Flood Managed Aquifer Recharge
Merced River Reconnaissance Study

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Study Purposes & Goals

- Proof of concept study: Investigate the Flood-MAR concepts & implementation factors

Governance and Coordination: How will project needs be coordinated?
- Landowner willingness
- Local or system needs and opportunities
- Partnerships and agreements
- Coordination and operations decisions
- Legal/regulatory framework

Funding and Incentives: How will project be funded and landowners compensated?
- Available funding sources
- Landowner incentive or compensation programs
- Recharge quantification

Source Water: Where will the surface water come from?
- High flows
- Reservoir reoperation
- Timing and quantity of flows
- How are flows expected to change in the future?

Conveyance: How will surface water get to the site?
- Existing infrastructure
- New infrastructure

Site Suitability: Where are good candidate sites for recharge?
- Soil suitability
- Crop suitability
- Aquifer suitability
- Aquifer capacity
- Aquifer water quality
- Vadose zone water quality

Recharge Method: How will the water get into the ground?
- On-farm
- Fallowed land
- Dedicated basin
- In-lieu
- Direct injection

Groundwater Use: How will groundwater be recovered or otherwise used?
- Groundwater extraction wells
- Beneficial Uses
- Augmentation of groundwater for replenishment/irrigation

Feasibility Analysis: Is the project feasible?
- Benefits and benefits
- Costs and impacts
- Agreements and assurances
Study Purposes & Goals

- Integrate surface and groundwater analyses
- Assess multi-benefits and economics
- Document the process of planning, modeling, and analyzing a Flood-MAR project of this scale
- Template for future studies
Study Approach

- Outreach and coordination with local water interests
- Analyze a potential range of assumptions to understand the benefits
  - How much surface water is available?
  - How will surface water get to recharge areas?
  - What are good candidate sites for recharge?
- Analysis of results: What do they tell us about the implementation factors and barriers?
Analytical Procedure

• Analyze and screen scalable scenarios within three progressive levels of Flood-MAR implementation
  – Level 1 – Existing Operations / Existing Infrastructure
  – Level 2 – Revised Operations / Existing Infrastructure
  – Level 3 – Revised Operations / New and Expanded Infrastructure

• Analyze climate change using a vulnerability assessment methodology
Models

- Screening Analysis – Excel Model
- Hydrologic Routing – SAC-SMA-DA
- Reservoir Operations – HEC-ResSim
- Hydraulic Routing – HEC-RAS
- Flood Damage – HEC-FDA
- Groundwater Modeling – C2VSIM
- Systemwide Modeling – HEC-WAT
Preliminary Screening Results

Level 1 - Cumulative Flood-MAR Diversion to Groundwater Storage

Average Annual Flood-MAR
13.8 - 108TAF

Results subject to change
Preliminary Screening Results

Stage Decrease at Cressey - 1997 Event

- Minimal Flood-MAR Scenario Diversion – 1,560cfs
- Robust Flood-MAR Scenario Diversion – 2,000cfs
Climate Change Vulnerability Analysis

- Past studies have shown increasing future flood risk in the Central Valley due to climate change.
- Quantify deep uncertainties in flood and drought prediction with climate change
- Paleoclimatic reconstructed hydrology
  - 500 years of continuous hydrology
  - 0° to 4° Celsius increase in temperature
  - -30% to +30% change in precipitation
Global Climate Model Projections

Projected Range of Likely Climate Changes by 2050

Change in Temperature (°C)

Change in Precipitation (%)
System Response Surface
Annual Average Lake McClure Inflow Volume

Lake McClure Inflow Volume Change
(Oct01-Sep30)

Change in Temperature (°C)
0 1 2 3 4
30 20 10 0 10 20 30
Change in Precipitation (%)

500 years of model simulations
at each point

Current conditions
estimate
System Response Surface
Annual Average Lake McClure Inflow Volume = 1.0 MAF

**Flood Control**
(Average Flow Volume: 728 TAF)

**Water Supply**
(Average Flow Volume: 272 TAF)

- **Change in Flow Volume (Nov 01-May 31)** with 2050 Conditional Probability Space
- **Change in Flow Volume (Jun 01-Oct 31)** with 2050 Conditional Probability Space
Schedule

• Technical Analyses – Early 2019
• Technical Memos – Spring 2019
• Draft Report – Summer 2019
Thank You

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