

## **DEVELOPING WATER MANAGEMENT PERFORMANCE MEASURES**

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### **ABSTRACT**

The United States Bureau of Reclamation (Reclamation), in cooperation with the California- Bay Delta Water Use Efficiency Program (WUE), has developed performance measures to quantify the project level benefits of water management actions. Quantification of project benefits is an important means of determining the relative effectiveness of various water management efforts and for improving program level implementation. Additionally, with shrinking federal budgets, it is imperative to demonstrate the effectiveness of water management expenditures. Currently, quantifiable information is limited, and varying measurement methodologies make it difficult to compare benefits from program to program, or location to location. This paper presents and defines performance measures developed for a number of water management project types including water measurement, canal lining and piping, system automation, spillage reduction, drainwater reuse, water marketing and water banking. Use of these performance measures will help standardize quantification methods and facilitate comparability throughout the water management industry.

### **INTRODUCTION**

Reclamation was created by an act of Congress in 1902 to develop and provide water resources for the arid western United States. Since 1902, Reclamation has constructed over 475 major structures including Hoover Dam on the Colorado River and Shasta Dam on the Sacramento River. Beginning in the 1980's environmental concerns and population growth in such areas as Los Angeles, San Francisco, Las Vegas and Phoenix required Reclamation to expand its mission to include managing and protecting Reclamation's water resources in an environmentally friendly and economically sound manner in the interest of the American public.

Added to Reclamation's expanded mission is the increased accountability at state and federal levels to prioritize expenditures and determine the most cost-effective means of using limited funding resources. In the water management industry, this requires analyzing the cost versus the benefits of projects that focus on water demand management to determine which practices, in which situations, result in the best use of funding. In addition, decision makers need to determine whether the problems associated with limited water resources can be best addressed by concentrating funding on reducing water demands or increasing water storage.

This is a major dilemma now facing the CALFED Bay-Delta Program. CALFED is a combined State of California and federal program focused on the restoration of the Delta's fragile ecosystem while improving water supply reliability for urban and agricultural water users. Historically, competing stakeholder groups have debated the issue of storage versus demand management with limited data available to determine which combination of new water supply projects and demand management projects is most cost effective. By establishing performance measures and measuring the success of various WUE projects, decisions can be made based on objective criteria.

In addition to its involvement in CALFED, Reclamation has historically funded several WUE projects geared towards decreasing water demands in order to meet environmental, agricultural and growing urban needs. In 1997, Reclamation created the Water Conservation Field Services Program (WCFSP), designed to encourage water conservation through financial and technical assistance. The WCFSP provides cost share funding to Reclamation contractors for the implementation of best management practices identified in their water conservation plans. Over the last several years Reclamation has given hundreds of small grants to contractors for projects such as canal lining and piping, irrigation scheduling, system delivery, system modernization and measurement.

Another Reclamation program addressing water conservation is Water 2025. Initiated in 2004, Water 2025 focuses attention on the complex water issues of the West. The demand for urban water needs, the emerging needs for environmental and recreational water and the national importance of the domestic food and fiber production from western farms and ranches are driving major conflicts between competing water users. Water 2025 provides a forum for public discussion of the issues so that decisions can be made in advance of water supply crises.

An important aspect of Water 2025 is the Challenge Grant Program. Challenge Grant funding is provided on a 50/50 cost-share basis to irrigation and water districts, Western States and other entities with water delivery authority for projects that stretch existing water resources. Challenge Grant projects focus on modernizing aging water delivery infrastructure, water marketing and improving water use efficiency and conservation. Between years 2004 and 2006, the Water 2025 Challenge Grant program has funded 78 projects that represent approximately \$60 million in water system and water management improvement across the West. These projects will create new water banks, promote the use of advanced technology to improve water management and increase collaboration among Federal, State, tribal, and local organizations.

## PERFORMANCE MEASURE DEVELOPMENT

Prior to 2006, Reclamation had no standardized methods to quantify the results of WUE projects even though initial estimates of water savings were required. In order to quantify benefits of a project, determine effectiveness of water management efforts and summarize the overall effectiveness of the WUE grant programs, Reclamation, in cooperation with CALFED, developed performance measures to compare pre- and post-project water use data. By implementing these performance measures, one can calculate the anticipated project benefits and verify results, i.e. water conserved, after a WUE project is implemented.

This effort to quantify benefits is consistent with laws such as the Government Performance and Results Act of 1993 (GPRA) and with the Program Assessment Rating Tool (PART) which require federal agencies to strategically plan according to program objectives and to track and report their performance. GPRA and PART promote measurable results and assess performance using program results. Developing water management performance measures for Reclamation's WUE projects adheres to GPRA and PART requirements and will allow Reclamation to measure program effectiveness and to calculate the costs and benefits of conservation efforts. Performance monitoring will give output measurements that are expressed in a quantifiable manner, which will give water managers real data to use when evaluating the financial feasibility of future projects.

Currently, quantifiable information for water use efficiency projects is limited, and varying measurement methodologies make it difficult to compare benefits from program to program, or location to location. Standardizing quantification methods for measuring WUE benefits with performance measures will allow comparison of the results from varying grant programs such as Water 2025, WCFSP and CALFED WUE Programs. These programs have collectively spent over \$80 million in WUE projects in the last 5 years.

Performance measures for WUE projects are based on specific indicators to assess program performance and progress towards program goals. Indicators are used to measure quantitatively an attribute of interest. Indicators can be classified into three types, described below:

- **Administrative Indicators-** indicators that summarize administrative actions and describe resources (i.e. funds, personnel, projects) focused on a particular subject. Example: amount of funds spent on projects to improve water use efficiency.
- **Driver Indicators-** indicators that are representative of controlling factors (example: hydrologic year type) or implementation actions for example acres of district with improved delivery flexibility.

- **Outcome Indicators-** Indicators that are representative of a response to controlling factors. For example the improvement in WUE for a given project such as improved delivery flexibility.

Performance measures are used to determine if targets, the level of indicator performance sought within a given timeframe, have been attained. Targets may be quantitative (specific numbers or rates of change) or stated in qualitative terms. Quantitative targets can be useful when interpreting data and assessing progress towards goals. For example a canal-lining program may “target” a 10% annual reduction in deep percolation on an annual basis.

Specific performance measures were developed for various WUE projects including canal lining or piping, installation of measurement devices, SCADA, system controls to decrease spillage, drainage reuse projects, landscape evapotranspiration controllers, irrigation system improvements, water marketing and ground water banking. Types of data collected will include quantification of seepage, spills, water deliveries consumptive use, crop ET, improvements in delivery flexibility, pumping volumes and end of season water stores. Table 1 is an abbreviated version of Reclamation’s and CALFED’ s drafted performance measures for canal lining, measuring devices and data acquisition projects. The complete performance measures document can be viewed at [http://www.usbr.gov/mp/watershare/documents/PerformanceMeasures\\_final\\_3-2.pdf](http://www.usbr.gov/mp/watershare/documents/PerformanceMeasures_final_3-2.pdf).

Reclamation understands that there are limitations to the drafted performance measures. In some cases, baseline data may not be available for post-project comparisons. One may face challenges quantifying the direct benefits for certain projects such as measurement and automation since no previous data on water consumption exists for that area. It is also impossible to come up with a “one size fits all” performance measure for each project type. In addition, verifying water conserved from certain projects may take several years due to temporal and spatial scales.

**Table 1: Examples of drafted performance measures for WUE projects.**

<b>Action</b>	<i>Pre-project estimations of baseline data</i>	<i>Post-project verification methods</i>
<b><u>Canal Lining or Piping</u></b>	<ul style="list-style-type: none"> <li>▪ Ponding Tests: Conduct ponding tests along canal reaches proposed for lining or piping.</li> <li>▪ Inflow/Outflow testing: Measure water flowing in and out of the canal reach, taking evaporation into consideration.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Using ponding tests, compare pre- and post-project test results to calculate water savings.</li> <li>▪ If ponding or inflow/outflow tests cannot be performed, compare estimated historic seepage and evaporation rates for the lateral length of the canal to the post-project seepage and evaporation.</li> <li>▪ Compare ratio of historic diversion-delivery rates. Also include a comparison of historical and current canal efficiencies.</li> <li>▪ Record reduction in water purchases by shareholders and compare to historical water purchases.</li> </ul>
<b><u>Measuring Devices</u></b>	<ul style="list-style-type: none"> <li>▪ Pre-project estimated savings are difficult to measure; however, one can collect historical data on water use to estimate the amount of delivered water.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compare post-project water measurement (deliveries or consumption) data to historical water uses.</li> <li>▪ Compare pre- and post-project consumptive use by crop via remote sensing information.</li> <li>▪ Survey users to determine utility of the devices for decision making.</li> <li>▪ Document rate structure changes such as volumetric or tiered water pricing due to the use of measurement devices (assumes non-metered to metered district) so that water users are billed for actual water used instead of at a flat rate.</li> </ul>
<b><u>Data Acquisition</u></b>	<ul style="list-style-type: none"> <li>▪ Collect data on diversions and deliveries to districts and ditch companies, making estimates if necessary.</li> <li>▪ Document employee time spent on pre-project ditch/canal monitoring and water control.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Calculate amount of increased carryover storage in associated reservoirs. This measure will be more meaningful over a period of years.</li> <li>▪ Track and record the diversions to individual districts and ditch companies or district laterals and compare to pre-project diversions. This would show results of improved management if yearly fluctuations in weather are accounted for.</li> <li>▪ Report delivery improvements- i.e. changes in supply, duration or frequency that are available to end users because of SCADA.</li> <li>▪ Document other benefits such as less mileage by operators on dusty roads (which saves time and influences air quality) and less damage to canal banks due to fluctuating water levels in canals.</li> </ul>

## **CONCLUSION**

Until recently, Reclamation and CALFED's WUE efforts have been focused on administrative indicators. As with most funding efforts the initial step is to insure that funds are being expended for specific actions identified by legislation or agency priorities. This includes quantifying funds spent for specific WUE measures and the cost share provided by funding recipients.

As program implementation has matured, funding entities such as Reclamation and CALFED are now focusing on outcome indicators that can be used to identify the benefits received from WUE funding, determine which projects provide the greatest benefit and compare benefits derived from storage projects. The performance indicators addressed in this paper focus on quantifying the outcomes from the implementation of specific projects. Outcome indicators can also be used to evaluate the effectiveness of management actions and help refine our understanding of how the system works.

Reclamation has initiated this process with the understanding that performance measures are a work in progress that will be further refined as monitoring programs are implemented and project results are analyzed. It is Reclamation's desire that other local, state and federal efforts related to WUE will work with Reclamation in this effort in order to better assess the benefits and costs derived from implementing water use efficiency practices.