In-Delta Storage Program
February 2004 Public Workshop

Engineering Design &
Risk Analysis

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Presentation Outline

- Objectives
- Proposed Facilities
  - Embankment Design
  - Erosion & Piping Protection
  - Seepage Control
  - Integrated Facilities
- Project Cost & Construction Schedule
- Risk Analysis
- Summary
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Objectives of Engineering Design & Risk Analysis

- To determine the technical feasibility of the In-Delta Storage Project
- To ensure public safety and project reliability through…
  - Improved embankment design
  - Consolidation of inlet and outlet structures
Presentation Outline

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Proposed Facilities

- Reservoir Island Embankments
- Integrated Facilities

Legend:
- Integrated Facility
- Habitat Island
- Reservoir Island
Reservoir Embankment Design

- **“Rock Berm” Option**
  - Construct new embankment on top of existing levee
  - 3H:1V Slough-side slope
  - Place Rock Fill on slough-side to meet stability criteria

- **“Bench” Option**
  - Bench created by removing a portion of existing levee to an elevation between 0 and 6 feet
  - Bench shifts new embankment towards reservoir
  - Erosion protection provided above bench elevation
Recommended Embankment Design

- Recommended design includes both Options
  - “Rock Berm” used around majority (96%) of reservoir islands
  - “Bench” configuration used where:
    - Slough is deep
    - Existing slope too steep to place rock
    - Placement of rock would block portion of channel
- Design based on safety and risk analysis requirements established by DWR and Reclamation
- DWR’s Independent Board of Consultants reviewed and approved this design

Webb Tract - Bench Option Locations
Bacon Island - Bench Option Locations

Erosion & Piping Protection

- **Erosion Protection** (from wind and wave action)
  - Riprap
    - upper portion of slough-side slope
    - reservoir-side slope from crest to elevation +3
  - Soil Cement
    - north and west facing 10:1 reservoir-side slopes (general prevailing wind and storm wind directions)

- **Piping Protection**
  - Geotextile Filter Fabric
    - reservoir-side slopes between existing levee and new embankment fill
    - 10:1 reservoir-side slopes
Seepage Control System

- **Without Seepage Control**
  - The proposed reservoir islands may increase seepage flows onto adjacent islands beyond the current rate.

- **With Seepage Control**
  - Crop damage and increased pumping costs on adjacent islands will be prevented.

- **Proposed Seepage Control**
  - Interceptor wells along reservoir embankment crest
    - Average Depth – 50 ft
    - Average Spacing – 160 to 200 ft apart
    - Average Pumping Rate – 6 to 8 gallons per minute
Webb Tract
Seepage Control Locations
Bacon Island
Seepage Control Locations

Integrated Facilities
(Diversion and Release Structures)

- **Purpose of Integrated Facilities**
  - To control diversions and releases from reservoirs
  - To combine all operational components into a single facility for more efficient operations

- **Operational Strategy**
  - To maximize gravity flow and minimize pumping to reduce operation and maintenance costs
Webb Tract Integrated Facilities

San Joaquin River Integrated Facility
Max Diversion: 2,250 cfs
Max Release: 1,500 cfs

False River Integrated Facility
Max Diversion: 2,250 cfs
Max Release: 1,500 cfs

Total Project Diversions and Releases
Diversions (all islands combined):
Total max day: 9,000 cfs*
Total max month: 4,000 cfs*
* Habitat Island diversions included
Releases (all islands combined):
Total max day: 6,000 cfs

Bacon Island Integrated Facilities

Middle River Integrated Facility
Max Diversion: 2,250 cfs
Max Release: 1,500 cfs

Santa Fe Cut Integrated Facility
Max Diversion: 2,250 cfs
Max Release: 1,500 cfs

Total Project Diversions and Releases
Diversions (all islands combined):
Total max day: 9,000 cfs*
Total max month: 4,000 cfs*
* Habitat Island diversions included
Releases (all islands combined):
Total max day: 6,000 cfs
Integrated Facility Components

Integrated Facility Components

Integrated Facility Diversion Flow Paths
Integrated Facility
Release Flow Paths

Integrated Facility
Diversion & Release Flow Paths
Key Features of Integrated Facility

- Integrated Facilities consolidate all controls for improved operation and maintenance
- Year-around diversions and releases are possible with gravity flow and pumping combinations
- State-of-the-Art Fish Screens similar to CCWD’s Old River Intake
- Conceptual design approved by CVFFRT

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Project Cost Estimates

- Basis for Cost Estimates
  - Material quantities
  - Construction methods, task sequencing and construction duration
  - Market research to obtain unit costs for materials and cost of labor and equipment
  - Previous Investigations

Project Cost

- Total Project Cost: $774 Million
  - Includes
    - Base Construction Costs
    - Land Acquisition, Mitigation, Demolition, Relocations and Permits
    - Contingencies
    - Engineering Design
    - Construction Management
    - Legal
    - Administration
Project Cost Breakdown

- Costs shown include contingencies where applicable
- Other Items include: Land Acquisition, Mitigation, Demolition, Relocations and Permits

Project Construction Schedule

<table>
<thead>
<tr>
<th>Activity</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering &amp; Final Design</td>
<td>1</td>
</tr>
<tr>
<td>Bid &amp; Award Process</td>
<td>2</td>
</tr>
<tr>
<td>Embankment Construction</td>
<td>3</td>
</tr>
<tr>
<td>(Including Piping Protection &amp; Erosion Control)</td>
<td>4-9</td>
</tr>
<tr>
<td>Seepage Control System</td>
<td>5</td>
</tr>
<tr>
<td>Integrated Facilities</td>
<td>6</td>
</tr>
</tbody>
</table>
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Risk Analysis

- Objective
  - To evaluate the risk (probability and consequences of failure) of the existing levees and IDS Project embankments and integrated facilities under all loading events
  - To assess public risk and potential economic losses that may result if a failure occurs
Loading Events that could cause an Embankment Failure

- Flooding
  - Overtopping, piping / internal erosion
- Seismic
  - Foundation liquefaction, slope instability due to deformation & cracking
- Operational
  - Slope failure, piping / internal erosion, operational problems

Consequences of Embankment Failure

- Inward Breach
- Outward Breach
- Potential to Flood Neighboring Islands
Risk Analysis Findings

<table>
<thead>
<tr>
<th>Reservoir Island</th>
<th>Annual Failure Probability</th>
<th>Chance that 1 Person would become a Fatality During 50-Year Project Life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rock Berm</td>
<td>Bench</td>
</tr>
<tr>
<td>Webb Tract</td>
<td>2.1%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Bacon Island</td>
<td>2.1%</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

- Risk from existing levees is 2 to 8 times higher than the risk from re-engineered embankments at Webb Tract and Bacon Island

Summary

- The project design ensures public safety and project reliability
  - Safe embankment design recommended
  - Erosion & piping protection provided
  - Seepage control measures (on project embankments) established to prevent increased pumping costs and crop damage on adjacent islands
  - Integrated facilities provide flexibility in operations, improved operation and maintenance, and protection to fish
  - Overall risk lower than existing conditions
  - Cost of Project has been estimated
  - Project as designed is technically feasible
  - All work has been peer reviewed