



Delta Levees Investment Strategy

Technical Memorandum 3.2: Cost Allocation Methodology

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ACRONYMS AND ABBREVIATIONS

ATP	ability to pay
Council	Delta Stewardship Council
Delta	Sacramento-San Joaquin Delta
DLIS	Delta Levees Investment Strategy
EACH	expected annual change in habitat
EAD	expected annual damage
EAF	expected Annual fatalities
EAW	expected annual water supply disruption score
ENSC	Egalitarian Non-Separable Cost
ER	ecosystem restoration
FDR	flood damage reduction
NSCG	Non-Separable Cost Gap
OMRR&R	operations, maintenance, repair, rehabilitation, and replacement
%	percent
SCRB	Separable Costs-Remaining Benefits cost allocation method
SPA	single-purpose alternative
State	State of California
SWP	State Water Project
WTA	willingness to accept
WTP	willingness to pay

1. INTRODUCTION

The Delta Stewardship Council (Council) launched the Delta Levees Investment Strategy (DLIS) in response to the Delta Reform Act of 2009, which calls for strategic levee investments that attempt to reduce risks to people, property, and State of California (State) interests. While the primary purpose of levees is flood risk reduction, levees also contribute to the State-mandated coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem (Council 2015).

Flood risk reduction can be measured by expected annual damages (EAD) and by expected annual fatalities (EAF) due to natural flooding and levee failures; EAD and EAF may be reduced as a result of levee investments (refer to Technical Memorandum 3.1, *Methodology*). For purposes of cost allocation, however, EAD can serve as a proxy for EAF. This is appropriate for three reasons: (1) the initial cost allocation method proposed and subsequently described limits benefits to development cost of the least-cost alternative project providing the same benefits, which is likely to be lower than either EAD or EAF for a properly formulated levee improvement plan; (2) use of the least-cost alternative project eliminates the need for and uncertainty associated with calculation of costs of fatalities; and (3) protection of life and property are normally considered together in project formulation, and formulation of a least-cost alternative project exclusively for one purpose or the other is impractical.

Delta levees also affect hydraulic capacity for conveyance of water from the Sacramento-San Joaquin Delta (Delta) for export to the State Water Project (SWP) and the Central Valley Project. By changing the hydrodynamics that affect mixing of fresh and brackish water, sediment, and constituent transport, the levees can affect water quality. Water conveyance and water quality together have a major effect on water supply reliability. See Technical Memorandum 3.1, *Methodology*, for a description of EAW – expected annual water supply disruption score. Agricultural, municipal, and industrial water users are EAW beneficiaries.

The Delta's aquatic ecosystem potentially benefits from improved water conveyance and water quality afforded by levees. Water levels and other hydraulic and hydrologic alterations accompanying levee development can affect aquatic habitats both positively and negatively. As a consequence, design modifications to levees (changes in levee configuration, alignment, features, or facilities) may be needed for ecosystem protection. For ecosystem restoration or enhancement, further design modifications may be needed. For example, levee setbacks can reduce water surface elevations (and therefore EAD and EAF) while creating a more frequent inundation of floodplain habitat. These adjustments could increase costs of levee improvements and in some cases reduce EAD and EAW benefits in comparison to levels of service achievable in the absence of ecosystem enhancement goals. See Technical Memorandum 3.1, *Methodology*, for a description of expected annual change in habitat (EACH).

2. OBJECTIVES AND ASSUMPTIONS

This technical memorandum proposes cost allocation methods, assumptions, and procedures consistent with the objectives of the Council in launching the DLIS. The principal objective of the proposed approach is equitable and efficient (to the extent permitted by the fairness objective) allocation of levee improvement costs between State and local governments, as well as individual beneficiaries of levee improvements.



Equity in this case is traditionally defined by the *compensation principle* originally adopted by the National Resources Planning Board in 1941, which proposed that "...costs should be repaid as far as practicable by the beneficiaries, with due consideration for the amount of benefits received." This criterion has been interpreted in federal planning to mean that equitable cost recovery is limited to the least cost of benefits provision, with costs allocated in proportion to actual benefits received (Greeley-Polhemus Group 1991). This technical memorandum assumes that California Department of Water Resources (DWR) policies for planning and economic analysis (DWR 2008) associated with the SWP also apply to Delta levee investments. And because principles and policies for federal water resource development planning (U.S. Water Resources Council 1983; USACE 2000) are fully incorporated by reference in DWR policy, they are applicable to determination of State interest in levee investments and cost-recovery procedures.

As previously described, the DLIS objectives considered in the cost allocation methodology proposed in this technical memorandum are therefore EAD, EAW, and EACH, summarized as follows:

- Flood risk reduction, measured by reduction in EAD; limited to minimum costs of provision.
- Water supply reliability (EAW), enhanced by increased water system conveyance capacity and improved water quality; while EAW is a score, monetary benefits in terms of avoided costs of water supply disruption (quantity or quality) can be computed (and should be during project formulation); limited to minimum costs of provision.
- Ecosystem protection, restoration, and enhancement (EACH); limited to minimum costs of provision.

Benefits in each of the above-listed categories are limited to minimum costs of provision. Consistent with DWR and federal policy, the underlying assumption applicable to levee investments is that the State's interest is maximized when development costs are minimized and net benefits are maximized.

Compensation in excess of minimum costs of provision (in this case levee improvement costs, including features for water supply and ecosystem enhancement) is not in the State's interest because net benefits are then reduced by the amount of excess compensation. When willingness-to-pay (WTP) in markets for benefits received exceeds actual costs of levee improvements, efficient and equitable cost allocations may differ, in which case equity supersedes efficiency as the primary objective of cost allocation methods proposed in this technical memorandum.

There are two types of levees in the Delta: project levees, comprising approximately one-third of the levees in the Delta, and non-project levees, comprising the remainder. Project levees are included in the State Plan of Flood Control, which qualifies them for financial assistance from the federal government. Costs for building or improving levees have historically been shared by the federal government, the State, and local agencies in varying proportions. This technical memorandum does not prescribe federal-State cost-sharing guidelines, but rather provides a flexible and practical approach to allocation of levee improvement costs remaining after federal participation (regardless of level), to State and local governments, and subsequently to individual beneficiaries.

The DWR has used cost-sharing to provide financial assistance to local agencies for costs of building, maintaining, and improving non-project levees, i.e., levees not included in the State Plan of Flood Control. For levee improvements, DWR has recently published guidelines for application of cost sharing formulas for both project and non-project levees (DWR 2014b).



Benefits of levee investments within the three categories previously described (EAD, EAW, and EACH) will accrue to the State and local governments, to public utilities and infrastructure, and to municipal, industrial, commercial, and agricultural water users within and outside of the Delta. Benefits to the State as a whole are acknowledged and reflected in the State's cost-sharing guidelines.

To ensure fairness and practicality of equitable allocation of costs of levee improvements remaining after federal participation, this technical memorandum proposes the following four-step approach:

1. Initial allocation of separable and non-separable costs of inclusion of purposes (EAD, EAW, and EACH) in the project.
2. Determination of State interest in EAD, EAW, and EACH and determination of State share (remaining after federal participation) of separable and non-separable costs for each, for project and non-project levees.
3. Determination of ability to pay (ATP) of local governments toward State share.
4. Allocation of user costs (remaining after State and local participation) to beneficiaries through facilitated or non-facilitated negotiations, or user fees, consistent insofar as practicable with the prescribed initial cost allocation, federal-State and State-local cost-sharing arrangements.

This technical memorandum recommends and provides an example application of the recommended initial cost allocation method (Step 1). This technical memorandum provides policy guidelines but no specific recommendations for State-local cost sharing (Steps 3 and 4), and likewise identifies alternative approaches without a recommendation for final allocation of user costs to beneficiaries (Step 4). Comments are provided, however, on methods addressed in Steps 2, 3, and 4 relative to practicality of implementation in a spreadsheet-based cost allocation tool. The tool itself is anticipated to be able to accommodate a variety of cost allocation formulas. While the methodology and spreadsheet tool proposed by this technical memorandum may inform federal-State and State-local cost-sharing negotiations, ultimately agreement between the parties will be required before final calculations can be made.

3. INITIAL COST ALLOCATION BY PURPOSE (STEP 1)

In accordance with the *Economic Analysis Guidebook* (DWR 2008), cost allocation for multipurpose water projects should satisfy conditions of fairness and economic efficiency (to the extent consistent with fairness) among the participating users in the local share. Ideally, cost allocation procedures should also be transparent to users and straightforward in application, even if the calculation of the underlying benefits and costs may be complex.

Costs that may be allocated in accordance with the DWR policy are as follows:

- Specific costs are costs of facilities serving only one included purpose.
- Separable costs are project cost savings with one purpose excluded, or costs incurred for structures serving multiple (but not all) purposes. In some cases, specific and separable costs are the same.
- Non-separable costs, also known as joint or residual costs, are costs of features that support all included purposes plus otherwise unallocated costs (e.g., environmental, aesthetic, and social).
- Alternative costs are costs of the least costly single-purpose alternative (SPA) providing the same benefits to the included purpose, whether structural or non-structural.



- Justifiable costs are the lesser of benefits or alternative costs, and the maximum that can be allocated to any purpose.
- Remaining benefits are justifiable costs minus separable costs for each purpose.

Allocated and unallocated costs are generally assumed to include capital costs and annual operations, maintenance, repair, rehabilitation, and replacement expenses (OMRR&R).

3.1 Included Purposes

Included purposes are generally those for which monetary benefits of project implementation are realized and can be reasonably estimated. As previously described, quantifiable economic benefits of Delta levee improvements include flood protection (EAD reduction) and water supply and water quality (contributing to EAW due to dependency of water supply on adequate water quality). Ecosystem restoration (EACH) is also an objective of levee investments. However, federal and State guidelines recommend against monetary valuation of ecosystem restoration benefits in favor of cost-effectiveness or physical measures (e.g., cost-per-restored-habitat-acre or habitat units) (DWR 2008, pp. x, 12) for comparison with other project purposes, i.e., flood damage reduction and water supply reliability in the case of levee investments. In any case, ecosystem restoration benefits are limited to least cost of provision by the cost allocation method subsequently recommended, and consequently monetary valuation of ecosystem restoration benefits is unnecessary provided ecosystem benefits were expected to exceed costs of provision in formulation of the levee improvement project.

The methods considered and recommended in this technical memorandum for initial cost allocations by purpose attribute separable as well as non-separable costs to EAD, EAW, and EACH objectives, each of which is designated as an included purpose in application of the initial cost allocation methods subsequently described.

3.2 Alternative Cost Allocation Methods

Numerous ad hoc methods can be devised based on cooperative game theory and can be applied to apportion costs of multipurpose water resource projects to included purposes. However, many of these are based on WTP rather than minimum costs of provision, and for a variety of reasons can lead to unfair assignment of costs (Heaney and Dickenson 1982) from the perspective of public works financing. This technical memorandum describes only those cost allocation methods reasonably consistent with DWR guidelines.

Separable Costs-Remaining Benefits (SCRB) method: The criterion known as the *compensation principle* was effectively adopted for federal water resource development in 1941, when the National Resources Planning Board proposed that "...costs should be repaid as far as practicable by the beneficiaries, with due consideration for the amount of benefits received." Procedures for implementation of this philosophy were later prescribed in the "*Green Book*," a compendium of institutional thinking on the proper federal role in equitable apportionment of water resources (Federal Interagency River Basin Committee 1958.) The compensation principle supersedes traditional Pareto efficiency considerations (i.e., when some are made better off and no one is made worse off by a project) in federal planning, following the rationale that the nation is better off when with-project gains are sufficiently large that everyone could in theory be made



better off by some re-distribution of goods or income following project implementation (Greeley-Polhemus Group 1991). The Green Book presented a systematic procedure for distributing costs of publicly financed water projects among the purposes served. The SCRB method was adopted by interagency agreement as the preferred method for allocating costs, and remains the method endorsed in current federal and State guidelines.

An essential distinction between SCRB and game-theoretic approaches to cost allocation is its basis in cost of provision rather than WTP, i.e., prioritization of fairness over economic efficiency. Proper application of SCRB is meant to ensure that:

- All purposes and beneficiaries share equitably in the benefits of multipurpose development, and
- No purpose subsidizes any other purpose.

Application of SCRB involves the following steps:

1. Estimate benefits for each included purpose (calculated in the formulation of the recommended multipurpose project).
2. Estimate minimum SPA costs to obtain same benefits for each included purpose.
3. For each included purpose, calculate justifiable cost as the lesser of estimated benefits (1) and SPA costs (2); monetary value of ecosystem restoration (EACH in the case of levee investments) is assumed to be equivalent to SPA cost for ecosystem restoration (2).
4. Estimate separable cost for each included purpose based on the least costly project capable of providing the same benefits for remaining project purposes.
5. Deduct separable (4) from justifiable costs (3) for each purpose to determine its remaining justifiable costs (remaining benefits).
6. Calculate total non-separable (joint) costs as total project cost less total of separable costs for all included purposes.
7. Calculate ratio of remaining justifiable costs (remaining benefits) (5) for each purpose to total remaining benefits (5) for all purposes.
8. Multiply total joint costs (6) by ratios (7) to determine joint costs allocated to each purpose.
9. Calculate total costs allocated to each purpose as sum of separable (4) and allocated joint costs (8).

The SCRB method is often preferred for publicly financed water resource development because of larger returns to scale of multipurpose in comparison to single-purpose projects, so that gains of participation in the multipurpose project exceed gains of single-purpose (i.e., "go-it-alone") alternatives for each included purpose. Potential drawbacks are larger environmental mitigation costs for large multipurpose projects in comparison to multiple smaller SPAs. This scenario appears unlikely in the case of Delta levee investments given the extent to which flood risk reduction, water supply reliability, and ecosystem enhancement are planned to be conjunctive uses, integrated by design of the levee improvement project.

Egalitarian Non-Separable Cost (ENSC) method: The ENSC method is a variant of SCRB in which non-separable costs are assigned equally to included purposes rather than apportioned based on remaining benefits (Driessen and Tijs 1985). The ENSC is sometimes considered a "naïve" method due to this simplification (Wu and Chang 2001). If joint costs are small in comparison to separable costs, or



separable costs for included purposes are roughly equivalent, cost allocations computed using ENSC and SCRB may not be significantly different. An advantage of ENSC over SCRB is simplicity, by elimination of steps (5), (7), and (8) previously described.

3.3 Recommended Initial Cost Allocation Method

The SCRB method is the preferred cost allocation procedure identified in the Economic Analysis Guidebook for repayment purposes for the SWP (DWR 2000, Chapter 7, *Financial Analysis*). Moreover, the Economic Analysis Guidebook fully incorporates federal water resource development policy (U.S. Water Resources Council 1983) and planning guidance (USACE 2000), as stated:

Because of its considerable water management partnerships with the Federal government, the Department of Water Resources (DWR) has a policy that all economic analyses conducted for its internal use on programs and projects be fundamentally consistent with the Federal Economics and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G), which was adopted by the US Water Resources Council on March 10, 1983. The P&G set forth principles "...intended to ensure proper and consistent planning by Federal agencies in the formulation and evaluation of water and related land resources implementation studies..." and guidelines that "...establish standards and procedures for use by Federal agencies in formulating and evaluating alternative plans for water and related land resources implementation studies."

Because the SCRB procedure is preferred as a matter of DWR policy, the initial allocation of Delta levee costs should be made initially to each included purpose (EAD, EAW, and EACH) using SCRB. If non-separable costs of levee improvements are small in comparison to separable costs of any purpose, or alternatively if separable costs of included purposes are roughly equivalent, the ENSC method can fulfill the requirements of SCRB with the added advantage of simplicity.

3.4 SCRB Application Case Study

Appendix B to the *Economic Analysis Handbook* (DWR 2008) provides a case study illustration of SCRB application to the Hamilton City Flood Damage Reduction and Ecosystem Restoration Study, a joint federal-State project on the Sacramento River about 85 miles north of Sacramento. The project was initially formulated as a single-purpose flood control project. The rebuilding and improvements to existing private levees, however, could not be justified based on flood damage reduction (FDR) alone because project cost exceeded FDR benefits. However, the project became feasible as a multipurpose project with ecosystem restoration (ER) benefits, measured by SPA costs of ecosystem protection, added.

Without addressing details of plan formulation, assessment, and comparison, tables excerpted from Appendix B of the *Economic Analysis Handbook* are provided on Figures 3-1 and 3-2 summarizing SCRB application to the recommended plan.



Table B-9 Estimated first costs of recommended plan

Cost category	Total first cost (in \$1,000)
Land and damages	13,347
Relocation	563
Fish and wildlife	24,540
Levees	921
Cultural resources	170
Planning, engineering, and design	3,123
Construction management	2,212
Total first cost	44,876
Annualized first cost 1	2,687

1. 50-year analysis period; 5 5/8% discount rate.

Figure 3-1. Estimated First Costs of Recommended Plan, Hamilton City Study (from DWR 2008, Appendix B)

Table B-10 Preliminary cost allocation using SCRB Method (October 2003 price levels)

	Annual costs (in \$1,000)		
Total project annual first cost (a+b+c)	2,687		
(a) Flood damage reduction (FDR) separable costs	67		
(b) Ecosystem restoration (ER) separable costs	1,797		
(c) Joint costs	823		
	Annual costs and benefits (in \$1,000)		
	FDR	ER	Total
(d) Average annual benefits	577	888 AAHUs	
(e) Least cost single purpose alternative plan	922 (Alt 1)	3,521 (Alt 3)	
(f) Limited benefits (lesser of d and e)	577	3,521	
(g) Separable costs (a and b)	67	1,797	
(h) Remaining benefits (f - g)	510	1,724	2,234
(i) Percentage of remaining benefits	23%	77%	
(j) Allocated joint costs (c x h)	189	634	823
(k) Total allocated costs (l + a and i+b)	256	2,431	2,687

Figure 3-2. Preliminary Cost Allocation Using SCRB Method, Hamilton City Study (from DWR 2008, Appendix B)



The example shows that FDR benefits were not sufficient to justify a single-purpose project, i.e., were less than SPA costs. Also illustrated in the example is the substitution of ER SPA costs (e) for habitat values in calculation of limited ER benefits (f).

4. DETERMINATION OF STATE COST-SHARING RESPONSIBILITY (STEP 2)

As previously noted, project levees are included in the State Plan of Flood Control, which qualifies them for financial assistance from the federal government. According to California Water Code, sections 12310-12318, the federal government has typically paid between 50 percent (%) and 75% of the total costs of flood control projects authorized by Congress (including the State Plan of Flood Control). The non-federal costs have been shared, typically 70% by the State and 30% by local agencies. Cost sharing varies with the benefits provided by the project. For example, the federal share for ER can be as much as 65% in urban flood risk reduction projects. Other benefits such as water supply and recreation can further increase the federal cost share in flood risk reduction projects. Recommendation of processes and procedures for determination of federal share of levee investments is not within the scope of this technical memorandum. However, once the federal share has been determined, the next step in the cost allocation process is determination of State interest in the non-federal shares of EAD, EAW, and EACH purposes and responsibility for cost sharing with local governments.

For improvements to project levees, DWR recently published guidelines for determination and application of cost sharing formulas (DWR 2014b). The guidelines state that "...the minimum State share of the non-Federal portion of the project is 50%," and in addition to that, the formulas shall "...consider the ability of local governments to pay their share of the capital costs of the project." These guidelines apply to all flood management funding and grant agreements reached after January 1, 2015.

The DWR guidelines also provide for increasing the State base-level cost share for levee improvements if any of the following objectives are satisfied: 1) the project serves a disadvantaged area community; 2) the project improves the system; 3) the project includes ecosystem enhancement and improvement; and 4) the project includes other multi-benefit features. Satisfying all four objectives can increase the State share to a maximum of 90%. The State may increase its share up to 80% for projects with setback levees due to additional environmental and flood protection benefits they potentially provide. Additional capital and OMRR&R costs, if any, associated with setback levees in comparison to conventional levees provide an example of separable costs (and possibly joint costs as well) that can be initially allocated using the SCRB method previously described.

In addition to the 50% State funding of the non-federal portion, current guidelines also provide for increasing the State's share for disadvantaged area flood management projects by up to an additional 40%, in 1% increments. In other words, the ability (or inability) of local governments to pay their share can be used to increase the State's cost share up to 90% of the total project costs. The exact amount of the increase in the State's cost share depends on the degree to which the project serves economically disadvantaged communities.

DWR has also developed guidelines for improvements to non-project levees in the Delta (DWR 2014a). In general, the State share is limited to \$10 million, which may be modified by DWR in project solicitation packages. The State may pay up to 20% of pre-construction costs and in no case will the State pay more



than 100% of the cost of a project. For projects in the Primary Zone that comply with the guidelines, the State's base cost share is 75%. For projects in the Secondary Zone, the State's share is 50%, which may be increased up to a maximum of 75% based on the results of an ATP study (or, LABA, Local Agency Benefits Assessment). The base share may also be increased as follows:

- *Habitat*: Projects that contribute to restoring habitat may receive an increased cost share of up to 40% over base funding. If habitat benefits are judged to be significant, DWR may pay 100% of the project cost.
- Enhanced cost share:
 - The State's share may be increased up to 20% for projects that make a significant contribution to specific public purposes that are described in the project solicitation packages. The ceiling for overall State share including the enhanced cost share is generally 95% of the local share or the total project cost.
 - The State may enhance its cost share up to 10% for projects that fully mitigate habitat impacts and contribute to net habitat improvement. If habitat benefits are judged to be significant, DWR may pay 100% of the project cost.
 - Projects that contribute to subsidence control or reversal may receive an enhanced cost share up to 10%.
 - Projects that contribute to statewide interests, including water supply reliability and ecosystem enhancement or beneficial reuse, may receive an enhanced cost share up to 10% for each.
 - The State may provide a 50% match for all third-party contributions to a project, up to 95% of local share or total project cost.

5. DETERMINATION OF LOCAL GOVERNMENTS' ABILITY TO PAY (STEP 3)

California Water Code section 12986 states the intent to reimburse eligible local agencies for costs incurred for maintenance or improvement of project or non-project levees. The details of cost sharing for maintenance of non-project levees are described in the Delta Levees Maintenance Subventions Program (Central Valley Flood Protection Board 2011). Subject to availability of State funds, the program will reimburse local agencies for up to 75% of remaining eligible maintenance costs for non-project levees after local agencies have expended at least \$1,000 per mile using local funds. The California Water Code requires that:

- Local agencies provide information regarding the ATP for the cost of levee maintenance or improvement.
- DWR use the information on the local agency's ATP as the basis for determination of maximum allowable reimbursement.

The California Water Code also sunsets this particular requirement of section 12986 on July 1, 2018, and fully repeals it on January 1, 2019. In its place, beginning July 1, 2018 the California Water Code will provide, subject to the availability of State funds, reimbursement to local agencies for up to 75% of remaining eligible maintenance costs for non-project levees after local agencies have expended at least \$1,000 per mile using local funds. In other words, the ATP provision will no longer apply.



According to its 2007 report (DWR 2007), DWR has evaluated methodologies for determining a local agency's ATP. DWR considered two different approaches to measure ATP – a benefits-based approach and a financial approach. Under the benefits-based approach, ATP is based on the value of the economic benefits of the project computed using EAD averted. No provisions are included for valuation of EAW or EACH benefits, though least-cost SPA, previously identified for SCRB application for initial cost allocation by purpose, could potentially be used as a surrogate for EAD, EAW, and EACH and would in addition be more consistent with the overall fairness objective of the SCRB procedure.

Using the financial approach, projected revenues, expenses, assets, and debts of the local agency are evaluated and economic benefits of the project are not directly considered. The ability of the local agency to raise revenues through assessments for special projects or maintenance is based on the financial ability of landowners and land users to pay for levee maintenance and improvements. While the benefits-based approach may be more economically efficient, the type of benefits received by local agencies and SCRB cost allocations to EAD, EAW, and EACH purposes may determine which approach (benefits-based or financial) is more 'fair.' In any case, the current version of the Delta Levees Maintenance Subventions Program does not include provisions for determining or obtaining ATP information.

6. FINAL ALLOCATION OF USER COSTS (STEP 4)

As discussed above, formulas for sharing costs of levee improvements between the State and local agencies are specific and well established by State policy. On the theory that private beneficiaries of flood risk reduction and increased water supply reliability should share in the cost of improving those facilities, the final step in the cost allocation process is assessment of EAD and EAW purpose costs remaining after federal, State, and local government shares have been determined. Because environmental restoration is a public benefit, costs allocated to EACH should be considered to be fully compensated by federal, State, and local government shares and not passed on to private beneficiaries.

The initial cost allocation is a fairly straightforward process using SCRB procedures that inform federal-State and State-local cost-sharing agreements. However, specific allocation of costs to private beneficiaries will require either (1) agreement on an allocation formula acceptable to State and local governments and to individual beneficiaries as well, or (2) practical and enforceable mechanisms for State or local government assessments.

Some of the potential problems and issues that must be addressed for negotiated agreement on user costs are briefly described as follows:

- Lack of consistent objective basis for valuation of EAD and EAW benefits received by individuals; for example, individuals or individual property owners will value the mix of flood risk reduction benefits provided by levee improvements differently based on appraised value of property, income and employment, and owners' WTP for flood risk reduction and willingness to accept (WTA) flood risk.
- Property acquisitions, easements, and rights of way required for levee construction and maintenance are within the Delta; flood protection benefits are riparian, realized by beneficiaries located within the Delta, whereas most of the water supply beneficiaries are located south of the Delta.
- Benefits may be provided that are incidental to levee investments (i.e., at no cost) and which are not identified as purposes of levee improvements; incidental benefits are consequently not included in



SCRB cost allocations, but identified beneficiaries may demand compensation should previously received incidental benefits be foregone due to levee improvements.

Individual beneficiaries may be identified and / or natural coalitions formed based on the predominant source of benefits (EAD or EAW), by location within (direct) or south of Delta (indirect), or based on the form of benefits received (e.g., property value, income, employment).

This technical memorandum proposes for consideration, but does not provide detailed scopes for, alternative approaches to determine and allocate user costs. For purposes of description of alternative approaches, the following definitions are useful:

- Cost allocation: Allocation of costs among program or project purposes, benefit categories, or specific users (CALFED 1999).
- Cost share: Portion of costs assessed to project beneficiaries.
- Beneficiary: Any entity (individual, group, organization, agency, or community) potentially benefiting from investments in levee improvements through reduced flood risk, increased water supply reliability, ER, or other benefit incidental to levee improvements. (See also Technical Memorandum 2.1, *Baseline Information on Islands and Tracts, Assets, Hazards, and Beneficiaries*.)
- Direct beneficiary: Any entity that owns property or assets within the Delta (includes landowners, easement owners, and owners of assets such as roads, pump stations, telecommunication / electrical towers, and railroads that traverse the islands in the Delta) primarily benefiting from flood risk reduction afforded by levee improvements.
- Indirect beneficiary: Any entity that does not own land or assets within the Delta primarily benefiting from increased water supply reliability (e.g., south of Delta agricultural and domestic water users).
- Incidental beneficiary: Any entity, whether owning land or assets within the Delta or not, benefiting from levee improvements in ways not accounted for among project purposes, or to which separable or non-separable costs have not been allocated.

6.1 Facilitated Negotiation of User Costs

One approach for determination and allocation of user costs is to prescribe minimum cost recovery amounts by purpose based on the SCRБ allocation of separable and joint costs. Subsequently, the Council can provide data and facilitate negotiations among beneficiaries, beneficiary groups, or beneficiary coalitions formed, either with Council assistance or independently.

6.2 Market-Based (Non-Facilitated) Allocation of User Costs

Another approach uses a game-theory version of SCRБ known as the Non-Separable Cost Gap (NSCG) method, in which non-separable costs may be allocated to included purposes (or even individual beneficiaries) based on a "concession amount." The concession amount represents beneficiaries' WTP, limited to the minimum of gaps (total less separable costs) by all coalitions formed by beneficiaries of which an individual beneficiary is a member (Driessen and Tijs 1985).

A limitation to this method relative to cost sharing of public works is the potential trade-off of distributional fairness for economic efficiency by (1) substitution of demand / WTP for replacement costs of the least-cost



SPA, and (2) potential created for building of (or threats to build) coalitions specifically designed to shift costs from some beneficiaries to others. However, the approach could promote consensus on otherwise suboptimal cost allocations (in comparison to SCRB) by enabling allocation of costs to incidental beneficiaries, or by allowing concessions to be charged by direct beneficiaries over and above their SCRB-allocated costs for guarantees or assurances of property rights, easements, or use of facilities for future levee maintenance and / or improvements.

6.3 User Fees

If levees are considered a public utility asset, the utility or facility owners – presumably the local governments responsible for sharing costs of levee improvements – can impose fees or taxes to recover those costs in whole or in part. An advantage of user fees under the current version of the Delta Levees Maintenance Subventions Program is the potential to increase local governments' ability to pay and shoulder a greater share of State costs than otherwise possible.

7. CONCLUSIONS

This technical memorandum concludes that four steps are needed for equitable allocation of user costs:

1. Initial allocation of separable and non-separable costs of inclusion of purposes (EAD, EAW, and EACH).
2. Determination of State interest in EAD, EAW, and EACH and determination of State share (remaining after federal participation) of separable and non-separable costs for each, for project and non-project levees.
3. Determination of ATP of local governments toward State share.
4. Allocation of user costs (remaining after State and local participation) to beneficiaries through facilitated or non-facilitated negotiations, or user fees, consistent insofar as practicable with the prescribed initial cost allocation, federal-State, and State-local cost-sharing arrangements.

Consistent with DWR guidelines, the above-styled approach emphasizes equitable allocation of levee improvement costs over economically efficient cost allocations based on beneficiary valuation of and WTP for benefits received. Detailed assessment and recommendations for steps (2) through (4) above, along with development of a spreadsheet tool to inform cost allocation planning, are left for future study. However, a prototype tool capable of SCRB calculation and adaptation to alternative federal-State and State-local cost-sharing formulas is recommended for development and proof of concept in the near term.

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