



650 Capitol Mall, 5th Floor
Sacramento, CA 95814
916.445.5511 FAX 916.445.7297
<http://calwater.ca.gov>

Agenda Item: 7-7
Meeting Dates: April 7 and 8, 2004

California Bay-Delta Public Advisory Committee Water Use Efficiency Subcommittee

Date : April 2, 2004

To : Mr. Gary Hunt, Chair
California Bay-Delta Authority

From : David Guy and Frances Spivy-Weber, Co-chairs
Water Use Efficiency Subcommittee

As Co-chairs of the Bay-Delta Public Advisory Committee's (BDPAC) Water Use Efficiency (WUE) Subcommittee, we are confirming our support for the California Bay-Delta Authority Staff Proposal on Appropriate Agricultural and Urban Water Use Measurement and urge the Authority to authorize the Director, or his designee, to work with the State administration and the Legislature on implementing this staff proposal.

Since this Water Use Measurement document was introduced to the Authority in February, there has been substantial review of issues that you and other Authority members raised. This review has occurred through public hearings, phone interviews with those who will have to submit the information called for in the proposal, checking in with two of the participants in the Independent Science Review Panel, and lengthy discussions at the BDPAC and WUE Subcommittee meetings in March. The proposal is greatly improved, and we are pleased (relieved) to express the view of the WUE Subcommittee, acting as directed by BDPAC, that we agree now is the time for the California Bay-Delta Authority to take action. Though some WUE Subcommittee members do not favor all elements of the proposal, the Subcommittee clearly recognizes that the proposed package is ready to be considered by the Authority.

For many stakeholders who participated in the BDPAC and WUE Subcommittee discussions, this proposal offers an excellent opportunity to dedicate limited time and minimal additional State or agency cost to gather information that will enable the State to act with greater assurance on agriculture and urban water use measurement issues in the future. We expect these stakeholders to remain engaged in this issue as the proposal moves forward. Therefore, we further recommend that the Authority and the BDPAC receive periodic updates as this package is implemented.

Thank you for your help in asking questions that have improved the proposal and in advancing this foundational milestone that will be important for the Authority and others to make future decisions that affect water use in California.

Agenda Item: 7-7 (Rev. 4/5/04)
Meeting Dates: April 7 and 8, 2004

**CONSIDERATION OF A RESOLUTION
AUTHORIZING THE DIRECTOR, OR HIS DESIGNEE, TO WORK WITH
THE STATE ADMINISTRATION AND THE LEGISLATURE ON IMPLEMENTING
THE STAFF PROPOSAL FOR WATER USE MEASUREMENT**

Summary: The CALFED Record of Decision called for staff to: 1) develop a definition of appropriate water use measurement; and 2) together with the CALFED implementing agencies, work with the Legislature to develop draft legislation that requires appropriate measurement of all water use in California. The definition of appropriate agricultural water use measurement was completed by an independent panel of experts in September 2003. Staff has also prepared a draft definition of appropriate urban measurement. Staff is presenting a proposal for consideration by the Authority that presents legislative, budgetary, and administrative actions for implementing appropriate measurement.

Recommended Action: Staff recommends that the Authority adopt the attached Resolution 04-04-01.

Background

Attachment 1 (Executive Summary) and Attachment 2 (California Bay-Delta Authority Measurement Staff Proposal), together, provide an overview on the status of the Authority staff efforts to develop implementation approaches for both agricultural and urban water use measurement.

Significant progress has been made in moving forward with discussions on this topic. Over the past few months, the CALFED Program has convened multiple stakeholder-agency work groups to provide informal, technically focused feedback on the evolving drafts. In addition, staff has conducted outreach meetings throughout California to broaden stakeholder awareness of these activities and seek comments on the emerging approach.

This staff proposal was discussed at the February 11, 2004 meeting of the Authority; the February 18, 2004 meeting of the Bay-Delta Public Advisory Committee (BDPAC) Water Use Efficiency Subcommittee; and the March 11, 2004 meeting of the full BDPAC, where the course of action being considered here was unanimously recommended.

Fiscal Information

Not applicable.

List of Attachments (Revised)

Attachment 1 – Summary of Stakeholder Comments – Water Measurement Proposal

Attachment 1 - Executive Summary

Attachment 2 - California Bay-Delta Authority Measurement Staff Proposal

Appendix 1 - Final Report: Independent Panel on Appropriate
Measurement of Agricultural Water Use

Appendix 2 – Staff Definition of Appropriate Measurement of Urban
Water Use

Appendix 3 - Summary of Stakeholder Comments – Water Measurement
Proposal

Resolution 04-04-01

Contact

Tom Gohring
Interim Deputy Director of Water Management
and Regional Coordination

Phone: (916) 445-0936

EXECUTIVE SUMMARY

Staff Proposal – Implementation Approach for Agricultural and Urban Water Use Measurement

The Issue

The August 2000 CALFED Record of Decision recognized that appropriate measurement can play an important role in effective water management and directed the development of policies to improve measurement of water use in California.

Over the past three years, the California Bay-Delta Authority (Authority) convened an independent scientific review panel, two ad hoc stakeholder work groups, and numerous technical and public workshops to identify critical water use measurement gaps and needs related to overarching state and federal water management objectives. The findings of these efforts paint a picture of a system struggling to and falling far short of adequately assessing agricultural and urban water use in California. Key failings include inconsistent and redundant state requirements and incomplete and incompatible measurement and reporting of crucial water use data by both local water suppliers and the State.

These failings place an unnecessary burden on local water suppliers striving to comply with oftentimes conflicting or redundant standards. More disturbingly, they undercut the State's ability to wisely manage its increasingly limited water resources and make important long-term investment decisions such as constructing new surface storage facilities.

Summary of Proposed Actions

Authority staff has developed what it believes to be a balanced and necessary package of actions related to appropriate measurement that would collectively make important contributions to the State's overarching water management needs. Key elements include:

- *Development of database and reporting standards:* This would involve the development and maintenance of a coordinated water use database. It would also entail the development of associated data collection and reporting standards and protocols. This new data management system would combine existing reporting requirements and eliminate redundant and inconsistent reporting.
- *Measurement of urban service deliveries:* This would require urban water suppliers above a certain size threshold to measure service water deliveries. This requirement would affect the approximately 7% of urban water suppliers not already measuring service water deliveries. Urban water suppliers above a certain size threshold would also be required to report in accordance with state water data collection standards and protocols.
- *Reporting of aggregate farm-gate delivery data:* This would require agricultural water suppliers above a certain size threshold to report aggregate farm-gate delivery data. This would impact all affected water suppliers, as this is a new requirement. This requirement would mandate a look-back – informed by Authority-sponsored studies assessing the causality of farm-gate measurement and application efficiency – to assess the adequacy of current measurement methods and recommended changes as needed.

- *Measurement and reporting of agricultural diversions:* This would require surface water diverters with diversion capacities above a certain threshold to measure diversions using the best available technologies and report the data annually to the State. Data suggests the measurement requirement would capture about 90% of all diversions; the increased reporting requirement would impact all affected agricultural water suppliers.
- *Measurement of crop consumption and net groundwater usage:* This would upgrade the State's methods for measuring crop consumption and net groundwater usage. This action would have no impact on locals but would drastically improve the State's ability to project water use.
- *Ongoing research and adaptive management:* The State would undertake a research and adaptive management program to ensure that the State's measurement approach keeps current with emerging technologies and shifting economics.

Several of these actions – e.g., reporting of agricultural farm-gate deliveries, increasing the frequency of reporting agricultural diversion data, requiring measurement of service meter deliveries, and changing the format for reporting urban water use data – may necessitate legislative action.

Rationale

While discussions to-date suggest there is support among diverse stakeholders for many of the actions called for in this proposal, some elements of this package are not supported by all stakeholder groups. Authority staff nevertheless believes this proposed package of actions is both necessary and appropriate for the following reasons:

- **Results in meaningful change.** The actions outlined above would dramatically improve the ability of state water managers to resolve disputes over Bulletin 160 projections and better inform decisions on future investment needs, including new storage.

- **Represents a balanced package.** The actions outlined above represent a significant departure from “business as usual” in both the agricultural and urban sectors and would reap benefits across all water uses. Both efforts include changes that would impact and potentially benefit most users. Both efforts would demand significant financial commitments. And both efforts would embed a significant enough shift from current policy to require legislative action (farm-gate for agriculture, service meters for urban).

Agricultural vs. Urban Water Use

The package proposed here does not always recommend parallel actions across agricultural and urban water use. These differences – most notable in end-user measurements – are due to important differences in the way the two systems work. Perhaps the most fundamental difference is their delivery systems. Urban water is available on-demand – a characteristic that makes it essential to track end-user deliveries with a recording measurement device. Agriculture end-users, in contrast, take their water only periodically – a practice that allows for a variety of methods (some directly measured, some estimated) to be used.

- **Minimizes impacts to locals.** The package of actions is designed to meet state needs in a manner that minimizes impacts to locals. Proposed actions include cost-effectiveness and size exemptions; in many cases, funding and technical assistance is also provided.

- **Puts forward fiscally realistic options.** Authority staff is mindful of the State’s current fiscal realities and has tried to put together a cost-effective package.

Cost Summary

The table below summarizes preliminary estimates of the costs associated with this staff proposal. Authority staff will continue to refine cost projections, as necessary, to inform future deliberations.

Preliminary Cost Estimate				
Action	Ag (\$Million/year)		Urban (\$Million/year)	
	Local	State	Local	State
Develop and maintain state database and protocols	0	0.6	0	0.6
Measure and report water sources	0.4	0	0	0
Measure and report water deliveries	0.7	0	42.7	
Groundwater net usage and crop consumption	0	3.0	0	0.5
Research and adaptive management	0	1.8	0	1.8

Next Steps

At the Bay-Delta Authority’s April 8, 2004, meeting, the Authority will be asked to: (1) confirm the appropriateness of the technical work; (2) determine the need for additional information-gathering; and, (3) direct senior staff to work with state policymakers, as necessary, to put forward an implementation approach. This approach will likely necessitate state legislative changes, administrative changes, or both.

Authority staff will provide ongoing progress reports to the Authority and its advisory bodies as implementation-related discussions move forward.

California Bay-Delta Authority

**STAFF PROPOSAL:
IMPLEMENTATION APPROACH FOR
AGRICULTURAL AND URBAN WATER USE
MEASUREMENT**

**For Discussion at the April 8, 2004, Meeting
Of the California Bay-Delta Authority**

Prepared by the California Bay-Delta Authority

California Bay-Delta Authority
Staff Proposal: Implementation Approach for
Agricultural and Urban Water Use Measurement

TABLE OF CONTENTS

Section I: Background	1
Intent and Use of This Document	1
Impetus for This Effort	1
Process for Developing the Proposed Approach	2
Next Steps	3
Section II: Staff Proposal Overview	4
Summary of Actions	4
Rationale for Overall Package	5
Cost Summary	6
Section III: Proposed Approach for Agricultural Water Use Measurement	7
Critical Needs	7
State Standards /Protocols for Recording/Reporting Agricultural Water Use	7
Farm-Gate Deliveries	8
Surface Water Diversions	10
Groundwater Use	11
Crop Water Consumption	12
Research and Adaptive Management Programs	13
Other Elements	15
Section IV: Proposed Approach for Urban Water Use Measurement	16
Critical Needs	16
State Standards /Protocols for Recording/Reporting Urban Water Use	16
Metering of Urban Customer Deliveries	17
Reporting of Urban Water Source and Delivery Data	18
Groundwater Use	20
Research and Adaptive Management Programs	21
Other Elements	22
Section V: Appendix	23
Appendix 1: Final Report: Independent Panel on Appropriate Measurement of Agricultural Water Use	
Appendix 2: Staff Definition of Appropriate Measurement of Urban Water Use	
Appendix 3: Summary of Stakeholder Comments	

California Bay-Delta Authority

Staff Proposal: Implementation Approach for Agricultural and Urban Water Use Measurement

Section I: Background

Intent and Use of This Document

This document outlines the California Bay-Delta Authority's (Authority) Staff Proposal on an implementation approach for agricultural and urban water use measurement.

This document represents nearly three years of technically focused work involving extensive stakeholder discussions, deliberations by an Independent Review Panel, and numerous public workshops to solicit broad input.

Authority staff believes it is putting forward a balanced and necessary package of actions that is capable of affecting meaningful change. Moreover, Authority staff believes the package is responsive to the many comments and concerns raised by diverse stakeholder groups.

The concepts and recommendations outlined in this document are intended to guide senior Authority leadership as it works with legislative, administration and stakeholder representatives to review and refine a final package of implementation actions.

Impetus for This Effort

As California's water resources have become increasingly scarce, diverse stakeholder groups have recognized the importance of measurement to state and federal agencies trying to manage a much-in-demand resource¹. Measurement can assist state and federal agencies in their efforts to achieve the following four key *water management objectives*:

1. Fill critical data gaps to enable more effective statewide and regional water management planning and investment decisions;
2. Allow users to undertake and demonstrate the effects of water use efficiency measures;
3. Facilitate valid water transfers; and
4. Help the state more effectively administer the existing state water rights system.

Recognizing the potential impact of water use measurement on these overarching objectives and the intense stakeholder interest in this topic, the August 2000 CALFED Record of Decision (ROD) called for the California Bay-Delta Authority to take a closer look at measurement, determine what is needed, and, as appropriate, put forward legislative or other strategies to bolster the current approach.

¹ CA Water Code calls for water to be put to beneficial use and for measures to be taken to prevent waste.

Process for Developing the Proposed Approach

To move forward with this task, Authority staff undertook two distinct steps: framing the problem, and identifying solutions.

Framing the Problem. The first step was to develop credible definitions of appropriate water use measurement and sharpen the need for future actions, if any. On the agricultural side, as called for in the ROD, Authority staff convened an Independent Review Panel. The six-member Panel met for nearly two years – holding its final session in June 2003 – and, consistent with ROD guidance, successfully prepared a consensus definition of appropriate measurement for agricultural water use. On the urban side, Authority staff undertook an initial series of structured discussions with stakeholders and technical experts in the urban water arena and then convened extensive stakeholder discussions to help it develop a comprehensive definition. (Both definitions are available on the Authority’s website and are attached to this document as Appendix 1 and 2.)

The findings of these two efforts paint a picture of a system struggling to and falling far short in adequately assessing water use in California. Key failings include inconsistent and redundant state requirements and incomplete and incompatible measurement and reporting of crucial water use data by both local water suppliers and the State. These failings place an unnecessary burden on local water suppliers striving to comply with often times conflicting or redundant standards. More disturbingly, they undercut the State’s ability to wisely manage its increasingly limited resources, effectively administer water rights, and make important long-term investment decisions such as constructing new surface storage facilities. These findings are discussed in greater detail elsewhere in this document.

Identifying Solutions. Given these concerns, Authority staff convened ad hoc stakeholder work groups – one focused on agricultural water use, the other on urban – to serve as a sounding board for the Program as it drafted an implementation approach for measuring urban and agricultural water use. Authority staff also convened a series of public outreach meetings to solicit broader feedback.

In crafting possible implementation approaches for discussion with CALFED implementing agencies and affected stakeholder communities, Authority staff relied on the following guiding considerations to create an approach it believes is warranted and pragmatic:

- Base implementation actions in the definitions of appropriate agricultural and urban water use developed through the earlier Authority-supported processes;
- Adhere to the Authority’s overarching principles such as beneficiary pays and no redirected impacts;
- Streamline and rationalize state and federal reporting requirements to minimize redundancies and improve value of information;
- Use legislative remedies only when existing statutes and regulations are deemed insufficient to ensure effective implementation;
- Acknowledge and account for smaller water suppliers’ current resource limitations;
- Foster meaningful progress within both the agricultural and urban sectors; and,
- Stress incentives over penalties.

The results of these deliberations – referred to as the Staff Proposal – are presented in Sections II, III and IV of this document.

Next Steps

At the Bay-Delta Authority's April 8 meeting, the Authority will be asked to: (1) confirm the appropriateness of the technical work; (2) determine the need for additional information-gathering; and, (3) direct senior staff to work with state policymakers, as necessary, to put forward an implementation approach. This approach will likely necessitate state legislative changes, administrative changes, or both.

Authority staff will provide ongoing progress reports to the Authority and its advisory bodies as implementation-related discussions move forward.

Section II: Staff Proposal Overview

Summary of Actions:

This Staff Proposal puts forward a package of actions that it believes would collectively make important contributions to the State's overarching water management needs. Key elements of the package include:

- Requiring urban water suppliers above a certain size threshold to measure service water deliveries. This measurement requirement would affect the approximately 7% of urban water suppliers not already measuring service water deliveries. Urban water suppliers above a certain size threshold would also be required to report in accordance with state water data collection standards and protocols.
- Requiring agricultural water suppliers above a certain size threshold to report aggregate farm-gate delivery data. This would impact all affected water suppliers, as this is a new requirement. This requirement also would mandate a look-back – informed by Authority-sponsored studies assessing the causality of farm-gate measurement and application efficiency – to assess the adequacy of current measurement methods.
- Requiring surface water diverters with diversion capacities above a certain threshold to measure diversions using the best available technologies and report the data annually to the State. The best available data indicates that this measurement requirement would capture about 90% of all diversions by volume; the increased reporting requirement would impact all affected agricultural water suppliers.
- Upgrading methods the State uses to measure crop consumption and net groundwater usage – an action that would have no impact on locals but would drastically improve the State's ability to project water use.
- Developing and maintaining a coordinated database among the state agencies currently collecting water supplier water use data to minimize the impact of numerous and often redundant and inconsistent reporting requirements to locals and maximize the value of the data to the State and others.
- Undertaking a research and adaptive management program that would ensure that the State's measurement approach keeps current with emerging technologies and shifting economics.

Several of these actions – e.g., reporting of agricultural farm-gate deliveries, increasing the frequency and format of reporting agricultural diversion data, requiring measurement of service meter deliveries, and changing the format for reporting urban water use data – may necessitate legislative action. The other elements would likely require either administrative and/or budgetary actions.

It is important to note that these recommended elements are being put forward as a comprehensive package – and not individual actions – as it is the aggregation of these

different data that collectively supports state objectives. Moving forward with only a subset of the package would significantly diminish the value of the overall effort.

Rationale for Overall Package

While discussions with stakeholders indicate there is fairly broad support for many actions called for in this proposal, staff recognizes that some elements of this package are not supported by all stakeholder groups. But staff believes this proposed package of actions is both necessary and appropriate and represents a balanced way forward:

- **Results in meaningful change.** The actions outlined above would dramatically improve the ability of state water managers to resolve disputes over Bulletin 160 projections; better inform decisions on future investment needs, including new storage, by generating better demand data; more effectively administer state water rights by improving the quality of information used in expeditiously resolving disputes and making determinations regarding issuance of new permits; and better prioritize and target limited public water conservation incentive funding.

- **Represents a balanced package.** The actions outlined above represent a significant departure from “business as usual” in both the agricultural and urban sectors and would reap critical benefits across all water uses. Both efforts include changes that would impact most users

(reporting farm-gate deliveries for agriculture; changing reporting formats on water use data for urban). Both efforts would demand significant financial commitments. And both efforts would embed a significant enough shift from current policy to require legislative action (farm-gate for agriculture, service meters for urban.)

Agricultural vs. Urban Water Use

The package proposed here does not always recommend parallel actions across agricultural and urban water use. These differences – most notable in end-user measurements – are due to important differences in the way the two systems work. Perhaps the most fundamental difference is their delivery systems. Urban water is available on-demand – a characteristic that makes it essential to track end-user deliveries with a recording measurement device. Agriculture end-users, in contrast, take their water only periodically – a practice that allows for a variety of methods (some directly measured, some estimated) to be used.

- **Minimizes impacts to locals.** The package of actions is designed to meet state needs in a manner that minimizes impacts to locals. Proposed actions include cost-effectiveness and size exemptions; in many cases, funding and technical assistance is also provided. Moreover, where practical, the State has assigned data collection responsibilities to itself.
- **Puts forward fiscally realistic options.** Authority staff is mindful of the State’s current fiscal realities and has tried to put together a cost-effective package. Excluding urban service meters, total annual costs to the State are not expected to exceed \$8.3 million and the total annual local cost is expected to be around \$1.1 million. It is not yet known how the costs associated with installing service meters – estimated to be about \$43 million per year – would be split between the State and local suppliers.

Cost Summary

Cost projections associated with individual elements of this proposal are identified elsewhere in this document. Below, however, is a table summarizing preliminary overall costs associated with this initiative. Staff will continue to refine cost projections, as necessary, to inform future deliberations. (Staff anticipates, in particular, refining the cost split between local and state entities regarding measuring urban water deliveries.)

Preliminary Cost Estimate				
Action	Ag (\$Million/year)		Urban (\$Million/year)	
	Local	State	Local	State
Develop and maintain state database and protocols	0	0.6	0	0.6
Measure and report water sources	0.4	0	0	0
Measure and report water deliveries	0.7	0	42.7 (exact split between State and Central Valley purveyors is not yet known)	
Groundwater net usage and crop consumption	0	3.0	0	0.5
Research and adaptive management	0	1.8	0	1.8

It is important to reiterate that the actions included in this Staff Proposal have not been screened through a strict cost-benefit analysis. As the Independent Review Panel noted in its September 2003 Final Report, such an analysis is not possible when staff must compare qualitative benefits and quantitative costs. Still, staff takes seriously the imperative to justify any costs to State and local entities and has strived to articulate expected benefits throughout this document.

Sections III and IV of this document provide a detailed look – by sector – at the proposed actions, highlighting the rationale and summarizing the proposed implementation approach. Section V provides background materials related to this effort, including definitions of appropriate agricultural and urban water use measurement and a synopsis of stakeholder comments heard during public outreach meetings and in discussion with Authority advisory bodies.

Section III: Proposed Approach for Agricultural Water Use

Based on the Independent Review Panel's Final Report and the Authority's discussions with the stakeholder/agency work groups, Authority staff is putting forward a proposed implementation package focusing on a handful of key actions related to agricultural water use measurement.

These critical needs – detailed below – apply most directly to the overarching state water management objectives mentioned earlier. Implemented as a package, Authority staff believes these actions would significantly impact critical state activities related to planning, water rights, and water use efficiency activities.

Based on a review of existing statutes and regulatory requirements, a mix of legislative, administrative, and budgetary actions may be needed to implement these actions. Specific actions are called out within each section below.

Critical Needs

1. *State standards/protocols for recording/reporting water use*

Description of need: Current state regulations require water suppliers to provide data in multiple formats and to multiple agencies. These requirements can and often do place an unnecessary burden on water purveyors. Moreover, as there are no overarching standards and protocols to guide the way purveyors compile this data, the value of the information to the State is greatly diminished due to inconsistencies across water supplier data. Finally, data already reported to the State is unavailable to analysts because it is not kept in an accessible database. In fact, much of the data is not even converted into digital form, which – given the quantity of data submitted – is required for analysis, comparison, and quality control.

Proposed Action: Standardize how agricultural water purveyors compile and provide data to the State. Working closely with local water purveyors and other concerned stakeholders, the Department of Water Resources (DWR) and State Water Resources Control Board (SWRCB) would establish standards and protocols for collecting, recording, and reporting agricultural water measurement data and develop an electronic system for receiving, compiling, storing, managing, quality-checking, and making available this data. Efforts would be made to eliminate data recording and reporting redundancies.

Other key elements of this proposed approach include:

- *Timeline for development of standards/protocols.* Development of standards and protocols is proposed to begin in July 2004. Proposed standards/protocols would be completed by July 2006, with an interim milestone at July 2005 to assess progress. (This timeline assumes availability of state funding.)

- *Timeline for implementation.* Phased implementation of standards and protocols over five to ten years, with ongoing reports to the Authority and public to summarize progress towards development and implementation of state standards and protocols.
- *Funding/costs.* Moderate costs – \$600,000 per year – are projected to develop database. An additional \$400,000 per year would be needed to maintain and confirm data provided by local water suppliers on an ongoing basis.
- *Implementation vehicle.* Authority for this action would come from existing agency authorities; the California Bay-Delta Authority would serve as convenor for action given its composition and existing oversight and coordination role.

2. Farm-Gate Deliveries

Description of need: The Independent Review Panel looked at the topic of farm-gate measurement and reached several consensus conclusions.

- Measurement of farm-gate deliveries is a necessary component of sound district and on-farm water management practices.
- Most farm-gate deliveries are directly measured; some are indirectly measured or estimated. For those indirectly measuring or estimating water use (approximately 11%), a shift to direct measurement may result in local and statewide benefits. However, due to the lack of available farm delivery data and the wide diversity of delivery conditions, no credible method is available to quantify these potential benefits. Therefore, the benefits² of upgrading measurement at those locations can not be demonstrated at this time to justify the cost of the improvements.
- The State needs – but is not now receiving – data on farm-gate delivery in order to support its various water management tasks. Accordingly, the State should require districts to report aggregated data on farm-gate deliveries.

Moreover, post-Panel efforts by Authority staff to quantify the benefits associated with shifting the remaining 11% to direct measurement underscored the Panel's conclusion that there was insufficient data on-hand to infer a causal link between farm-gate measurement and application efficiency. (The technical work suggested annual on-farm application reduction ranging between 0 to 1.5-million-acre-feet, with significant additional investments ranging from \$13- to \$75-million per year. This application reduction represents primarily rerouted flow and not reductions in irrecoverable losses.)

Proposed Action: Require multi-phase process to improve state's understanding of farm-gate deliveries and conservation potential.

² The Panel's assessment of costs and benefits does not encompass costs and benefits associated with related district or on-farm water management changes.

- **Phase One:** Require agricultural water suppliers (irrigation districts, water districts, and mutual water companies) to report aggregated farm-gate delivery data to the State (DWR) annually; reports should summarize data on a monthly or every-other month basis, as this is needed by the State to develop accurate water balances and target limited water use efficiency incentive grants. Agricultural water suppliers would use best professional practices and take steps necessary to attain and maintain accuracy of measurement and reporting devices and methods. This data collection and reporting requirement is expected to be ongoing.
- **Phase Two:** Within two years of the start of data collection, the CALFED Science Program, or their designee, will determine if the data being collected is sufficient to establish a causal link between farm-gate measurement accuracy and application efficiency. Research programs will be initiated, as required, to collect additional needed data. This effort will also take an initial look to ascertain the quality and comprehensiveness of farm-gate delivery data being provided to the State and recommend steps, as needed, to ensure the quality of data.
- **Phase Three:** Within three years of the start of data collection, undertake preliminary staff-level analysis to estimate the correlation between farm-gate measurement accuracy and application efficiency. Determine additional information needs or development of other analytic methodologies to inform the five year look-back in Phase Four described below.
- **Phase Four:** Within five years of the start of data collection, use farm-gate delivery data to better understand the causal link between farm-gate measurement and application efficiency and, as appropriate, recommend changes to current farm-gate measurement practices. (Specific questions to be addressed are summarized in the research section of this Staff Proposal.)

Other key elements of this proposed approach include:

- *Exemptions.* Water suppliers delivering less than 2,000 acre-feet of water annually or serving fewer than 2,000 acres would be exempted from this requirement. This threshold is preliminarily recommended as it is expected to capture roughly 90% of all deliveries, generates a volume of data that can be handled by the implementing agency, and is largely consistent with existing Central Valley Project (CVP) thresholds. Additionally, thresholds would be reevaluated – as part of a formal regulation-setting process – within five years to confirm its effectiveness.
- *Funding/costs.* Total local costs would be approximately \$700,000 per year. Significant state-provided technical assistance beyond current levels is not anticipated. Additionally, state funding (grants or loans) may be needed to support water districts where actions are not locally cost-effective.
- *Assurances.* Access to incentives (i.e., grants and loans) would be tied to compliance. DWR would verify compliance with reporting requirements and

analyze reports to ascertain erroneous or incomplete information; review would focus on broad discrepancies.

- *Timeline for implementation.* Districts would report aggregated farm-gate delivery data to the State within two to three years from DWR promulgation of measurement and reporting standards.
- *Adaptive management.* The validity/adequacy of different measurement methodologies may shift as various conditions -- water availability, water pricing, on-farm economics -- change. Accordingly, as noted above, the Program would conduct an ongoing evaluation of farm-gate data and practices to ensure current methodologies remain effective and consistent with the Independent Review Panel's intent.
- *Implementation vehicle.* Legislation may be necessary to implement farm-gate reporting requirements, as this would represent a significant departure from current practice and legal authorities.

3. **Surface Water Diversions**

Description of need: Accurate data on surface water diversions is essential if state and federal water agencies are to adequately manage and plan for current and future needs. The completeness, consistency, and accuracy of current reports do not now allow these managers to quantify the amount of water diverted. This data is also needed to more effectively administer the State's existing water rights system. Better data on individual diversions would facilitate faster and more efficient resolution of water rights disputes. Better aggregated data on diversions would allow the State Board to better determine whether individual streams are over-allocated, which would streamline the processing of future water rights permitting applications.

Proposed Action: Require surface water diverters to measure all major surface water diversions using best available technologies such as flow-totaling devices, data loggers, and telemetry. (Approximately 80% of all major diversions are already measured using such devices.) Additionally, diverters would be required to report this data to the State (State Water Resources Control Board) annually; reports should include summaries of diversion data on a monthly basis, as this is needed by the State to develop accurate water balances. Water diverters would use best professional practices and take steps necessary to attain and maintain accuracy of measurement and reporting devices and methods.

Other key elements of this proposed approach include:

- *Exemptions.* Any surface water diverter with a combined diversion capacity from a natural channel of less than 50 cubic feet per second would be exempted from both the measurement and reporting requirement. This threshold is preliminarily recommended as it is expected to capture roughly 90% of all deliveries, generate a volume of data that can be handled by the implementing agency and is largely commensurate with existing CVP requirements. This

exception would not exempt suppliers from existing measurement and reporting requirements. Additionally, the threshold would be reevaluated – as part of a formal regulation-setting process – within five years to confirm its effectiveness. (In implementing this recommendation, it may – on a stream-by-stream basis – be advisable for the State Board to adjust the threshold up or down dependent on the relative size of the diversion to overall stream flow.)

- *Timeline for implementation.* Districts would use best available technologies and begin reporting aggregated diversion data to the State within two to three years from State Board promulgation of measurement and reporting standards.
- *Funding/costs.* Total local costs – hardware and reporting – would be approximately \$400,000 per year. State funding would be made available where costs of new measurement practices are not locally cost-effective. Significant state-provided technical assistance beyond current levels is not anticipated.
- *Assurances.* Access to incentives (i.e., grants and loans) would be tied to compliance. State Board would verify compliance with measurement and reporting requirements and analyze reports to ascertain erroneous or incomplete information; review would focus on broad discrepancies.
- *Adaptive management.* Data would be collected and interpreted in a manner that helps assess the validity/adequacy of reporting requirements and practices.
- *Implementation vehicle.* Legislation may be necessary due to the change in reporting requirements from current practices. Such legislative action would supplement the State Board's existing general authorities.

4a. Groundwater Use

Description of need: Current state and federal characterizations of groundwater resources are not conducted using consistent methods and are not done frequently enough to adequately characterize groundwater usage. This hampers the State's efforts to determine the amount of groundwater used in various regions and to characterize the extent of overdraft.

Proposed Action: The State (DWR) would perform continuous regional characterization of groundwater net usage in all sub-basins statewide. This approach would enable the State to better monitor the overall status of groundwater in the state. It would not entail any additional measurement of individual self-supplied groundwater use outside of what is already required in adjudicated and managed basins. Implementation of this action would be coordinated with ongoing revisions to the California Water Plan.

Other key elements of this proposed approach include:

- *Timeline for implementation.* Implementation of new methodologies would take place prior to preparation of Bulletin 160 (2008). DWR would phase in new methodology, focusing first on those basins with the most impacted

groundwater resources. DWR would state in each Bulletin 160 the extent to which groundwater data is based on this approach.

- *Funding/costs.* New measurement approach projected to cost the State an additional \$3 million per year. (Cost estimate includes costs associated with measuring net groundwater usage in both agricultural and urban areas of the State.)
- *Implementation vehicle.* Performing this assessment would fall under DWR's existing responsibilities related to preparing Bulletin 160 and Bulletin 118; no new legislation or regulation would be anticipated.
- *Adaptive management.* Ongoing evaluation would determine the degree to which information coming from net groundwater usage measurement is satisfying state and federal water management information needs. The Program would re-evaluate the need for additional gross groundwater extraction data.

4b. Crop Water Consumption

Description of need: Current approaches to measuring crop water consumption rely on indirect and theoretical methods applied infrequently, a practice that means state estimates of crop consumption – the largest single element of the state's water balance – are not validated and could include significant error. Improved accuracy and precision is needed for adequate preparation of water plan updates and ongoing planning and analysis, such as CALSIM II modeling.

Proposed Action: The State (DWR) would incorporate into its ongoing estimating procedures the use of satellite-generated remote sensing of evaporative crop water consumption, with a monthly time step, during the growing season. This approach would have no direct impact on growers or water districts. Implementation of this action would be coordinated with the next update to the California Water Plan.

Other key elements of this proposed approach include:

- *Funding/costs.* Remote-sensing would be expected to cost the State an additional \$500,000 per year.
- *Timeline for implementation.* The new methodology would be phased-in over a five-year period. DWR would report annually to the Authority on implementation status; additionally, DWR would describe water measurement actions taken in the body of Bulletin 160.
- *Implementation vehicle.* Performing this assessment would fall under DWR's existing responsibilities; no new legislation or regulation is anticipated.
- *Adaptive management.* An adaptive management component would include an ongoing effort during the transition period to compare results of new measurement methodologies to old practices to validate efficacy of the new measurement approach.

5. *Research and adaptive management programs*

Description of need: Improving the State's ability to forecast and plan for future agricultural water demands requires a fuller understanding of how water is used by the agricultural sector and how this is changing over time due to evolving land use and cropping patterns, demographics, technology, and economics. Previous State Water Plan Updates have been characterized by the use of very general and simplified assumptions to predict future agricultural water demand.

Proposed Action: Adopt a two-pronged strategy to address this concern:

a. *Research Program:* State agencies would work with water purveyors and universities/research organizations to develop and sustain an agricultural water use research program. The Authority's Science Board would establish a priority list for research to be performed. The research program would likely have three tracks:

- *Track One – Farm-gate deliveries:* Initiate four-phased approach to determine the causal link between farm-gate measurement accuracy and farm application efficiency:
 - **Phase One:** Require agricultural water suppliers (irrigation districts, water districts, and mutual water companies) to report aggregated farm-gate delivery data to the State (DWR) annually; reports should summarize data on a monthly or every-other month basis, as this is needed by the State to develop accurate water balances and target limited water use efficiency incentive grants. Agricultural water suppliers would use best professional practices and take steps necessary to attain and maintain accuracy of measurement and reporting devices and methods. This data collection and reporting requirement is expected to be ongoing.
 - **Phase Two:** Within two years of the start of data collection, the CALFED Science Program, or their designee, will determine if the data being collected is sufficient to establish a causal link between farm-gate measurement accuracy and application efficiency. Research programs will be initiated, as required, to collect additional needed data. This effort will also take an initial look to ascertain the quality and comprehensiveness of farm-gate delivery data being provided to the State and recommend steps, as needed, to ensure the quality of data.
 - **Phase Three:** Within three years of the start of data collection, undertake preliminary staff-level analysis to estimate the correlation between farm-gate measurement accuracy and application efficiency. Determine additional information needs or development of other analytic methodologies to inform the five year look-back in Phase Four described below.

- **Phase Four:** Within five years of the start of data collection, use farm-gate delivery data to better understand the causal link between farm-gate measurement and application efficiency and, as appropriate, recommend changes to current farm-gate measurement practices. (Specific questions to be addressed are summarized in the research section of this Staff Proposal.)

This work will seek to answer how much on-farm water application efficiency will change with a change in farm-gate measurement accuracy. The answer to this question will require computation of on-farm efficiency and a comparison of efficiency to farm-gate measurement for several locations. This type of correlation process will require normalization of the data by crop mix, climate, farm size, district size, and other factors. The CALFED Science Board or its designee (e.g. the soon to be formed Water Management Science Board) will review both the methodology for conducting this technical analysis and the analysis itself. Completion of this work will require much of the data called for in this measurement proposal, including data on diversions, farm deliveries, net groundwater use, and crop evapotranspiration.

- *Track Two – Return flow, water quality, and in-stream flow:* Initiate immediate studies related to return flow, water quality, and in-stream flows (post July 2004). Develop recommendations related to measurement and reporting needs by July 2007.
 - *Track Three – Other research priorities:* Develop initial priorities for other research by 2005. Research topics could include items such as assessing costs and benefits of farm-gate measurement and direct measurement of groundwater extraction, and comparing remote-sensing and conventional crop consumption estimation methods. It also would likely incorporate efforts to improve key data gaps, such as better understanding the water use associated with different farm-gate structures in California.
- b. *Adaptive management:* State agencies (Authority Science Board working in conjunction with DWR and other State Water Plan actors) would identify and pursue adaptive management needs for measurement as appropriate over time. This adaptive management program would serve to evaluate the adequacy of agricultural water use information available and the effectiveness of the measurement actions adopted. Likely topics could include, among other things:
- Value of agricultural water use measurement data being collected to address state and federal objectives.
 - Efficacy of new system for recording, reporting, and disseminating data.
 - Quality and comprehensiveness of agricultural water use measurement data being collected.

Other key elements of this proposed approach include:

- *Funding/costs.* Funding for this effort would be expected to cost \$1.8 million/year, which includes \$150,000 for adaptive management. Cost-sharing would be pursued to the extent possible. Activities would be prioritized and phased to meet actual funding levels.
- *Implementation vehicle.* The Authority (Science Board) and DWR would be responsible for oversight and coordination of the research program; key implementing partners would include water suppliers/users, university/college research institutions, USBR, the Agricultural Water Management Council (AWMC), and others. The Authority and implementing agencies would be responsible for ensuring ongoing focus on measurement. No legislation would be needed to support this action.
- *Adaptive management.* The approach would incorporate annual review and reprioritization of research needs. Research implementation structure would be reviewed every five years to evaluate effectiveness of approach and results. Program-wide review of measurement and reporting approach would be carried out every three to five years.

Other Elements

This Staff Proposal incorporates other vital elements. These include:

- *Measurement of return flow, water quality, and in-stream gauging.* Authority staff acknowledges the need to define and implement appropriate measurement as it relates to return flow, water quality, and in-stream gauging. Authority staff recognizes the importance of the Independent Review Panel's recommendation that it complete the technical work associated with these measurement needs and commit to moving forward in the near-future with a measurement strategy necessary to support state water management objectives.
- *Measurement and reporting of groundwater substitution transfers.* Authority staff endorses current state policies and practices that require groundwater substitution transfer permittees to measure and report groundwater wells directly involved in substitution transfers at the highest technically practical level, including continuous measurement, monitoring and frequent reporting. Authority staff is confident that current practices will remain effective due to DWR's role as either (1) a purchaser of water, (2) an owner of facilities through which transferred water is wheeled; or, (3) a potentially injured downstream user. The Program believes these current efforts are appropriate and should continue to be supported and funded.

Section IV: Proposed Approach for Urban Water Use

Authority staff has worked with technical experts, agency staff, and stakeholder representatives over the past year to take a comprehensive look at urban water use measurement needs in the areas of urban water purveyor supplies (surface water and groundwater) and deliveries and urban wastewater discharger collection and discharge.

Based on these efforts, Authority staff is putting forward a proposed implementation package focusing on a handful of key actions related to urban water use measurement.

These critical needs – detailed below – apply most directly to the overarching state water management objectives mentioned earlier. Implemented as a package, Authority staff believes these actions would significantly impact critical state activities related to planning, water rights, and water use efficiency activities.

Based on a review of existing statutes and regulatory requirements, a mix of legislative, administrative, and budgetary actions may be needed to implement these actions. Specific actions are called out within each section below.

Critical Needs

1. State standards/protocols for recording/reporting urban water use

Description of need: Current state regulations require water suppliers to provide data in multiple formats and to multiple agencies. These requirements can place an unnecessary burden on water purveyors. Moreover, as there are no overarching standards and protocols to guide the way purveyors compile these data or centralized system to store and retrieve the data, the value of the information to the State is greatly diminished due to inconsistencies across water supplier data.

Proposed Action: Standardize how urban water purveyors compile and provide data to the State. Working closely with local water purveyors, pertinent state agencies (e.g., the State Water Resources Control Board and the Department of Health Services), and other concerned stakeholders, the Department of Water Resources (DWR) would establish standards and protocols for collecting, recording, and reporting urban water measurement data and develop an electronic system for receiving, compiling, storing, managing, quality-checking, and making available this data. This computer-based data system would allow local purveyors to report data in a convenient format and data users to access targeted data. Efforts would be made to eliminate data recording and reporting redundancies and enable water purveyors to submit all required water data through a single database.

Other key elements of this approach include:

- *Timeline for development of standards/protocols.* Development of standards and protocols would begin in July 2004. Proposed standards/protocols would be completed by July 2006, with an interim milestone at July 2005 to assess progress. (This timeline assumes availability of state funding.)

- *Timeline for implementation.* Phased implementation of standards and protocols would take place over five to ten years to enable purveyors to embed these new standards and protocols as part of routine upgrading of billing systems. Earliest implementation efforts would move forward through beta testing. Ongoing reports would be provided to the Authority and the public to summarize progress towards development and implementation of state standards and protocols. In those instances where conversion to state standards is considered to be unduly burdensome, the State would work with the local purveyor to develop conversion or translation factors that the State could use to facilitate incorporation of the purveyor's information into the database.
- *Funding/cost.* Moderate costs – \$600,000 per year – are projected to initially develop database. An additional \$400,000 per year is expected to be needed to maintain and confirm data provided by local water suppliers on an ongoing basis.
- *Implementation vehicle.* Authority for this action would come from existing agency authorities; the California Bay-Delta Authority would serve as convener for action given its composition and existing oversight and coordination role.

2. Metering of urban customer deliveries

Description of need: For decades, many of California's diverse regions have pursued a policy of metering urban water purveyor customer water deliveries. Empirical research conclusively demonstrates that metered water service coupled with volumetric pricing can reduce water demand by 20-25% or more. Currently, approximately 7% of urban water deliveries in the state have no requirement to meter³. While not all of these water savings constitute "net water savings," the demand reduction would enable purveyors to avoid the cost of purchasing new water. Metering also provides the basis for effective management of purveyor water systems.

Proposed Action: Require the use of suitable water meters at all customer connections to the water delivery system. This proposal is consistent with the Authority's proposed Urban Water Use Efficiency (WUE) Certification Program (BMP 4).

Other key elements of this proposed approach include:

- *Exemptions.* Smaller water purveyors would be exempted from the measurement requirement. Exemptions include community water systems which serve less than 15 service connections used by yearlong residents or regularly serve less than 25 yearlong residents, or a single well which services the water supply of a single family residential home.

³ These figures developed within the Staff Work Group on Urban Water Use Measurement -- Compilation of Background Information on Current Urban Water Use Measurement Practices, Costs, and Benefits. March 31, 2003.

- *Timeline.* Implementation would occur within 10 years from the establishment of relevant state standards and protocols.
- *Funding/Costs.* Total costs are expected to be \$42.7 million per year⁴. Action would be locally funded by affected urban water purveyors. In cases where retrofitting is not locally cost effective, state grant funding may be provided. In instances where grant funding is not available to the local agency, a deferment process consistent with the Authority's proposed Urban Water Use Efficiency (WUE) Certification Program (BMP 4) would be used. Grant funding to support this should be made available by the State. Calculations of local cost effectiveness would use the California Urban Water Conservation Council's (CUWCC) definition of local cost effectiveness.
- *Implementation vehicle.* Legislation may be needed, as the administrative actions to strengthen required compliance, consistency, and quality assurance/quality control of urban customer water deliveries measurement would represent a significant departure from current practice.

3. Reporting of urban water source and delivery data

Description of need: In the past, California Water Plan water balance calculations have been based on long-term averages of water uses and supply. However, these data suffer because they cannot be used as "representative" conditions or conditions that are reasonably expected to reoccur. (For example, long-term average data cannot be used to estimate how much water might be available for a proposed groundwater recharge program due to the many one-time anomalies in any given year.) Consequently, as part of its 2003 California Water Plan Update, DWR is instituting a Water Portfolio approach to state water planning and management. The Water Portfolio approach relies instead on actual water use data as well as an accounting of the source of water used by all sectors and in all regions of the state. This approach is best supported by annual water use data, which is updated annually with monthly or bi-monthly breakdowns of source and delivery data, and breakdowns by customer class.

Annual data is needed to synchronize data submitted by local agencies in different years and to show differences in water use across different water-year types. It also enables continual or yearly (rather than once every 5 years) updating of the Water Plan. Annual updates are also needed to ensure efficient collection, quality control, and computation. If some of the data is collected annually and some every five years as is current practice, it makes combining data streams very time intensive. Further, for the data submitted on a five-year schedule, if quality control issues are identified, it would likely be very time-consuming and costly to repair the data for the preceding five-year period. And finally, the latest computational approach adopted by DWR calls for continually updating water use computations to keep staff costs more constant – thereby increasing the state resource use.

⁴ The local and state share can not be determined at this time, given the variability in both local meter installation costs and avoided supply costs and the uncertainty of available state funding.

Monthly (or bi-monthly, in the case of deliveries) data is needed to show seasonal variation and allow computation of both indoor and outdoor water use. Customer class data is needed to improve estimates of future use as well as the potential for conservation savings.

In the aggregate, the State's existing reporting systems (in particular, the DHS Annual Report and DWR's Urban Water Management Plans) already call for much of this data. This data is not, however, being collected in a coordinated fashion. Nor is all of the data needed to support DWR's Water Portfolio approach being collected on an annual basis with sufficient specificity in terms of time step or customer classification. By combining existing reporting systems into a single system (as recommended in Action 1, State Standards and Protocols, above), a key data gap would be filled with negligible impact on local water purveyors.

Proposed Action: Require urban water purveyors to provide more specificity in their annual reports of water sources and customer deliveries as outlined below:⁵

- Water production by month subtotaled by water source definitions conforming to state water data collection guidelines and protocols.
- Annual water deliveries subtotaled by customer class definitions conforming to state water data collection guidelines and protocols.
- Monthly or bi-monthly water deliveries, according to meter read frequency, subtotaled by customer class definitions conforming to state water data collection guidelines and protocols.

These requirements would apply to both retailers and wholesalers, except that wholesalers would not be required to provide annual and monthly/bimonthly water delivery data by customer class. Urban water purveyors would use best professional practices and take steps necessary to attain and maintain accuracy of measurement and reporting devices and methods.

Other key elements of this proposed approach include:

- *Exemptions.* Consistent with exemptions specified in the Urban Water Management Planning Act, urban water purveyors serving less than 3,000 service connections or supplying less than 3,000 acres-feet of water annually would be exempted from reporting of the specified data. This exception would not exempt suppliers from existing reporting requirements.
- *Timeline.* Urban water purveyors would be required to report the specified data to the State within two to three years of promulgation of measurement standards/protocols. Existing reporting requirements would remain in effect prior to promulgation of new standards/protocols.

⁵ A complete list of recommended urban water use reporting information is shown in the Draft Definition of Appropriate Urban Water Use Measurement (Appendix 2).

- *Funding/cost.* State would provide technical assistance to assist local purveyors; no significant costs are expected beyond current local and state outlays anticipated.⁶ Staff recognizes that some suppliers may face upfront costs but believes that, over time, consolidated reporting requirements may reduce the overall local administrative burden.
- *Assurances.* Access to incentives (i.e., grants and loans) would be tied to compliance. DWR would verify compliance with measurement and reporting requirements and analyze reports to ascertain erroneous or incomplete information. Review would focus on broad discrepancies.
- *Implementation vehicles.* Legislation may be needed (e.g., to amend statutes governing existing reporting requirements).

4. Groundwater Use

Description of need: State water planners currently have an incomplete understanding of water withdrawal and consumption by groundwater users. This pertains in particular to non-adjudicated basins, which constitute the majority of groundwater basins in the state. This impedes the State's (and regional/local government's) ability to plan for growth and more effectively manage groundwater resources in times of drought.

Proposed Action: The State (DWR) would perform continuous regional characterization of groundwater net usage in all sub-basins statewide. This would enable the State to better monitor the overall status of groundwater in the state. It would not entail any additional measurement of individual self-supplied groundwater use outside of what is already required in adjudicated and managed basins. Implementation of this action would be coordinated with ongoing revisions to the California Water Plan.

Other key elements of this proposed approach include:

- *Timeline.* Implementation of new methodologies would take place prior to preparation of Bulletin 160 (2008). DWR would phase in the new methodologies, focusing first on those basins with the most impacted groundwater resources. DWR would state in each Bulletin 160 the extent to which groundwater data is based on this approach.
- *Funding/cost.* This new measurement approach is projected to cost the State an additional \$3 million per year. (Cost estimate includes costs associated with measuring net groundwater usage in both agricultural and urban areas of the State.)

⁶ As water suppliers are already asked to provide much of this data on an annual basis to either DHS, DWR or both, reporting requirements tied to increasing the data specificity (e.g., providing data on monthly or bi-monthly rather than annual timesteps) are not expected to significantly impact local water suppliers costs.

- *Implementation vehicle.* Performing this assessment would fall under DWR's existing responsibilities related to preparing Bulletin 160 and Bulletin 118; no new legislation or regulation is anticipated.
- *Adaptive management.* Ongoing evaluation would determine the degree to which information coming from net groundwater usage measurement is satisfying state and federal water management information needs. The Program would re-evaluate the need for additional gross groundwater extraction data.

5. Research and adaptive management programs

Description of need: Improving the State's ability to forecast and plan for future urban water demands requires a fuller understanding of how water is used in urban areas and how this is changing due to evolving land use patterns, demographics, technology, and economics. Previous State Water Plan Updates have been characterized by the use of simplified assumptions to predict urban water demand.

Proposed Action: Adopt a two-pronged strategy:

- a. *Research Program:* State agencies would work with water purveyors and universities/research organizations to develop and sustain an urban water use research program. The Authority's Science Board would establish a priority list for research to be performed.
- b. *Adaptive management:* State agencies (the Authority Science Board working in conjunction with DWR and other State Water Plan actors) would identify and pursue adaptive management needs for measurement as appropriate over time. This adaptive management program would serve to evaluate the adequacy of urban water use information available and the effectiveness of the measurement actions adopted.

Other key elements of this proposed approach include:

- *Funding/cost.* Funding for this effort would be expected to cost \$1.8 million/year, which includes \$150,000 for adaptive management. Cost-sharing would be pursued to the extent possible. Activities would be prioritized and phased to meet actual funding levels.
- *Implementation vehicle.* The Authority (Science Board) and DWR would be responsible for oversight and coordination of the research program; key implementing partners would include water suppliers/users, university/college research institutions, USBR, CUWCC, and others. The Authority and implementing agencies would be responsible for ensuring ongoing focus on measurement. No legislation is seen as necessary to support this action.
- *Adaptive management.* This approach would incorporate annual review and prioritization of research needs. Research implementation structure would be reviewed every five years to evaluate effectiveness of approach and

results. Program-wide review of measurement and reporting approach would be carried out every three to five years.

Other Elements

This Staff Proposal recognizes the vital importance of ongoing measurement activities related to urban water use. These current efforts, described below, are appropriate and should continue to be supported and funded.

- *Measurement of urban water purveyor water sources/production.* Authority staff endorses current state policies requiring urban water purveyors to measure water at all source and production points (including surface water, groundwater, and recycled water) using suitable and suitably maintained water meters and to read these meters and record data at least once a month.
- *Measurement and reporting of urban wastewater discharges.* Authority staff endorses current state and federal policies requiring urban wastewater dischargers to install suitable measurement devices, read and maintain the accuracy of these devices, record and store both effluent and wastewater reclamation data per existing wastewater discharge standards and protocols, and report the specified information annually to the State. Authority staff is confident that the data management system currently being developed by the State Water Resources Control Board will be satisfactory for collecting this data and disseminating it to governmental agencies, wastewater dischargers, and other interested publics. Nothing in this Staff Proposal should be construed to supercede existing state and federal authority and requirements embodied in or through the federal Clean Water Act and state Porter-Cologne Water Quality Control Act to impose measurement, monitoring, and reporting requirements on wastewater discharges subject to regulation under these acts.
- *Measurement and reporting of self-supplied groundwater use in adjudicated basins.* Authority staff endorses the current measurement of groundwater use by self-supplied users in adjudicated basins as required by the existing governing adjudications. Authority staff acknowledges that the adjudications require reporting to watermasters and that these reports become public documents available to state water planners and managers once received by the watermasters.
- *Measurement and reporting of groundwater substitution transfers.* Authority staff endorses current state policies and practices that require groundwater substitution transfer permittees to measure and report groundwater wells directly involved in substitution transfers at the highest technically practical level, including continuous measurement, monitoring, and frequent reporting. Authority staff is confident that current practices will remain effective due to DWR's role as either (1) a purchaser of water, (2) an owner of facilities through which transferred water is wheeled; or, (3) a potentially injured downstream user. Authority staff believes these current efforts are appropriate and should continue to be supported and funded.

Section V: Appendix

Appendix 1 – Final Report: Independent Panel on Appropriate Measurement of Agricultural Water Use – and Appendix 2 – Staff Definition of Appropriate Measurement of Urban Water Use – are not included in this version. These can be accessed on the BDA website at:

<http://calwater.ca.gov/BDPAC/Subcommittees/WaterUseEfficiencySubcommitteeMeetingMaterials.shtml>

Appendix 3 – Summary of Stakeholder Comments – is provided on the following pages.



Independent Panel on Appropriate Measurement of Agricultural Water Use

Convened by the California Bay-Delta Authority

FINAL REPORT

SEPTEMBER, 2003

September 2003

Mr. Tom Gohring
Assistant Deputy Director, Water Management
California Bay-Delta Authority

Dear Mr. Gohring:

Attached please find our Final Report on the Definition of Appropriate Agricultural Water Use Measurement. We believe appropriate measurement is essential for the well being of California and its natural resources.

The Report, representing the consensus view of all six panelists, puts forward the Panel's definition of appropriate agricultural water use measurement. The Report represents more than two years of work.

As readers will see, a definition of appropriate agricultural water use measurement defies a simplistic answer. Nonetheless, the Panel believes it is putting forward a perspective that is grounded in a thorough analysis, is meaningful given today's agricultural water use measurement practices and needs in California, and is useful for future deliberations by affected stakeholder communities and state decision-makers.

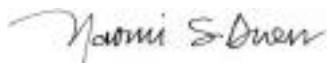
The recommended definition of appropriate agricultural water use measurement builds upon the extensive technical analysis conducted by Authority staff and consultants. The Panel believes the analysis is both consistent with past Panel guidance and sufficient to support the Panel's deliberations.

The recommendation also is shaped by the important and ongoing involvement of stakeholder and agency representatives. These representatives, many participating in an unpaid capacity, provided essential information on local conditions and perspectives throughout the process. The Panel wishes to thank these many individuals for their remarkable commitment to this effort.

Finally, while the Panel recognizes that concepts included in this report may be controversial to some, the Panel believes it has honored its commitment to—in a neutral manner—put forward a consensus definition rooted in well-informed and well-reasoned deliberations.

The Panel hopes this Report will be useful to the stakeholder and agency representatives who must now craft a strategy for implementing this consensus definition. We are available to answer questions or concerns that may arise as this process moves forward.

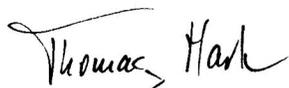
We thank the Authority for the opportunity to be involved in this effort and compliment it on its efforts to further California's understanding of this important topic.



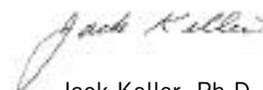
Naomi Duerr, P.G.
South Florida Water Management District



Chris Kapheim
Alta Irrigation District



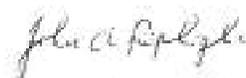
Thomas Harter, Ph.D.
University of California, Davis



Jack Keller, Ph.D.
Keller-Bliesner Engineering, LLC



Steve Hatchett, Ph.D.
Western Resource Economics



John Replogle, Ph.D.
U.S. Water Conservation Laboratory

TABLE OF CONTENTS

EXECUTIVE SUMMARY	07
INTRODUCTION	11
PANEL REPORT	19
TECHNICAL REPORT	
Section 1: Measurement Components and Objectives	31
Section 2: Baseline Conditions	39
Section 3: Potential Benefits	43
Section 4: Cost Analysis of Measuremet Improvements	53
Section 5: Technical Team Preliminary Findings	65
APPENDICES	
A. Panel Participants	77
B. California Legal Authorities	81
C. Measurement in Selected States	121
D. Stakeholder Comment Summary	141
E. Glossary	143

EXECUTIVE SUMMARY

BACKGROUND

The August 2000 CALFED Record of Decision (ROD) called for legislation requiring the appropriate measurement of all water uses in California. As a first step towards that goal, the ROD directed that a panel of independent experts be convened to help define appropriate agricultural water use measurement.

APPROACH

Based on this and related ROD commitments, the California Bay-Delta Authority (Authority)—formerly referred to as the CALFED Bay-Delta Program—convened six nationally recognized experts who collectively provided understanding in the areas of measurement technology/hardware; resource economics; groundwater hydrology; technical water policy; water district operations; and, irrigation engineering.

The Panel, first convened in June 2001, deliberated over a two-year period. The Panel's deliberations were informed throughout by the ongoing involvement of stakeholder and agency representatives with both policy and technical perspectives. Additionally, the Panel's deliberations were grounded in an extensive technical analysis shaped by the panelists and conducted by Authority staff and consultants.

FINDINGS

The attached Panel Report, representing the consensus view of all six panelists, puts forward the Panel's definition of appropriate agricultural water use measurement.

Building off the regionally based technical analysis, the Panel's recommended definition focuses on those measurement practices panelists identified as likely to—in a cost-effective manner—support state and federal planning and water rights objectives, allow water users to undertake and demonstrate the effects of efficiency measures, and facilitate valid water transfers. Key elements of the Panel's definition include:

Farm-Gate Measurement: Require districts to report delivery data to the State. State and federal planners are currently unable to adequately assess the potential of on-farm water use efficiency improvements due to gaps in how farm-gate delivery data is presently collected and reported to the State. Accordingly, the Panel recommends that districts be required to report aggregated farm-gate delivery data to the State. Changes in methodology are not recommended at this time, since current practices—whether estimated or directly measured—are considered sufficient to support both water transfers and efficient on-farm water management practices. Moreover, roughly 90% of all farm-gate deliveries are already measured at an accuracy of $\pm 6\%$ by volume. This recommendation is not intended to preclude state and federal entities from linking approval of site- or condition-specific grant-funding applications or water contracts to higher levels of farm-gate measurement.

Groundwater Use Measurement: Employ more precise methods to compute and report net usage to the State. Current state and federal characterizations of groundwater resources are not conducted using consistent methods and are not done frequently enough to adequately characterize groundwater usage. This hampers the State's efforts to determine the amount of groundwater used in various regions and to characterize the extent of overdraft. Accordingly, the Panel recommends that the State employ more precise methods—specifically, continuous regional characterization of groundwater—to compute net usage. This approach, expected to cost the State an additional \$2 million per year, represents a substantial change from current practices. This recom-

EXECUTIVE SUMMARY

mentation is not intended to preclude the most precise measurement standards, which are needed to support water transfers or are required by various authorities to meet site- or condition-specific needs.

Crop Water Consumption Measurement: Measure using satellite-generated remote-sensing. Current approaches to measuring crop water consumption rely on indirect methods applied infrequently, a practice that means state estimates of crop consumption—a significant portion of California’s total water use—are not validated and could include significant error. The Panel’s recommended approach—using satellite-generated remote sensing to measure crop consumption—is expected to yield significantly better estimates than current practices. It represents a minimum of \$500,000 additional annual cost to state or federal water agencies, and would have no direct impact on water users.

Surface Water Diversion Measurement: Measure all major surface water diversions using the best available technologies and report data to the State. Accurate data on surface water diversions is essential if state and federal water agencies are to adequately manage and plan for current and future needs. The completeness, consistency and accuracy of current reports do not allow these managers to quantify the amount of water diverted. Accordingly, the Panel recommends that all major surface diversions employ the best-available technologies—such as flow-totaling devices and data loggers—and report the data to the State. As most diversions are already using best-available technologies, the impact to districts is expected to be minimal.

Undertake comprehensive reviews to determine measurement needs for return flows, water quality and in-stream flows. The Panel recognizes that measurement of return flows, water quality and in-stream flows is

Agricultural vs. Urban Water Use: Measuring Water Delivery to End Users

PREPARED BY PANELIST JACK KELLER, ON BEHALF OF THE PANEL

Different approaches are required to measure water deliveries to agricultural and urban water users because of inherent differences in agricultural and urban demand patterns, delivery systems, water quality, and costs (see Table Below).

Perhaps the most fundamental difference between agricultural and urban water systems is their patterns of use which dictate important characteristics of their delivery systems. Urban water is available to all customers on demand—although the range of flow is typically low, when an urban water user turns on the tap, water comes out. This level of service is expected by residential and industrial customers throughout the United States. To provide this level of service, urban water systems—storage, pumps, and pipes - must be sized to provide peak water demand to many customers at once while meeting fire hydrant flow and pressure standards. Because urban water users can take water many times a day at different flow rates, only a recording measurement device—such as a totalizing meter—can give accurate delivery data.

On the other hand, agricultural distribution systems are sized to deliver water to only a few customers at a time on delivery schedules that provide water to farms once every two to six weeks. Typical agricultural delivery systems are designed to provide water for traditional surface irrigation methods that periodically apply relatively large quantities of water to a field and then use the on-farm water storage properties of the soil root zone to provide water to the crops between irrigations. These systems must use either fixed rotational or arranged delivery schedules to match deliveries to system inflow. Over-delivery results in some customers not getting their optimal flow rate; under-delivery results in canal spills (most agricultural water suppliers use open-channel gravity-flow delivery systems). Either of these conditions leads to low water use efficiency. Water district operators usually measure water delivery flows during these delivery events to make sure that their canal system does not get out of balance. As a result of these operational requirements, agricultural water suppliers typically have a record of the farm delivery flow rate and duration for each water use event. This data can be used to estimate the volume of water delivered even without a recording water measurement device.

Agricultural water quality and the variability of agricultural deliveries also affect end user water measurement. Farm size, crops, and irrigation methods are different from field to field. Water delivery rates can even vary on a given field from one irrigation event to another because of plant maturity or cultural practices such as rice paddy flood-up. Flow rate changes are even possible during an irrigation event due to irrigation management actions. Unlike urban water systems that deliv-

EXECUTIVE SUMMARY

needed to support a variety of state and federal water management objectives. However, given the lack of information regarding the location, distribution and type of existing measurement for these locations, the Panel was unable to develop a more specific recommendation at this time. The comprehensive reviews are recommended as a state follow-on responsibility.

Additionally, the Panel stressed that its definition is not static and is likely to defy a one-size-fits-all prescription. Any implementation approach must be adaptive, include appropriate exemptions, and allow for local flexibility and creativity.

NEXT STEPS

Following review of this material with the Authority's public advisory bodies, the Authority intends to move forward with its next step: developing an implementation strategy capable of being broadly supported by affected stakeholder communities. This phase, expected to take no more than six months, will incorporate the following tasks:

Program Manager Work Group: Convene a diverse stakeholder group to give guidance to Authority staff in developing an implementation proposal.

Public Reviews: The proposed approach will be discussed with CALFED advisory and decision-making bodies, and the public. (This step might also incorporate an urban water use measurement approach, which is being developed separately.)

Legislative/Agency Discussions: Finally, the Authority will work with state policymakers, as necessary, to put forward an implementation approach. This approach could necessitate legislative changes, administrative changes or both.

Though the issuance of this Report represents the Panel's final task, the Panel remains available to answer questions that may arise as this process moves forward.

er potable water, agricultural systems contain debris such as plant matter or algae. Consequently, agricultural water measurement devices must handle a variety of flow rates under very difficult conditions. For example, while a water meter may work adequately at the beginning of the irrigation season when flow rates are high and debris is low, later in the season they may not work at all because flow rates have been reduced below the operating range of the device or because aquatic weeds foul the impeller. Because agricultural delivery flow rates, system configurations, and water quality varies so much, agricultural water end user measurement defies a "one size fits all" solution.

Finally, the relative costs of measurement are very different in agricultural and urban settings. For residential customers, the cost of implementing measurement (hardware, meter-reading, etc.) represents an increase in water rates of \$5 to \$20 per month (\$60 to \$240 per year). On the other hand, agricultural farm-gate measurement represents an increase in farm costs for a single field of \$30 to \$200 per month. For most crops, this is a significant fraction of farm income—in some cases eliminating the ability of the farm to make a profit. This high sensitivity to the cost of end use water measurement makes decisions about farm-gate measurement particularly significant.

COMPARISON OF AGRICULTURAL & URBAN RESIDENTIAL WATER DELIVERY SYSTEMS

Characteristics	Agricultural	Urban Residential
Demand Patterns	Ability to serve peak crop ET and typical losses; only deliver to 5% to 15% of customers at a time	Ability to serve peak demand and meet fire hydrant flow/pressure standards; could serve virtually all customers at once
System Hardware	Mostly open channel, gravity flow; unexpected changes in deliveries can result in canal spills	Piped and pressureized systems; pipes flow full
Delivery Frequency	Deliveries arranged in advance or on fixed schedule (rotation) - two to six weeks between deliveries	Deliveries available on demand
Delivery Rate	0.5 to 20 cfs (225 to 9,000 gpm)	0.5 gpm to 20 gpm
Delivery Duration	2 to 72 hours	5 minutes to 2 hours
Water Quality	Untreated, contains debris	Treated to potable standards
On-Site Storage	Root zone stores crop demand for 2 to 6 weeks	None

INTRODUCTION

OVERVIEW

Measurement of water usage in the agricultural landscape is nearly as varied as the crops themselves. Some regions or districts rely on precise and frequent measurement to track how water moves through and within their systems. Others depend more heavily on estimates. The current approach to measurement grows out of unique, place-specific histories, economics and needs.

Water users and suppliers rely on the information generated for a variety of purposes. Measurement data can help local water districts distribute water to users, make operational decisions and improvements, and charge for water according to the amount used.

More recently, as California's water resources have become increasingly scarce, diverse stakeholder groups also have recognized the importance of measurement to state and federal agencies trying to manage a much-in-demand resource. Measurement can, among other things, provide better information on statewide and regional water use to support planning and water rights objectives, allow water users to undertake and demonstrate the effects of efficiency measures, and facilitate valid water transfers.

IMPETUS FOR THE PANEL

The California Bay-Delta Authority (formerly referred to as the CALFED Bay-Delta Program) is a cooperative effort among state and federal agencies and the public to ensure a healthy ecosystem, reliable water supplies, good quality water, and stable levees in California's Bay-Delta system.

Recognizing the potential impact of water use measurement on these overarching goals and the intense stakeholder interest in this topic, the August 2000 Record of Decision (ROD) called on the Authority's Water Use Efficiency (WUE) Program to take a closer look at measurement and deter-

mine what is needed and, as appropriate, put forward legislative or other strategies to bolster the current approach:

"Diverse stakeholder groups have recognized the importance of, and need for, appropriate measurement of water deliveries. Measurement will provide better information on statewide and regional water use, enable water purveyors to charge for water according to the amount used, allow water users to demonstrate the effects of efficiency measures, and facilitate a water transfers market. CALFED Agencies have initiated a public process to add greater definition to 'appropriate measurement':

- An independent review panel on appropriate measurement will be convened. This panel will provide guidance that will help define appropriate measurement as it relates to surface and groundwater usage. The panel will prepare a consensus definition of appropriate measurement by the end of 2001.
- At the completion of this stakeholder/technical process, CALFED Agencies will work with the California State Legislature to develop legislation for introduction and enactment in the 2003 legislative session requiring the appropriate measurement of all water uses in the State of California."

Based on this ROD commitment, the Authority convened an Independent Review Panel on Appropriate Agricultural Water Use Measurement to: (1) assist it in defining appropriate measurement as it relates to agricultural water use efficiency; and (2) outline possible steps for moving forward. [The

INTRODUCTION

ROD-stipulated deadlines noted above have shifted to satisfy the Panel's subsequent call for a more detailed and time-consuming analysis than initially anticipated.]

The intent of the Panel's deliberations were neither to chart nor preclude any particular implementation path. That task is to be handled in subsequent stakeholder discussions and will, like other facets of the Authority's Water Use Efficiency Program, be underpinned by the Program's commitment to regionally sensitive, incentive-driven and cost-effective approaches. (A separate process is being used to address urban water use.)

PANEL PARTICIPANTS

In designing the Panel, the Authority sought to bring together a cross-disciplinary mix of independent experts capable of credibly tackling the potentially controversial question of defining appropriate agricultural water use measurement for both surface and ground water. The Authority further strove to craft a set of deliberations that would be objective-driven, involve the input of affected and informed stakeholder com-

munities, be outcome-focused, and be perceived as credible.

To recruit panelists, the Authority worked with stakeholder and agency representatives to identify and select nationally recognized technical experts who collectively were able to provide understanding of the following areas:

Measurement technology/hardware: This panelist is to bring an understanding of existing and emerging measurement technologies and hardware. He/she should also be familiar with the technological limitations.

Resource economics: This panelist is to bring expertise related to the costs and benefits associated with measurement. He/she should also be familiar with issues related to financing measurement improvements.

Groundwater hydrology: This panelist is to bring an understanding of the purposes, benefits, limitations and costs associated with groundwater measurement.

The Value of Information

PREPARED BY PANELIST NAOMI DUERR, ON BEHALF OF THE PANEL

Water measurement plays an important role in managing California's water resources.

PLANNING AND MANAGEMENT

In order to manage California's water, the State must first know something about its characteristics, such as its quantity, quality, depth, location, ease of access, current use, and source and rate of replenishment. These characteristics must all be measured (or estimated). Once we have knowledge about a water system, we can assess how changes in weather, water withdrawal patterns, water uses, or restoration efforts might affect it. Measurement is key to understanding dynamic systems and assessing impacts to them over time.

BASELINE TO MEASURE EFFECTIVENESS OF CONSERVATION MEASURES

Water resources are increasingly valuable as demands rise over time. Conservation can be a cost-effective way to stretch water supplies. Conservation can delay the need to construct larger wellfields or to expand a community's water treatment facilities. Yet without measuring current water use, we can only guess at which conservation techniques might be most cost-effective. Should a farmer line a canal or invest in a drip irrigation system? Should a district build a new reservoir or store water underground? Only by measuring water use and understanding the nature of that use can we predict which conservation measures are likely to be most cost-effective. Once appropriate conservation tools are implemented, measurement is again key to quantifying actual gains and determining whether we are reaching our targets.

FINALLY, THE ACT OF MEASURING IMPLIES INTRINSIC VALUE

The accuracy with which we measure the use of a resource generally reflects its unit value—the cost of measuring more accurately needs to be justified by the benefit achieved. Resources which are perceived to have very high economic value per unit are measured precisely (diamonds are measured in hundredths of a carat), while resources with low unit value are measured imprecisely (fill dirt is measured to the nearest cubic yard). In the past, water supply for irrigation has been relatively abundant in some regions of California, due to firm and abundant water rights. Although water is extremely valuable to these areas (essential in fact), its marginal value has been relatively low. As a result, the cost of precise measurement has not seemed worth it. However, these days, good, clean plentiful water is not as available as it once was, and treatment costs have increased over time as concerns about purity have grown. If we appropriately measure water extraction, end use, return flows, and quality, we recognize water's inherent value. Valuing water is a cornerstone of sound resource management.

INTRODUCTION

Ideally, he/she would have experience working in and out of adjudicated basins.

Technical water policy advisor: This panelist is to bring an in-depth understanding of how the integration and interpretation of large data sets can be used to inform public-sector policy making. This includes understanding: 1) what’s required to collect and use data, and, 2) what are the relative costs and benefits of maintaining centralized data.

Water district operator: This panelist will contribute an on-the-ground perspective of a water district operator intimately familiar with agricultural irrigation in California.

Senior integrator/irrigation engineering: This panelist is to contribute expertise related to irrigation engineering. As well, this panelist will bring practical experience in recommending measurement programs for water agencies.

Potential panelists also were considered for their ability to meet the following criteria: 1) objectivity, as reflected in the perceived willingness/ability to integrate diverse viewpoints; 2) ability to work collaboratively; 3) understanding of the various objectives related to measurement; 4) practical experience with on-the-ground use of measurement; 5) competent and comfortable with analysis, storage, dissemination and use of measurement data; and, 6) availability. A list of the panelists, along with their expertise and affiliation, is provided in the chart below. (More detailed biographies are included in Appendix 1.)

To foster a process informed by local stakeholder views and perspectives, the Panel process also incorporated the

continued input of diverse and informed stakeholders and state and federal agency representatives. These individuals participated in two different ways.

Technical Advisors: Each major stakeholder group—agricultural, environmental and agency—was asked to name three technical representatives to support the Panel’s deliberations by helping the panelists and the Authority to better understand local issues and information sources. These Technical Advisors were invited to participate in Panel deliberations and provided interim guidance as well. A listing of these individuals is included in Appendix 1.

Ad Hoc Work Group: Each major stakeholder group—agricultural, environmental and agency—also was asked to name representatives able to provide more policy-focused guidance to the Authority and Panel. These participants—also invited to contribute to Panel deliberations and provide between-meeting guidance—served as a sounding board regarding Panel design, panelist selection and ongoing Panel process. A listing of these individuals is included in Appendix 1.

Finally, the Panel’s deliberations were supported by a Technical Team consisting of Authority staff and consultants with expertise in hydrology, irrigation technologies and practices, resource economics, water law and stakeholder involvement/ facilitation. At times, panelists Jack Keller and Steve Hatchett also participated in a liaison role to ensure the Technical Team’s work was consistent with previous Panel guidance. A listing of Technical Team members is included in Appendix 1.

PANELISTS WITH AFFILIATION AND AREA OF EXPERTISE		
Panelist	Affiliation	Expertise
Naomi Smith Duerr	Director, Environmental Monitoring and Assessment Department, South Florida Water Management District	Technical Water Policy Advisor
Thomas Harter	Associate Cooperative Extension Specialist, Department of Land, Air and Water Resources, University of California, Davis	Groundwater Hydrology
Steve Hatchett	Economist, Western Resource Economics	Resource Economics
Chris Kapheim	General Manager, Alta Irrigation District	Water District Operator
Jack Keller	Professor Emeritus of Agricultural and Irrigation Engineering, Utah State; Founder and CEO, Keller-Bliesner Engineering	Irrigation Engineering
John Repogle	Research Hydraulic Engineer and Chief Scientist, U.S. Water Conservation Laboratory	Measurement Technology

INTRODUCTION

PANEL MEETING SCHEDULE

Initially, the Authority anticipated the Panel process would require two meetings and last six to nine months. Given the complexity of the topic and early-on Panel guidance that directed the Technical Team to undertake an extensive, rigorous and region-specific analysis, the Panel's deliberations spanned two years and involved numerous in-person and teleconference meetings.

The Panel met in three face-to-face sessions. The first session, held in June 2001, focused on scoping questions and information needs related to the Panel's deliberations. The second session, held in October 2001, centered on an interim review of a preliminary technical analysis. The third and final session, held in June 2003, focused on developing a consensus definition of appropriate agricultural water use measurement.

The Panel also held numerous teleconferences to review the evolving technical analysis and provide continued input to the Technical Team. Panelists also reviewed and commented on interim staff technical analyses via e-mail.

Throughout the process, the deliberations were structured to incorporate and encourage the participation of affected stakeholder communities. As noted above, stakeholder and agency representatives were invited to participate in Panel deliberations. The public also was invited to attend Panel meetings. Finally, CALFED held a series of public workshops

throughout the state to provide updates and information to interested members of the public.

TECHNICAL APPROACH

In its earliest deliberations, Panel members stepped out a series of topics essential to better understand prior to answering the primary question: What is the definition of appropriate measurement?

Most generally, the Panel called on the Technical Team to undertake a region-by-region analysis of the following:

- What are the purposes of agricultural water use measurement?
- What are the current baseline conditions, including an overview of measurement locations and intensities and regional snapshots?
- What are the benefits and limitations of the current approach?
- What would be the costs and benefits associated with altering the current measurement approach?

To develop comprehensive and credible answers to these questions, the Technical Team worked with the Panel and local consultants and stakeholders to undertake a rigorous analysis that relied on the following overarching methodology:

Implication of Irrigation Measurement Accuracy

PREPARED BY PANELIST JOHN REPLOGLE, ON BEHALF OF THE PANEL

Water measurement, as referred to in this document, is usually worded, for example, "...accurate to within $\pm 6\%$ by volume." Water measuring devices may display either *flow rate* or *flow volume*, or both. Suppose a weir, which is basically a flow-rate device—that is, a depth reading used in an equation or table to indicate, say, 4000 gallons per minute—is fitted with a depth gauge on the canal sidewall that has been accurately referenced to the weir lip. However, waves make reading of the wall gage difficult to within 20% of the depth. The basic flume or weir may have a proven accuracy better than 2% to 5%, but expensive stilling wells or sonic level detection and time-rate accumulation may not be practical at the site. Can this location produce a "by volume" measurement to meet accuracies to within $\pm 6\%$ for system management and billing purposes?

The answer is that it is possible to meet the requirement. This is true because, if enough manual readings are accumulated over the delivery time of interest, some of the wave-hampered readings will be high and some will be low, so that by applying statistical methods, the sloppy readings (if enough are available) will give a volume delivery to the customer that approaches the basic 2% to 5% accuracy of the weir. This would be well within the $\pm 6\%$ target. The number of readings needed can be determined by statistics. However, the wide margin on individual readings does not bode well for the farmer who is trying to determine when to return to his canal gate to change the water to the next field. Ultimately, it is hoped that more precise instantaneous measurements can be implemented to improve the farmer's on-farm management. Meanwhile, for canal system operations, measurements of $\pm 15\%$ by volume, is tolerated as being acceptable at individual customer levels, again because the random "overages" and "underages" of many customers will compensate and produce a volumetric accuracy suitable for the delivery authority who uses the information to assure that the main canal is adequately operated and for billing purposes.

The above explanation illustrates the desires of the Panel to incorporate and make use of flow measurements for one or more of at least two purposes. The limits recommended for a flow measurement that is accurate enough depends on the

INTRODUCTION

Step One: Articulate objectives of measurement. The Panel called for the analysis to be structured to explore objectives of measurement (surface and groundwater) that support both specific Authority goals and broader statewide needs. In doing so, panelists strongly recommended that the analysis focus primarily on state and federal objectives related to water planning, water availability, water transfers and water use efficiency. At the same time, the Panel recommended that the analysis also identify important linkages between measurement and local objectives. The results of this analysis are presented in Section 1.

Step Two: Identify measurement components. In order to undertake a regional analysis, it was necessary for the Technical Team to develop a strategy for characterizing and considering changes to existing measurement practices. To accomplish this task, the Technical Team articulated three critical aspects of measurement: (1) the general location of where measurement is made (in other words, how the data is derived); (2) the intensity of the measurement; and, (3) the fate of the data associated with a measurement (how the data is used). The results of this analysis also are presented in Section 1.

Step Three: Track baseline conditions. In order to characterize the capabilities of existing measurement practices and estimate the incremental costs and benefits associated with different measurement strategies, it was first necessary to articulate the existing baseline conditions. This step necessitated working with regional experts to develop region-by-region estimates of existing measurement infrastructure and practices. It also required characterizing the State's current legislative and regulatory approach to measurement. These assessments are included in Section 2 (Baseline Conditions) and Appendix 2 (California Legal Authorities).

Step Four: Characterize benefits, limitations and potential changes to existing practices. Once baseline conditions were understood, the Technical Team undertook a regional analysis to: (1) characterize the ability of current measurement practices to meet the critical state and federal objectives identified in Step One; and, (2) identify possible and realistic changes to existing practices. In doing so, the analysis sought to identify—in a qualitative manner—the potential benefits to state and federal objectives if water suppliers and users altered their current measurement practices. The results of this analysis are presented in Section 3.

intended use of the measurement. One use of measurement information is for *flow volume* accounting over a day, a month or season. Water districts need information on volume of water delivered if they are going to equitably allocate water supplies to growers or bill growers by volume of water delivered. Growers need information on volume of water delivered if they are going to use a field water budget to schedule their irrigations. Here, as illustrated above, the measuring accuracy need not produce an instant reading that is highly precise at any moment. An example of “precise” is the ability to distinguish the markings on, say, a wall gage. “Accuracy” refers to the ability to determine a flow rate, or flow volume, in relation to some otherwise determined correct flow rate or flow volume. It is not always possible to have a correct value for comparison outside of a laboratory setting. On the other hand a “precise” reading may not necessarily equate to an “accurate” reading because the zero-setting on a weir may have shifted, or the rating equation or table may not be well matched to the structure, causing a bias error.

A more stringent and rarely needed form of measurement is for immediate *flow-rate* management applications. This situation could arise if that same farmer, mentioned above, needs to know instantaneously when he has applied the correct amount of water. For precision-leveled basin irrigation of upland crops at a steady, known flow rate, the irrigator can calculate a shutoff time. For example, irrigating 10 acres at 10 acre-inches per hour (10 cfs) will apply 4 inches in 4 hours. This measurement reading would need to be as precise and accurate as practical, because a 20% error in his single reading of the flow metering system could cause his shut-off time to be wrong by over three-quarters of an hour. However, this is less important for most other irrigation methods such as furrow and sloping border irrigation as the timing of irrigations is based on the relatively unpredictable time it takes for the water to reach the ends of the furrows or border strips. And for flooding rice basins, differences in flow rates merely alters the depth of the water stored in the basins.

For these reasons, the Panel believes the accuracy levels incorporated into its recommendations are both appropriate and achievable.

INTRODUCTION

Step Five: Develop cost projections associated with different measurement practices. Relying on baseline conditions developed in Step Three and potential changes to measurement practices first outlined in Step Two and further considered in Step Four, the analysis looked at the quantitative costs associated with altering current measurement practices (both hardware and data management). These costs were developed at both regional and statewide levels. The results of this analysis are presented in Section 4.

Step Six: Analyze costs and benefits. As directed by the Panel, the last step in the analysis was to put forward a draft staff analysis of the potential quantitative costs and qualitative benefits associated with changes to current measurement practices and develop draft recommendations based on that analysis. This analysis also included any general recommendations related to future implementation considerations. The results of this regionally based analysis were presented to the Panel during its final set of deliberations and served as the foundation for their discussions. This analysis is included in Section 5.

The Technical Team relied on a variety of strategies and information sources to develop and confirm the analytic steps outlined above. It surveyed water suppliers and water users throughout the state, catalogued measurement practices and

costs, talked with state and federal water managers and interviewed environmental stakeholders. Team members reviewed the State's regulatory and statutory framework, as well as talked with water managers in six other states to better understand their experiences. Additionally, the Technical Team met with local experts throughout the state to gather relevant data, present the results of its analysis and solicit feedback. Finally, public workshops were held to solicit feedback and comment on the analysis. (A summary of the public comment on the draft analysis is included in Appendix 4.)

More specific descriptions of the analytic techniques and information sources are outlined within each section of this report.

NEXT STEPS

As noted earlier, CALFED is committed to working through a two-step process to ensure it puts forward an approach to agricultural water use measurement that is both technically sound and capable of being broadly supported.

The first step—the Panel's determination of a definition of appropriate measurement—is summarized in this report, which will be distributed to and discussed with CALFED advisory- and decision-making bodies and the public. A summary of all public comments received on this Panel report will be attached as part of the permanent record.

Following these discussions, the Authority intends to move forward with the second step: developing an implementa-

Project Specific Costs and Benefits

PREPARED BY PANELIST STEVE HATCHETT, ON BEHALF OF THE PANEL

A comment received from water users concerned the need to evaluate the costs and benefits of measurement (especially farm-gate measurement) in the context of future water use efficiency and water management projects that might require or be enabled by better measurement. The comment suggested using a comprehensive benefit-cost evaluation of both the measurement approach itself and any linked future projects.

The Panel considered this comment seriously. The Panel's approach throughout the process has been that measurement needs to serve one or more defined objectives, and it has not recommended measurement levels simply because there may be future uses of the information. However, the Panel also felt that the Technical Team's ability to make reasonable and quantitative estimates of future benefits is limited. Therefore, the Panel came to two general conclusions regarding the comment:

1. It would not be reasonable to attempt to estimate the costs and benefits of future water use efficiency and management projects requiring or enabled by better measurement. Such an analysis would be virtually unlimited in scope and too speculative to be meaningful.
2. The state should be cautious in supporting measurement approaches that significantly increase costs when the benefits are uncertain. Rather, a tiered recommendation is preferred which sets a lower, but acceptable baseline level of measurement and then identifies conditions under which higher (more precise) measurement would be appropriate. These conditions could include: state grant funding of water use efficiency projects that require better measurement; and/or, local agency decisions to implement volumetric water pricing.

INTRODUCTION

tion strategy capable of being broadly supported by the many affected stakeholder communities. This phase, expected to take no more than six months, will have several steps:

Program Manager Work Group: The WUE Program will convene a diverse stakeholder group to serve as a sounding board as it develops a proposed implementation approach. As discussed earlier, the Program's proposed approach will draw on the Panel's report and be shaped by the Program's commitment to regionally sensitive, incentive-driven and cost-effective approaches.

CALFED and Public Reviews: Once drafted, the WUE Program proposed approach will be drafted for review, discussion with and final revision by CALFED advisory and decision-making bodies and the public. It is possible that this step will incorporate an approach to

urban water use measurement that is being developed through a separate process.

Legislative/Agency Discussions: Finally, the WUE Program will work with state policymakers, as necessary, to put forward an implementation approach. It is uncertain at this point whether a final recommended implementation package will necessitate legislative change, administrative changes or both. Again, it is possible that this step will incorporate an approach to urban water use measurement that is being developed through a separate process.

Interested stakeholders are invited to review the accompanying materials and submit any comments to the California Bay-Delta Authority for its consideration as it continues discussions related to this important topic.

CVPIA Water Measurement Requirements

PREPARED BY USBR AGENCY REPRESENTATIVE TRACY SLAVIN, ON BEHALF OF THE PANEL

The United States Bureau of Reclamation requires all Central Valley Project water service or repayment contracts for agricultural, municipal, or industrial purposes that are entered into, renewed, or amended under any provision of Federal Reclamation law after enactment of the Central Valley Project Improvement Act (CVPIA), shall provide that the contracting district or agency:

- Ensure that all surface water delivery systems within its boundaries are equipped with water measuring devices or water measuring methods of comparable effectiveness acceptable to the Secretary within five years of the date of contract execution, amendment, or renewal;
- Ensure that any new surface water delivery systems installed within its boundaries or on or after the date of contract renewal, are so equipped; and
- Inform the Secretary and the State of California annually as to the monthly volume of surface water delivered within its boundaries.

This requirement is also incorporated into the Criteria for Evaluating Water Management (Conservation) Plans (Plans) prepared under the CVPIA. The Plan is required of each contractor which receives more than 2,000 irrigable acres or receives more than 2,000 acre feet in their service area, or receives more than 2,000 acre feet for M&I purposes. For these contractors, the Plan can be used to ensure that they are meeting the water measurement requirements under CVPIA.

The Water Conservation Criteria were first developed in 1993 through an extensive public scoping process. Water Measurement to each farmer was determined to be a Best Management Practice (BMP) that, when tied with volumetric pricing, provided farmers with a strong price signal resulting in agricultural water conservation. Based on this input, Reclamation identified measurement as a critical BMP and incorporated this requirement into the Standard Criteria.

Both Reclamation and the CALFED's Agricultural Water Management Panel address requirements for farm-gate measurement, but the purposes of the measurement differ. The Panel's recommendations focus on the need to aggregate estimates of farm-gate measurement in the context of providing information that will assist state and federal water planning and water balance estimates. The Panel recommendations reflect its conclusion that the hardware currently in place is appropriate for such planning purposes if data are collected and reported.

Independent Panel on Appropriate Measurement of Agricultural Water Use

Convened by the California Bay-Delta Authority

PANEL REPORT

SEPTEMBER, 2003

PANEL REPORT

As directed by the August 2000 CALFED Record of Decision, the California Bay-Delta Authority (Authority) convened the Independent Review Panel on Appropriate Agricultural Water Use Measurement (Panel) in June 2001 to develop a consensus definition of appropriate agricultural water use measurement.

The Panel represents a cross-disciplinary mix of six nationally recognized experts who collectively provide understanding in the areas of measurement technology/hardware; resource economics; groundwater hydrology; technical water policy; water district operations; and, irrigation engineering. A complete listing of Panel members is included in Appendix 1.

This final Panel Report, representing the consensus view of all six panelists, puts forward the Panel's definition of appropriate agricultural water use measurement. The Report represents more than two years of work by the Panel, involving three in-person meetings and numerous teleconferences, frequent communications with staff and consultants to the Authority, and the ongoing involvement of and input from stakeholder representatives. The Panel's final set of deliberations was held June 9, 2003, in Sacramento, California.

The recommended definition builds off the extensive technical analysis conducted by Authority staff and consultants (referred to as the Technical Team). That analysis, shaped by the Panel and presented in Part Two of this document, identified—on a region-by-region basis—the quantitative costs and qualitative benefits likely associated with changes to current agricultural water use measurement practices.

As guided by the Panel, the analysis centered on the potential for measurement improvements at seven specified locations to meet state and federal water management objectives. The seven locations are: 1) surface water diversions, 2) groundwater use, 3) crop consumption, 4) return flow sites, 5) water quality monitoring sites, 6) in-stream flows and 7) farm-gate deliveries. The Panel further directed the Technical Team to use state and federal objectives related to water allocation, water planning, water transfers, and water use efficiency to

guide their analyses. The Panel also instructed the Technical Team to note the potential for measurement improvements to contribute to local objectives—such as on-farm water management—but not to use these local objectives as the basis for justifying the definition of appropriate measurement.

Following the general recommendations presented below, a set of “Location-Specific Definitions” summarize the Panel's consensus view on the definition of appropriate measurement at the seven locations under discussion. Each location-specific discussion is summarized into four parts:

ISSUE: This provides a brief description of the rationale for improved measurement.

RECOMMENDATION: This provides a summary of the Panel's recommendation related to what measurement it considers appropriate. The recommendations are characterized as either “basic,” “high” or “highest technically practical,” to be consistent with terminology used in the detailed technical analysis. (Although the Panel recognizes there are more than just three measurement options for each location, the analysis focused on the three discrete levels introduced above to provide a consistent basis for analysis of costs and benefits.) Taken together, these recommendations constitute the Panel's definition of appropriate measurement.

EXPECTED IMPACT: This outlines the expected impact—both in terms of cost and burden—to local water users. It also identifies where the State is likely to bear the cost.

FOLLOW-ON NEEDS: This lists out key follow-on needs raised during the Panel discussion.

The Panel hopes this Report will be useful to the stakeholder and agency representatives who will now work with the Authority to craft a strategy for implementing this consensus definition.

PANEL REPORT

GENERAL RECOMMENDATIONS

The Panel believes that its consensus recommendations articulate a definition of appropriate agricultural water use measurement that is both grounded in a sound technical analysis and responsive to California's current and near-term needs. Moreover, the Panel believes the definition can serve as a solid foundation for follow-on discussions, to be convened by the Authority, centered on crafting an implementation approach.

Still, as the Authority moves forward with this initiative, the Panel wishes to put forward some important general recommendations related to the Authority's development of an implementation approach.

1. The Panel's final definition of appropriate measurement needs to be summarized in a manner that is straightforward, accessible and supported by the underlying detailed technical analysis.

2. The intent of these recommendations is neither to chart nor preclude any particular implementation path. The Panel recognizes that the implementation task is to be handled in connection with subsequent stakeholder discussions and will be underpinned by the Authority's commitment to regionally sensitive, incentive-driven and cost-effective approaches.

3. Any new approach to measurement must be adaptive and structured in a manner that enables an evolving definition of "appropriateness." This adaptive structure would, over time, account for changes in pertinent factors such as technology

and economics. Accordingly, any legislative or regulatory implementation strategy must be carefully crafted to account for, among other things: (1) technological advancements over time; and (2) statewide growth, development, and increases in relative scarcity of water for various beneficial uses over time.

4. As the Authority drafts its implementation approach, the Panel recommends it consider the following: (1) the need to accompany any measurement requirements with an appropriate set of available exemptions, variances and "second-best" approaches; (2) the importance of focusing on how measurement "data" will be turned into "information" useful to governmental and private entities; and, (3) the necessity to provide staffing adequate to carry out certain labor-intensive measurement requirements or to implement approaches that allow requirements to be satisfied in a way that minimizes the labor involved.

5. The Panel has some concern that certain measurement costs included in the analysis (particularly those for groundwater and crop consumption) may have been underestimated by the Technical Team. The Panel urges the Technical Team to either re-review their cost estimates or indicate that further refinement may be required. The Panel does not believe its definition of appropriate agricultural water use measurement is contingent on the precision of cost information provided. In other words, the Panel would have made the same recommendations even if the actual costs are considerably higher than indicated.

Measurement and On-farm Efficiency

PREPARED BY PANELIST JACK KELLER, ON BEHALF OF THE PANEL

Many factors influence a farmer's decision to invest in on-farm water conservation. Aside from the obvious issue of how much the conservation improvement will cost, the farmer will consider: the amount and reliability of the farmer's water right or allocation; the price paid for water delivery, assuming the cost varies with volume received and the price is large enough to provide a meaningful cost signal; the availability of other water sources; the cost of other farm inputs; the relative financial health of the farm; and the potential impact on other water users. In many situations, factors such as the availability of other water sources, the perceived scarcity of water, the cost of other farm inputs, and the relative economic health of the farm overshadow the water delivery and water cost factors.

In California, surface water rights and the resulting supply are treated much the same as property rights and are typically collectively held by water suppliers for their water users. The agricultural water suppliers (irrigation districts) are non-profit public agencies with Boards of Directors that are elected by their water-users. The charges for supplying irrigation water for the lands the district was formed to serve cannot be greater than the cost of operating the district, and water-users favor having low water service costs. Approaches such as tiered pricing can be used to maintain a district's revenue equal to its cost, but these are often resisted by growers for various reasons.

All districts already have some means for diverting their legal share of surface water and distributing it to the farms they serve in a reasonably equitable manner. The delivery efficiency and accuracy of allocations generally depends on the size of the district's dependable water supply relative to irrigation demand during the dry periods, especially in drought years. (For purposes of this discussion, demand is the sum of applied water requirements for comfortably irrigating all the farmland in the district's service area.) The delivery efficiency, measurement and allocation accuracy is typically directly related to the district's relative water supply. The lower the surface water supply is relative to the demand, the higher

PANEL REPORT

Farm-Gate Deliveries

ISSUE

State and federal agencies need accurate information on the sources and destinations of agricultural water to allow them to adequately manage and plan for current and future needs. To this end, the State needs improved estimates of water balance components, including improved information on farm-gate deliveries. This information is required so the State can adequately update the State Water Plan, make decisions about future storage and conveyance investments, and determine whether to direct water use efficiency grant funds and technical assistance toward farm or district improvements.

Farm-gate deliveries are measured using a variety of methods. Approximately 11% of all farm-gate deliveries statewide—primarily in the Sacramento Valley and Eastside of the San Joaquin Valley—are currently at the basic (estimated) level*. These estimated measurements are typically accurate to within $\pm 15\%$ by volume. (Due to a lack of a comprehensive data reporting system for agricultural water deliveries, the exact volume of water delivered to the 11% is not known at this time.) The remaining 89% of turnouts are directly measured using rated flow structures coupled with duration of use or with continuous or totalizing measurement devices. These are typically accurate to within 6% of volume. However, regardless of the measurement method used, virtually none of this data is currently reported to the

State. This information gap hampers state and federal water managers' ability to assess the potential of on-farm water use efficiency improvements.

RECOMMENDATION

It is appropriate to measure the volume of water delivered to farms. Also, it is appropriate for aggregated farm-gate delivery data, whether currently estimated or directly measured, to be collected, managed locally and reported to the State.

Regarding farm-gate measurement methodologies, the Panel believes the current approaches are sufficient to support efficient on-farm water management practices at this time. Although more accurate farm-gate delivery measurement can be an important component of local water management strategies, changes in farm-gate measurement alone will not likely result in significant water management improvements. This is due to the fact that there are many factors that motivate improved on-farm water use efficiency, including knowledge of the volume of water delivered, water price and pricing structure, water availability (or scarcity), the availability of other water sources, the costs of other farm inputs and the financial stability of the farm enter-

* The Panel recognizes that there are many different strategies for measuring farm-gate deliveries. The analysis defined three discrete levels—basic, high and highest technically practical—to provide a consistent basis for the analysis of costs and benefits.

the corresponding efficiency and measurement accuracy. However, where groundwater is available and inexpensive this may not be the case.

Some districts measure, allocate, and deliver the required or available amount of surface water to each farm-turnout; additional deliveries are made only if the grower has arranged for a transfer from within the district. This is done where a limited supply of water is being taken from a dedicated amount of surface storage. However, it is not really an issue where the surface water rights are ample for the area served or there is easy and cheap access to groundwater.

The water requirements during peak growth periods are similar for most crops within a region. However, due to different crop planting dates, crop cycles and irrigation practices, water requirements for different fields can vary considerably during non-peak periods. Consider, for example, the beginning of the season in a rice growing area. The first field planted and flooded in a given area may actually end up recharging the perched water table in the surrounding fields. Thus much more water may be required for it compared to its neighboring fields. In such cases, it may be more equitable or effective to meter the water delivered to the whole area rather than to individual fields.

Districts with sufficient relative water supplies can simplify operations to keep costs low by choosing not to measure and charge according to the volume of water delivered. To cover the costs of operation, they divide the district's total operating cost by the total number of irrigated acres served to arrive at a per acre delivery charge. Then districts would charge each customer according to the number of irrigated acres they have. However, some districts adjust the per acre charge to account for the different irrigation delivery requirements of various crops, soil, and application system types and/or the value of various crops.

In conclusion, water delivery data and water cost signals can be contributing factors in motivating growers to conserve water. However, their efficacy in inducing water conservation is frequently overshadowed by other factors including farm economics, district operations, and overall water availability.

PANEL REPORT

prises. Therefore, given current physical and institutional conditions, it is not necessary to require flows at farm-gates to be more rigorously or accurately measured at this time.

The Panel acknowledges that there would be increased benefits to state goals if all measurements were at the high level. However, the Panel believes that the costs associated with changing those farm gates still at the basic level outweigh the benefits. Panel members also note the following:

- The basic level of farm-gate measurement (which relies on estimated flow rates) is typically accurate to within $\pm 15\%$ by volume.
- The high level of farm-gate measurement (which relies on collecting flow measurements on rated structures and duration of use data) is typically accurate to within $\pm 6\%$ by volume.
- The highest technically practical level of farm-gate measurement (which relies on continuous or totalizing measurement devices) is typically accurate to within $\pm 3\%$ by volume.

Additionally, the Panel notes that incentive-pricing methods (such as tiered pricing) can be used with all current

farm-gate measurement methods.

Finally, the Panel acknowledges that state and federal entities may wish to link approval of site or condition-specific grant-funding applications or water contracts to higher levels of measurement. Accordingly, this general statewide recommendation should in no way be considered to preclude or limit higher standards of farm-gate delivery measurement that may be deemed necessary by appropriate entities, including local agencies or authorities, to meet site- or condition-specific needs.

EXPECTED IMPACT

The definition does not represent an upgrade of farm-gate hardware or changes in measurement methodologies, but it does imply an increase in data collection and reporting activities for water suppliers. Water suppliers not currently collecting this information may need to add a half- to full-time staff position for data management.

Note: If and where grant applications are conditioned on applicants' demonstration of higher levels of measurement, some costs may be borne by water users.

FOLLOW-ON NEEDS

None at this time.

Who Pays for Measurement?

PREPARED BY TECHNICAL TEAM MEMBER DAVID MITCHELL, ON BEHALF OF THE PANEL

The Panel's recommendations of appropriate measurement of agricultural water uses is expected to lead to higher costs for measurement compared to existing practices, at least for some locations. The anticipated changes in costs are discussed in detail in Section 4 of this report. This sidebar discusses briefly the question of who would likely incur these costs.

Costs Likely to be Borne by State or Federal Agencies

The Panel's definitions of appropriate measurement for groundwater and crop water consumption entail improvements in the way state and federal water management agencies currently characterize groundwater and crop water uses. This primarily involves improvements in state-sponsored surveying and modeling practices. These are functions that CALFED agencies such as DWR or USBR would perform and pay for. It is not anticipated at this time that agricultural water districts or their customers would be allocated costs for these activities. Similarly, it is anticipated that installation, operation, and maintenance of stream gauging stations would remain within the purview of state and federal agencies and costs associated with these activities—either for flow or quality measurements—would continue to be borne by these agencies.

Costs Likely to be Partially or Completely Borne by Local Water Districts

The Panel's definition of appropriate measurement for major surface water diversions would require surface water diversion points with "basic" or "high" measurement capability to be upgraded to "highest technically practical." This would entail changes to approximately 16% of current major surface water diversion points. Local water districts would likely have primary responsibility for associated costs for the upgrades. However, loan and grant programs administered through the Water Use Efficiency Program may allow some state and federal cost sharing. While the Panel was unable to provide a definition of appropriate measurement of agricultural surface water return flows because of data limitations, it is expected that cost allocation would be similar to major surface water diversions. Water districts would have primary responsibility for necessary infrastructure improvements. However, loan and grant programs administered through either the Water Use Efficiency Program, Ecosystem Restoration Program, or Water Quality Program may allow some state and federal cost sharing.

The Panel's definition of appropriate measurement of farm-gate deliveries does not entail changes to existing delivery hardware, but would require more extensive data collection, management, and reporting. It is anticipated that water districts would pay for district-level data management and administrative costs. Costs associated with state or federal data repositories would be paid for with state or federal funds.

PANEL REPORT

Groundwater Use

ISSUE

State and federal agencies need accurate information on the sources and destinations of agricultural water to allow them to adequately manage and plan for current and future needs. To this end, the State needs improved estimates of water balance components, including improved measurement of net groundwater use. This information is required so the State can adequately update the State Water Plan, make decisions about future storage and conveyance investments, and characterize and assess the sustainable yield of groundwater basins.

State and federal water management agencies currently conduct periodic assessments of groundwater resources for selected basins. However, these analyses are not conducted using consistent methods and are not done frequently enough to adequately characterize groundwater usage. More rigorous and consistent methods are required to determine the amount of groundwater used in various regions of the state and to characterize the extent of overdraft.

RECOMMENDATION

It is appropriate to measure net groundwater use at the high level*—in other words, continuous regional characterization of groundwater volume using two methods simultaneously: (1) development of detailed sub-basin hydrologic balances; and, (2) the water table/specific yield method. Initial cost analyses indicate these methods can be implemented statewide at reasonable cost. However, should the cost of these methods exceed available state resources, the State should focus its effort on those sub-basins with the greatest need for improved groundwater use data.

Additionally, when water transfers involve groundwater substitution, the groundwater wells directly involved in the transfer require the highest technically practical level of

measurement (i.e., some form of continuous measurement, monitoring and frequent reporting).

This definition should in no way be considered to preclude or limit higher standards of groundwater measurement that may be deemed necessary by entities with legal jurisdiction over groundwater management, including local agencies or authorities, to meet site- or condition-specific needs.

EXPECTED IMPACT

The expected impacts to water users are likely to be minimal. The proposed method of continuous regional characterizations will mean higher state planning costs: roughly \$2 million extra per year. Note: Where continuous measurement of well discharge is required due to water transfers, opportunities may exist for costs to be internalized into the transaction costs borne by the participants to the transfer.

FOLLOW-ON NEEDS

In moving forward with this definition, the Panel recommends that the Authority reconfirm the incremental costs associated with measurement at the high level (including the costs of data collection and quality control) and amend its costs analysis, as necessary.

As was the case for surface water measurement, the Panel notes that benefits from the proposed improvements in groundwater measurement will be fully realized only if they are coupled with improved measurement of surface water diversions and crop water consumption. Finally, the Panel suggests highlighting the initial groundwater system characterization—i.e., soil types, hydrology—inherent in this definition.

* The Panel recognizes that there are many different strategies for measuring net groundwater usage. The analysis defined three discrete levels—basic, high and highest technically practical—to provide a consistent basis for the analysis of costs and benefits.

PANEL REPORT

Crop Water Consumption

ISSUE

State and federal agencies need accurate information on the sources and destinations of agricultural water to allow them to adequately manage and plan for current and future needs. To accomplish this activity, the State needs improved estimates of water balance components, including improved measurement of crop consumption. This information is required so the State can adequately update the State Water Plan, make decisions about future storage and conveyance investments, determine whether basins are over-allocated, verify water transfers, and adjudicate water rights disputes.

The Department of Water Resources currently estimates crop consumption using indirect methods on a rotating frequency of approximately once every five years for each county. These estimates do not provide information on crop consumption during alternate years. They also are not validated on a large scale and could include error due to lack of information on localized crop consumption variability (such as crop stress, microclimates or other site-specific factors). These uncertainties are of particular concern, given that crop consumption accounts for a significant portion of California's total water use.

RECOMMENDATION

It is appropriate to implement crop water consumption measurement at the high level*—in other words, to incorporate into the State's current estimation procedure the use of satellite-generated remote-sensing of evaporative water consumption, with a monthly time-step, during the full growing season. It is also appropriate for the data to be housed in a state repository.

EXPECTED IMPACT

This measurement approach is not expected to have a direct impact on water users. It does, however, represent a major change in how crop consumption is measured in California. Annual cost of measurement, beyond current state outlays, would be a minimum of \$500,000 and would likely be borne by state and federal water agencies.

FOLLOW-ON NEEDS

The Panel believes the additional cost for this level of measurement may prove substantially higher than has so far been projected in the technical analysis to date. Accordingly, in moving forward with this definition, the Panel recommends that the Authority reconfirm the incremental costs associated with measurement at the high level and amend its costs analysis, as necessary.

Additionally, the Panel notes that—to maximize benefits—changes to the measurement of crop consumption need to be coupled with improved accuracy of surface water diversions and groundwater use.

Finally, the Panel believes measurement at the high level may serve other local or regulatory purposes and recommends that the Authority more fully explore and articulate these potential benefits.

* The Panel recognizes that there are many different strategies for measuring crop water consumption. The analysis defined three discrete levels—basic, high and highest technically practical—to provide a consistent basis for the analysis of costs and benefits.

PANEL REPORT

Surface Water Diversions

ISSUE

State and federal agencies need accurate information on the sources and destinations of agricultural water to allow them to adequately manage and plan for current and future needs. To this end, the State needs improved estimates of water balance components, including improved measurement of surface water diversions. This information is required so the State can adequately update the State Water Plan, make decisions about future storage and conveyance investments, determine whether basins are over-allocated and adjudicate water rights disputes.

The State—through the State Water Resources Control Board—receives limited diversion data from water rights permits. However, the completeness, consistency and accuracy of these reports does not now allow state or federal water management agencies to quantify the amount of water diverted. Quantification of diversions would greatly improve the credibility of and confidence in ongoing water resource initiatives, such as the Bay-Delta Program's integrated storage investigation.

RECOMMENDATION

It is appropriate to measure all major surface water diversions at the highest technically practical level*—in other words, using flow-totaling devices and, if necessary, data loggers and telemetry. It is also appropriate for data to be managed locally and reported to the State.

EXPECTED IMPACT

The impact to water users is expected to be minimal since more than 80% of major surface water diversions are already at the highest technically practical level. Local agencies and the State will have expanded data management requirements. Where upgrades are needed, incremental costs on an annual basis are expected to range between \$1,000 and \$8,000 per diversion point. The total statewide incremental cost is expected to range from \$75,000 to \$125,000 per year.

FOLLOW-ON NEEDS

In moving forward with this definition, the Panel recommends that the Authority more clearly define what it means by "major diversions." It further recommends that the Authority confirm the data management costs, if any, associated with those diversions already at the highest technically practical level and amend its costs analysis, as necessary.

Additionally, the Panel notes that although these measurements are necessary, the State would derive even more benefit if groundwater use and crop water consumption measurements are also improved.

* The Panel recognizes that there are many different strategies for measuring surface water diversions. The analysis defined three discrete levels—basic, high and highest technically practical—to provide a consistent basis for the analysis of costs and benefits.

Return Flow

ISSUE

State and federal agencies need accurate information on the sources and destinations of agricultural water to allow them to adequately manage and plan for current and future needs. To this end, the State needs improved estimates of water balance components, including improved information on return flows. This information is required so the State can adequately update the State Water Plan, make decisions about future storage and conveyance investments, verify water transfers and determine the potential for agricultural water conservation to contribute to water quality and in-stream flow and timing objectives.

However, the technical analysis suggests there is a lack of information regarding the location, distribution and type of existing return flow measurement points. There is also a lack of information on the number and type of return flow sites required to adequately collect the needed information. Given these constraints, the Panel concludes there is insufficient information to articulate credible statewide measurement requirements.

RECOMMENDATION

It is appropriate to measure return flow. However, given the lack of information, it is not yet possible to develop a statewide or even region-by-region definition of appropriate measurement for return flow.

EXPECTED IMPACT

There is no expected direct impact to water users at this time, as the State would be responsible for this comprehensive review.

FOLLOW-ON NEEDS

The Panel recommends that the State undertake a comprehensive review to determine existing return flow measurement needs focusing on location specific return flow information requirements. Wherever possible, the analysis should build on existing data sets.

PANEL REPORT

Water Quality

ISSUE

State and federal agencies need accurate information on the existing and desired water quality of agricultural surface and subsurface return flows. This information is required so the State can adequately update the State Water Plan and determine the potential for agricultural water conservation to contribute to water quality objectives.

However, the technical analysis suggests there is a lack of centralized information regarding the location, distribution and type of existing water quality measurement sites. There is also a lack of information on the number and type of water quality measurement sites required to adequately collect the needed information. Given these constraints, the Panel concludes there is insufficient information to articulate credible statewide agricultural water quality measurement requirements.

RECOMMENDATION

It is appropriate to measure water quality. However, given the lack of information, it is not yet possible to develop a statewide or even region-by-region definition of appropriate measurement for water quality.

EXPECTED IMPACT

There is no expected direct impact to water users at this time, as the State would be responsible for this comprehensive review.

FOLLOW-ON NEEDS

The Panel recommends that the State undertake a comprehensive review to determine existing water quality measurement needs focusing on location specific return flow information requirements. Wherever possible, the analysis should utilize existing information sources such as the U.S. EPA's 303(d) list, the State Water Resources Control Board's watershed initiative and the Regional Water Quality Control Boards' Basin Plans.

In-Stream Flows

ISSUE

State and federal agencies need accurate information on the sources and destinations of agricultural water to allow them to adequately manage and plan for current and future needs. To this end, the State needs improved estimates of water balance components, including improved information on in-stream flows. This information is required so the State can adequately update the State Water Plan, make decisions about future storage and conveyance investments and determine the potential for agricultural water conservation to contribute to in-stream flow and timing objectives.

However, the analysis suggests there is a lack of information regarding the number and location of in-stream flow measurement sites required to adequately collect the needed information. Given these constraints, the Panel concludes there is insufficient information to articulate credible statewide in-stream flow measurement requirements.

RECOMMENDATION

It is appropriate to measure in-stream flow. However, given the lack of information, it is not yet possible to develop a statewide or even region-by-region definition of appropriate measurement for in-stream flow measurement.

EXPECTED IMPACT

There is no expected direct impact to water users at this time, as the State would be responsible for this comprehensive review.

FOLLOW-ON NEEDS

The Panel recommends that the State undertake a comprehensive review to better determine its needs for the number and location of additional in-stream flow measurement sites. Wherever possible, the analysis should build on existing information from U. S. Geologic Survey, California Data Exchange Center and local and regional agencies. In addition, the Panel recommends that this analysis begin with an assessment of the costs and benefits of restoring recently discontinued USGS stream gauging stations.

**THE TECHNICAL REPORT AND APPENDICES ASSOCIATED
WITH THIS REPORT MAY BE FOUND ON THE
CALIFORNIA BAY-DELTA PROGRAM'S WEB SITE:**

WWW.CALWATER.CA.GOV

California Bay-Delta Authority

Staff Definition of Appropriate Urban Water Use Measurement

**For Discussion at the February 18, 2004 Meeting of
the Water Use Efficiency Subcommittee**

Definition

Appropriate Urban Water Use Measurement

California Bay-Delta Authority

Contents

The outline for the Draft Definition of Appropriate Urban Water Use Measurement is as follows:

Section	Page #
Introduction	2
Background	2
Structure and organization of document	2
Guiding perspective and considerations	3
Process approach	3
Anticipated next steps	4
Definition of terms	5
Definition of Appropriate Measurement for Urban Water Systems	6
I. State standards and protocols for recording and reporting urban water use	6
II. Measurement of urban water uses	8
A. Urban water purveyor water sources and production	8
B. Urban water purveyor customer water uses	10
C. Urban wastewater discharger wastewater collection and discharge	14
D. Urban groundwater use	16
III. Reporting of urban water uses	19
A/B. Urban water purveyor reporting to State of California	19
C. Urban wastewater discharger reporting to State of California	22
IV. Urban water use research program	24
Appendices	26
1. Participants – Staff Work Group on Urban Water Use Measurement	26
2. Participants – June 3, 2002 Urban Water Measurement “Brainstorming” Session	27

Introduction

Background

This document constitutes the California Bay-Delta Authority's (Authority or CBDA) proposed definition of appropriate urban water use measurement.

The impetus for addressing this topic stems from longstanding stakeholder concerns over the increasing scarcity of California's water resources and recognition of the need for more complete and accurate measurement of urban and agricultural water deliveries. Improved measurement along these lines can assist state and federal agencies in their efforts to achieve the following four key *water management objectives*:

- Provide better information on statewide and regional water use to support planning;
- Allow users to undertake and demonstrate the effects of water use efficiency measures;
- Facilitate valid water transfers; and
- Help the State more effectively administer the existing water rights system.

Recognizing the potential impact of water use measurement on these overarching objectives and the intense stakeholder interest in this topic, the August 2000 CALFED Record of Decision (ROD) called for the CBDA to produce a definition of what it termed "appropriate" measurement of urban water use. The ROD also called for CBDA staff to recommend legislative and/or other strategies, as appropriate, to bolster the current approach.

Structure and organization of document

The proposed definition of appropriate urban water use measurement is structured into four main sections as follows:

- I. State standards and protocols for recording and reporting urban water use
- II. Measurement of urban water uses
 - Urban water purveyor water sources and production
 - Urban water purveyor customer water uses
 - Urban wastewater discharger wastewater collection and discharge
 - Urban groundwater use
- III. Reporting of urban water uses
 - Urban water purveyor reporting to State of California
 - Urban wastewater discharger reporting to State of California
- IV. Urban water use research program

Each of these sections and sub-sections begins by defining the Authority's current thinking on what constitutes an appropriate level, amount, or reporting of urban water use measurement. This is followed by discussion of: 1) the justifications for the

proposed definition, 2) expected impacts (mostly cost-related), and 3) follow-on considerations. The follow-on considerations will be addressed in the development of an implementation approach (see companion Draft Implementation Approach document).

Guiding perspective and considerations

The perspective by which Authority staff and consultants have approached the task of defining “appropriate” urban water use measurement has been guided in large part by the following question: What level, form, and/or process of urban water use measurement is necessary to better achieve state and federal water management objectives related to planning, allocation, transfer, and water use efficiency?

Authority staff and consultants also based their proposed definition of appropriate measurement of urban water use on the following additional key considerations:

- Declared policy of state of California
- Industry practice and standards
- Empirical evidence demonstrating the efficacy of the proposed measurement definition
- Assessment of need (based upon meetings and interviews with experts in the field as well as background research)
- Prioritization of flow information over water quality information¹
- Practical and achievable steps capable of yielding meaningful benefits to state water management objectives
- Need for an adaptive management approach

Process approach

To inform this proposed definition, Authority staff and consultants have drawn upon the expertise and advice of broad stakeholder and technical expert communities as follows:

- In the summer and fall of 2002, the Authority conducted stakeholder interviews with 25 individuals representing a cross-section of water suppliers, environmental organizations, CALFED agencies and partners, business groups, citizen groups, and consultants.
- In the spring of 2003, Authority staff convened a multistakeholder Staff Work Group on Urban Water Use Measurement to begin providing individual feedback on Authority staff’s proposed definition of appropriate urban water use measurement (see Appendix 1 for a list of the Staff Work Group members).
- In the summer of 2003, Authority staff convened a meeting among urban water use technical and policy experts to better establish the specific information needs driving considerations of urban water use measurement. Authority consultants

¹ The decision to prioritize flow information over water quality information arose out of consultations with representatives of DWR, DHS, and SWRCB. It is assumed that water quality measurement and reporting are currently adequately handled.

also conducted a series of targeted follow-up interviews to provide additional clarity from the perspective of state urban water managers and planners (see Appendix 2 for a list of the meeting attendees and the individuals interviewed).

- In the fall of 2003, Authority staff reconvened the Work Group on Urban Water Use Measurement to further assist Authority staff efforts to define appropriate measurement and develop an associated implementation approach.

Anticipated next steps

Authority staff have drawn upon this Definition of Appropriate Urban Water Use Measurement and the definition of appropriate agricultural water use measurement produced by the Independent Panel on Appropriate Measurement of Agricultural Water Use to develop a proposed implementation approach for all water use measurement in the state of California. This document is entitled Staff Proposed Implementation Approach for Agricultural and Urban Water Use Measurement. This process has been informed by the Urban Water Use Measurement Work Group mentioned above as well as a corresponding ad hoc stakeholder work group focused on agricultural water use measurement.

Authority staff intends to take the additional next steps toward implementation of a broadly supportable approach to water use measurement:

- *Conduct broader Authority and public reviews.* Authority staff to submit the Staff Proposed Implementation Approach for Agricultural and Urban Water Use Measurement for review by and discussion with Authority advisory and decision-making bodies as well as the public. Final revisions will be made at that time.
- *Initiate legislative discussions.* CBDA staff to work with implementing agencies and state policymakers, as necessary, to put forward an implementation approach.

Definition of Terms

Water Meter - includes any suitable water measuring device or facility that measures or determines the volumetric flow of water.²

Water Service - means the sale, lease, rental, furnishing, or delivery of water for beneficial use, and includes, but is not limited to, contracting for the sale, lease, rental, furnishing, or delivery of water, except bottled water.³

Water Purveyor - means any person who furnishes water service to another person.⁴

Urban Water Purveyor - means a water purveyor that provides water service for domestic, municipal, or industrial uses.⁵

Urban Wastewater Discharger - means any discharger subject to an NPDES permit or Waste Discharge Requirement.

NPDES Permit - is a federal permit governing discharge of wastewater to surface waters authorized by the federal Clean Water Act. (In California, authority to issue NPDES permits has been delegated to the State Water Resources Control Board.)

Waste Discharge Requirements - is the state "permit" governing the discharge of wastewater to surface or groundwater in California authorized by the state Porter-Cologne Water Quality Control Act⁶ (For surface water discharges, the State Water Resources Control Board/Regional Water Quality Control Boards issues a combined NPDES permit and WDR; for ground water, only a WDR is issued.)

Water Reclamation Requirements - is the state "permit" governing wastewater reclamation activities in California issued by the Regional Water Quality Control Boards in lieu of a WDR.⁷

² Cal. Water Code, § 516.

³ Cal. Water Code, § 515.

⁴ Cal. Water Code, § 512. "Person" means any individual, firm, association, partnership, corporation, or public entity of any kind." Cal. Water Code, § 513. "Public entity" includes a city, county, city and county, whether general law or chartered, a district, board, commission, bureau, authority, agency, department, division, section, any other political subdivision of the state of any kind, or the state." Cal. Water Code, § 514.

⁵ As such, "Urban Water Purveyors" are not confined to urban areas.

⁶ Cal. Water Code, § 13374.

⁷ Cal. Water Code, § 13523.

Definition of Appropriate Measurement for Urban Water Systems

I. State Standards and Protocols for Recording and Reporting Urban Water Use

Appropriate measurement of urban water uses requires the state to develop the following:

- a) *Data collection guidelines and protocols for urban water purveyors and wastewater dischargers. At a minimum, the guidelines and protocols need to address (1) estimation of service area population; (2) classification of water supply source measurement data; (3) classification of customer water use measurement data; (4) classification of wastewater source and disposal measurement data; (5) classification of water service rates and charges; and (6) estimation of service area economic (including income) data.*
- b) *Systems for water purveyors and wastewater dischargers to report urban water use data annually to the state.*
- c) *Systems to disseminate urban water use data to local, regional, state, and federal water planning and management agencies and authorities; water purveyors and customers; research institutions and universities; and the general public.*
- d) *Guidelines for ensuring the accuracy of the measurement data.*

Justification of Definition:

1. Most urban water and wastewater purveyors in California currently collect vast amounts of data to manage their own systems. These purveyors also report some of these data to a variety of state and federal water management agencies. These data are not always readily obtainable, comparable, or understandable by water managers outside of these utilities. Nor can state/federal agencies readily share the data that they each collect. There is a generally recognized need to develop data collection standards and protocols—i.e., determine what kinds of data need to be collected, how this will be done and how this information will be transmitted to others, and measures for QA/QC. Standardizing to some degree how urban water purveyors compile and provide data to state and federal water planners is an essential step in achieving the state's overarching policy objective of determining and communicating the quantities of water in use throughout the state to the maximum extent reasonable.⁸ The absence of standards for urban water use data collection and reporting greatly diminishes the value of this data for regional and statewide planning and water resource management.
2. The adoption of standards and protocols would likely lead to reporting efficiencies and may well diminish the reporting burden on local purveyors.

⁸ Cal. Water Code, § 520. The California State Legislature has declared that, "pursuant to the primary interest of the people of the state to put the limited available supplies of water in this state to beneficial use to the fullest extent of which they are capable, and to prevent waste, unreasonable use, or unreasonable method of use, it is necessary to determine the quantities of water in use throughout the state to the maximum extent that is reasonable to do so."

Expected Impacts:

1. The state would incur costs to develop state water data collection guidelines and protocols; provide technical assistance to water and wastewater purveyors implementing the guidelines and protocols; administering data collection processes; and enforcing adoption of any standards. Federal funds for developing a statewide reporting system for wastewater discharges subject to NPDES permitting requirements have already been committed. A statewide system for NPDES reporting is projected to be operational in 2005.⁹
2. Some, possibly most, urban water purveyors and wastewater dischargers would incur costs to conform their data collection and reporting systems to the guidelines and protocols.
3. The State as well as urban water purveyors might incur potential cost benefits if the standards and protocols developed enable combination of the multiple existing planning and reporting processes (e.g., DWR, DHS, USBR, CUWCC).

⁹ Personal Communication with State Water Resources Control Board; Personal Communication with Environmental Protection Agency, Region 9.

II. Measurement of Urban Water Uses

A. Urban water purveyor water sources and production

*Appropriate measurement of urban water purveyor water sources and production requires the following:**

- a) *Use of suitable water meters at all water source and production points, including source water intakes, treatment works, and storage reservoir outlets. Source water includes surface water, groundwater, and recycled water. A suitable water meter is one that is in compliance with relevant standards of the American Water Works Association and any relevant state standards and legal requirements.*
- b) *Source and production meters to be read at least once each month.*
- c) *Source and production meters to be sized appropriately, well maintained, and periodically calibrated to ensure reasonable accuracy.*
- d) *Source and production measurement data to be recorded using standard measurement units and stored by the urban water purveyor using a suitable database management system. Data structures and classification schemes should conform to relevant state water data collection guidelines and protocols (see Section I).*

** Nothing in this definition should be construed to supercede existing state and federal authority and requirements embodied in or through the federal Safe Drinking Water Act and the California Safe Drinking Water Act to impose measurement, monitoring, and reporting requirements on water quality subject to regulation under these acts.*

Justification of Definition:

1. **The California State Legislature has declared that, “pursuant to the primary interest of the people of the state to put the limited available supplies of water in this state to beneficial use to the fullest extent of which they are capable, and to prevent waste, unreasonable use, or unreasonable method of use, it is necessary to determine the quantities of water in use throughout the state to the maximum extent that is reasonable to do so.”¹⁰ Volumetric measurement of urban water purveyor water sources and production is a necessary and reasonable action to determine the quantities of water in use by urban areas in California.**
2. **The California Public Utilities Commission (CPUC or Commission), pursuant to General Order 103, requires water systems within its jurisdiction to install a suitable measuring device, or otherwise determine production, at each source of supply in order that a record may be maintained of the quantity of water produced by each source. It further requires that at least once each month, the quantity produced from each source of supply be determined. Twelve-month totals by sources are to be recorded and transmitted to the Commission in the utility’s annual report to the Commission.¹¹**
3. **The California Department of Health Services (DHS) issues permits to public water systems. Among the conditions which must be demonstrated for issuance of a permit is that the water system “assure a reliable and adequate supply of**

¹⁰ Cal. Water Code, § 520.

¹¹ California Public Utilities Commission, General Order 103, Rules Governing Water Service Including Minimum Standards for Design and Construction (as amended March 9, 1994), § I.1.a.

water at all times that is pure, wholesome, potable and does not endanger the health of consumers.”¹² During DHS preparation of a technical report in support of the permit, the DHS engineer reviews each water source. A water system cannot add a water source without applying for and receiving a permit amendment. As a result of the strong linkage of water source with permit issuance, the water systems are required to correlate their production capacity with the existing demand. DHS requires water systems to report annually on the aggregate quantity of water produced and/or delivered.

4. As a matter of policy, the American Water Works Association (AWWA) recommends “that every water utility meter all water taken into its system and all water distributed from its system to its users.” AWWA policy further states that “[m]etering of all water services is an effective means of improving and maintaining the close control of water system operations necessitated by the increasing difficulty in maintaining and providing adequate water supplies and the increasing costs of providing water service to consumers.... Metering provides a database for system performance studies, facility planning, and the evaluation of conservation measures. It also improves accountability for water delivered through the system and, therefore, facilitates management decisions. Periodic performance testing, repair, and maintenance of meters are essential parts of an effective metering program.”¹³
5. Preparing urban water system water balances, assessing and pinpointing system water losses, and characterizing and managing system water demands require accurate measurement of source water intake, production, and distribution. Empirical evidence conclusively demonstrates the necessity of frequent flow measurement of source water intake, production, and distribution to undertake these management activities.¹⁴
6. Meter accuracy is a function of correct sizing and proper maintenance. Incorrectly sized and/or poorly maintained source and production meters will result in inaccurate water measurement data.¹⁵

Expected Impacts:

1. Minimal. The above definition is consistent with standard water industry practice in California. Urban water purveyors may incur some cost to conform their data collection and storage systems to relevant state water data collection guidelines and protocols.

¹² Reference Health and Safety Code 116540.

¹³ Adopted by the Board of Directors of the AWWA on Jan. 26, 1969, and revised on June 15, 1980, reaffirmed June 22, 1986, revised June 6, 1993, and June 21, 1998.

¹⁴ Farley, Malcom and Stuart Trow, Losses in Water Distribution Networks, IWA Publishing, 2003.

¹⁵ Ibid.

B. Urban water purveyor customer water deliveries

Appropriate measurement of urban water purveyor customer water deliveries requires the following:

- a) *Use of suitable water meters at all customer connections to the water delivery system. A suitable water meter is one that is in compliance with relevant standards of the American Water Works Association and any relevant state standards and legal requirements.*
- b) *Customer meters to be read at least monthly if possible, and under no circumstances less frequently than bi-monthly.*
- c) *Customer meters to be sized appropriately, well maintained, and periodically calibrated to ensure reasonable accuracy.*
- d) *Customer measurement data to be recorded using standard measurement units and stored by the urban water purveyor using a suitable database management system. Data structures and customer classification schemes should conform to relevant state water data collection guidelines and protocols (see Section I).*
- e) *Measurement data on water consumed to be forwarded to the customer for the customer's information. This should include previous year data for the same period.*

** Nothing in this definition should be construed to supercede existing state and federal authority and requirements embodied in or through the federal Safe Drinking Water Act and the California Safe Drinking Water Act to impose measurement, monitoring, and reporting requirements on water quality subject to regulation under these acts.*

Justification of Definition:

1. **The California State Legislature has declared that, “pursuant to the primary interest of the people of the state to put the limited available supplies of water in this state to beneficial use to the fullest extent of which they are capable, and to prevent waste, unreasonable use, or unreasonable method of use, it is necessary to determine the quantities of water in use throughout the state to the maximum extent that is reasonable to do so.”¹⁶ Volumetric measurement of urban water purveyor customer water uses is a necessary action to determine the quantities of water used for domestic, municipal, and industrial purposes.**
2. **The California State Legislature has declared that “water furnished or used without any method of determination of the quantities of water used by the person to whom the water is furnished has caused, and will continue to cause, waste and unreasonable use of water, and that this waste and unreasonable use should be identified, isolated, and eliminated.”¹⁷ It has also declared that “waste or unreasonable use of water imposes unnecessary and wasteful consumption of energy to deliver or furnish the water, and it is necessary, therefore, to determine the quantities of water in use throughout the state to the maximum extent that it is reasonable to do so in order to reduce that energy consumption.”¹⁸**

¹⁶ Cal. Water Code, § 520.

¹⁷ Cal. Water Code, § 521.

¹⁸ Cal. Water Code, § 522.

3. Since 1991, California law has required meters on all new potable water connections.¹⁹ The 1991 law does not include provisions that the meters be read, just installed. By limiting the metering requirement only to new connections, implementation of the law has resulted in dual measurement systems within some water systems. It has been suggested that this has at best complicated and at worst discouraged a unified measurement and pricing policy to isolate and eliminate waste and unreasonable use of water within these water systems, thereby thwarting the original intent of the legislation.
4. As a matter of policy, the American Water Works Association (AWWA) recommends “that every water utility meter all water taken into its system and all water distributed from its system to its users.” AWWA policy further states that “[m]etering of all water services is an effective means of improving and maintaining the close control of water system operations necessitated by the increasing difficulty in maintaining and providing adequate water supplies and the increasing costs of providing water service to consumers.... Metering provides a database for system performance studies, facility planning, and the evaluation of conservation measures. It also improves accountability for water delivered through the system and, therefore, facilitates management decisions. Periodic testing, repair, and maintenance of meters are essential parts of an effective metering program.”²⁰
5. Federal law enacted under the Central Valley Project Improvement Act (CVPIA) makes universal metering of urban CVP contractors a condition of CVP contract renewal. The United State Bureau of Reclamation (Bureau or USBR) deems metering of customer deliveries coupled with volumetric pricing an essential demand management practice for CVP M&I contractors. Metering coupled with volumetric pricing is the only non-exemptible Best Management Practice (BMP) required under Bureau Conservation Plan Requirements. Based on review of demands between metered and unmetered service areas, the Bureau has concluded that metering can reduce M&I demands by 20% to 25%. This level of demand reduction is consistent with findings from other empirical studies.²¹
6. The California Public Utilities Commission, pursuant to General Order 103, recommends all water sold by a utility be on the basis of metered volume sales.²²
7. Retrofitting unmetered customer connections with meters coupled with volumetric pricing is a BMP under the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU). Urban water purveyors providing water service to more than 70% of the state’s populace have

¹⁹ This law became effective January 1, 1992.

²⁰ Adopted by the Board of Directors of the AWWA on Jan. 26, 1969, and revised on June 15, 1980, reaffirmed June 22, 2986, revised June 6,1993, and June 21, 1998.

²¹ CALFED Water Use Efficiency Program Staff Work Group on Urban Water Use Measurement -- Compilation of Background Information on Current Urban Water Use Measurement Practices, Costs, and Benefits. March 31, 2003.

²² California Public Utilities Commission, General Order 103, Rules Governing Water Service Including Minimum Standards for Design and Construction (as amended March 9, 1994), § I.1.a. It should be noted that under General Order 103 the Commission has discretion to waive metering requirements for a water utility under its jurisdiction.

signed the MOU. Retrofitting unmetered customer connections with meters coupled with volumetric pricing is also a BMP under the Water Forum Agreement.

8. Empirical evidence conclusively demonstrates that metered water service coupled with volumetric pricing can reduce water demand by 20% to 25% or more.²³ These studies strongly indicate that metering customer uses discourages very low value water uses and wasteful practices.
9. Meter accuracy is a function of correct sizing and proper maintenance. Incorrectly sized and/or poorly maintained customer meters will under-read water flow and result in inaccurate water measurement data.²⁴ Because meters tend to under-read as they age, meter maintenance programs often can pay for themselves through recovered water sales revenue.

Expected Impacts:

1. Urban water purveyors with a large number of unmetered customer connections would incur capital costs to retrofit unmetered connections. It has been estimated that statewide retrofitting of unmetered connections would cost in the neighborhood of \$250 million.²⁵ Some of this cost would be recouped by water purveyor customers through avoided operation and water system expansion costs due to slower growth in demand. Most urban water purveyor service areas in California, particularly in coastal areas, are already universally metered. Large pockets of unmetered customer connections, however, remain in the Central Valley and Foothill regions. Thus, impacts of the definition would not be uniformly distributed across the state's urban water purveyors, but rather concentrated within a subset of urban water purveyors located mostly in the Central Valley.
2. Urban water purveyors with a large number of unmetered customer connections would incur O&M costs to operate and maintain the new meters. For some purveyors, the O&M costs may be significant.
3. Water purveyors could incur costs to conform to state water data collection guidelines and protocols. Water purveyor data collection and storage systems are designed primarily for customer billing, financial accounting and water system management purposes. These systems are quite heterogeneous across

²³ CALFED Water Use Efficiency Program Staff Work Group on Urban Water Use Measurement -- Compilation of Background Information on Current Urban Water Use Measurement Practices, Costs, and Benefits. March 31, 2003.

²⁴ Ibid.

²⁵ CALFED Water Use Efficiency Program Staff Work Group on Urban Water Use Measurement -- Compilation of Background Information on Current Urban Water Use Measurement Practices, Costs, and Benefits. March 31, 2003.. This estimate assumed an average retrofit cost of \$600 per meter and did not account for any upgrades to the delivery network. The average cost per AF of water saved through meter retrofitting has been estimated at about \$350/AF. This estimate assumed an average retrofit cost of \$600 per meter, a 20% average reduction in demand, and a 15-year average useful life for a meter. Compared to recycling and desalination, with costs ranging from \$600 to \$1500 per AF, meter retrofitting would appear to be a cost-competitive alternative.

urban water purveyors. Many may need to be modified to some degree to conform to state water data collection guidelines and protocols.

4. Most urban water purveyors, especially those already metering customer connections, already deliver customer water use data to their customers via their billing systems. Those urban water purveyors with large numbers of unmetered customer connections would incur a cost to retrofit their billing systems to include customer water use data.

C. Urban wastewater discharger wastewater collection and discharge

*Appropriate measurement of urban wastewater requires the following:**

- a) *Use of suitable measurement devices at all effluent discharge points (including wastewater reclamation) capable of measuring and recording continuous flow. Use of monitoring equipment or methods, including, where appropriate, biological monitoring and effluent sampling methods as prescribed by NPDES permits, Waste Discharge Requirements, or Water Reclamation Requirements.*
- b) *Effluent and wastewater reclamation measurement data should be recorded and stored by the urban wastewater discharger using a suitable database management system. Data structures and classification schemes should conform to relevant permit/WDR requirements as well as state water data collection guidelines and protocols.*

** Nothing in this definition should be construed to supercede existing state and federal authority and requirements embodied in or through the federal Clean Water Act and state Porter-Cologne Water Quality Control Act to impose measurement, monitoring, and reporting requirements on wastewater discharges subject to regulation under these acts.*

Justification of Definition:

1. Measurement of discharges consistent with the above definition is necessary to implement, monitor, and enforce compliance with various provisions of the federal Clean Water Act (CWA) and state Porter-Cologne Water Quality Control Act.
 - a. The California Porter-Cologne Water Quality Control Act applies to both surface and groundwater and to both point and nonpoint sources. More narrowly, the federal CWA establishes a program to regulate point source discharges to surface waters under the National Pollutant Discharge Elimination System (NPDES). Discharges that are not subject to the CWA but that nonetheless have the potential to affect the quality of the waters of the state remain subject to regulation under the state's Porter-Cologne Water Quality Control Act, which was enacted earlier and is broader in scope than the federal CWA.
 - b. Under the Porter-Cologne Water Quality Control Act, the state regulates, in part, by requiring that persons proposing to discharge or reclaim wastewater first obtain Waste Discharge Requirements (WDRs), or Water Reclamation Requirements (as the case may be), from the state. U.S. EPA has delegated the NPDES program to the State of California to implement based on findings that the Porter-Cologne Water Quality Control Act is sufficiently equivalent to the federal Clean Water Act. Accordingly, state-issued WDRs also serve as federal NPDES permits for surface water discharges. [The terms "waste discharge requirements" and "NPDES permits" are often used interchangeably when they cover surface point sources.²⁶] WDRs and NPDES permits are issued and enforced by the Regional Water Quality Control Boards and, when necessary, are further enforced by the State Water Resources Control Board.

²⁶ Cal. Water Code, § 13374.

- c. Issued for varying durations, WDRs and NPDES permits contain monitoring and reporting provisions necessary to evaluate discharger compliance. Monitoring requirements generally include daily effluent flow measurement from the permitted facility along with a variety of water quality monitoring requirements specific to the effluent discharge of the facility and the water quality status of the receiving water body. Permitted dischargers generally submit monthly reports to their Regional Board on daily flow and various water quality parameters.
2. Quantification of discharges will facilitate estimation of urban water uses for statewide and regional planning.
3. Quantification of discharges and water quality assessments will also facilitate estimation of urban water recycling potential for statewide and regional planning.
4. Currently, state water planners do not have a good understanding of water withdrawal and consumption by self-supplied large industrial water users. Quantification of wastewater discharges from self-supplied industrial water users (where they have a separate discharge permit), coupled with information about facility water uses and processes, should facilitate estimation of urban uses for statewide and regional planning.
5. Measurement of effluent flow can by and large serve as a surrogate for influent flow into wastewater discharger facilities, given that the approximate volume of materials being extracted during the treatment process is known.

Expected Impacts:

1. Negligible. The above definition is consistent with standard wastewater industry practice in California. Urban wastewater dischargers may incur some cost to conform their data collection and storage systems to relevant state water data collection guidelines and protocols. However, the state and federal governments are already proceeding with development of a statewide NPDES reporting system and will start transitioning NPDES permit holders to this system in 2004 or 2005. Use of this system for non-NPDES WDRs will follow. Thus, the proposed definition does not represent a change in current or planned measurement and reporting of urban wastewater discharges.

D. Urban Groundwater Use

Appropriate measurement of urban groundwater use requires the following:²⁷

- a) Continuous regional characterization of groundwater net usage using two methods simultaneously: (1) development of detailed sub-basin hydrologic balances; and (2) the water table/specific yield method. [This is consistent with findings from the Agricultural Water Use Measurement Panel.]
- b) In cases of groundwater substitution transfers²⁸ where water is being transferred from urban users, continuous measurement (via totalizing flow or power meters²⁹) and monitoring of the groundwater wells involved. Measurement is to be focused on the transferring entity. [This is consistent with findings from the Agricultural Water Use Measurement Panel.]
- c) Measurement (and associated reporting) of individual groundwater extraction as required in adjudicated and managed basins.

Justification of Definition:

1. The California State Legislature has declared that, “pursuant to the primary interest of the people of the state to put the limited available supplies of water in this state to beneficial use to the fullest extent of which they are capable, and to prevent waste, unreasonable use, or unreasonable method of use, it is necessary to determine the quantities of water in use throughout the state to the maximum extent that is reasonable to do so.”³⁰ Quantification of groundwater use is a necessary and reasonable action to help facilitate local, state and federal agency water management and planning.
2. State water planners currently have an incomplete understanding of water withdrawal and consumption by groundwater users, including self-supplied users. Complete information is only being collected for adjudicated and managed basins—i.e., basins already determined to be at risk for overdraft. Improved measurement of net groundwater use in all sub-basins statewide will facilitate estimation of groundwater uses for non-adjudicated basins. This recommended approach represents an improvement in the consistency of the analytic rigor with which the groundwater resources of the state are assessed, and will serve to improve understanding of amounts used and the extent of overdraft. Additionally, where there is a proposal for a water transfer or a project converting land from an agricultural to an urban use (e.g., to a residential development exceeding 500 units), regions that have been measured consistent with the above definition will have improved data available in order to evaluate whether a factual basis exists to support legally required agency findings of fact.

²⁷ Measurement associated with groundwater banking project can be treated as a composite or hybrid of some of the disparate measurement challenges entailed in each of the numerous elements that make up the banking program.

²⁸ A groundwater substitution transfer is a water transfer involving the substitution of groundwater in lieu of surface water diversions. As such, it entails a reduction in surface water use which is offset with additional groundwater pumping.

²⁹ Measurement via totalizing flow meters is preferred over power meters, as power meters provide only an estimate of groundwater pumped.

³⁰ Cal. Water Code, § 520.

3. There is not currently sufficient evidence to support mandated measurement of all self-supplied urban groundwater uses. Before requiring such direct measurement, further research is needed to better characterize the scope of self-supplied groundwater users (number, impact on overall groundwater use, geographic distribution, etc.) and refine the costs and benefits associated with such measurement. This research is called out in Section IV of this definition. [This is consistent with the CBDA-convened Agricultural Water Use Measurement Panel's finding regarding direct measurement of agricultural groundwater use.]
4. Current practice requires direct measurement of groundwater extraction in managed or adjudicated basins. In any suit brought in any civil action in a federal or state court for determination of the rights to water, the court can order that the matter be referred to the State Water Resources Control Board, for resolution of any issue, including investigation and report on the physical facts involved. (Cal. Water Code, §§ 2000, 2001, 2075.) The SWRCB produces a report containing opinions, findings, and conclusions on the applicable law and facts. (Cal. Water Code, §§ 2011, 2012.) The report becomes evidence, before the reviewing court, of the issues referred and reported on. (Cal. Water Code, § 2019.) The SWRCB can also file an action in state court to restrict pumping, or to impose physical solutions, or both, pursuant to statutory procedures. (Cal. Water Code, § 2100.) In addition, individual right holders can turn to the courts to settle disputes. In any of these instances, the courts may appoint a watermaster to oversee implementation of the court's eventual judgment, including measurement and reporting of quantity of water used.
5. In connection with water transfers, California law typically requires that there be no injury to other legal users of the water. DWR has pointed to two steps that help ensure that this "no injury" standard will be satisfied. First, participants should determine the water available for transfer based on conditions that would exist absent the transfer. Second, participants should include real-time monitoring programs to trigger rapid response corrective actions to help avoid possible impacts as they may develop. The first set of measurements help establish a baseline for identifying the quantity available, but also can help ensure that the groundwater to be pumped is not hydrologically connected to the surface supply to be foregone. Thus, measurement, along with other factors such as distance between a well and surface supplies, can help ensure that it is a true transfer. Real-time monitoring is important not only to avoid injury, but also to avoid wrongly attributing adverse impacts to a transfer. That is, after a transfer has started, an adequate monitoring/measurement program can help participants shut off the wells involved in the transfer when they are causing adverse impacts and better know when neighbors' adverse impacts on their own wells are likely due to some other cause (e.g., ordinary seasonal or annual variation in water levels). In addition, the purchaser of water transferred will typically be purchasing it with a price based on volume delivered at a particular time of year when it is most needed. Thus, the purchaser will have it in their own self interest to insist on measurement by the transferor.

Given considerations such as these, DWR has developed nonregulatory guidance to shape its involvement in groundwater substitution transfers. Along with Reclamation where appropriate, DWR has instituted a program to require that adequate measurement and other steps be taken whenever one or more of the following situations exists in a proposed groundwater substitution transfer: (1) DWR is purchasing water; (2) DWR is an operator of facilities through which the transferred water is to be conveyed; or (3) DWR is a downstream user potentially injured by a proposed transfer.

Expected Impacts:

1. The expected impact on water users of measuring groundwater extraction in adjudicated basin is minimal, as this practice is already required by law and largely implemented.
2. The expected impact of net groundwater use measurement to water users are likely to be minimal. The proposed method of continuous regional characterization will mean higher state planning costs: roughly \$2 million additional per year. Where continuous measurement of well discharge is required in the case of a water transfer, opportunities may exist for costs to be internalized into the transaction costs borne by the participants to the transfer.
3. As water basins become at risk for overdraft and are recategorized as adjudicated or managed, the expected impact on water users becomes large, as this requires all water users to measure groundwater extraction.

III. Reporting of Urban Water Uses

A/B. Urban water purveyor reporting to State of California

Appropriate measurement of urban water uses requires urban water purveyors to report annually the following to the State of California:*

- a) An estimate of service area population that conforms to state water data collection guidelines and protocols
- b) The number of metered and unmetered customer connections subtotaled by customer class definitions conforming to state water data collection guidelines and protocols.
- c) Water production by month subtotaled by water source definitions conforming to state water data collection guidelines and protocols.
- d) Annual water deliveries subtotaled by customer class definitions conforming to state water data collection guidelines and protocols.
- e) Monthly or bi-monthly water deliveries, according to meter read frequency, subtotaled by customer class definitions conforming to state water data collection guidelines and protocols.
- f) Water service rates, rate design (i.e., inclining block rates, declining block rates, or uniform rates), and charges (fixed and commodity) in effect for report year.

* Nothing in this definition should be construed to supercede existing state and federal authority and requirements embodied in or through the federal Safe Drinking Water Act and the California Safe Drinking Water Act to impose measurement, monitoring, and reporting requirements on water quality subject to regulation under these acts.

Justification of Definition:

1. The California State Legislature has declared that, “pursuant to the primary interest of the people of the state to put the limited available supplies of water in this state to beneficial use to the fullest extent of which they are capable, and to prevent waste, unreasonable use, or unreasonable method of use, it is necessary to determine the quantities of water in use throughout the state to the maximum extent that is reasonable to do so.”³¹
2. The California State Legislature has declared that “the people of the state have a primary interest in the orderly and coordinated control, protection, conservation, development, and utilization of the water resources of the state by all individuals and entities and that it is the policy of the state that The California Water Plan, with any necessary amendments, supplements, and additions to the plan, is accepted as the master plan which guides the orderly and coordinated control, protection, conservation, development, management and efficient utilization of the water resources of the state.”³²
3. It is the responsibility of the Department of Water Resources to “plan for the orderly and coordinated control, protection, conservation, development, and utilization of the water resources of the state ... “ and to update this plan – The

³¹ Cal. Water Code, § 520.

³² Cal. Water Code, § 10005.

California Water Plan -- “on or before December 31, 2003, and every five years thereafter.”³³ The Department of Water Resource is required by law to release assumptions and other estimates used for the California Water Plan, including, but not limited to, the following:

- a. Current and projected population
 - b. Current and projected water use for all of the following:
 - Interior uses in a single-family dwelling.
 - Exterior uses in a single-family dwelling.
 - All uses in a multifamily dwelling.
 - Commercial uses.
 - Industrial uses.
 - Parks and open spaces.³⁴
4. As part of its 2003 California Water Plan Update, the Department of Water Resources is now instituting a Water Portfolio approach to state water planning and management. While past California Water Plan water uses and supply data have been based on long-term averages, the Water Portfolio approach is based instead on actual water uses and supplies. This approach is founded on the development of annual water portfolios, and these are best supported by annual reporting of water use data.
5. The Department of Water Resources administers annually a survey of about 700 urban water purveyors to collect the kinds of data listed in the proposed definition.³⁵ The Department has indicated that the present approach suffers from the following shortcomings:
- a. Individual surveys are frequently incomplete or improperly filled out. Unmetered service areas in particular are unable to provide data on deliveries to different customer classes or must estimate these deliveries.
 - b. About 50% of responses don't report water deliveries by customer class either because they don't maintain records on water use by customer class or because their customer classes don't match the survey's categories. As an example, many systems classify multi-family residential water use as commercial whereas the production survey provides a separate category for this use. Guidelines and protocols for classifying urban water users are needed to provide state planners with consistent and comparable data on urban water uses.
 - c. DWR considers the population estimates provided by survey respondents to be unreliable. Experience suggests that many (perhaps most) urban water suppliers do not provide reliable estimates of the total population served by

³³ Cal. Water Code, § 10004.

³⁴ Ibid.

³⁵ One exception is information about water rates and charges, which is currently not part of the survey. Department staff has indicated that information about water rates and charges is needed to make projections of future water demands by customer class for the California Water Plan.

their system. Thus per capita use estimates derived from the data can be inaccurate. Guidelines and protocols for estimating service area population are needed to provide state planners with reliable population estimates.

- d. The survey does not always provide good geographic representation of urban water uses. In particular, the survey frequently under-samples less densely populated areas. More comprehensive data collection is required to provide adequate representation statewide.
- e. The survey does not collect water use information for self-supplied residential, commercial, or industrial water users. Because many of these users are in rural areas this compounds the problems associated with under-sampling discussed previously.
- f. The survey currently does not collect information about water rates or costs. The Department requires information about rates and cost trends to forecast how costs are changing and how this might affect water demand.

The proposed definition will provide the Department of Water Resources with more comprehensive and accurate data on urban water uses needed for statewide water planning.

6. Data to be collected and reported under this definition is needed by urban water purveyors subject to regional and urban water management planning requirements under state water code sections 10530 – 10546 and 10610 – 10657. The Urban Water Management Planning Act calls for urban source and delivery data to be submitted with monthly specificity. However, as purveyors are only required to submit Urban Water Management Plans every five years, this leaves significant gaps in the availability of this data.
7. The Department of Health Services (DHS) currently requires water sources and deliveries data annually from virtually all urban water suppliers. However, the DHS system only collects this data with annual specificity. Monthly (or bi-monthly, in the case of deliveries) data is needed to show seasonal variation and allow computation of both indoor and outdoor water use.

Expected Impacts:

1. Reporting requirements for some urban water purveyors will increase. Not all urban water purveyors participate in DWR's current survey.
2. Urban water purveyors may incur costs to conform their data collection and reporting system to state water data collection guidelines and protocols.

C. Urban wastewater discharger reporting to State of California

*Appropriate measurement of urban water uses requires urban wastewater dischargers report at least annually the following to the State of California:**

- a) *Conditions and limits of discharge (including wastewater reclamation) specified in relevant NPDES permits, waste discharge requirements, or water reclamation requirements.*
- b) *Volume of effluent from each discharge location.*
- c) *Effluent discharge and receiving water body quality measurements as specified by the relevant NPDES permit or WDRs.*

**Nothing in this definition should be construed to supercede existing state and federal authority or requirements embodied in or through the federal Clean Water Act and state Porter-Cologne Water Quality Control Act to impose measurement, monitoring, and reporting requirements on wastewater discharges subject to regulation under these acts.*

Justification of Definition:

1. Water Code section 13166 requires the State Water Resources Control Board, with the assistance of the Regional Boards, “to prepare and implement a statewide water quality information storage and retrieval program. Such program shall be coordinated and integrated to the maximum extent practicable with data storage and retrieval programs of other agencies.”
2. State compilation of NPDES permit information is needed to fulfill the state’s NPDES permit reporting obligations under Title 33, Chapter 26, Subchapter IV of the US Federal Code.
3. Compilation of wastewater discharge data will facilitate estimation of urban water uses for statewide and regional planning. Currently the Regional Boards in a variety of ways house data on permitted discharges. Mostly this data is collected and filed using paper-based reporting systems. Little of this information is currently stored in electronic format, rendering much of it inaccessible from a practical standpoint. State data warehousing would enable currently collected data on wastewater discharges to be used for a variety of regional, state, and federal water management purposes, including, but not limited to: (1) monitoring, reporting, and enforcement responsibilities specified by CWA and Porter-Cologne Act; (2) State Water Plan updates; and (3) regional and state recycled water planning.
4. Currently, state water planners do not have good understanding of water withdrawal and consumption by privately- or self-supplied large industrial water users, especially when the source is groundwater. Quantification of wastewater discharges from self-supplied industrial water users (where they have a separate discharge permit), coupled with information about facility water uses and processes, should facilitate estimation of urban uses for statewide and regional planning. While discharge data from these permitted facilities is collected by the Regional Boards it is not centrally stored or accessible. State data warehousing would allow access to this data.

Expected Impacts:

1. Minimal. The state and federal governments are already proceeding with development of a statewide NPDES reporting system and will start transitioning NPDES permit holders to this system in 2004 or 2005. Use of this system for non-NPDES WDRs will follow. Thus the proposed definition does not represent a change in planned measurement and reporting of urban point source discharges.

IV. Urban water use research program

Appropriate measurement of urban water uses requires the state to implement and sustain an urban water use research program.

Highest priority: The following research areas have been identified as having significant potential impacts on state/federal water management and planning efforts and should be given the highest priority: The state will establish a budget and timeline for accomplishing each of these:

- a. Measurement of irrigated landscape water use. These studies should address, at a minimum, the following questions:
 - What are the benefits of more precise measurement of irrigated landscape use?
 - Do dedicated landscape meters (or other technologies such as ET controllers or remote sensing) have a measurable impact on landscape water use when compared to landscapes served by mixed-use meters, after controlling for climate, price, and policy variables?
 - Are dedicated landscape meters (or other technologies such as ET controllers or remote sensing) necessary to the effective implementation of landscape budget and pricing programs, or can such programs be implemented in the presence of mixed-use meters?
 - Are the planning, management, and water supply benefits that may be realized by dedicated landscape meters (or other technologies such as ET controllers or remote sensing) sufficient to justify the costs of the policy?

Other priorities: Other research topics that have been defined as important include (but are not limited to):

- b. Submetering in multi-family dwellings.
- c. Contributions of self-supplied urban groundwater use (including industrial, commercial, and residential users) to net groundwater usage. These studies should address, at a minimum, the following questions:
 - What is the scope of self supplied groundwater use with respect to: number of self-supplied users, type of use, impact on overall groundwater use, geographic distribution, etc.?
 - With respect to groundwater extractions in adjudicated and managed basins, what data is being collected by watermasters? To what degree is this data being collected in a consistent fashion? And to what extent does this data help the state meet its water management and planning objectives?
- d. Residential, commercial, and industrial water end use studies
- e. Urban land use changes and associated changes in water uses
- f. Efficacy of alternative urban water use forecasting methods
- g. Economic studies addressing:
 - Value of water in alternative urban uses
 - Household water use decision-making
 - Commercial and industrial water use decision-making
 - Water demand reduction potential of emerging conservation technologies and programs
- h. Evaluation of the methodologies (and the consistency among these methodologies) by which urban water suppliers and local agencies (cities and counties) develop actual versus projected water use for projects covered by SB 610 water supply assessments and

SB 221 written verifications of water supply (verifications and assessments may be prepared by local agencies if there is no water supplier).

Research results and adaptive management: *The state should take into consideration the results of the research program to re-evaluate annually its definition of appropriate measurement of urban water uses as defined previously in Section II.*

Justification of Definition:

1. Improving the state's ability to forecast and plan for future urban water demands requires a fuller understanding of how water is used in urban areas and how this use is changing over time due to changes in land use patterns, demographics, technology, and economics.
2. A frequent criticism of previous State Water Plan Updates is the use of very general and simplified assumptions to predict future urban water demand. A robust and sustained research program could provide the Department of Water Resources with tools (e.g. a statewide urban GIS of urban land and water uses) and information (e.g. value of water in alternative urban uses) that would substantially improve its ability to make regional urban water use forecasts.
3. A fuller understanding of how water is used in urban areas would support regional water management planning activities authorized under California Water Code sections 10530 through 10546 (Integrated Regional Water Management Plans) and 10610 through 10657 (Urban Water Management Plans).

Expected Impacts:

1. State and/or urban water purveyors and wastewater dischargers would incur cost to fund research program.

APPENDIX 1

Participants – Staff Work Group on Urban Water Use Measurement

Water Suppliers

Angela Anderson – Water Conservation Administrator, City of Sacramento
Dick Bennett – Water Conservation Administrator, East Bay Municipal Utility District
Mary Lou Cotton – Water Resources Manager, Castaic Lake Water Agency
Luis Generoso – Water Resources Manager, City of San Diego Water Department
Mike Hollis – Director, Conservation, Metropolitan Water District of So. CA
Joe Lima – Water Use Manager, Modesto Irrigation District
Steve Macaulay – Executive Director, California Urban Water Agencies
Bill Miller – General Manager, North of the River Municipal Water District
Rich Plecker – General Manager, Fair Oaks Water District
Tim Treloar – Asst. District Manager, Bakersfield District, California Water Service Co.

Environmental Groups:

Roberta Borgonovo - Water Director, League of Women Voters—CA
Dana Haasz - Research Associate, Pacific Institute
Ed Osann - Consultant, Natural Resources Defense Council
Betsy Reifsnider - Executive Director, Friends of the River
Fran Spivy-Weber - Executive Director, Policy, Mono Lake Committee
Eric Wesselman - Regional Representative, Sierra Club (CA-NV-HI Field Office)

Environmental Justice Organizations:

Michael Stanley-Jones - State Director, California Clean Water Action

Business Organizations:

Darin Gale - Governmental Relations Mgr, Sacramento Metropolitan Chamber of Commerce
Brian White - Legislative Advocate, CA Building Industry Association

CBDA Implementing Agencies and Partners

Jeff Barnickol - Statewide Assistance Section, Chief, State Water Resources Control Board
Lucille Billingsley - Water Conservation Specialist, Bureau of Reclamation
Nadine Feletto - Safe Drinking Water State Revolving Fund, Department of Health Services
David Todd - Supervising Land and Water Use Analyst, Department of Water Resources
Mary Ann Dickinson - Executive Director, California Urban Water Conservation Council

California Bay-Delta Authority Staff/Consultants

Tom Gohring - Assistant Deputy Director, Water Management
David Mitchell - M.Cubed
Lee Axelrad - Resources Law Group
Bennett Brooks - CONCUR, Inc.
Eric Poncelet - CONCUR, Inc.

APPENDIX 2

Participants – June 3, 2002 Urban Water Measurement “Brainstorming” Session

Scott Matyac (DWR)
David Todd (DWR)
Monique Wilbur (DWR)
Scott Hayse (DWR)
Tracy Slavin (USBR)
Lucille Billingsley (USBR)
Nadine Felleto (Dept. of Health Services)
Mary Ann Dickinson (CUWCC)
Mike Hollis (Metropolitan Water District)
Warren Teitz (Metropolitan Water District) – *by phone*
Dana Haasz (Pacific Institute)
Eric Wesselman (Sierra Club)
Peter Vorster (Bay Institute) – *by phone*
Tom Chestnut (A & N Technical Services, Inc.) – *by phone*
Bill Madaus (Maddaus Water Management)
Julio Sanchez (Conservation)
Anil Bamezai (Western Policy Research) – *by phone*
Michael Hanneman (University of California, Berkeley) – *by phone*
Caitland Durkman (University of California, Berkeley)

California Bay-Delta Authority Staff/Consultants

Tom Gohring (Assistant Deputy Director, Water Management)
David Mitchell (M.Cubed)
Mark Roberson (Independent consultant)
Lee Axelrad (Resources Law Group)
Bennett Brooks (CONCUR, Inc.)
Eric Poncelet (CONCUR, Inc.)

Follow up interviews – Urban Water Use Measurement Experts

Scott Matyac (DWR)
Tracy Slavin (USBR)
Jay Lund (University of California – Davis)
Jacque De Bra (City of Davis)

Appendix 3

Summary of Stakeholder Comments

California Bay-Delta Authority staff has undertaken a series of stakeholder involvement and public outreach efforts to inform its development of an Implementation Approach for Agricultural and Urban Water Use Measurement. Stakeholder involvement was structured through the use of several standing public advisory and ad hoc work groups, including the Bay-Delta Authority, Bay-Delta Public Advisory Committee, the Water Use Efficiency (WUE) Subcommittee, the Agricultural Water Use Measurement Staff Work Group, and the Urban Water Use Measurement Staff Work Group. Other outreach efforts conducted in the January-March 2004 timeframe included:

- Briefing for California Urban Water Agencies' (CUWA) general managers
- Briefing for the Regional Water Authority Program Advisory Committee
- Public Workshops held in the Bay Area, Escondido, Bakersfield, and Modesto
- Targeted outreach to operations/planning managers of urban water suppliers (Metropolitan Water District, Contra Costa Water District, City of San Diego, and Castaic Lake Water Agency)
- Individual communications with concerned stakeholders

Summary of Primary Comments

The Staff Proposal has been revised to incorporate many of the comments heard during this outreach process. Below is a summary of the primary issues raised and addressed over the past several months.

Urban Water Use Measurement -Focused Comments

- ***Need for improved urban water use data.*** A number of stakeholders from the WUE Subcommittee, the Urban Staff Work Group, and the outreach efforts expressed the view that the Staff Proposal did not make a sufficiently compelling case for why some of the proposed actions, such as increased frequency of reporting or increased consistency of data brought by new standards/protocols, will make a significant difference for state water management. Authority staff has worked with DWR water planners to develop a better articulated rationale for why state water managers and planners require improved urban water information. This rationale has been incorporated into the "Description of Need" portion of the "Reporting of Urban Water Sources and Delivery Data" section (section IV. 3) of the Staff Proposal.
- ***Local burden associated with proposed urban reporting requirements.*** Stakeholders from the WUE Subcommittee, the Urban Staff Work Group, and several outreach meetings suggested that the Program's proposed urban water reporting

requirements may prove more burdensome – either in effort or cost, or both – than anticipated by the Staff Proposal. Authority staff re-analyzed current reporting requirements and reached the conclusion that this assumption of minimal local impact only applies for purveyors already submitting both the annual DHS Report and an Urban Water Management Plan (or the USBR’s Water Management Plan). Accordingly, Authority staff has increased its proposed urban reporting exemption threshold from 200 connections to 3,000 connections to match that of the UWMPA. [Note: Authority staff vetted the revised exemption threshold with members of the Urban Staff Work Group and received general (although not unanimous) support, given that this threshold covers 90% of the state’s population.] Authority staff then vetted its overall proposed urban reporting approach with operations and planning managers of four urban purveyors (City of San Diego, CCWD, MWD, and Castaic Lake Water Agency) to solicit detailed feedback. These purveyors generally agreed that the urban reporting requirements called for in the Staff Proposal would not entail significant reporting effort or cost for their organizations.

- ***Local cost effectiveness of urban meter retrofitting.*** Several commenters from the WUE Subcommittee recommended that Authority staff verify the presumed local cost-effectiveness cost breakout for urban meter retrofitting. In response, Authority staff conducted a sensitivity analysis of potential costs to both the State and local urban purveyors taking into account the dependency of local cost-effectiveness on both local meter installation costs and local avoided supply costs. Given the many variables involved in this analysis and the disparity of costs and conditions from region-to-region, Authority staff determined it is not able at this time to provide meaningful estimates on the potential split between state and local costs.

Agricultural Water Use Measurement-Focused Comments

- ***Farm-gate deliveries.*** Some stakeholders from the WUE Subcommittee and the Agricultural Staff Work Group recommended that the package be revised to require all farm-gate deliveries be measured at a +/-6% level of accuracy. Additionally, the Bay-Delta Authority requested that staff attempt to quantify the potential benefits associated with shifting the remaining farm gates (about 11%) to the +/-6% accuracy level. Staff attempts to undertake this analysis underscored the Independent Review Panel’s conclusion that there was insufficient data on-hand to infer a causal link between farm-gate measurement and application efficiency. (The technical work – undertaken with the assistance of Steve Hatchett, a member of the Independent Review Panel – suggested annual on-farm application reductions ranging between 0 to 1,500,000 acre-feet with significant additional investments ranging from \$13- to \$75-million per year. This application reduction represents primarily rerouted flow and not reductions in irrecoverable losses.) Staff recognizes the importance of this potential linkage, however, and has revised its proposal to put forward a phased strategy:

- Phase One would require agricultural water suppliers to report aggregated farm-gate delivery data to the State (DWR) annually.
- Phase Two would require BDA, within two years of the start of data collection, to determine if the data being collected is sufficient to establish a causal link between farm-gate measurement accuracy and application efficiency.
- Phase Three would require BDA, within three years of the start of data collection, to undertake a preliminary staff-level analysis to estimate the correlation between farm-gate measurement accuracy and application efficiency.
- Phase Four would require BDA, within five years of the start of data collection, to use the newly gathered farm-gate delivery data to better understand the causal link between farm-gate measurement and application efficiency and, as appropriate, recommend changes to current farm-gate measurement practices.

Staff also looked at the exemption threshold for reporting farm-gate delivery data and, based on its analysis, revised the reporting threshold to exempt all suppliers delivering fewer than 2,000 acre-feet of water annually or supplying fewer than 2,000 acres. This threshold is expected to capture roughly 90% of all deliveries, generate a volume of data that can be handled by implementing agencies, and is largely commensurate with current CVP standards. Staff recognizes that this threshold may warrant some adjustment as better data becomes available.

- ***Exemptions for measuring agricultural diversions.*** Several commenters from the WUE Subcommittee requested that Authority staff take a closer look at the proposed threshold for measuring and reporting agricultural diversions and confirm the appropriateness of the level. Staff worked with the State Board and consultants to improve its analysis of the likely impact of different thresholds. Based on its review, staff has revised its threshold to exempt those surface water diverters with a combined diversion capacity of 50 cubic feet per second or less. This threshold is expected to capture roughly 90% of all diversions, generate a volume of data that can be handled by implementing agencies, and is largely commensurate with current CVP standards. Staff recognizes that this threshold may warrant some adjustment as better data becomes available.

Other Comments

The various outreach efforts elicited a number of other comments and recommended changes. Below is a summary of those comments.

- ***Groundwater use measurement.*** Though this issue was not raised during any public workshops, some stakeholders during the Staff Work Group process said the Staff Proposal should require direct measurement and reporting of groundwater extractions (i.e., wellhead measurement) throughout the State. Given the State's current policy of not managing or allocating groundwater resources and consistent

with the Independent Review Panel's findings, staff does not now believe the costs associated with wellhead measurement are likely to yield sufficient benefits to justify the expenditures. Staff does, however, recognize the importance of groundwater data and has included several specific steps intended to deepen the State's understanding of groundwater uses and inform future decisions.

- ***Staff Proposal implementation timeline.*** Several commenters expressed concern that the timeline for Staff Proposal consideration by various BDA advisory and decision-making bodies was too compressed and suggested that more time was needed to garner adequate stakeholder feedback. Authority staff believes it has responded to this request in two substantive ways: (1) conducting extensive outreach between the February BDA meeting and the March 29 WUE Subcommittee meeting; and, (2) stepping out a revised timeline that calls for senior decision-makers to refine the implementation approach for consideration in the 2005 legislative session.
- ***Volumetric billing of urban water use.*** Several stakeholders have noted that water savings are incentivized by a combination of measurement and billing structures and questioned why the Staff Proposal did not address the issue of volumetric billing. Authority staff believes that the issue of volumetric billing, while an important driver of water use efficiency, is beyond the scope of the water use measurement issues addressed in the CALFED Record of Decision.
- ***Impact on the wastewater treatment industry.*** At least one stakeholder from the sanitation industry expressed concern that the Staff Proposal did not clearly address water quality measurement. The stakeholder wanted to be reassured that the Staff Proposal would not result in redundant requirements being placed on wastewater dischargers. Authority staff has added language to the Staff Proposal to make clear that the proposal does not supercede existing state or federal water authority and requirements embodied in or through the federal Clean Water Act and state Porter-Cologne Water Quality Control Act to impose measurement, monitoring, and reporting requirements on wastewater dischargers subject to regulation under these acts. Nor does the Staff Proposal call for any measurement or reporting actions in addition to what is already presently being pursued.
- ***Loan funding of meter retrofits.*** Several stakeholders have sought clarification of the Program's intent to fund the retrofit of urban service meters proven not to be locally cost-effective. Some stakeholders are seeking to ensure the availability of grants. Others are interested in seeing the Program rely more heavily on loans. Authority staff believes that offering grants rather than loans is consistent with the Authority's longstanding advocacy of the principle of "beneficiary pays." At the same time, given the varying local cost structures and the State's current fiscal constraints, Authority staff recognizes that grant funding may be limited. Staff believes the

exact funding split between local and state, loans and grants, will have to be determined on a case-by-case basis.

- ***Agricultural/urban parity.*** Several stakeholders from both the agricultural and urban Staff Work Groups commented on an apparent lack of equity between the agricultural and urban actions being proposed in the Staff Proposal. Staff believes the proposal represents a significant departure from “business as usual” in both the agricultural and urban sectors and would reap critical benefits across all water uses. Both efforts include changes that would impact most users. For example, both efforts would demand significant financial commitments, and both would embed a significant enough shift from current policy to require legislative action (farm-gate for agriculture, service meters for urban.)
- ***Use of data.*** Commenters in several of the public outreach workshops expressed concerns over possible misuse of the new measurement information called for in the Staff Proposal. These stakeholders, largely from the agricultural sector, wanted assurances that the information being collected would not be used in ways to regulate water users beyond those detailed in the Staff Proposal. Staff recognizes that data can be used in ways not originally intended. However, staff believes it is in the interest of sound policy that the State take steps to improve the accuracy and quality of data being collected on both agricultural and urban water use.
- ***Potential data gaps.*** Several commenters from the BD-PAC as well as from some of the outreach meetings pointed out potential data gaps left unaddressed by the Staff Proposal. In particular, stakeholders highlighted the measurement of refuge water and tribal water rights. Staff recognizes the importance of these areas and intends to address them in follow-on discussions as part of its prioritization of research needs.

Based on discussions to-date, staff believes it is putting forward a proposal that is responsive to stakeholder concerns and consistent with Authority goals.

Agenda Item: 7-7
Meeting Dates: April 7 and 8, 2004

**CALIFORNIA BAY-DELTA AUTHORITY
RESOLUTION 04-04-01**

**AUTHORIZING THE DIRECTOR, OR HIS DESIGNEE, TO WORK WITH THE STATE
ADMINISTRATION AND THE LEGISLATURE ON IMPLEMENTING THE STAFF
PROPOSAL FOR WATER USE MEASUREMENT**

WHEREAS appropriate measurement of water use can lead to better water supply reliability by providing critical information to local, state and federal water managers and planning; and

WHEREAS the August 2000 CALFED Record of Decision called for the development of the definition of appropriate measurement and the implementation of appropriate measurement which may include legislation; and

WHEREAS, Authority staff has convened an independent panel through an open process that included interested stakeholders and implementing agency staff to define appropriate of agricultural water use; and

WHEREAS, staff has prepared a definition of appropriate measurement of urban water use through an open process that included interested stakeholders and implementing agency staff; and

WHEREAS, staff has developed, through an open process that included interested stakeholders and implementing agency staff, a draft proposal for implementing appropriate measurement that contains potential state administrative actions and potential budget and authorizing legislation; and

WHEREAS, this staff proposal was discussed at the February 11, 2004 meeting of the Authority; the February 18, 2004 meeting of the Bay-Delta Public Advisory Committee (BDPAC) Water Use Efficiency Subcommittee; and the March 11, 2004 meeting of the full BDPAC, where the course of action being considered here was unanimously recommended;

NOW, THEREFORE, BE IT RESOLVED that the California Bay-Delta Authority authorizes the Director, or his designee, work with the State Administration and the Legislature on implementing the staff proposal for water use measurement.

IT IS FURTHER RESOLVED that the Director, or his designee, will report further progress of this activity to the Authority.

Agenda Item: 7-7, Resolution
Meeting Dates: April 7 and 8, 2004
Page 2

CERTIFICATION

The undersigned Assistant to the California Bay-Delta Authority does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the Authority held on April 7 and 8, 2004.

Dated: _____

Heidi Rooks
Assistant to the California Bay-Delta Authority