Central Valley Project (CVP) Cost Allocation Study (CAS)
Municipal and Industrial Benefit Methodology

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Purpose of Paper:
Proposed Municipal and Industrial (M&I) Benefit Estimation Methodology and Model Options

Measuring M&I Benefits:
The 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) govern how to estimate the benefits of water related projects for planning and cost allocation studies. Reclamation's Economics Guidebook further clarifies economic analyses prepared by the agency.

Chapter I, Section VII, part 1.7.2 of the P&G indicates that willingness to pay is the general standard for valuing the economic benefits of a Federal water resources project. Willingness to pay is commonly defined as the dollar amount that an individual or firm is willing to forgo or pay to acquire a good or service. The P&G identify four techniques to estimate economic benefits for federal water resources projects. (1) willingness to pay based on actual or simulated market price, (2) change in net income, (3) cost of the most likely alternative, and (4) administratively established values. These four techniques are generally listed in order of preference for estimating benefit values. Willingness to pay and cost of the most likely alternative are the benefit estimation approaches most commonly applied for measuring M&I benefits.

Chapter II, Section II, part 2.2.2, of the P&G states that the conceptual basis for evaluating the benefits from M&I water supply is society's willingness to pay for the increase in the value of goods and services attributable to the water supply. Where the price of water reflects its marginal cost (i.e., the cost of next unit of water supplied), that price can be used to calculate willingness to pay for additional water supply. Furthermore, the P&G state that in the absence of direct measures of willingness to pay, the benefits of water supply can be measured by the resource cost of the alternative most likely to be implemented in the absence of the proposed federal plan.

The Economics Guidebook notes that the price charged for M&I water is generally not a reflection of marginal cost because water utilities do not typically operate in a competitive environment and use average cost pricing. Therefore, since price typically cannot be used to directly calculate M&I water supply benefits, the cost of the most likely alternative method has been the method most frequently used to measure M&I benefits. This alternative cost approach requires that the alternative is a likely and realistic non-federal alternative that would be implementable in the absence of the federal project. Moreover, the alternative must be viable in terms of engineering and financing and must be

institutionally acceptable. The estimate of alternative costs should be based upon the same standards or criteria with respect to type of facility, design, interest rate, and period of analysis that are used by municipalities to compare the average annual costs of alternative sources of water supply available to them.

The Economics Guidebook also identifies two additional methodologies to estimate willingness to pay, contingent valuation and benefits transfer. Contingent valuation utilizes a survey based approach which directly obtains information on respondent willingness to pay. Benefits transfer involves the use of existing benefit estimates or models from one site to another site for which benefit data are not available.

Available Tools and Approaches for Estimating M&I Benefit Values:

Four tools are available to estimate M&I benefit values for the CVP CAS which would comply with the P&G and the Economics Guidelines: (1) the California Municipal Demand Model (CMDM), (2) the Least-Cost Planning SIMulation model (LCPSIM), in combination with (3) Other Municipal Water Economics Model (OMWEM) and (4) information from individual water supplier water management plans and water supply master plans.

Approach with CMDM:

Conceptually, the approach using CMDM is based on an estimated M&I water demand curve. The demand curve reflects willingness to pay, and the area under the demand curve represents the benefit of the M&I water supply. Therefore, the CMDM provides an approach to directly measure willingness to pay for municipal water supply. A recently completed household demand model using individual water use and water rate data obtained from 11 water agencies in California and Nevada can be used to estimate benefits. The model estimates demand as a function of explanatory variables including lagged average price, number of price tiers, household and socio-economic characteristics (lot size, household income, household size), and climatic factors (average annual precipitation and temperature, drought index). The model does not include commercial water users. Previously completed commercial and industrial demand studies could be used to estimate benefits for non-residential use.

Pros: Consistent with the P&G; provides a direct measure of willingness to pay; represents a benefits analysis; model is new, but approach is not; underlying data used to estimate the model is based on actual, observed behavior.

Cons: Has not been applied to date and is a not well known; commercial and industrial water user not in the demand model.

Approach with LCMSIM and OMWEM:

This approach would combine results from two models that apply to different geographic areas. LCPSIM is used to estimate the economic effects of changes in water supply in the urban areas of southern San Francisco Bay and the South Coast regions. OMWEM extends the geographic area to include CVP M&I supplies for small water providers north of the Delta, State Water Project (SWP) and CVP supplies to the Central Valley and the Central Coast, and SWP supplies or supply exchanges to the desert regions east of LCPSIM's South Coast region.

These tools are annual time-step urban water service system simulation and optimization models. The objective is to find the least-cost water management strategy for a region, given the mix of demands and available supplies. The models use shortage management measures (e.g., use of regional carryover storage, water market transfers, contingency conservation), and shortage allocation rules to reduce regional costs and losses associated with shortage events. They also consider long-term regional demand reduction and supply augmentation measures (e.g., toilet retrofit programs, wastewater recycling) that reduce the frequency, magnitude, and duration of shortage events.

A shortage event, or forgone use, is the most direct consequence of water service system unreliability. Forgone use occurs when residential users or businesses have an established lifestyle or level of economic production based on expected availability of water that is not met in a particular year or sequence of years. These models use shortage loss functions derived from contingent valuation studies and water agency shortage measures to value the forgone use.

Assuming that long-term demand reduction and supply augmentation measures are adopted in order of their cost, with lowest cost measures adopted first, these models find the water management strategy that minimizes the sum of the total annual cost of the adopted long-term measures and the annual shortage costs and losses remaining after their adoption. The value of the availability of supply from a proposed project can be determined from the change it produces in this least-cost mix of demand and supply measures and shortages.

Pros: Tools and approach are consistent with P&G; these models have been reviewed and endorsed by the California Department of Water Resources (DWR) and Reclamation; these models have been used to estimate M&I benefits for numerous Reclamation and DWR studies.

Cons: These tools and approach do not provide a direct measure of willingness to pay; the tools and approach provide a cost effectiveness analysis as opposed to a benefits analysis; local planning decisions are likely to be influenced by local cost effectiveness and political concerns that are not necessarily related to the model objectives; base urban use amounts are not reduced in response to the higher urban user water prices

Local Water Management Plans:

Some M&I water districts have indicated that they do not believe the above valuation options accurately reflect their specific costs of obtaining additional supplies or the cost of conserving water to address supply-demand imbalances. In an attempt to address these concerns, a third valuation approach based on the cost of obtaining water or conserving water is also considered. The source of information for this approach would be urban water management and water supply master plans, but specific information on the assumptions used to estimate these costs would need to be provided.

Pros: This approach may be more acceptable to M&I water districts; this approach is consistent with the P&G.

Cons: This approach doesn't provide a direct measure of willingness to pay; this approach is a cost effectiveness analysis as opposed to a benefits analysis.

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