TABLE OF CONTENTS

Tables

2.1 BUILDING BLOCK AND SCENARIO IDENTIFICATION

After reviewing the results of the Phase 1 Risk Analysis and holding discussions with the Delta Risk Management Strategy (DRMS) Steering Committee and others, the Department of Water Resources and the consulting team identified improvements that directly mitigate the observed vulnerabilities of Delta levees or indirectly mitigate adverse impacts to the assets or resources of the Sacramento–San Joaquin River Delta (Delta), Suisun Marsh, or the state of California.

This report presents two types of improvements: *building blocks* and *scenarios.* The building blocks are defined as individual improvement that cannot be further subdivided into sub-components and still maintain their functionality as built projects. The scenarios are defined as ensembles or combinations of building blocks. The scenarios aim to achieve multiple risk reduction objectives or benefits to the various assets or resources in the Delta and Suisun Marsh. The scenarios can be divided into subcomponents.

The building blocks were developed on the basis of the apparent and direct mitigation value they offer to the flood control system or the resources or assets they would protect. For example, levee upgrade solutions are used to reduce the risk of levee failures, a through-Delta conveyance is considered to preserve and protect water export capabilities if levees fail, and ecological restoration solutions are considered to increase and diversify the habitat in the Delta and Suisun Marsh and hence mitigate the potential impacts of levee failures. Table 2-1 lists the building blocks used in this analysis and briefly describes each one. The list of building blocks in Table 2-1 is not exhaustive; nor does this list address all possible improvements in the Delta and Suisun Marsh. The building blocks considered were identified as a starting point for evaluation, and their number and scope were mainly controlled by the limited time and resources available to complete Phase 2 of the DRMS project. The building blocks were selected based on input from and consultations with the DRMS Steering Committee and DWR. Additional building blocks should be considered and evaluated beyond those considered in this document. As more building blocks are evaluated and compared, improved solutions will emerge.

Similarly, limited time and resources were available to develop the scenarios. Therefore, this Phase 2 Report addresses only four scenarios. The four scenarios selected for this analysis were developed to offer risk reduction benefits to as many assets and resources in the Delta and Suisun Marsh as possible. The four scenarios all contain a central levee improvement / water conveyance theme, because the scope of the DRMS project is to address the risk of levee failures and their consequences. Other studies, publications (PPIC 2007; URS 2007b; BDCP 2007) and work group products (SCG Charrettes 2007) were reviewed and used to develop these scenarios. The scenarios selected for this evaluation are a reasonable first set of strategic risk-reduction solutions. It is recommended that additional scenarios be evaluated for their risk reduction values. Nonetheless it should be recognized that there is no one solution (scenario) that would achieve the “best outcome” in all cases and conditions. Ultimately, a more extensive and detailed quantitative evaluation of the building blocks and scenarios considered here and others should provide further objective information to use as the technical basis for decisions.

2.2 BUILDING BLOCKS

As shown in Tables 2-1 and 2-2, three main categories of building blocks were developed: (1) conveyance and flood risk reduction, (2) infrastructure risk reduction, and (3) environmental

risk mitigation. The building blocks are described in detail in Sections 3 through 17. The building blocks were developed to a level of engineering detail to enable verification of their technical feasibility and constructability. Further, conceptual designs were developed for each building block with enough detail to allow estimation of construction quantities, material sources, and construction costs. The risk reduction associated with each building block is also quantitatively estimated, when possible. For example, the raising of highways (i.e., providing elevated structures) will mitigate the economic cost and impacts from potential losses of use of the highway system. However, care must be taken in using these estimates. When building blocks are combined in a scenario, their values change. The economic loss reductions are not easy to develop in all cases. For example, the potential risk-reduction benefits associated with improvements to habitat in the Delta are estimated more on a qualitative basis.

2.3 SCENARIOS

As indicated in Section 2.1, the scenarios consist of combinations of building bocks such that the each scenario as a whole offers risk-reduction value to many assets and resources in the Delta and Suisun Marsh. The number and type of building blocks that form each of the four scenarios are shown in the last three columns of Table 2-2. Each column defines a scenario and the colored bullets in the respective columns identify the building blocks included in that scenario.

Although the building blocks are evaluated for their direct independent benefits, the scenarios are evaluated for the integrated risk reduction benefits gained for the Delta and Suisun Marsh and the state as a whole. Only the evaluation of the scenarios can quantify the potentially complex interactions among the building blocks that constitute each scenario. The Phase 2 analysis quantifies the risk-reduction consequences of each of the four scenarios. The same failure cases (flood and seismic) evaluated in the Phase 1 risk analysis are evaluated in the Phase 2 scenarios to estimate the difference in impacts (i.e., difference in risk-reduction values).

Tables

Table 2-1 Summary of Building Blocks

Type	Building Block No. and Description		Option Identification and Description	
Conveyance and Flood Risk Reduction	1.1	Improved Delta Levee Maintenance	a.	Delta levee subventions increased to ~$12 million/year (2 × current level)
			b.	Delta levee subventions increased to ~$25 million/year (4 × current level)
	1.2	Upgraded Delta Levees	a.	Selected Delta levees (~764 miles) upgraded to PL 84-99 (Class 3) standards
			b.	Selected Delta levees (~187 miles) upgraded to Urban Project Levee (Class 5) standards
	1.3	Enhanced Emergency Preparedness/Response	a.	Spend ~$50 million for pre-positioning rock, sheet piles, and other emergency response materials
			b.	Spend ~$100 million for pre-positioning rock, sheet piles, and other emergency response materials
	1.4	Pre-Flooding of Selected Islands	a.	Compares pre-flooding a group of western, eastern, and southern islands
	1.5	Land Use Changes to Reduce Island Subsidence	a.	Change land use from farming to wetlands/carbon sequestration (e.g., rice growing, fish food farm) for all islands projected to have more than 3 feet of additional subsidence by 2100
	1.6	Armored Pathway Through Delta Conveyance (modified PPIC "Armored Island" Concept)	a.	Seismically (Class 8) upgraded levees along armored "pathway," channel dredging, operable barriers
	1.7	Isolated Conveyance Facility Alternatives	a.	Dual conveyance ICF (say 5,000 cfs capacity)
			b.	Intermediate ICF (say 10,000 cfs capacity)
			c.	Full ICF (15,000 cfs capacity)
	1.8	San Joaquin Bypass	a.	San Joaquin River detention and bypass
		San Joaquin River Widening	b.	San Joaquin River widening

Table 2-1 Summary of Building Blocks

Type	Building Block No. and Description		Option Identification and Description	
Infrastructure Risk Reduction	2.1	Raise State Highways and Place on Piers (similar to I-80 across Yolo Bypass)	a.	SR 4, SR 12, SR 160
	2.2	Construct Armored Infrastructure Corridor Across Central Delta	a.	Mokelumne Aqueduct, BNSF railroad, SR 4, gas pipeline (Class 7 setback levee)
Environmental Risk Mitigation	3.1.	Suisun Marsh Tidal Wetland Restoration	a.	Suisun Marsh tidal wetland restoration
	3.2	Tidal Marsh Cache Slough Restoration	a.	Tidal marsh Cache Slough restoration (Yolo Bypass, upper and lower)
	3.3	Install Fish Screens	a.	River diversions
			b.	Armored pathway
			c.	ICF
	3.4	Setback Levees to Restore Shaded Riverine Habitat	a.	20 to 30 miles (Use BDCP, Sutter, Steamboat, and San Joaquin widening)
	3.5	Reduce water exports from the Delta	a.	2 to 3 percent
			b.	4 to 5 percent
			c.	6 to 7 percent

BDCP = Bay-Delta Conservation Plan
cfs = cubic feet per second
ICF = Isolated Conveyance Facility
PL = Public Law
PPIC = Public Policy Institute of California
SR = State Route

Table 2-2 Summary of Building Blocks and Scenarios

Type	Building Block No. and Description		Option Identification and Description		Trial Scenario: Improved Levees	Trial Scenario: Armored Pathway	Trial Scenario: Isolated Conveyance Facility	Trial Scenario: Dual Conveyance
1 - Conveyance and Flood Risk Reduction	1.1	Improved Delta Levee Maintenance	a.	Delta levee subventions increased to ~$12 million/year (2 × current level)	●	●	●	●
			b.	Delta levee subventions increased to ~$25 million/year (4 × current level)				
	1.2	Upgraded Delta Levees	a.	Selected Delta levees (~764 miles) upgraded to PL 84-99 (Class 3) standards	●	●	●	●
			b.	Selected Delta Levees (~187 miles) upgraded to Urban Project Levee (Class 5) standards		●	●	●
	1.3	Enhanced Emergency Preparedness/ Response	a.	Spend ~$50 million for pre-positioning rock, sheet piles, and other emergency response materials	●	●	●	●
			b.	Spend ~$100 million for pre-positioning rock, sheet piles, and other emergency response materials				
	1.4	Pre-Flooding of Selected Islands	a.	Compares pre-flooding a group of western, eastern, and southern islands				
	1.5	Land Use Changes to Reduce Island Subsidence	a.	Change land use from farming to wetlands/carbon sequestration (e.g., rice growing, fish food farm) for all islands projected to have more than 3 feet of additional subsidence by 2100	●	●	●	●
	1.6	Armored Pathway Through Delta Conveyance (modified PPIC “Armored Island” Concept)	a.	Seismically (Class 8) upgraded levees along armored “pathway,” channel dredging, operable barriers		●		●
	1.7	Isolated Conveyance Facility Alternatives	a.	Dual conveyance ICF (say 5,000 cfs capacity)				●
			b.	Intermediate ICF (say 10,000 cfs capacity)				●
			c.	Full Isolated Conveyance Facility (15,000 cfs capacity)			●	
	1.8	San Joaquin Bypass	a.	San Joaquin River detention and bypass				
		San Joaquin River Widening	b.	San Joaquin River widening				
2 - Infrastructure Risk Reduction	2.1	Raise State Highways and Place on Piers (similar to I-80 across Yolo Bypass)	a.	SR 4, SR 12, SR 160	(SR 12 and SR 160 only) ●	(SR 12 and SR 160 only) ●	●	●
	2.2	Construct Armored Infrastructure Corridor Across Central Delta	a.	Mokelumne Aqueduct, BNSF railroad, SR 4, gas pipeline (Class 7 setback levee)	●	●		
3 - Environmental Risk Mitigation	3.1	Suisun Marsh Tidal Wetland Restoration	a.	Suisun Marsh tidal wetland restoration	●	●	●	●
	3.2	Tidal Marsh Cache Slough Restoration	a.	Tidal marsh Cache Slough restoration (Yolo Bypass, upper and lower)	●	●	●	●
	3.3	Install Fish Screens	a.	River diversions	●	●	●	●
			b.	Armored pathway		●		●
			c.	ICF			●	●
	3.4	Setback Levees to Restore Shaded Riverine Habitat	a.	20 to 30 miles (Use BDCP, Sutter, Steamboat, and San Joaquin widening)	●	Included in Armored Pathway ●	●	Included in Armored Pathway ●
	3.5	Reduce water exports from the Delta	a.	2 to 3 percent				
			b.	4 to 5 percent				
			c.	6 to 7 percent				

Notes:

Colored circle indicates inclusion in respective scenario:

- ● Scenario 1: Improved Levees
- ● Scenario 2: Armored Pathway
- ● Scenario 3: Isolated Conveyance Facility
- ● Scenario 4: Dual Conveyance

BDCP = Bay-Delta Conservation Plan
cfs = cubic feet per second
ICF = Isolated Conveyance Facility
PL = Public Law
PPIC = Public Policy Institute of California
SR = State Route