8.0 Construction Cost Estimates

8.1 Introduction

This chapter summarizes the results of the Task 14, Cost Estimating work for the five overall restoration alternatives under evaluation by Reclamation. These estimates consider only the embankment related features of the alternatives. The costs associated with facilities such as canals, treatment systems, and control systems, are not included in these estimates but are documented in Volume 1 of Reclamation's Salton Sea restoration report. The cost estimating process has consisted of developing quantity models and unit pricing information using a bottoms-up approach. The unit price and quantity data are then merged into a construction cost subtotal for each of the alternatives listed under Sub-section 8.2 below.

The construction cost estimates are presented in the context of 2006 dollars. Davis Bacon labor rates for the Imperial Valley (September 15, 2006) were utilized. The project schedule and duration are entirely dependent on the alternative selected and the schedule-related impacts to the cost estimates have not been included at this time. It should be noted that these are appraisal level cost estimates for planning purposes and should not be used to establish project funding until feasibility level evaluations and designs have been completed.

8.2 Embankment Elements and Construction Requirements

A total of seven different cost estimates are presented below. This includes two estimates for Alternative No. 2 and three estimates for Alternative No. 3.

For Alternative No. 2, the mid-Sea barrier, the costs are presented for the embankment configuration that meets both static and seismic design criteria (shown as estimate 2A – with stone columns), and for the embankment configuration that meets only static design criteria (shown as estimate 2B – without stone columns). This will allow Reclamation to estimate the overall lowest project cost from a risk-based standpoint.

Similarly, two separate cost estimates are presented for restoration Alternative No. 3, the concentric lakes dikes. Cost estimate 3A (without stone columns) is for dikes that meet only static design criteria. Cost estimate 3B (with stone columns) is for dikes that meet both static and seismic design criteria. Note that the cost estimate 3C for dikes constructed with Geotubes® was developed separately by Reclamation and are presented in Reclamation's Summary Report.

8.3 Cost Estimate Model Development

Cost estimates have been prepared with a spreadsheet model that includes: 1) bottoms-up unit price derivations for each of the major construction material and placement requirements and 2) estimates of construction material quantities. Costs for the contractor's direct costs, indirect costs and profit only have been developed. This is summed to the "Subtotal Construction Costs" level only. These costs do not include allowances and contingencies for design, construction management, permitting, mobilization, unscheduled items, and changed conditions. Quantity estimating portions of the model are based on geometric equations that will allow for updating of the overall cost estimates should some of the dimensions of the embankments change. Sub-sections 8.4 and 8.5 that follow describe the development of the unit prices and quantity estimates. Sub-section 8.6 presents a summary of the estimated costs.

8.4 Unit Prices

Unit price information has been generated using 2006 cost data for similar size projects in the southern California area. Davis Bacon wage scales for the Imperial Valley (September 15, 2006, see Section 8.1) were used to estimate labor costs. Equipment rates assume that the contractor will use owned equipment. Given the project duration, we assumed all of the equipment would be fully depreciated over the project life with a zero salvage value. These unit costs have been developed using a resource loaded model which assigns fixed and variable costs for the construction of the 9 main construction elements described in Chapter 7 that include:

- Type A Sand/Gravel
- Type B Sand/Gravel
- Stone Columns
- Riprap Slope Protection
- Dredging
- Soil-Cement-Bentonite Slurry Wall without Membrane
- Habitat Pond Embankments
- Wick Drains
- Filter Rock

The methodology used to build up these rates is described below. The actual computations used for equipment, labor, supplies, tools etc. are listed in the accompanying Appendix 2F.

8.4.1 Fixed Direct Costs

Fixed costs were developed for each of the major cost items. The fixed costs consist of one- time costs that are required but are not a function of the volume of the material produced. For instance, constructing a truck crossing over Highway 86 represents a fixed cost that is independent of the volume of material that would be hauled over this feature. By identifying the fixed costs separately, one can allocate the fixed cost portion of the unit rates depending on the volume of each material needed. An example of this is reflected in the varying cost of Type A sand and gravel material from alternative to alternative. The unit price portion of the fixed direct costs is computed by dividing the fixed direct cost by the estimated quantity of material produced. Obviously, the unit price portion of the fixed costs decreases as the volume of material produced increases and vice versa.

8.4.2 Variable Direct Costs

Variable costs are defined as those costs that are directly related to the production of each individual unit. For instance, blasting for riprap production can be directly estimated based on the quantity of material produced. The variable unit costs are constant regardless of the volume of materials created.

8.4.3 Total Direct Unit Costs

Total direct unit costs consist of the summation of the variable unit costs and the fixed unit costs for each material type. This is the actual cost that the contractor would expend to produce each of the various material types. Total direct unit costs are the expense accrued to the contractor's operations. These are not the rates that would be charged to the owner.

8.4.4 Indirect Costs

Indirect costs are the overhead expenses that the contractor must absorb incidental to the total direct costs listed above. Items that fall under the Indirect Cost category include:

- Supervision and project management
- Temporary buildings
- Temporary utilities
- Temporary job construction
- Job transportation
- Office expenses
- Insurance
- Employee move costs
- Bonds
- Equipment contingency
- Summer/Winter protection
- Escalation
- Contractor's "Internal" Contingency
- Surveying

Indirect costs have been estimated as 10 percent of the direct costs.

8.4.5 Markup and Profit

The contractor's profit is compounded to the total of direct and indirect expenses. The Salton Sea restoration project represents a very large construction project and therefore represents a high risk to the contractor charged with its execution. Accordingly, a contractor's target profit may be as high as 20% commensurate with such a high-risk endeavor. Following Reclamation's costing protocols, a profit target of 10% was used in the cost estimate.

8.4.6 Unit Price Escalation

Cost estimates are presented using 2006 dollars and no allowance for escalation that would occur over an extended construction duration has been included at this time. Escalation will be a significant consideration when developing funding level cost estimates. Future construction costs are dependent on the level of labor and materials inflation. Construction cost inflation averages were between 2 and 3% prior to 2003. Since then, construction cost inflation has become much more volatile, approaching 10% or more per year. It is recommended that a risk-based approach to estimating costs and inflation factors be used during feasibility level cost estimate development.

8.4.7 Production Rates and Constraints

More detailed project schedules should be developed as the timelines for construction are developed. Once completed, the production rates and constraints listed in the accompanying cost estimates should be appropriately updated.

8.5 Quantity Estimates

Quantity models have been developed for each of the project alternatives. These models are mathematical in nature and automatically calculate the volume of the various construction elements as described in Chapter 8.0 above. A brief description of the quantity modeling is included in Appendix 2F (see Quantity Estimation Spread Sheets, located about 2/3 through appendix). The quantity models allow for changes in both the embankment height and foundation depth as the input variables. With changes in the input variables, the quantity models automatically recompute the new embankment volumes. The revised volumes are then loaded into the cost estimate sheets and the new cost estimate is generated. The quantity models are attached in Appendix 2F.

8.6 Summary of Estimated Costs

Using the "optimized" cross-sections, appraisal-level cost estimates were prepared for each of the five overall project alternatives and options (A and B) under consideration by Reclamation. A summary of the estimated subtotal construction costs for the embankment portion of these alternatives is as follows:

	Alternative		Estimated Subtotal Embankment Construction Costs
1.	Mid-Sea Dam/North Marine Lake		$ 3,339,066,140
2.	Mid-Sea Barrier/South Marine Lake:		
	2A	Static/Seismic design criteria	$ 898,087,677
	2B	Static/Non-seismic design criteria	$ 707,092,179
3.	Concentric Lake Dikes:		
	3A	Static/Seismic design criteria	$ 8,999,280,347
	3B	Static/Non-seismic design criteria	$ 6,944,914,735
4.	North-Sea Dam/Marine Lake		$ 5,021,163,338
5.	Habitat Enhancement without Marine Lake		$ 568,560,600

Table 8.1 contains a more detailed summary of these total costs.

It should be noted that this planning level study has developed embankment configurations and cost estimates beyond what was accomplished in the 2005 appraisal level studies. However, because of the limited amount of subsurface exploration work that has been completed to date, the concepts and cost estimates are not yet at a funding level of detail. Funding level concept and cost estimate updates should be prepared when sufficient supplemental explorations are completed for this purpose. The concepts and cost estimates could change dramatically if additional exploration information indicates significant differences from the baseline assumptions that have been made.

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Table 8.1
Summary of Estimated Construction Costs-Embankment Elements Only

Salton Sea Restoration Study - Kleinfelder Inc. (December 2006)

Alternative Components	ALTERNATIVES AND ASSOCIATED COMPONENT CONSTRUCTION COSTS							
	Alternative 1: Salton Sea Authority (SSA) Alternative	**Alternative 2A:** Mid-Sea Barrier with South Marine Lake with Habitat Enhancements	**Alternative 2B:** Mid-Sea Barrier with South Marine Lake with Habitat Enhancements: Risk Based Design without Stone	**Alternative 3A:** Concentric Ring Alternative With Stone Columns	**Alternative 3B:** Concentric Rings Alternative Without Stone Columns	**Alternative 3C:** Concentric Ring Alternative with Geotubes	**Alternative 4:** North-Sea Dam and Marine Lake with Habitat Enhancements	**Alternative 5:** Habitat Enhancement Without Marine Lake
1. SSA Mid-Sea Dam and Marine Lake - SCB Slurry Wall Dam	$1,735,660,191							
2. SSA West and East Perimeter Dikes	$487,172,367							
3. SSA South Sea Dam and Marine Lake - SCB Slurry Wall Dam -	$954,557,582							
4. SSA Habitat Pond Dikes - Earthen Dikes for Habitat Ponds (5 Ft)	$161,676,000							
5. Mid-Sea Barrier with South Marine Lake		$605,723,577	$414,728,079					
6. Mid-Sea Barrier Habitat Pond Dikes		$292,364,100	$292,364,100					
7. Four Concentric Ring Dikes with Stone Columns				$8,999,280,347				
8. Four Concentric Ring Dikes without Stone Columns					$6,944,914,735			
9. Four Concentric Ring Dikes with "Geotubes" Construction						$0		
9. North Sea Dam and Marine Lake - SCB Slurry Wall Dam							$4,519,967,738	
10. North Marine Lake Habitat Pond Dikes							$501,195,600	
12. Saline Habitat Complex - Earthen Dikes for Habitat Ponds (5ft)								$568,560,600
Subtotal Construction Costs	**$3,339,066,140**	**$898,087,677**	**$707,092,179**	**$8,999,280,347**	**$6,944,914,735**	**$0**	**$5,021,163,338**	**$568,560,600**
Environment Mitigation (10% +/-)								
Subtotal Contract Costs								
Unlisted Items (15% (+/-)								
Total Contract Costs								
Contingencies (25% +/-)								
Total Field Costs								
Permitting/Design/CM (33% +/-)								
Total Project Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Net Add On Multiplier								
Annual O&M&E Costs								
Repair & Replacement Cost (5 %) - Dam								
Repair & Replacement Cost (5 %) - Barrier								
Repair & Replacement Cost (5 %) - Dikes								
Repair & Replacement Cost (50 %) - Ponds								
Repair & Replacement Cost (50 %)- Canals/Outlets								
Repair & Replacement Cost (5 %) - Treatment Plant								
Annual Probability of Failure (Seismic) - Dam								
Annual Probability of Failure (Seismic) - Barrier								
Annual Probability of Failure (Seismic) - Dikes								
Annual Probability of Failure (Seismic) - Ponds								
Annual Probability of Failure (Seismic) - Canals/Outlets								
Annual Probability of Failure (Seismic) - Treatment Plant								
Annual Risk Cost - Dam	$0	$0	$0	$0	$0	$0	$0	$0
Annual Risk Cost - Barrier	$0	$0	$0	$0	$0	$0	$0	$0
Annual Risk Cost - Dikes	$0	$0	$0	$0	$0	$0	$0	$0
Annual Risk Cost - Ponds	$0	$0	$0	$0	$0	$0	$0	$0
Annual Risk Cost - Canals/Outlets	$0	$0	$0	$0	$0	$0	$0	$0
Annual Risk Cost - Trtmnt	$0	$0	$0	$0	$0	$0	$0	$0
Total Annual Risk Cost	$0	$0	$0	$0	$0	$0	$0	$0
Annual O&M&E&R Costs	$0	$0	$0	$0	$0	$0	$0	$0
Annual O&M&E&R Present Value*	$0	$0	$0	$0	$0	$0	$0	$0
Net Present Value Total Costs								$0

*** Present value calculated for 50 year period at 5.375%.**