, career development/training, and budget to meet strategic challenges and Board policies.



Asset Management

The Water Utility Enterprise implemented an asset management program beginning in 2002. The program began with a narrow focus for the organization to improve maintenance activities. The program began implementing information technology tools, such as risk analysis and funding forecasting, and improving upon the Computerized Maintenance and Monitoring System (CMMS) that was already in place. The Water Utility Enterprise has implemented the framework of asset management in the organization and is currently in the process of integrating the information produced by the asset management framework into decision-making processes. Through the asset management program, the Water Utility Enterprise intends to make maintenance a proactive effort where they can budget for specific activities. Moreover, the division would like to be able to use their asset management data to perform cost-benefit analyses on what work is most necessary.

Other Management Efforts

The District's Watershed Operations is ISO 9001/14001 compliant, and the District's Capital Program Service Division is 9001 compliant. In these parts of the District, management processes are documented, deployed, and are externally validated to ensure key work processes and activities are measured and continually improved to meet quality and/or environmental management policies adopted by the District. The District has decided to expand the EMS to include the entire District including the Water Utility Enterprise. The EMS expansion will take place in 2005-2006. Santa Clara Valley Water District is also considering a triple bottom line project evaluation approach. Triple bottom line seeks to balance three sustainability categories: environmental; social; and financial.

Drivers for Management Systems Change

The District's overall management systems efforts have been influenced by a set of competitive success factors and a set of strategic challenges.

The following are the key competitive factors for the District:

- Maintaining status as an independent special District with a Board of Directors focused on the County's water resources needs.
- Maintaining legal authority and jurisdiction to ensure agility and rapid decision making.
- Managing storm water, surface water, reservoirs, streams, and groundwater comprehensively for flood protection, water supply (municipal, industrial, and agricultural), recreation, and environmental benefits.
- Maintaining a diverse, reliable, and affordable water supply.
- Maintaining comparable rates for water supply.
- Collaborating and working regionally with other regulatory, land use, and water management agencies.
- Preserving and protecting water quality in the County's extensive natural groundwater basin.
- Maintaining and improving the District's flood protection and water supply infrastructure.

Strategic challenges fall into three categories: 1) The District is implementing increasingly stringent regulations to ensure environmental protection and water quality to protect ecosystems and public health. This requires investment in infrastructure and changes in work processes and behavior. 2) Public expectations for improved quality of living and environmental sustainability. 3) While costs steadily increase, state and federal deficits are resulting in loss of property tax revenues to the District and other local governments. This is intensifying competition among governmental entities for funding and in some cases, resulting in reductions in services.

Taking these challenges into consideration, the District is emphasizing "Getting Cleaner, Greener, and Leaner" as its strategic focus and vision for the future. This is in addition to the ongoing focus on District mission and delivery of services to the public. There are a number of other challenges the District faces, but these are the three biggest for the next few years, and serve as the foundation for the strategy of the District. The strategic challenges sort out among the three vision elements as follows:

Cleaner

- Meeting increasingly stringent regulatory requirements for drinking water quality and environmental protection.
- Providing transparent and accountable management of public resources and funds.
- Managing projects and maintaining facilities to ensure that the District is being a "good neighbor" to its customers.
- Open and transparent decision-making and ethical behavior

Greener

- Producing a net positive impact on the environment.
- Integrating and incorporating environmental management practices and benefits into District planning and work practices to more effectively and cost efficiently produce environmental benefits.

Leaner

- Improving processes to do more with less; focus on collaboration and process improvement.
- Ensuring accountability and credibility with stakeholders and voters to ensure support for future funding initiatives.

As previously indicated, the Water Utility Enterprise has brought substantial focus since 2002 to implementing an optimized asset management system. The decision to implement asset management was primarily an internal effort led by Water Utility Enterprise managers. The organization implemented asset management with the intention of assessing overall performance in terms of the service they were providing for water treatment. One of the main drivers for the Water Utility Enterprise to implement an asset management program was economic considerations. The Water Utility Enterprise faced increasing financial constraints (e.g., economic downturn following September 11, state budget shortfall, and increasing costs of imported water) and retail customers demanded more information on maintenance and capital project plans. Furthermore, the age profile of the infrastructure was moving to "middle-age" in need of greater maintenance attention. Asset management was seen as a method for documenting projects, maintenance, and replacement needs leading to greater efficiency.

The Government Accountability Standards Board statement number 34 (GASB 34) also played a role in influencing the decision to put asset management in place. The Water Utility Enterprise believed that having an asset management program would facilitate meeting GASB 34 requirements for local government financial reporting. In addition, Santa Clara Valley Water District anticipates that formal management systems and initiatives will impact bond ratings in the future.

Asset Management System Resource Requirements

The Water Utility Enterprise hired an external consultant and assigned three full time utility employees to implement their asset management program. The consultant cost was approximately $600,000 over the period of one year. The total cost for implementation is estimated to be about $1.2 million. The division also invested in hardware and software purchases for risk analysis and other maintenance management software totaling approximately $60,000 to $70,000.

In terms of resources required for ongoing management system operation, the Water Utility Enterprise has three full time employees assigned to the asset management program. The positions were created for asset management, but were all lateral movements within the organization. Annual consultant and software maintenance costs are approximately $20,000 to $25,000 per year. Half of these annual amounts are for software maintenance costs.

Asset Management System Challenges to Implementation and Effective Attributes

Although there was strong support from District Water Utility Maintenance Staff, the largest barrier for Santa Clara Valley Water District in their asset management implementation has been in changing habits and educating those who need to apply asset management concepts. The District is implementing changes to a long standing cultural approach to infrastructure management that will require a period of training and practical application before advanced asset

management concepts are fully integrated. There was a general misunderstanding about the purpose and need for asset management in the organization, and thus resistance to the program. Overcoming this barrier is the most difficult aspect of implementation. The Water Utility Enterprise management noted that the term "asset management" brings about misunderstanding over what it is and what it encompasses. There was confusion over whether it was considered a work plan, a capital project, or something else. The District believes it will be useful to have a nationally-accepted set of definitions for terms relating to asset management.

Another challenge to implementation for the District was having the organization compartmentalized with minimal communication between departments. For example, the financial department did not historically coordinate well with the maintenance department, which is a key link for asset management. While the Water Utility Enterprise was not able to restructure the organization in the implementation of asset management, the communication and cooperation among divisions improved.

Measures of Performance

Asset Management Measures

Santa Clara Valley Water District has asset management programmatic measures. The Water Utility Enterprise identified performance measures to track what they need to do their work more efficiently and effectively. Starting in 2003, the Division has tracked performance year after year on the programs key goals, such as:

- Ratio of expenditures to budget;
- Cost of treatment for a foot-acre of water;
- Leaks per 100 miles of pipeline; and
- Investments in rehabilitation or renewal.

Attached below are the formal performance measures relating to *service reliability* established as part of the asset management program. Below the *service reliability* measures are the *water quality*, and *water quantity* measures.

Table 1. Current, Retailers' input and Recommended LOS Performance metrics

Performance Measures	**West**			**East**		
	Current Practice	Retailers' Range of Input	Suggested Performance Metrics	Current Practice	Retailers' Range of Input	Suggested Performance Metrics
Tolerable interruption duration for an unplanned shutdown	4 hours	Summer: 3 hours to indefinite Winter: Days to indefinite	Summer: 24 hours Winter: Next business day	4 hours	Summer: 3 hours Winter: 1 to several days	Summer: 24 hours Winter: Next business day
Longest interruption duration for a planned shutdown	48 hours	Summer: Hours to indefinite Winter: 7-10 days to	Summer: 24 hours Winter: 10 days	48 hours	Summer: Short (hours) Winter: Weeks	Summer: 24 hours Winter: 10 days

Performance Measures	West			East		
	Current Practice	Retailers' Range of Input	Suggested Performance Metrics	Current Practice	Retailers' Range of Input	Suggested Performance Metrics
		indefinite				
Tolerable number of planned shutdowns per year	2 events	Min: 1 event Max: Several (More frequent, shorter duration)	Min: N/A Max: 2 long (7-10 days) event or more frequent, shorter duration (2-3 days)	2 events	Min: No response Max: 1 long (7-10 days) event or more frequent, shorter duration	Min: N/A Max: 2 long (7-10 days) event or more frequent, shorter duration (2-3 days)
Tolerable number of unplanned shutdowns per year	2 events	Min: 1 event Max: 15 events	Min: N/A Max: 3 events system wide. No more than 1 per retailer.	2 events	Min: 1 event Max: >1 event	Min: N/A Max: 2 events system wide. No more than 1 per retailer.

Water Quality Performance Measures

Water Quality Parameter	Performance Measure/ Target Performance Measure	Definition of Measure
For health (microbiological) related water quality parameters	*Performance measure*: % Compliance with the Requirements of the California Drinking Water Regulations for health related parameters Target Performance Measure = 100%	(The number of samples that successfully meet the Requirements of the California Drinking Water Regulations for health related parameters) x 100 ÷ (The total number of samples taken to measure for health related parameters)
For chemical related water quality parameters	*Performance measure*: % Compliance with the Requirements of the California Drinking Water Regulations for chemical related parameters Target Performance Measure = 100%	(The number of samples that successfully meet the Requirements of the California Drinking Water Regulations for chemical related parameters) x 100 ÷ (The total number of samples taken to measure for chemical related parameters)
For aesthetic related water quality parameters	*Performance measure*: % Compliance with the Requirements of the California Drinking Water Regulations for aesthetic related parameters Target Performance Measure = 100%	(The number of samples that successfully meet the Requirements of the California Drinking Water Regulations for aesthetic related parameters) x 100 ÷ (The total number of samples taken to measure for aesthetic related parameters)
For overall water quality parameters	*Performance measure*: % Compliance with the Requirements of the	(The number of samples that successfully meet the Requirements of the California Drinking Water Regulations) x 100 ÷ (The total number of samples taken

Water Quality Parameter	Performance Measure/ Target Performance Measure	Definition of Measure
	California Drinking Water Regulations Target Performance Measure = 100%	to measure for all parameters)
For transmission pressure requirements	*Performance measure*: % Compliance with the Requirements of the California Drinking Water Regulations for pressure Target Performance Measure = 99.8%	100% - (The number of hours of supply at insufficient pressure to meet the Requirements of the California Drinking Water Regulations for pressure) x 100 ÷ (The total number of hours of supply) Note: As a result of an unplanned shutdown. Does not include planned shutdown.
For taste & odor requirements	*Performance measure*: % Compliance with the *validated* retailer's customer complaints Target Performance Measure = Less than 20 per year	Annual Number of Episodes (# of validated retailer's customer complaints) Note: Complaints must be validated by SCVWD to the taste and odor complaints were warranted to be considered an episode.
Contracted flow requirements	*Performance measure*: % of contracted flow requirements met Target Performance Measure = 100%	(Volume of contracted flow provided) x 100 ÷ (Volume of contracted flow required to be provided)

Core Performance Measures

In addition to asset management program measures, and resulting from the CEO's vision of "Getting Cleaner, Greener, and Leaner," the District is early in the process of creating new performance measures to create a quarterly reporting "CEO dashboard." The dashboard will include measures from financial tracking to operations performance. The dashboard will allow for performance management and improved data integrity, serve as a management tool for enhanced District accountability, and allow for uniform performance reporting to support continual improvement. The dashboard will set targets in six key areas of concern (CEO Gauges) and measure initiatives or activities that support those gauges. The District anticipates having the dashboard in use starting in 2006. The six gauges are:

- Products and Services;
- Organizational Effectiveness (including a reliability index covering asset management);
- Customer;
- Financial;
- Human Resources; and
- Leadership and Social Responsibility.

Asset management program measures will explicitly link to the dashboard in the Organizational Effectiveness gauge through the reliability index. Asset integrity and reliability will be a key aspect of the primary measure revolving around annual water supply, usage, and reserves.

Key Management System Benefits

A major benefit of implementing asset management for the Water Utility Enterprise was being able to justify to managers, customers, and/or the board spending on capital projects. It has enabled the organization to categorize projects and other work in terms of cost effectiveness and prioritize projects accordingly. For employees in the maintenance division, it has been a powerful tool to know in advance of what work needs to be done or what areas need attention. Furthermore, the asset management program identified cost discrepancies between treatment plants (for example, up to 12 times the maintenance cost for solids treatment, and plans to significantly reduce costs through process changes and efficiencies). As part of the District's scorecard development, cost and efficiency metrics will be developed to manage and articulate the cost-benefit of the asset management program.

APPENDIX G: SEATTLE PUBLIC UTILITIES (WASHINGTON)

Based on interviews with utility managers and research of management system documentation, this appendix profiles Seattle Public Utilities' water and wastewater collection operations and its management system change efforts, including an optimized asset management program and "triple bottom line" – based business strategic planning.

Utility Overview

Seattle Public Utilities (SPU) is responsible for Seattle's water, drainage, wastewater collection, and solid waste utility services. This profile addresses drinking water supply, treatment, and distribution services and wastewater collection services.

SPU supplies drinking water to more than 1.3 million people in the Seattle area. SPU's two drinking water treatment plants obtain supply from watersheds that are publicly owned—the city owns 99 percent of 141 square miles in the Cedar River watershed and 70 percent of the 21 square mile South Fork Tolt River Watershed (the rest is owned by USFS). SPU maintains 177, 928 metered service lines and 18,000 fire hydrants, 2,500 fire protection service lines, 1,670 miles of distribution water mains, and 176 miles of water transmission pipelines. The water transmission system was originally built in 1889, with most of the city area covered by the 1930s. Most of the transmission lines have been replaced since the 1960s.

SPU also owns and operates the wastewater collection system for the city of Seattle, which includes 1,491 miles of combined sewer and sanitary pipelines. SPU does not treat the wastewater, but rather sends the wastewater to two King County operated sewage treatment plants. SPU serves approximately 570,000 people with the wastewater collection system.

SPU has an average drinking water flow of 140 MGD. The Cedar River water treatment facility is located approximately 25 miles east of Seattle in the Cascade foothills and was upgraded in 2004 with treatment capacity of 180 MGD and a transmission capacity of 275 MGD. The Tolt River water treatment facility is also located approximately 25 miles east of Seattle and opened in 2001 with a facility capacity of up to 120 MGD. Both treatment plants are located in undeveloped areas on land owned largely by the City of Seattle. Watershed areas upstream of the water supply intake on the two rivers consist of approximately 104,000 acres of forest land.

SPU's FY 2004 operating revenues for wastewater services was approximately $160 million, and its capital improvement program budget is estimated at between $43 and $53 million per year through 2009. Operating revenues for the water system are approximately $135 million, and the capital improvement program is estimated between $80 and $100 million per year through 2008. SPU has approximately 1,400 full-time employees.

SPU is considered a department of the City of Seattle. SPU consists of the Director's Office and five Executive Branches. The Director of SPU administers SPU in accordance with the policies established by the Mayor of Seattle and the City Council. Water rates are proposed by the Mayor, reviewed by the City Council, and adopted after public hearings. The Mayor and City Council have exclusive authority to set rates and charges for water services. The Mayor and City Council also establish financial policies.

Management System Development Efforts

SPU has a number of management initiatives that work together, all with the intention of utilizing the "triple bottom line" (i.e., effective balance among financial, social, and environmental performance) sustainability concept.

Strategic Planning

SPU's management system hierarchy includes a twenty-year comprehensive plan that provides long-term direction setting; a three-year strategic plan that sets the agency's objectives and targets in line with the comprehensive plan; and specific management systems to support the objectives and targets of the strategic plan.

The farthest looking of SPU's plans are the 20-year comprehensive plans for water, solid waste, drainage, and wastewater. Portions of the comprehensive plans are legally required, however SPU broadened the requirements to be more comprehensive. Comprehensive plans set the direction for both the capital improvement program and the operating program. The plans are updated every five years.

In addition, SPU creates Strategic Business Plans that set high-level organizational goals in three-year increments. SPU drives the planning process by defining customer service levels, environmental performance expectations, and social parameters then establishes a budget, capital plan, and rates to fulfill those needs. In this way, SPU looks to build rates and budgets from the bottom up (zero-based budgeting). As a result, the budget is made and refined based on lifecycle rather than short-term needs. SPU sees this as the pathway to achieve long-term utility sustainability. In the 2004-2007 Strategic Business Plan, there are six goal areas that, based on the organization's vision, mission statement, and values, roll out in 19 strategic initiatives. Each strategic initiative has an action plan, responsible parties, time frame, and reporting processes. Asset management and environmental management systems are encompassed within the strategic business plan.

Asset Management Program

Beginning in FY-2002, SPU initiated a significant overhaul of its asset management efforts modeled after asset management approaches used by Hunter Water, Australia. These efforts focused on a detailed analysis of asset conditions, defining service levels, conducting risk analysis (asset failure and consequence analysis), full life-cycle costing, and "triple bottom line"-based cost-benefit analysis. A key aspect of the asset management program is managing for risk by disaggregating the assets (by material, size, age, etc.) to allow for greater precision in characterizing the system. For example, SPU identified 25 different categories of assets, such as sewer pipes, water pipes, wastewater pump stations, etc. Many of these asset classes were further disaggregated, such as pump stations, which can be looked at in terms of motors, pumps, belts, etc. Once disaggregated, SPU defined for each asset type a Strategic Asset Management Plan (SAMP) that covers an asset inventory, a capital improvement program, and explicit asset service level goals.

As part of the asset management program, SPU requires a Project Development Plan (PDP) be conducted for all capital improvement projects over $250,000. The PDP considers multiple project solution options and applies triple bottom line analysis to compare the net present value of each option. Factors in the PDP analysis include capital costs, full life cycle operation costs and benefits, social costs and benefits, and environmental costs and benefits. SPU attempts to quantify the environmental and social costs and benefits where possible. Even where some

costs or benefits are not quantifiable (such as public trust and safety), SPU lists those attributes and applies decision models to rank and compare the value of different benefits. SPU has trained 150 project managers to perform the analysis, and each project has an executive team member as a sponsor, and an economist to assure there is quality control over analysis. The project sponsor presents the PDP to the executive team with a recommended option.

Drivers for Management Systems Change

The drivers for SPU to implement their asset management program and associated initiatives were largely economic and internal. SPU believed its rates to be relatively high in relation to comparable utilities and was experiencing constraints on financing options given its previous debt levels. Optimized asset management was viewed as an important opportunity to improve financial standing in these two areas.

SPU management further identified shortcomings through benchmarking efforts such as QualServe that suggested operational improvement opportunities and improvement tools were available. Later, SPU conducted benchmarking with the Water Services Association of Australia on asset management and civil maintenance. SPU was involved in studies in 1999 on repair and replace decisions for water mains that were focused on looking for best practices. The consultants and utilities involved with the study concluded that best practices were to be found outside of the United States. SPU identified Hunter Water, Australia as a best-in-class operation that provided a model to emulate. This process led SPU to launch its asset management improvement efforts and develop accompanying initiatives.

Management System Resource Requirements

To launch the asset management program in 2002, SPU brought in the Managing Director from Hunter Water, Australia for six months as an asset management specialist. For the last several years, SPU management has traveled to Australia and brought in Hunter Water management for periodic asset management program consultations. In addition to the cost of the Hunter Water consulting, SPU committed staff time, including several full time employees for the entirety of the multi-year implementation and significant Executive Team time. However, the cost for staff time was not explicitly tracked since it was considered part of the job for senior management. SPU did not create any new staff positions to support its asset management development efforts.

As part of ongoing resource commitment to the asset management program, SPU has a seven-person Corporate Asset Management Group and one person dedicated to utility performance measurement and benchmarking. In addition, executive team members review all Project Development Plans and participate in asset management program activities throughout the course of business operations. While there is a budget for asset management, SPU does not view this as an “extra” cost, but rather the way they do business

Management System Challenges to Implementation and Effective Attributes

SPU faced culture change challenges when implementing the asset management program. The changes in operations came in addition to changes in some job responsibilities between management and operations. Previously, an operations manager or engineer would have had project sponsorship/planning and execution responsibilities. SPU, however, identified best

practice in implementing capital improvement programs as dividing responsibility between project sponsorship/planning and project execution. This required a shift to transfer sponsorship/planning responsibilities away from operations personnel to senior management. This added a difficult element of culture change management to the implementation process.

SPU used extensive training to assist in the changes resulting from the asset management system. SPU also used strong leadership to drive the implementation, starting with the Mayor and including the SPU director, who chairs weekly asset management meetings.

Measures of Performance

SPU uses its strategic business planning process to drive the development of high-level utility performance measures. The current business plan identifies six goal areas: assets and operating infrastructure; customers; employees; environment; community; and organizational excellence. For each goal area, SPU identifies an overarching goal (e.g., for the assets and operating infrastructure goal area the goal is to provide reliable infrastructure and high-quality cost effective utility services for drinking water and wastewater removal), related strategic issues (e.g., the need to improve the capital investment strategy), and specific strategic initiatives with distinct objectives to reach the overall goal. In this measurement system, programmatic and management system tracking fits explicitly into the overall performance measurement system.

SPU has then developed specific performance indicators for each of the six goal areas. Each indicator has an established target level with performance tracked on a quarterly basis and rolled up into a quarterly report. Currently, SPU is tracking approximately 50 indicators in all. The report also includes easy-to-recognize achievement or failure symbols to rate the goal area. Table 1 provides examples the SPU indicators and associated target levels.

Table 1: SPU Indicators and Associated Target Levels

Goal Area	Performance Indicator	Target
Assets and Operating Infrastructure	Percent CIP projects completed within 3 months of schedule	90%
Assets and Operating Infrastructure	Percent scheduled critical CCTV lineal feet) completed	100%
Customers	Average wait until answer	60 seconds
Customers	Percent achievement of taste and odor goals	100%
Customers	YTD number of customers experiencing planned and unplanned water outages	4% of customers
Employees	Safety – severity rate	210 days of time loss per 100 employees per year
Employees	Overtime as a % of total hours worked	4.5%
Environment	Percent environmental facility audits & corrective actions completed within schedule	100%
Environment	Compliance with environmental regulations as demonstrated by the number of formal notices-of-violation, fines for violation, and known exceedances of established standards	N/A

Goal Area	Performance Indicator	Target
Community	Percent use of WM BE/HUB firms	6%
Community	SPU basic infrastructure expenditures by geographic area and by community	TBD
Organizational Excellence	Percent samples meeting key water quality objectives	100%
Organizational Excellence	Percent emergency responses within targeted times	80%

In addition to these current measures, SPU is currently considering approximately 30 additional performance indicators for use across the six performance goal categories. For example, in the organizational excellence area, SPU is considering indicators related to debt to assets ratio, a rate affordability index, and average expected life of current year CIP projects relative to the associated bond repayment period.

Key Management System Benefits

SPU's strategic business planning and asset management program efforts have provided a wide range of important benefits to the utility. The strategic business plan efforts have helped the utility bring substantial focus to needed areas of performance improvement and to introduce a systemic, continual improvement approach to overall organizational goal setting and improvement. In the capital projects area, the use of triple bottom line analysis and a restructured review and approval process has enabled a more efficient and effective allocation of capital investments and have provided a more transparent decision making process. The increase in the rigor of asset analysis, including asset failure and consequence analysis, has enable a substantial rethinking of capital project needs. The analysis suggested SPU could extend the life of more assets than previously expected resulting in saving approximately $150 million in previously programmed capital investments over a three year period. SPU also estimates the asset management program has lowered annual operations and maintenance costs by eight to ten percent.

In addition, SPU anticipates benefits from:

- Measuring the percent of total operating revenue used for debt service (payment of principle and interest on debt) and aims to stabilize this percentage at approximately 40% through the year 2009.
- Tracking the debt to assets ratio, which has risen since 1997, and aiming to stabilize the rate over the next 5 years. SPU also aims to increase the percentage of cash funding of CIP to over 20 percent by 2009.

APPENDIX H: CITY OF SHELBY UTILITIES (NORTH CAROLINA)

Based on interviews with utility managers and research of management system documentation, this appendix profiles the City of Shelby Utilities and its International Organization for Standards (ISO) certified Environmental Management System (EMS).

Utility Overview

The Shelby utilities system is a municipally owned and operated combination public utility system which provides water, sewer, electric, and natural gas services to residential, commercial, and industrial customers. The system is managed by two divisions: Environmental Services; and Energy Services. The Environmental Services Division includes water treatment and wastewater treatment plants and water distribution/sewer collection systems. The water and wastewater operations serve a residential population of approximately 19,500 and six industrial users. The water and wastewater operations each have one individual treatment plant with a combined 185 miles of collection pipeline and 216 miles of distribution pipeline.

The original water treatment plant was constructed about 85 years ago, with the last upgrade in 1991-1992. The facility has an average flow of three million gallons per day (MGD) and max treatment flow capacity of 14 MGD. The wastewater treatment plant was constructed in 1963 and last upgraded 1993-1994. The wastewater facility has an average flow of three MGD and a max flow capacity of 6 MGD. Wastewater treatment consists of primary treatment, secondary treatment, and disinfection. Shelby has a biosolids program producing Class A compost that is distributed openly to the public.

Shelby Utilities' water and wastewater treatment annual revenues for FY 2004 were approximately $1.2 million and $1.5 million, respectively. The two operations consist of about 20 full time employees with eight in water and 12 in wastewater. The City of Shelby Utilities is municipally owned and operated. The board for Shelby Utilities includes the Mayor, City Manager, and members of the city council. In setting utility rates, Shelby Utilities department heads make recommendations for the rate structure which then require approval from the board.

Management System Development Efforts

The Environmental Services Division implemented ISO 14001 EMS for the wastewater operation in 2002 and expanded the EMS to cover the water operation in November 2004. The original fenceline for EMS was the wastewater operation, including the biosolids program. Realizing improvements from the continual improvement process in the wastewater operation, the Environmental Services Division leveraged existing knowledge and expertise to include the water operation in the EMS certification. Drawing on the experience with the wastewater side, Shelby found it a relatively quick and easy process to duplicate for the water operation.

Drivers for Management Systems Change

The impetus for the ISO EMS originally came from a state initiative for EMS training. The state of North Carolina provided a series of training sessions over the period of one year for public utilities on designing and implementing EMSs. Environmental Services Division managers found the

training sessions to be helpful and were able to begin the initial stages of implementation prior to the completion of the training courses.

In addition to state sponsored training sessions, another driver to implement an EMS was EPA's Capacity, Management, Operations, and Management (CMOM) initiative. In EPA Region 4 in particular, utilities were encouraged to adopt a management system to improve capacity management. The Environmental Services Division determined that an ISO certified EMS would be an effective means to address the CMOM program.

Environmental Management System Resource Requirements

Estimates for the initial EMS implementation costs for the wastewater operation include approximately $15,000 in staff time and $10,000 for travel and internal audit training over the course of a one-year period. Because of the implementation training provided by the state, Shelby did not hire consultants to support development of their EMS. The resource requirements for ongoing EMS maintenance are minimal. There is an informal EMS coordinator, but the position is not considered outside the normal scope of work for water and wastewater operations. Employees involved with EMS maintenance spend less than five percent of their time each month in management system activities.

Management System Challenges to Implementation and Effective Attributes

Environmental Services Division managers cited having employees not recognize or understand the benefits of having a management system as the most significant barrier to EMS implementation. Many employees expressed concern that the EMS would create unnecessary work. There was an initial resistance to having a structured management system, and creating buy-in throughout the organization was a large component of the initial effort.

One challenge for ongoing implementation for Shelby has been the uncertainty of EMS financial benefits. The utility has not performed an in-depth analysis of EMS-related costs savings. There is a general sense throughout the organization that it has not yet recouped the program implementation investment in terms of costs savings. However, the Environmental Services Division's use of EMS is centered on improving and systematically instituting core operational improvements that will continue to provide benefit over time.

Measures of Performance

EMS Measures

Environmental Services Division performance measures divide between the EMS objectives and targets at the plant operations level and "core measures" at the headquarters level. The Environmental Services Division's goal with EMS implementation has been to maintain and go beyond compliance - the performance measures consequently track targets to that goal. Tables I and II below list the EMS FY-2005 objectives and targets tracked by the Division for the Wastewater Treatment Plant and the Water Treatment Plant, respectively. The Environmental Services Division EMS objectives and targets indicate that the EMS is used to systematically manage core operational performance improvements and to address CMOM-related program efforts. Targets in the tables below indicate progress toward, for example, better compliance (stream toxicity), better customer service (pressure), and better resource utilization (water

conservation). These objectives and targets are reviewed in quarterly Management Review Board (MRB) meetings including headquarters management and the EMS Management Team.

Table I - Wastewater Plant

Objective	Target
To install new SCADA system for a more efficient way to monitor the system; this would be Phase I - the compost building.	To have a better way to track what is going on with the Compost Facility to be completed by January 2005 – this will be Phase I
Fats, Oils and Grease (FOG) Program to monitor these in the system	So we can monitor the amount of fats, oils, and grease that is put into the system on a daily basis. To comply with new regulations. To be completed by January 2006.
East Side Sewer Project annexation to add new sewer lines for this community	To install new sewer lines for the annexation of the East Side property. To be completed by January 2006.
Bess-Hoey Annexation Project to fix the low pressure in the system	To help the low pressure in the system. To be completed by January 2006.
To fix the Dechlorination Facility to comply with new regulation of 20 micro grams per residual	To be in compliance with the New State Requirements on C12 residuals leaving the system back into the streams for the waste treatment facility. To be completed by January 2006.

Table II - Water Plant

Objective	Target
Install dechlorinator system on the filter effluent backwash to reduce stream toxicity	To meet regulation requirements and to reduce stream toxicity. To be completed by May 31, 2005.
Clean out Alum Lagoon Sludge to let the decant water settle out	To have more room for backwash and wastewater from cleaning settling basins to settle out before entering our streams. To be completed by June 30, 2005.
North Tank RTU to have better SCADA communications	To have a better idea of the amount of water we have in our North tank so we won't waste or over flow the tank. To be completed by July 31, 2005.
Paint the North and South Elevated tanks to prevent corrosion and to prolong the life of the tanks.	To prevent the water tank from corroding and contaminating the water and to prolong the life of the tank so it won't have to be replaced. To be completed by July 31, 2005.
Install new valve so that PPG elevated tank can be taken out of service and for cleaning and repair.	By the first quarter of 2005 to implement this measure and maintain adequate water and pressure supply to PPG pump station temporarily.
To wash out the backwash tank and North tank for inspection for deterioration	To have this done per the Utilities Services by November 2005
Install new lighting to improve the security of the water plant and to minimize vandalism of the water supply or the environmental issues.	By the end of December 2004 to install security lights to prevent vandalism and protect the water supply to the City of Shelby
Install security cameras around the plant and at the raw water intake for added security	Contractors hired to perform the work in April 2005
To have the fence repaired around the water plant grounds for security reasons	Acquired bids, hired contractors, and purchased materials for work in March 2005

Objective	Target
To fix and repair electric gates for added security at the Water Plant	Acquired bids, hired contractors, and purchased equipment for work in September 2004

Core measures of performance

In addition to the EMS objectives and targets, the Environmental Services Division utilizes a set of core performance measures. The core measures track the organization's primary functions and responsibilities, such as state regulatory environmental requirements for water and wastewater (e.g., NPDES permit limits), operational measures and efficiency (e.g., flow and energy use), and financial metrics (e.g., revenue and budget tracking). These measures are reviewed by management on a quarterly basis. While the EMS objectives and targets mentioned above do not explicitly roll-up to the core measures, there are implicit connections between the plant initiatives and the core measures.

Key Management System Benefits

The Environmental Services Division uses the EMS to manage core operational improvements in a more systematic and effective manner. Benefits, in this context, will be widespread and subtle. For example, EMS implementation included improved documentation and communication through a systematized framework provided by the management system. The management system also made the organization more environmentally conscious and has fostered an organizational manner that is more oriented towards stewardship and resource conservation.

Through implementation of their ISO 14001 EMS, the Environmental Services Division has gained recognition from state regulators for going beyond compliance. The agency has noticed that since their EMS implantation, inspections have significantly decreased. Specifically, the utility has not been inspected in the past 20 months by state regulators. The utility attributes the decrease in inspections to having the EMS in place.

In addition, the EMS objectives and targets anticipate future measurable benefits. For example:

- EMS objectives include a project designed to address low pressure in the system;
- EMS objectives include upgrades to the chlorination/dechlorination facility to comply with new state regulations for chlorine residuals;
- The water plant plans to reduce stream toxicity by installing a dechlorinator system on the filter effluent backwash;
- The water plant plans to increase security through installation of security cameras, electric gates, and increased lighting to better protect its water supply;
- Process controls conserve energy use
- Several EMS objectives address stoppages and overflows in the system due to the build up of fat, oil, and grease; and
- The water plant plans to more closely monitor water tanks to reduce water waste and prevent overflows.

GLOSSARY: MANAGEMENT SYSTEM DESCRIPTIONS

Note: These descriptions are adapted from "Continual Improvement in Utility Management: A Framework for Integration," EPA, January 2004.

American Public Works Association (APWA) Management Accreditation Program
The American Public Works Association (APWA) Management Accreditation Program is a planning tool that can be used in the context of a management system framework to provide an approach for: assessing existing policies, practices, and procedures; identifying deficiencies that need correction; establishing goals for complying with recommended practices (recommended by APWA); and developing strategic plans to meet goals and correct deficiencies.

Balanced Scorecard
The Balanced Scorecard is a high-level planning tool. Balanced Scorecard seeks to align measures with strategies in order to track progress, reinforce accountability, and prioritize improvement opportunities. Balanced Scorecard integrates four related perspectives: finance; customers; internal processes; and learning and growth. Utility managers who have implemented a formal management system framework could utilize Balanced Scorecard in developing the vision, goals, and objectives for expansion to include other management areas. Alternatively, utility managers could utilize the Balanced Scorecard before implementing a management system to determine how a management system framework might best support the overall organization vision, goals, and objectives.

Bid-to-Goal
Bid-to-Goal is a service improvement and cost saving planning tool. Utility managers wanting to focus on the bid process and confronting privatization pressures might utilize Bid-to-Goal. Bid-to-Goal provides an approach for establishing goals that are reflective of the level of savings needed to be competitive with potential private proposals. Bid-to-Goal provides an approach for developing a strategy that focuses on the hitting of a savings goal rather than using managed competition. Public employees meet that savings goal via a detailed offering, or a memorandum of understanding (MOU), much like that of the private sector service agreement. During the term of the agreement, which could run five to six years (with options to extend), performance discrepancies could trigger an automatic bidding process.

Capacity, Management, Operation and Maintenance Programs (CMOM)
The CMOM program as developed by U.S. EPA's Region IV emphasizes that good operation and maintenance is a function of good management. The capacity aspect of the program stresses: proper installation of new and rehabilitated lines; inter-jurisdictional agreements for wastewater services; requirements for the implementation of an information management system; capacity assurance; development of overflow response and emergency operations plans; an assessment of the system's physical conditions; and a determination of which components need repair. CMOM also requires training, a summary of the management program, and periodic audits to determine the effectiveness of the program.

International Organization of Standardization (ISO) 14001 Environmental Management System (EMS)
ISO 14001 is an internationally recognized EMS standard that can be utilized by any industrial sector or type of organization. ISO 14001 is built around the plan-do-check-act cycle of continual improvement. ISO 14001 provides an approach for the self-identification of environmental policy, impacts, performance goals, and objectives, with the expectation that the minimum performance

target is beyond environmental regulatory compliance. Organizations that implement ISO 14001 determine how to establish operational policies, practices, and procedures that align with organizational objectives and targets for environmental performance improvement.

National Biosolids Partnership (NBP) EMS for Biosolids

The NBP EMS for Biosolids provides implementation component elements similar to ISO 14001. However, since the NBP EMS for Biosolids is specifically focused on biosolids management, elements related to the establishment of operational procedures are limited to the specific business units associated with biosolids management. The NBP EMS for Biosolids also has additional requirements associated with public participation and communications. One of the most significant differences of the NBP EMS for Biosolids from ISO 14001 is that the NBP Program provides a National Manual of Good Practices. In this regard, the NBP EMS for Biosolids provides specific guidance and direction on the use of operational-level good practices related to biosolids production and management.

Optimized Asset Management

Optimized asset management provides an approach for utilities to develop an infrastructure investment strategy that will support capacity needs. The goal is to provide an identified level of service at a minimum cost and risk. Asset Management methods can be applied to evaluate capacity needs in light of current infrastructure and support a utility's development of an infrastructure investment strategy that is fully integrated with and supportive of overall utility performance objectives. Asset Management will also make transparent the mid- and long-term financial requirements for achieving performance objectives.

Partnership for Safe Water

The Partnership for Safe Water is a voluntary performance program that incorporates benchmarking through data collection. The Partnership for Safe Water program provides specific targets for drinking water turbidity that are more stringent than federal regulations for safe drinking water. Utility managers who want to focus on decreasing drinking water turbidity can implement the Partnership for Safe Water by: adopting turbidity performance targets; collecting turbidity data to benchmark utility performance; evaluating unit treatment processes and other factors (such as financial resource support) that may limit performance; and continuing an annual cycle of making improvements and collecting turbidity data. How a utility increases turbidity performance through adjustment of policies and practices is up to the individual utility – Partnership for Safe Water does not provide best practices in this regard.

QualServe

QualServe provides an approach for utilities to perform a high-level evaluation of all aspects of utility operations. QualServe covers all utility management areas including financials, quality, impacts/risk (environment, health and safety management), and human resources. Utility managers can implement QualServe to prepare a baseline or benchmark of where it is starting from, which can be utilized in the process of setting strategic direction and policy, as well as in setting organizational goals and objectives. In this fashion, QualServe can support the planning phase of developing a management system framework. However, while QualServe provides insights to an organization on where opportunities for improvement exist, it does not provide specific guidance or direction on how to implement those improvements.