Technical Memorandum

Multi-Agency Benchmarking Project

To:	Multi-Agency Steering Committee
From:	Damon S. Williams, Damon S. Williams Associates, L.L.C.
Date:	January 12, 1999
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If you have other questions about the Benchmarking Project, please contact Damon Williams (phone: 602-265-5400; e-mail: dwilliams@dswa.net), or Jill Mercurio (phone: 925-685-3792; e-mail: dswajat@aol.com) of Damon S. Williams Associates, L.L.C.

Thank you.

Technical Memorandum

MULTI-AGENCY

Benchmarking Project

January 1999

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Introduction and Background

This technical memorandum provides a summary to date of the Multi-Agency Benchmarking Project, a collaborative effort among seven large West Coast wastewater utilities, collectively known as the Multi-Agencies. A Benchmarking Project final report will be issued in the first quarter of 1999. The final report will describe in detail the agencies participating in the project and compare their processes, performance, and costs. The report also will draw specific conclusions and make recommendations designed to help the Multi-Agencies gain efficiencies and reduce costs.

This is the second phase of the Benchmarking Project. In the first phase, three agencies—Sacramento Regional County Sanitation District (SRCSD), East Bay Municipal Utility District (EBMUD), and Orange County Sanitation District (OCSD, then operating under the name of County Sanitation Districts of Orange County)—worked together for several years on benchmarking projects initiated by EBMUD. These agencies, collectively known as the Tri-Agencies, agreed to perform detailed benchmarking analyses in order to accurately and completely compare their respective operating costs. The Tri-Agencies developed a methodology to collect and compare operational costs between plants with different configurations, addressing one of the largest challenges faced in benchmarking and comparative analysis.

In this phase, which began in the summer of 1997, the project expanded to enable four additional agencies to benefit from benchmarking. These agencies are the City of Los Angeles, Bureau of Sanitation (CLABS); Central Contra Costa Sanitary District (CCCSD); City of Portland, Bureau of Environmental Services (CPBES); and King County (Washington) Department of Natural Resources (KCDNR).

The second phase of the project also saw the development of an Access database for collecting and managing cost data from the Multi-Agencies. The Multi-Agencies now share a comprehensive collection of cost data and information about each other's business practices, and thus are able to compare their operating costs in more meaningful ways than before. At the same time, this information exchange has strengthened the relationships of the Multi-Agencies and positioned them to collaboratively evaluate unique methodologies and cutting-edge practices for the future.

Considering the sensitivity of the data collected during the project, and adhering to a generally accepted code of conduct for benchmarking, no cost data in the final report refer to any of the Multi-Agencies by name. Instead, the report uses a letter designation for each agency whenever cost information is presented.

The final report will present more specific data about each participating agency. For this technical memorandum, Table 1, Key Agency Facts, provides summary information about the Multi-Agencies.

Table 1. Key Agency Facts

Agency	Number of Wastewater Plants	1996-1997 Avg Annual Influent Flow Rate (mgd[1])	Governing Organization
Central Contra Costa Sanitary District (CCCSD)	1	49	Special District
City of Los Angeles, Bureau of Sanitation (CLABS)	4	444	City of Los Angeles
City of Portland, Bureau of Environmental Services (CPBES)	1	85	City of Portland
East Bay Municipal Utility District (EBMUD)	1[2]	81	Special District
King County Department of Natural Resources (KCDNR)	2	200	King County
Orange County Sanitation District (OCSD)	2	244	Special District
Sacramento Regional County Sanitation District (SRCSD)	1	152	Sacramento County

[1] mgd = million gallons per day
[2] EBMUD also operates three wet weather treatment plants not covered by this study

Goals and Objectives

The ultimate goal of the Multi-Agency Benchmarking Project is to enable each of the participating agencies to improve its business practices, reduce its costs, and become increasingly competitive. A major objective during this phase of the project was to develop a data collection template that identifies and defines business unit costs, and which enables the agencies to gather and compare information consistently. Analyzing and responding to this information will enable the Multi-Agencies to improve the efficiency and cost-effectiveness of their wastewater treatment operations. This and other objectives are described below.

Develop Data Collection Template

Many benchmarking studies have been conducted within the public utility industry, but none has been designed solely for wastewater treatment facilities or by the people who actually run the plants. One objective of the Multi-Agency Benchmarking Project was to develop a tool that grows with the project to allow a wastewater agency to compare costs and business activities to other agencies. The tool that was developed is a template that allows all costs and processes to be categorized. The template is laid out as a block diagram to help visually depict where costs are allocated, and each block is defined so that multiple users can assign costs appropriately and consistently.

Conduct Performance Benchmarking

Performance benchmarking involves the development of comparative cost data. By using the template to collect this information, the Multi-Agencies will be able to compare their wastewater treatment costs with similar agencies. The comparisons will also be useful in providing internal direction for future optimization efforts or capital projects, as necessary. For accuracy, the overall costs are divided into the following cost centers: operations, maintenance, technical support, administration/general, and other non-wastewater treatment operating costs. Each agency can verify that the costs presented in the benchmarking study correlate with the actual expenditures for the study year.

Conduct Process Benchmarking

Process benchmarking focuses on how each agency does business. Process area work groups prepared and sent detailed surveys to each of the agencies in order to collect information on their current practices. These work groups are divided into Operations and Maintenance (O&M), Administration, Laboratory, Capital Program Engineering, and Source Control. The survey responses help explain the differences in costs. Linking the process and performance benchmarking efforts is important in determining why one agency is more cost-effective than another and assists in the development of best practices.

Develop and Foster Open Communications

Honest and open communications have been crucial to the success of the project. Regular meetings have provided a venue to discuss data collection methods, differences in cost allocations, differences in business operations, and areas of improvement identified by each agency. Discussions of where to distribute the incurred costs have helped identify alternative ways to distribute costs, perform work, and optimize systems. Each agency is responsible for providing accurate accounting of its costs in order for the data and comparisons to be meaningful.

Identify Potential Areas of Improvement

Another objective of this phase of the project is to help the Multi-Agencies identify potential improvements and prioritize future work. For example, some agencies may discover that their chemical costs for dewatering are higher than other agencies' and may determine that additional study into those chemicals is warranted. Another agency may want to continue researching its accounting and tracking systems and business practices before determining future actions.

Share Lessons Learned

By sharing lessons learned, the Multi-Agencies can minimize duplicate efforts and avoid reinventing the wheel. Pooled resources can help make future studies more feasible and cost-effective by distributing costs and benefits among participants. For example, several agencies may collaborate and share the costs of evaluating possible treatment alternatives, or discuss how changes in organizational structure and staffing changes have affected a facility.

Track Performance

A performance tracking system is an important objective for those agencies in their third year of benchmarking, and for the purpose of accommodating the future growth of the project. The Access database allows more agencies to be added to the project in the future, and will also allow comparisons of normalized cost data to be made more rapidly. Additionally, the database allows single-agency comparisons for multiple years so individual agencies can track their cost trends. As new cost-saving measures are implemented, the effects of these changes can easily be evaluated using the database. The agencies that participated in past studies can track their performance for fiscal year 1997 (FY 97) as well as their performance in previous years.

Approach to Work

The following subsection describes how this phase of the Benchmarking Project is organized. It also describes the methodology used to collect and compare costs among the agencies.

Project Organization

The Benchmarking Project is operated under a Memorandum of Understanding (MOU) between the seven Multi-Agencies. The project includes a lead agency, a Steering Committee, five work groups, contributing staff from each of the Multi-Agencies, and an outside consultant.

The lead agency is responsible for overall project management, resolving issues related to the MOU and consultant contract, and coordinating communication among the Multi-Agencies. The role of lead agency is alternated among the Multi-Agencies with each successive phase of the project. EBMUD is the lead agency for this phase of the project.

The Steering Committee consists of seven agency leads (one person from each agency who is responsible for that agency's timely cooperation throughout the project) and the leads from each of the five work groups. The Steering Committee assists the lead agency by overseeing and directing the project and ensuring that the needs of each participating agency are met. The committee handles budget issues and directs the contributors from each participating agency. The Steering Committee meets regularly to discuss the status and direction of the project.

The work groups are responsible for meeting regularly to develop and/or refine the template, collect, organize, and analyze the process and performance data associated with each cost center, and determine best practices when possible. In some cases, a work group may analyze more than one cost center (for example, the O&M Work Group). In other cases, the Steering Committee may create auxiliary work groups to examine specific areas of more complex cost centers (for example, the technical support cost center, which includes the Capital Program Engineering, Source Control, and Laboratory Work Groups) so that more meaningful comparisons can be made. The work groups are organized so that the people most involved with each cost center are responsible for the cost center data and reap the benefits of subsequent discussions.

The outside consultant assists the project by providing project management and scheduling, developing the Access database, collating the data collected by the individual agencies, overseeing project subconsultants, analyzing data, and assisting with the production of this technical memorandum and the forthcoming final report.

Methodology

This subsection describes how performance and process benchmarking data were collected, organized, and analyzed. It also discusses how data will be presented in the final report.

Data Collection

Performance Benchmarking. Data were requested for FY 97. A template developed in the first phase of this project was upgraded and refined for this phase of the project. Each of the Multi-Agencies reviewed its expenditures and divided them into the categories presented in the template. Each of the work groups met regularly to determine the best way to allocate costs to provide the most accurate comparisons. Use of the template brought up inevitable differences in the way each agency allocates costs. The template was revised accordingly.

Various tools were used for data verification as the project proceeded. Ultimately, each agency compared the costs reported in the study with its actual expenditures for the project year. Additional verification occurred when the individual work groups met to compare costs. This promoted more discussion about the different ways the individual agencies performed work or allocated costs. The data were reviewed to determine performance trouble spots and identify areas suitable for discussions about best practices.

Process Benchmarking. Each work group developed a process benchmarking survey designed to gather business practice information about the most important topics affecting its cost centers. The representatives from each agency within each work group were responsible for researching the information and reporting back to the group. The most appropriate people from each agency responded to specific questions in the survey and tracked the amount of time spent researching the responses. The responses were collated and distributed to the members of the work group to provide a basis for discussion on best practices.

Database Development

The Access database can be used as a data collection tool, as well as for data presentation after analysis. The structure of the cost collection database (CCD) is based on the data collection template. Each agency received an empty database and was responsible for direct data input at an appropriate level of detail.

Up to seven levels of depth for costs are available, but not all levels are used throughout all cost centers because some cost centers are simpler than others. Costs are subdivided as far as each agency's accounting system allows, with some agencies able to provide very detailed information on a specific area or a specific unit process.

The Capital Program Engineering Work Group developed a separate database to account for its cost collection and analysis.

Data Analysis

After the raw data were collected from each of the Multi-Agencies, they were entered into a project master database (except for Capital Program Engineering data). The master database was designed to accept sets of raw data from the individual agencies, normalize them, and then provide comparative tables and graphs. In order to accommodate the numerous types of analyses that could be run, the master database accepts many normalization factors.

Normalization factors are necessary to provide meaningful data comparisons. They help to reconcile the differences among the agencies by providing a common basis for comparison, such as cost per million gallons treated, rather than simple cost figures. Cost is affected by the size of a facility, and dividing by the amount of wastewater treated normalizes the data to allow straight comparisons. Appropriate normalization values vary with the type of analysis and the type of data desired. Many of the treatment plant processes, for example, can be normalized based on flow. Laboratory costs, however, may be more meaningful if normalized by the number of analyses run.

Other considerations also must be evaluated before making generalizations about the costs of any specific agency. For example, influent characteristics may make some processes more or less effective at one plant than another. The type and age of the equipment used at each facility can affect costs. Regional differences in the cost of living can also influence cost data.

Data Presentation

Each work group is preparing a number of tables and graphs that present the data from its applicable cost centers. This information will be presented and discussed in the individual group chapters as part of the final report.

The Capital Program Engineering Work Group is developing scatter plot graphs with trend lines to show average costs for each agency and the average of all agencies for capital projects from $100,000 to $100,000,000. The scatter plots allow the Multi-Agencies to compare costs for a wide range of projects without requiring the agencies to submit costs for projects of any specific or pre-determined size.

The other work groups are producing bar graphs, which generally present cost data from low-cost to high-cost agency (Agency A through Agency G). Because the low- and high-cost agencies change from one graph to another, no single agency is consistently represented by any single letter throughout the final report. Instead, for most graphs, Agency A is the low-cost agency and Agency G is the high-cost agency.

The bar graphs allow complementary costs to be summed flexibly across any combination of processes. For example, an agency can determine its total cost for odor control by adding isolated odor control costs from various liquids and solids stream processes. Similarly, an agency can determine its total cost for secondary treatment by adding together all secondary process costs.

Constraints

The Access database allows users to compare data at the level at which data are available. This flexibility allows the data from any agency to be compared to another agency, regardless of the different treatment processes used at each plant. It also may lead to misinterpretation of the data, because none of the qualifying information is adequately expressed in cost data alone.

Conclusions based solely on data are bound to contain inaccuracies because they do not account for the factors underlying the numbers. For example, data alone would not necessarily show that an agency has an extremely active public involvement program that successfully mitigates neighborhood dissent on planned projects. Raw data might reflect only that the program increases the overall cost of treatment, while failing to indicate the significant time and effort that such a program may save at a later date.

The cost data reflect factors such as differing regulatory constraints, political edicts, or innovative programs that provide value-added products or services to customers, but may not provide the detail or context necessary to fully understand the impact of these factors. For example, each of the agencies participating in the Multi-Agency Benchmarking Project has permit requirements that affect the level and cost of treatment required. Table 2, FY 97 Effluent Permit Limits, shows some of the effluent limits for each of the Multi-Agency plants. All plants have other effluent limits to meet, but those given in Table 2 are the most common parameters.

Some agencies operate under the umbrella of a larger organization over which the agency itself has no control. For example, overhead costs for an agency may be dependent on its role in the larger organization.

Similarly, the approach each agency takes to reclaiming wastewater or recycling biosolids will vary depending on local and state politics and regulations. These programs undoubtedly contribute to the overall cost of treatment, but may at the same time deliver a commensurate benefit to a community, or to an agency, in the form of research and development that may pay dividends in the future.

Table 2. FY 97 Effluent Permit Limits

Agency	Plant	BOD[1] (mg/l)	TSS[2] (mg/l)	Cl_2 Residual (mg/l)	Coliform (MPN/100 ml)[3]	
					Total	Fecal
Central Contra Costa Sanitary District		25[4]	30	0.0[5]	N/A[6]	200
City of Los Angeles Bureau of Sanitation	Hyperion	30	30	0.84[5]	1,000	200
	Tillman	20	15	0.1[7]	2.2[8]	N/A
	Terminal Island	15	15	0.1[7]	1,000	200
	LA-Glendale	20	15	0.1[7]	2.2[8]	N/A
City of Portland Bureau of Environmental Services		30	30	1.0[5]	N/A	200
East Bay Municipal Utility District		30	30	0.0[5]	240[9]	N/A
King County Department of Natural Resources	East plant	30	30	0.66[10]	N/A	200
	West plant	30	30	0.216[10]	N/A	200
Orange County Sanitation District	Plant 1	100	60	0.001	N/A	N/A
	Plant 2	100	60	0.001	N/A	N/A
Sacramento Regional County Sanitation District		30	30	0.018[11]	23[12]	N/A

1 Biochemical oxygen demand (5-day), milligrams per liter – monthly average
2 Total suspended solids, milligram per liter – monthly average
3 Coliform count, most probable number (MPN) per 100 milliliters – monthly average
4 Value is for carbonaceous biochemical oxygen demand, milligrams per liter – monthly average
5 Instantaneous maximum
6 Not applicable
7 Daily maximum
8 7-day moving median
9 Most recent permit limitation is 500 fecal coliform
10 Monthly average
11 Daily average (monthly average is 0.011 mg/l)
12 Monthly median

Preliminary General Findings

This section provides preliminary findings on the cost of treating wastewater and some general findings regarding labor-management relations, accounting systems, and organizational restructuring. (For preliminary work group findings, see page 9.)

Wastewater Treatment Costs

In FY 97, the average cost for the Multi-Agencies to treat wastewater was $791 per million gallons treated, with the costs ranging between $582 and $1,282 per million gallons. These costs include only administration/general, operations, maintenance, technical support, and other non-wastewater costs. Administration/general costs include the costs for overall utility management and clerical functions, human resources, legal services, training, employee benefits, and other functions. Operations and maintenance costs include all costs specific to the plant, including all unit processes, plant clerical support, and other plant O&M functions such as landscape maintenance. Technical support costs include all laboratory, source control, and other technical support for plant operations. Other non-wastewater costs include costs incurred by the Multi-Agencies for activities outside of the boundaries of the wastewater treatment facilities, such as water quality planning or lake and stream monitoring that is not required by permit limits. Some of the Multi-Agencies use this category for costs that do not fit well into the template. As a result, the non-wastewater costs for these agencies may be significant. Costs for collection systems were not studied in this phase of the project and are not included as a component of the cost to treat wastewater. Details on the components and costs will be presented in the final report.

The approximate distribution of costs, expressed as a percentage of total treatment expenditures, is shown in Figure 1, Cost Center Allocation Breakdown. This figure shows the average cost for all seven of the agencies for the breakdowns discussed above.

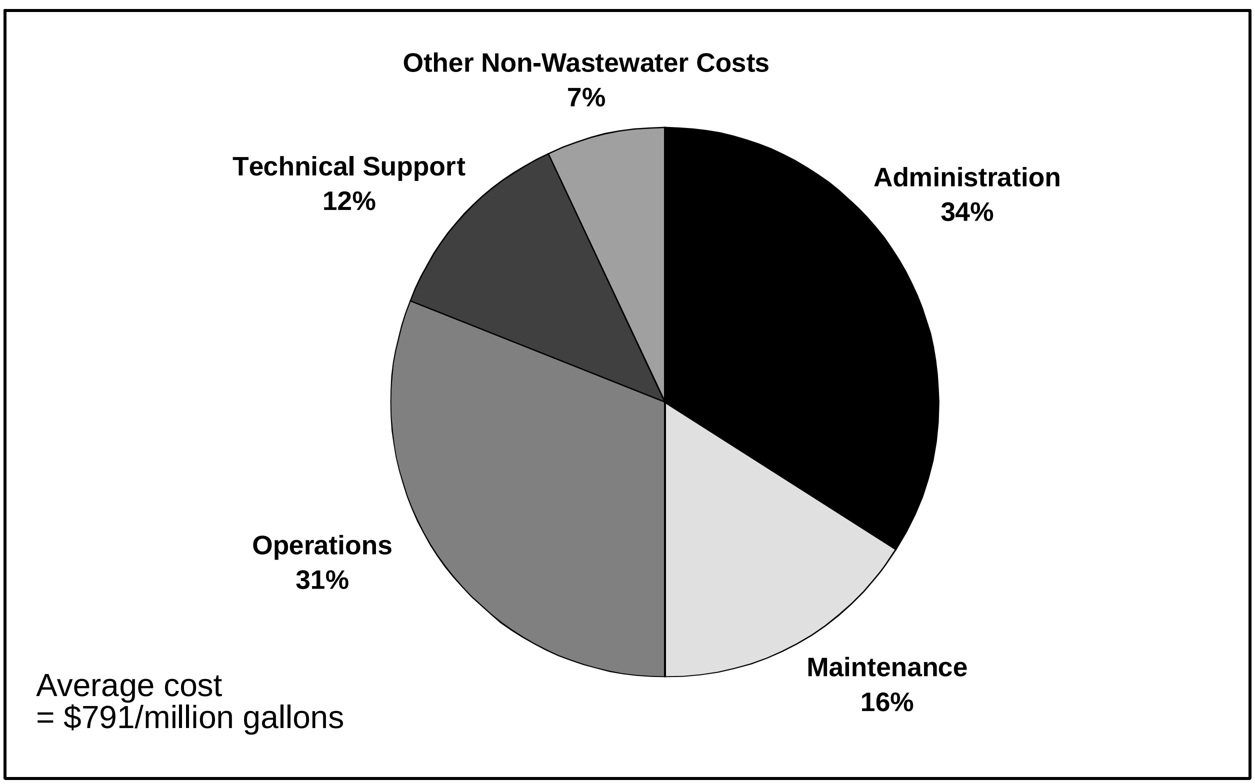

Figure 1. Cost Center Allocation Breakdown

Labor-Management Relations

In an effort to improve labor-management relations, some agencies:

- Use creative compensation packages that might include skill-based pay, gainsharing, and bereavement leave policies. In addition to rewarding people who improve their skills, agencies may benefit by being able to operate more efficiently with fewer, better-trained people.
- Use alternative dispute resolution practices, such as a joint labor-management committee, to increase collaboration and cooperation. These practices can lead to improved decision making and better labor-management relations.

Accounting Systems

Many agencies have accounting systems that do not directly allocate costs to unit processes, making allocation of past expenditures more challenging. Several agencies have modified their existing systems to match the template in order to accommodate requests for this type of information more efficiently.

Organizational Restructuring

Several agencies are undergoing restructuring in order to increase efficiency and decrease costs. These projects include multi-year plans with changes in structure and business practices along with adopted target reductions. Although the results of these changes are not evident in this year's report, they should be reflected in future reports.

Preliminary Work Group Findings

The following section describes the preliminary findings from each of the five work groups: Capital Program Engineering, O&M, Administration, Source Control, and Laboratory.

Capital Program Engineering

The Capital Program Engineering Work Group is evaluating the capital improvement programs at the Multi-Agencies. A total of 72 projects have been sorted into one of two project types—collection system or treatment plant. Only projects completed (designed and constructed) within the last 10 years are included in the analysis.

In order to reconcile regional differences in labor rates for both in-house staff and consultants, project construction costs have been compared to the total hours spent in each project phase by both in-house staff and consultants.

Process benchmarking data were collected through the use of 12 process topic area surveys. These topic areas include capital improvement program development, partnering and dispute resolution, customer identification, document management, authority levels, change order processing, consultant procurement, staffing, construction contract approval, project management, alternative capital project delivery methods, and inspection duties. Key findings from the Capital Program Engineering Work Group follow.

Change Order Management

In some agencies, change orders are regularly deferred to future contracts and only non-discretionary changes are completed. Additional study is required to determine whether deferral of changes is more efficient in the long run than incorporating changes with work in progress. Also, change order percentages vary widely for both collection system and plant projects and within individual agencies. This indicates that change order percentages may be affected more by the specifics of the project than by a management approach. Some agencies also have lower markups on change orders because they include a limit on markups in the specifications.

Selection and Use of Consultants

Some agencies have streamlined processes for consultant procurement, particularly for smaller projects. The findings indicate that as construction costs increase, the agencies tend to use more outside consultant hours compared to in-house staff hours. This may be done to avoid major staffing fluctuations.

Scope Control

Some agencies improve efficiency by preparing tight scopes of work on consultant agreements and aggressively managing projects to prevent changes in the scopes of work. This approach also applies to managing changes during construction.

Staffing

Some agencies try to keep staff "billable to projects," but also have overhead charge codes for work not attributed directly to projects.

Standards

Some agencies tend to have more repetitive type projects, which helps to keep costs down. They also have less formal procedures for project management, but use consistent filing systems.

Policy Issues

Some agencies have no minority/woman-owned business enterprise goals and requirements. At some agencies, the Board of Directors delegates more authority for capital projects to the staff than other agencies. These agencies also have corporate cultures that support timely decision making at relatively low levels in the organization.

Design Cost Effect on Change Orders

The graphs of design cost versus construction cost as related to change order percentage are relatively flat, indicating that spending more on design does not reduce the percentage of change orders. The changes related only to design issues are not categorized, so no correlation can be drawn between the design effort expended and the value of design-related changes.

Operations and Maintenance

O&M costs include everything for operation and maintenance of a facility. Combined O&M costs represent a large portion of total agency costs; this is appropriate because O&M are the core functions for each agency. The O&M costs are divided into plant-related costs (consisting of unit processes and associated functions), clerical support costs for the plant, and other O&M function costs (such as fleet services or buildings and grounds maintenance).

Performance benchmarking operations costs and maintenance costs were collected separately, but are being evaluated together for each unit process within the facility. The plant operations costs include costs for labor, energy, chemicals, contracts, utilities, materials, and disposal (where applicable) for each unit process. Plant maintenance costs include costs for electricians, mechanics, and instrumentation technicians. Each of these trades is subdivided to provide costs (if applicable) for predictive maintenance, preventive maintenance, repairs, parts, and other costs associated with each trade.

Operation and Maintenance Cost Centers

Both operations costs and maintenance costs have been collected for individual unit processes throughout the treatment plant. Table 3, Summary of Operation and Maintenance Cost Centers, shows which treatment processes and cost centers are present at each of the participating plants. A brief description of these processes and cost centers follows:

- **Influent pumping** is necessary when incoming wastewater (influent) cannot flow by gravity through the wastewater treatment plant. Centrifugal pumps, mixed flow pumps, or screw pumps are typically used to pump the influent into the plant.
- **Preliminary treatment** occurs as wastewater enters the plant. The purpose of preliminary treatment is to prevent damage to plant equipment (such as pumps) by removing large items, such as branches, grit, and rags. Preliminary treatment usually involves physical processes, such as screening, to remove these large items.
- **Primary treatment** follows preliminary treatment. It uses settling and flotation to decrease the load on subsequent biological treatment processes. The wastewater flow is slowed in large tanks called primary clarifiers, which allows suspended solids to settle and be removed, while floatable material (scum) is skimmed from the surface. Some agencies use advanced primary treatment that includes the addition of coagulation chemicals to enhance the removal of solids and biochemical oxygen demand (BOD).
- **Secondary treatment** is a biological process using microorganisms to metabolize organic matter in the wastewater as food. Wastewater is frequently pumped (**pumping to secondary**) to a bioreactor where organic matter is aerated. The bioreactors use air (**aeration basins**) or pure oxygen (**oxygen reactor basins**) to stimulate cell metabolism and growth. Air-activated sludge and oxygen-activated sludge processes are suspended growth processes in which the growth of microorganisms occurs in an agitated liquid suspension media (mixed liquor). Pure oxygen systems require pure oxygen that may be produced onsite using an **oxygen plant**. Some plants use **fixed film reactors** with a fixed media as a substrate for the growth of microorganisms. The media typically is a porous inert material such as rocks or plastic. Primary clarifier effluent is distributed evenly over the media, and the microbiological mass adhering to the media treats the effluent as it trickles down to the

Table 3. Summary of Operation and Maintenance Cost Centers

		Preliminary/ Primary Treatment			Secondary Treatment							Residuals Handling									Other Plant Processes								Misc.		
Agency	Flow[1]	Influent pumping	Preliminary treatment	Primary treatment	Pumping to secondary	Aeration basins	Oxygen reactor basins	Oxygen plant	Fixed film reactors	Secondary clarifiers	Other secondary processes	Screenings	Grit	Scum	Sludge thickening	Digestion	Dewatering	Biosolids disposal/reuse	Other residuals handling processes	Residuals stream odor control	Disinfection	Liquid stream odor control	Effluent pumping/outfall	Auxiliaries/utilities	Automated control systems	Tertiary treatment/reclamation	CMMS	Water reclamation/conservation	Other O&M functions	Plant Supervision	Clerical support
CCCSD	49	•	•	•	•	•				•	•	•	•	•	•		•	•	•	•	•	•	•	•	•		•	•	•	•	•
CLABS, Hyperion	355[2]		•	•	•		•	•		•	•	•	•		•	•	•	•	•	•		•	•	•	•				•	•	•
CLABS, Tillman	67	•	•	•		•				•	•								•		•	•		•	•			•	•	•	•
CLABS, Terminal Island	16	•	•	•		•				•					•	•	•	•		•		•	•	•	•	•			•	•	•
CLABS, LA- Glendale	20	•	•	•		•				•											•	•			•	•			•	•	•
CPBES	85	•	•	•		•				•		•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•
EBMUD	81	•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•		•	•	•	•	•				•	•	•
KCDNR, East Plant	79	•	•	•		•				•		•	•	•	•	•	•	•		•	•	•	•	•	•	•		•	•	•	•
KCDNR, West Plant	121	•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•
OCSD, Plant 1	89	•	•	•	•	•			•	•	•	•	•		•	•	•	•	•			•	•	•	•		•		•	•	•
OCSD, Plant 2	155	•	•	•	•		•	•		•	•	•	•		•	•	•	•	•			•	•	•	•		•		•	•	•
SRCSD	152	•	•	•			•	•		•		•	•		•	•		•		•	•	•	•	•	•		•		•	•	•

Agency Abbreviations:

CCCSD Central Contra Costa Sanitary District
CLABS City of Los Angeles Bureau of Sanitation
CPBES City of Portland Bureau of Environmental Services
EBMUD East Bay Municipal Utility District
KCDNR King County Department of Natural Resources
OCSD Orange County Sanitation District
SRCSD Sacramento Regional County Sanitation District

[1] Average annual flow in FY 97 in million gallons per day (mgd).

[2] Wastewater flows through the CLABS Hyperion Plant include 14 mgd residual flows discharged from the Tillman and L.A.-Glendale plants. These discharge flows are reflected in the flow listed here for Hyperion. Thus, although the total of all CLABS flows in this table is 458 mgd, actual flow through the system net of residuals is 444 mgd (458 mgd – 14 mgd = 444 mgd), as indicated in Table 1 on Page 2. Likewise, the net flow for Hyperion is 341 mgd (355 mgd – 14 mgd = 341 mgd).

bottom of the reactor. The finishing phase of secondary treatment takes place in **secondary clarifiers.** Secondary clarifiers slow the flow to allow suspended solids to settle to the bottom and be drawn out as sludge. Floatable material (scum) is skimmed from the surface. Some plants use **other secondary processes** that do not fall under the above categories.

- **Residuals handling** refers to all processes dealing with the solid matter removed from the wastewater during the treatment process. **Screenings** and **grit** are removed during preliminary treatment. **Scum** is removed during primary and secondary treatment. **Sludge thickening** is necessary to decrease the amount of water in the solids removed from the primary and secondary clarifiers. These thickened solids are then sent to digesters or to other solids handling facilities. **Digestion** involves the decomposition of organic and inorganic matter in the absence of molecular oxygen. Anaerobic digesters stabilize the solids that have settled out in the clarifiers during primary and secondary treatment. Anaerobic digesters produce gas that can be used beneficially in the plant or sold to a local utility. Biosolids **dewatering** decreases the amount of liquid in the biosolids and reduces subsequent treatment and handling costs. Belt filter presses, centrifuges, and other devices typically accomplish dewatering. **Biosolids disposal/reuse** refers to the many possibilities for ultimate reuse and/or disposal of the biosolids, such as composting and landfilling. Some plants may use **other residuals handling processes** not specified above. Many of the biosolids handling processes may require residuals stream odor control processes.
- **Disinfection** is the selective destruction of disease-causing organisms that are present in the wastewater. Disinfection can be accomplished through either chemical agents, such as chlorine or sodium hypochlorite, or through physical agents, such as ultraviolet radiation. Effluent dechlorination often is required to mitigate the adverse effects of chlorinated effluent on aquatic life in the water body to which the treated effluent is discharged. Where chlorine residual limitations are severe, effluent dechlorination must be practiced. Dechlorination typically is achieved by adding a chemical such as sulfur dioxide or sodium bisulfite to the chlorinated effluent stream.
- **Odor control** (**liquid stream** and **residuals stream**) occurs throughout the plant, frequently even upstream of the actual plant in the collection system. Odors generated from the wastewater or its treatment are minimized through any number of processes, such as adding chemicals, installing odor-containing covers, and scrubbing the foul off-gas with wet- or dry-type air scrubbers.
- **Effluent pumping** is required when treated effluent cannot leave the plant by gravity. Large centrifugal, mixed flow, screw, or vertical turbine pumps are often used for this purpose. A conveyance structure or pipeline called an **outfall** carries the treated effluent to the receiving waters.
- **Auxiliaries/utilities** includes all processes and systems that are not specific to any single unit process. Plant water or plant instrument air systems are examples of the auxiliary/utility cost center.
- **Automated control systems** refer to the various computer and automation systems used for monitoring and control at the plant.
- **Tertiary treatment/reclamation** is an advanced treatment process that produces a high-quality effluent for discharge into receiving waters. A typical process involves treating secondary effluent with chemicals to improve coagulation and flocculation, then allowing the effluent to percolate through a filtration tank consisting of finely-divided media such as sand, anthracite, or layers of both.

- **CMMS** (Computerized Maintenance Monitoring System) costs include everything associated with maintaining and monitoring the CMMS, which is used to assist in tracking and planning maintenance activities.
- **Water reclamation/conservation** is a tertiary treatment process that produces a high-quality effluent for purposes such as landscape irrigation, agricultural irrigation and/or industrial reuse. Some reuse regulations require effluent filtration to achieve target effluent coliform and/or turbidity requirements.
- **Power generation** uses digester gas, a byproduct of the anaerobic digester process, as a source of energy. Inherently high in methane content, digester gas lends itself well to energy/resource recovery efforts, because it has a typical energy value of approximately 600 Btu per standard cubic foot of gas. Many agencies recapture energy from digester gas by using it as a fuel to drive direct-coupled engine blowers for aeration or for power generation using engine generators or turbines. Power generation data were considered separately from other O&M data, thus power generation costs and revenues, though briefly discussed under "Operation and Maintenance Process Benchmarking Results," are not included in the average cost for treatment calculations, and the power generation cost center is not included in Table 3.
- **Other O&M functions** include functions that are related to the plant or wastewater treatment, but cannot be defined to a single unit process. Functions such as fleet services or building and grounds maintenance are included in this cost center.
- **Supervision** costs include all supervision that cannot be allocated directly to unit processes within the treatment plant.
- **Clerical support** at the treatment plant is broken out separately.

Operation and Maintenance Cost Comparisons

Table 4, Operation and Maintenance Costs, shows the average cost and the range of costs of O&M at all facilities. The first five unit processes/cost centers (biosolids disposal/reuse, other O&M functions, dewatering, disinfection, and plant supervision) constitute almost half of all O&M costs. Note that the average cost presented is normalized by the flow entering the plant regardless of flow through the specific unit process. The final report will include a more detailed analysis of the data collected for the O&M cost centers.

Operation and Maintenance Process Benchmarking Results

Process benchmarking data have been collected using surveys created for each of the following 14 process area topics: laboratory analysis, new technology development, automation, energy, information management, transition from capital project to operating system, predictive maintenance, off-shift staffing, combined operations and maintenance, workforce flexibility/skill-based pay, labor-management relations, biosolids reuse and disposal, fleet services, and year 2000 (Y2K) compliance.

Discussions of the costs and process benchmarking results have identified the following key O&M Work Group findings:

Preliminary Treatment/Influent Pumping. Some agencies find that consideration of operations and maintenance costs during facility design can reduce agency costs. For example, minimizing

Table 4. Operation and Maintenance Costs

Unit Process	Average Percentage of O&M Costs	Cost, $[1]		
		Average	Lowest[2]	Highest
Biosolids disposal/reuse	14.4	53.10	16.15	88.32
Other O&M functions	13.8	50.83	23.33	101.16
Dewatering	8.2	35.25	0.00	55.46
Disinfection	6.8	24.92	0.00	75.56
Plant supervision	6.3	23.10	11.36	43.58
Primary treatment	4.7	17.38	8.68	26.30
Anaerobic digestion	4.6	17.09	0.00	35.92
Auxiliaries/utilities	4.0	14.58	5.80	35.20
Influent pumping	3.6	13.20	2.76	19.79
Sludge thickening	3.3	12.27	3.68	28.93
Oxygen reactor basins	3.3	12.24	0.00	43.72
Liquid stream odor control	3.3	12.15	0.54	38.04
Aeration basins	3.3	11.99	0.00	27.87
Secondary clarifiers	3.2	11.72	1.71	24.53
Preliminary treatment	2.6	9.74	3.30	20.59
Oxygen plant	2.4	8.86	0.00	26.24
Effluent pumping/outfall	2.0	7.52	2.90	11.96
Automated control systems	1.9	6.90	0.00	17.90
Grit	1.4	5.03	1.25	10.74
Water reclamation/conservation	1.0	3.78	0.00	25.35
Clerical support	1.0	3.64	0.05	8.70
Pumping to secondary	1.0	3.57	0.00	12.71
Screenings	0.9	3.17	0.94	4.78
Other secondary processes	0.6	2.23	0.00	7.43
CMMS	0.6	2.09	0.00	4.82
Residuals stream odor control	0.5	1.93	0.00	9.16
Scum	0.5	1.86	0.00	4.74
Other residuals handling processes	0.4	1.55	0.00	6.02
Tertiary treatment/reclamation	0.4	1.39	0.00	5.06
Fixed film reactors	0.1	0.25	0.00	1.74

[1] Costs calculated per million gallons entering the plant.
[2] Low cost is frequently zero, indicating that there are plants that do not have said unit process.

the distance that grit must travel between grit chambers, classifiers, and hoppers can reduce both operations and maintenance costs.

Primary Treatment. Deep primary clarifiers and chemical addition are used by some agencies to optimize their primary treatment process.

- Some agencies find that deep primary clarifiers lead to better performance. The bottom of the clarifiers can be used to thicken the primary sludge.

- Some agencies find that chemical addition leads to better BOD and total suspended solids (TSS) removal. Primary sludge of up to 5 percent solids is attained at facilities adding chemicals to its primaries.

Secondary Treatment. Energy-saving strategies are key in reducing secondary treatment costs, while diffuser technology and secondary clarifier design significantly affect performance.

- Some agencies find that for oxygen-activated sludge systems, converting from submerged turbines to surface aerators results in lower energy costs. Additionally, there is evidence that cycling the surface aerators to match changes in diurnal flows and loads can save energy without compromising treatment performance.
- Some agencies find that for air-activated sludge systems, converting to fine bubble diffusers and blowers with variable inlet guide vanes and outlet diffusers can maximize energy savings.
- Some agencies recommend that secondary clarifiers be designed with sufficient depth (20 feet minimum) to improve performance.
- Some agencies recommend separating mixing zones from aeration zones to promote selector zone technology.

Tertiary Treatment/Water Reclamation. Discussions on tertiary treatment and water reclamation were limited and did not produce any significant findings.

Disinfection and Dechlorination. Some agencies find that better instrumentation can be used to improve chemical dosing and reduce chemical expenditures. They also use alternative disinfection and dechlorination control technology such as oxidation-reduction potential probes.

Odor Control. Discussions on odor control led to a commitment to spend time on this subject in future phases of the project.

Digestion. Key findings related to digestion include ways to reduce grit and foam in the digesters.

- Some agencies find that the amount of grit in the digesters can be reduced by ensuring that equipment and systems are properly designed and by removing grit further upstream in the plant.
- Some agencies reduce foaming in the digesters by installing fixed covers, using longer detention times with reduced temperatures, and making adjustments to the secondary processes.

Dewatering. The use of new technology and careful selection of equipment are important factors in maintaining an efficient dewatering process.

- Some agencies use state-of-the-art technology (for example, high-solids centrifuges) for dewatering to produce a drier cake. This reduces disposal costs, especially for those agencies requiring significant truck hauling.
- Some agencies obtain better results by pumping dewatered sludge as opposed to using mechanical conveyors. The advantages of pumping dewatered sludge are as follows: 1) odors are completely enclosed; 2) difficult maintenance on enclosed conveyor belts is eliminated; and 3) the pumps are more reliable than conveyors. Some agencies find that if conveyor belts are selected, the length of conveyance should be kept to a minimum. If using high-cake centrifuges, a conveyance method must be selected carefully. The chute slope into the hoppers should be steep to minimize bridging.

Biosolids. Planning, testing, promoting long-term partnerships, and producing biosolids with a high solids content are important in keeping biosolids disposal/reuse program costs down in an environment heavily influenced by changing regulations.

- The lowest cost agencies use biosolids disposal technologies that other agencies may not be able to use because of land restrictions, permitting considerations, or neighborhood concerns.
- Some agencies have a plan for a diverse biosolids disposal/reuse program. The plan might include, for example, jurisdictional diversity for land application sites, or multiple disposal/reuse options.
- Some agencies reduce costs by seeking multiple bidders for hauling and application of biosolids.
- Some agencies use sludge lagoons to reduce mass, increase quality, and to allow seasonal land application. It appears that the low-cost agencies incinerate or use biosolids onsite. Both strategies reduce truck hauling costs.

Power Generation/Energy. Discussions on power and energy indicate that there is a cost benefit to having the ability to generate power onsite.

Automation. Some agencies use automation in various aspects of plant operation to reduce costs.

- Some agencies use standardized process control as a means to reduce costs associated with training and warehousing multiple parts.
- Some agencies include automation considerations during capital projects to reduce off-shift staffing requirements.
- Some agencies use a “hot backup” for critical control systems.

Predictive/Preventive Maintenance. Some agencies use the following potential strategies for operating a predictive/preventive maintenance program:

- Assign predictive maintenance to complex equipment only.
- Operate equipment until it fails if there is redundancy in equipment or if the cost of equipment is minimal.
- Design a corrective maintenance program.
- Coordinate inventory with the maintenance program.
- Determine when life-cycle replacement may be more cost-effective than preventive maintenance.

Off-Shift Staffing. Some agencies have flexibility in the form of off-shift staffing and use innovative ways to communicate information between shifts.

- Several agencies have found that having a relief operator is more economical than paying overtime. Agencies with relief operators pay a premium to those operators.
- Some agencies are moving towards electronic billboards to transfer information between shifts.

Combined O&M Staff. Combining O&M staff is a complicated issue for those agencies with different certification requirements for O&M personnel. One approach is to keep O&M separate, but to have O&M personnel work together as a business unit on specific projects.

Working together encourages cooperation but does not require cross-training of personnel. Alternatively, maintenance personnel could be certified with a lower grade operator license.

Transition from Construction to Ownership. Involvement in the predesign process and training are key to a smooth transition from construction to ownership.

- Several agencies believe that it is important to involve O&M staff in the predesign process and have dedicated personnel to take the project from design through construction. This encourages coordination of construction and operation issues.
- Some agencies find that a key factor in startup is training given by the staff involved in the process, rather than by a manufacturer's representative. Staff training is more credible and more appropriate for personnel involved in day-to-day operations and maintenance.

Administration

The Administration Work Group was assigned to collect the administrative and miscellaneous costs not specifically identified in any of the other templates. The group also conducted process benchmarking in an attempt to identify best practices that could be adopted by other agencies to improve service and/or cost effectiveness. Though the administrative departments of each of the Multi-Agencies have similar responsibilities, differences in organizational structure, systems, and procedures all significantly affect costs and business practices.

Organizational factors, such as whether an agency is a single- or dual-purpose utility or part of a larger governmental structure with differing numbers of layers between the wastewater function and the governing body, make a significant difference in the ability of wastewater staff to make business changes. These factors also influence the ability of agencies to have complete control over costs. Unlike other work groups, such as the O&M Work Group, which is in control of the business to be studied, understood, and improved, the Administration Work Group focused primarily on documenting costs and practices.

Raw and normalized cost data for each of the major functional areas were collected and compared through the performance benchmarking. Process benchmarking information was gathered through process surveys developed for the following areas: payroll, purchasing, accounts payable, financial information systems, budgeting, training, rates and revenue, bond rating and reserves, and overhead. Process benchmarking discussions and efforts focused on the basic support functions common to all agencies—the people and financial support systems—that significantly affect day-to-day plant business.

Key findings from the administration group include the following:

Purchasing and Accounts Payable

At some agencies, the use of credit cards and early payment discounts from vendors have improved purchasing and accounts payable operations.

- Agencies that use credit cards for routine purchasing report advantages including increased simplicity, efficiency, timeliness, and flexibility for purchasers. Accounting costs are also reduced by eliminating many of the steps and paperwork usually required to purchase items and to process payments. Several agencies that currently do not use credit cards are considering using them in the future.

- Nearly all agencies report problems with timeliness of payment and subsequent problems with vendors. Agreeing upon goals for the percentage of early payment discounts and penalties for not meeting these goals successfully addresses this problem.

Payroll

All agencies are working toward a modern, integrated payroll system.

- Although no agencies currently use one-time entry to feed **all** information systems, they all consider it a goal.
- Every agency currently is implementing or soon will be implementing new payroll systems.
- Several agencies have recently tied their payroll systems to the benchmarking template and other agencies are considering doing so. Given that all agencies are implementing new payroll systems, the opportunity is immediate. The question being debated by most agencies is not whether to integrate these systems, but at what level of detail.

Internal Service Level Agreements

Some agencies secure written agreements with centralized support services to specify the work to be performed and by whom. They also include the expected performance measurements and important milestones in the agreement. The agencies that use this technique recommend it because it improves service and communication. At least one other agency is in the beginning stages of implementing such agreements.

Budget

Most agencies encourage preparing multi-year rather than annual budgets to avoid the non-value-added work involved in the budgeting process. Because agencies feel that there are usually few significant changes from year to year, there is little value in conducting repetitive annual exercises.

Source Control

The primary purpose of a source control program is to control discharges of wastewater from non-domestic sources into a public sewer system. An effective program should prevent discharges that could be harmful to people, the treatment works, and the environment. This means that the true measure of success of a source control program is hidden in the treatment and system maintenance **costs avoided**. In pursuing the goals of a successful source control program, all of the agencies have realized significant decreases in heavy metals concentration entering their plants.

This year's study focuses on identifying the tenets of a source control program and determining how the agencies can make meaningful comparisons. In doing so, it lays the foundation for future work, which would include both process benchmarking and fine-tuning of the performance benchmarking. The following are the key findings from the Source Control Work Group:[1]

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[1] Source control data and findings do not necessarily reflect or apply to CCCSD, which was unable to provide data for source control functions.

Program Differences

The cost of a source control program, in terms of both dollars and labor, is affected more by the fundamental discretionary decisions that determine how a source control program shall operate than by individual process improvements capable of leading to greater efficiency. These discretionary decisions include which companies a program chooses to regulate, how often it inspects and samples its companies, how it enforces, how much effort it devotes to pollution prevention, and whether the program is the basis of rate development and implementation for all users. These decisions are rooted in the basic environmental ethics of the communities served by the source control programs, and thus are difficult to change. The agency that wishes to find significant efficiencies in its source control program must pursue a thoughtful and thorough analysis of the cost and benefits of its actions, and include input from various stakeholders in its decisions. In some cases, changes may not be possible as major modifications to industrial pretreatment programs require approval from the oversight agency, such as the state or Environmental Protection Agency.

Outside Factors

Factors beyond the direct control of the agencies, such as National Pollutant Discharge Elimination System (NPDES) limits (or other applicable limits) and amount of scrutiny by the oversight agency can significantly affect the cost of source control programs. Some of these factors can be influenced; therefore, source control managers should be active participants in NPDES negotiations.

Data Management

A comprehensive, integrated data management system can provide efficiencies in data management, permitting and violation tracking, and reporting. Only one agency has such a system, but all agencies either have partial systems or are in the process of developing one.

Reducing Violations

Enforcement actions can be extremely time-consuming for a source control program and reducing the number of enforcement actions by increasing company compliance may improve efficiency. Some agencies employ user-friendly procedures, such as creating customized reporting forms and compliance calendars and calling companies with reminders. Eliminating limits on compounds that do not affect the treatment plant or water quality can also reduce violations.

Staffing Efficiencies

Further analysis of sampling and inspection practices may point to some best practices that could reduce labor requirements for these activities at some agencies.

- Some agencies collect samples for surcharge and compliance separately and may improve efficiency by concurrent sampling so that only one trip meets both needs.
- Some agencies use teams rather than individuals to perform inspections and/or sampling and may be able to use their resources more effectively by using individuals instead.
- Some agencies combine sampling and inspection events, which may increase efficiency.

- Some agencies rely more on company self-monitoring and less on agency monitoring, which may lead to efficiencies through reduced agency efforts on monitoring and reduced violations as companies take more responsibility for their discharge.

Laboratory

Laboratories from three additional agencies that are not participating in the Multi-Agency Benchmarking project have joined in a larger laboratory benchmarking effort. The laboratories from the seven Multi-Agencies compiled data for the laboratory portion of the template, and all ten of the laboratories completed a process benchmarking survey. The larger laboratory group is also working on an extensive cost per test comparison spreadsheet, and they have developed tables to compare factors such as staffing, salaries, benefits, workload, and laboratory organizational structure.

The management of municipal environmental laboratories has undergone significant changes during the past 10 years. The laboratory managers participating in this study agreed that they face increased pressure to provide cost-effective service, meet higher expectations from customers, deal with expanded regulatory requirements, and handle a greater complexity of work (for example, lower detection limit requirements). The managers have responded by making their operations more efficient, more cost competitive with the private sector, and more responsive to their customers' needs and requirements. The Multi-Agency Benchmarking project is helping the laboratory component of the wastewater industry to meet these challenges by enabling agencies to share information and identify opportunities to enhance the effectiveness of laboratory operations. The major findings of the Laboratory Work Group include the following:

Customer-Imposed Workload Versus Laboratory Efficiency

The interagency variation of flow-normalized laboratory costs is influenced by two factors: 1) volume and type of work requested, and 2) laboratory efficiency. Performance indicators over which the laboratory maintains control include: 1) time required to do each analysis; 2) percent rework; 3) turnaround time; 4) number of tests per instrument and analyst; and 5) the number of samples lost or that exceed holding times. The Laboratory Work Group observed that the volume and type of work requested by the customer has a greater impact on cost variation than factors characterized as laboratory efficiency. Therefore, the cost differences among the agencies for given categories such as discretionary monitoring or source control need to be accounted for by the customer group responsible for the category.

Heightened Communication with Customers

In line with the customer focus noted in the first observation, heightened communication with the customer enables laboratories to maximize efficiencies and performance while minimizing cost and unnecessary work. For example, optimizing batch size and sample scheduling makes the most efficient use of laboratory resources, thereby reducing the cost per test. This can be accomplished by integrating the laboratories' knowledge of relative analytical costs and scheduling efficiencies into a monitoring plan developed through joint laboratory-customer decisions. Some of these decisions include the analytical methods used, level of quality assurance required, sampling frequency, numbers of analyses needed, batch size, and reporting requirements.

Benchmarking Lab Performance

To analyze the cost efficiency of laboratory operations, the Laboratory Work Group developed a cost model to isolate comparable components of the laboratories' budgets. They delineated the laboratories' work by test (defined by method), and then adjusted the portions to include the overhead according to average salary costs for the four major lab areas (metals, organics, biology, and conventional chemistry). The resulting spreadsheet compares cost, time per test and numbers of tests by method for all of the agencies. This information will be used to determine the efficiencies among various methods, such as automated versus manual procedures, as well as efficiencies between laboratories using the same methods.

Lab Capacity and Sample Volume Comparisons

Calculating the annual number of analyses required to yield 250 analyses per staff per month can provide an interesting comparison. This measure assumes that all analyses are equivalent and all positions including support staff are counted. However, these figures should be carefully considered in the context of the fact that times per test range from a few minutes to several days. By using the time per analysis component of the unit cost spreadsheet, it is possible to make quantifiable comparisons between the mixtures of short timeframe tests. This information can then be used to determine optimal batch size and labor resource efficiencies. The consensus among the laboratories is that the more closely the sample volume matches the optimal capacity, the more efficient the laboratory.

Summary and Conclusions

The final steps in this phase of the Multi-Agency Benchmarking Project include preparing the final report. The final report will consist of an executive summary and a chapter from each work group that details the group's findings and the best practices they have determined from the current data. Several years of data will be necessary to track any changes implemented and reap the full benefit of the Multi-Agency Benchmarking Project.

The current phase of the Multi-Agency Benchmarking Project delivers a number of benefits to the Multi-Agencies and leads to important conclusions:

- **Discussions have resulted in valuable information**. Extensive discussion has enabled each of the work groups to gain insight into their processes and practices. Learning how others run their business and how to apply these lessons to other plants is one of the most worthwhile aspects of the project.
- **Detailed tracking and allocation of costs is advantageous**. Some agencies can track and allocate all of their costs to specific cost centers. They also can distinguish core activity costs from non-core activity costs. This enables them to more clearly evaluate the budgetary effects of providing value-added services to customers, and to set policy accordingly.
- **Low cost does not always correlate to high efficiency**. Cost must be weighed against other applicable factors.
- **Agencies are affected by factors out of their immediate control**. The low-cost agency for any given process frequently enjoys a unique operational environment not available to others.
- **Careful tracking of resources is beneficial**. Some agencies are better at tracking and delineating resources, both internal and external. Internal service agreements between

departments, for example, increase communication and understanding. External agreements should clearly assign and allocate responsibility between the agency and contractor.

- **Keeping abreast of the latest technologies and practices is important**. Some agencies constantly track and evaluate new technologies and business practices to determine their potential cost-effectiveness.
- **Agencies can benefit from clear communications**. Some agencies have clearer communications procedures. Staff at these agencies better understand their agency's purpose and goals, and how their individual actions contribute toward these goals.

Recommendations

Recommendations for improvements at the Multi-Agencies include the following:

- **Develop or modify accounting or financial information systems**. Make changes to enable agencies to use activity-based budgeting and tracking. Continue tracking costs, as this shows staff how their actions affect operational costs.
- **Review higher-than-average costs**. Determine the reason for the high costs and whether they can be reduced.
- **Investigate the possibility of joint studies**. Agencies can benefit from joint studies in which they share the work and cost of evaluating alternative technologies and practices.
- **Share past experiences**. Agencies should continue to share lessons learned to eliminate duplication of effort and repetition of mistakes.
- **Evaluate the effects of power deregulation**. Agencies need to stay informed about the potential changes in the electrical power industry to benefit fully from the trend toward deregulation.

Recommendations for the next phase of the Multi-Agency Benchmarking Project include the following:

- **Continue the work of the four new work groups**. The Laboratory, Administration, Capital Programs Engineering, and Source Control Work Groups that were formed this year should proceed with their work next year. New groups require a first-year learning curve before the full benefit of their work can be achieved.
- **Consider creating additional work groups**. The Steering Committee may wish to create new work groups to focus on the following:
  - Capital projects and O&M. Concentrate on the effects of capital improvements on facility operating costs and determine ways to incorporate life cycle cost analysis in capital planning. Also examine cost of capital improvements (planning, predesign, design, construction, and asset replacement) and ways to contain these costs.
  - Labor-management relations. Address this as an issue that affects the entire organization, rather than solely as an O&M issue.
  - Odor and air issues. A complicated topic due to the fact that odor and air costs cannot be allocated to a single process because treatment takes place at different locations throughout the plant. Furthermore, odor control processes affect other unit processes.
  - Environmental compliance.
  - Information technology.

- **Discuss potential new revenue streams**. Research how other municipal agencies generate revenue, and determine if any of these methods can be used by the Multi-Agencies.
- **Consider tracking costs by plant**. Determine whether it would be beneficial to track costs by plant for those agencies with more than one plant. If so, determine an accurate method of allocating shared overhead costs among the plants.
- **Continue refining benchmarking tools**. The Multi-Agencies should work together to improve existing benchmarking tools and create new ones in order to make the most accurate comparisons:
  - Refine the process benchmarking surveys and analysis to reflect lessons learned from this phase of the project.
  - Develop tools to assess the effects of decisions by participating agencies to change or modify business practices based on findings from this project.
- **Begin tracking trends**. The next phase of the project will allow the Multi-Agencies to compare data between fiscal years and track the effects of recently implemented changes.
- **Perform benchmarking against privately operated utilities**. Comparisons to privately-owned utilities may reveal additional ways that the Multi-Agencies could cut costs and operate more efficiently.