Reclamation District 2068 Groundwater Management and Conjunctive Use Planning

Presentation to the RD 2068 Board of Trustees

August 10, 2006

Background

- District Received $250,000 Grant from DWR to Study Conjunctive Use of Groundwater and Surface Water
- District's Adopted Groundwater Management Plan Helped Win Grant
- Study Undertaken to Assess Feasibility of Conjunctive Use within RD 2068

Objectives of Grant Funded Work

- Evaluate Potential for Conjunctive Use of Groundwater and Surface Water by RD 2068
- Update Groundwater Management Plan
  - Provide RD 2068 with approach for maintaining sustainable groundwater supply
  - Maintain state funding eligibility

Scope of Work

- Groundwater Management Plan
- Groundwater Characterization and Monitoring
- Conjunctive Use Feasibility Study

Groundwater Management Plan

Overview

- Existing Plan Was Adopted in 1997
- Revisions to Applicable Sections of California Water Code Effective January 2003 (SB 1938)
- New Plan Adopted December 8, 2005
- New Plan is a Tool for Implementing Conjunctive Use
- New Plan Consistent with CWC, as Required for State Funding

Planning & Coordination Aspects of Plan

- Includes Statements Describing How Interested Parties May Participate in Plan Development (Public Notice)
- Incorporates Mechanisms for Involvement and Cooperation of Other Agencies in the Groundwater Basin
- Consistent with Solano Water Authority Planning Efforts
  - Project SWA-4: Coordinated Groundwater Data Analysis

Technical Components of Plan

- Basin Management Objectives
- Components Addressing Monitoring and Management of:
  - Groundwater Levels
  - Groundwater Quality
  - Inelastic Land Subsidence
  - Surface Water/Groundwater Interactions
- Supporting Monitoring Protocols

Past Management Goal

"Work cooperatively with landowners to most effectively manage and monitor groundwater resources to maintain a reliable water supply for potential future emergency water supply needs."

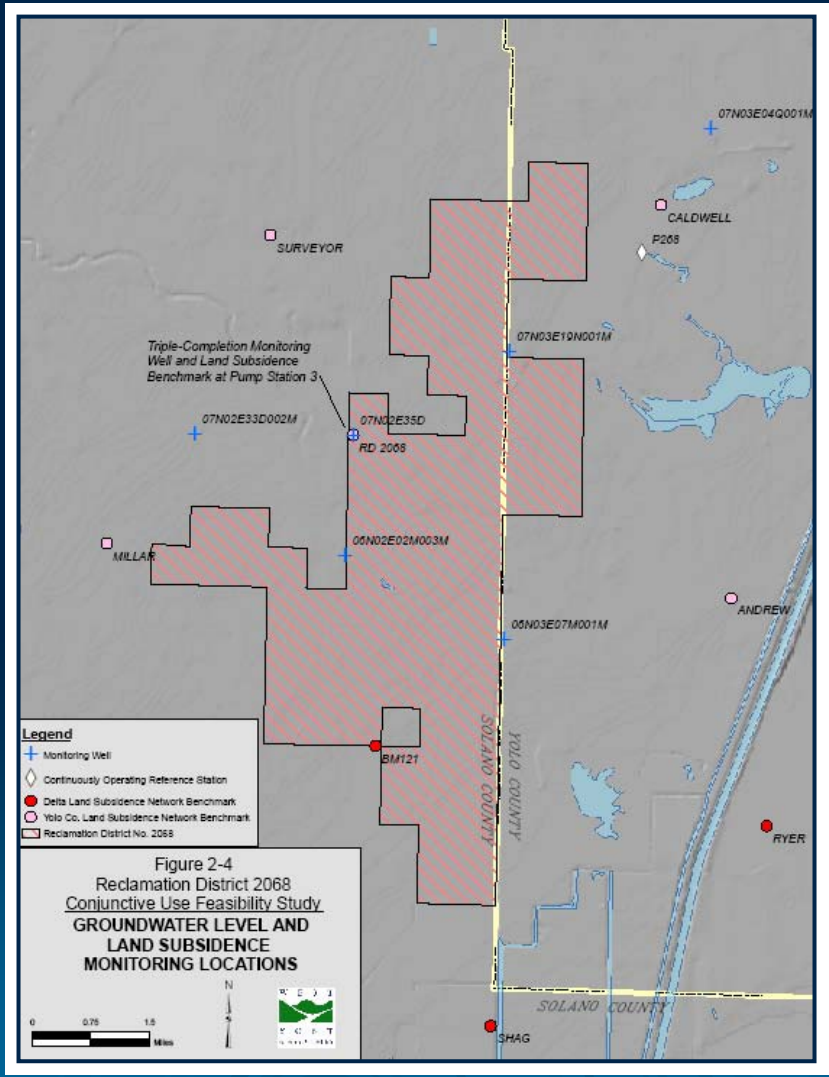
New Management Goal

"Work cooperatively with landowners and groundwater basin stakeholders to maintain sustainability, reliability, and quality groundwater supply for beneficial use on district lands."

Basin Management Objectives

- Objectives Used to Support the Overall Management Goal
- Plan Includes BMOs for:
  - Groundwater Elevations
  - Groundwater Quality
  - Inelastic Land Subsidence
  - Groundwater/Surface Water Interactions

Groundwater Level & Land Subsidence Monitoring Locations



Site Characterization and Monitoring

Site Characterization and Monitoring

- Monitoring Well Installation
- Pump Testing
- Land Subsidence Benchmark (Ongoing)
- Groundwater Level Monitoring (Ongoing)
- Water Quality Sampling (Ongoing)

Land Subsidence Benchmark at PS 3

Land Subsidence Benchmark

- Tied to Regional Network of Benchmarks
- Biennial Surveys Planned
- Allows Monitoring of Changes in Land Surface Elevations that Could Be Induced by Groundwater Withdrawal
- Supports Implementation of Groundwater Management and Conjunctive Use

Triple Completion Monitoring Well at RD 2068 Pump Station 3

Monitoring Well

- Equipped with DWR Data Loggers
- Allows Monitoring of Groundwater Levels and Quality
- Supports Implementation of Groundwater Management Plan and Conjunctive Use

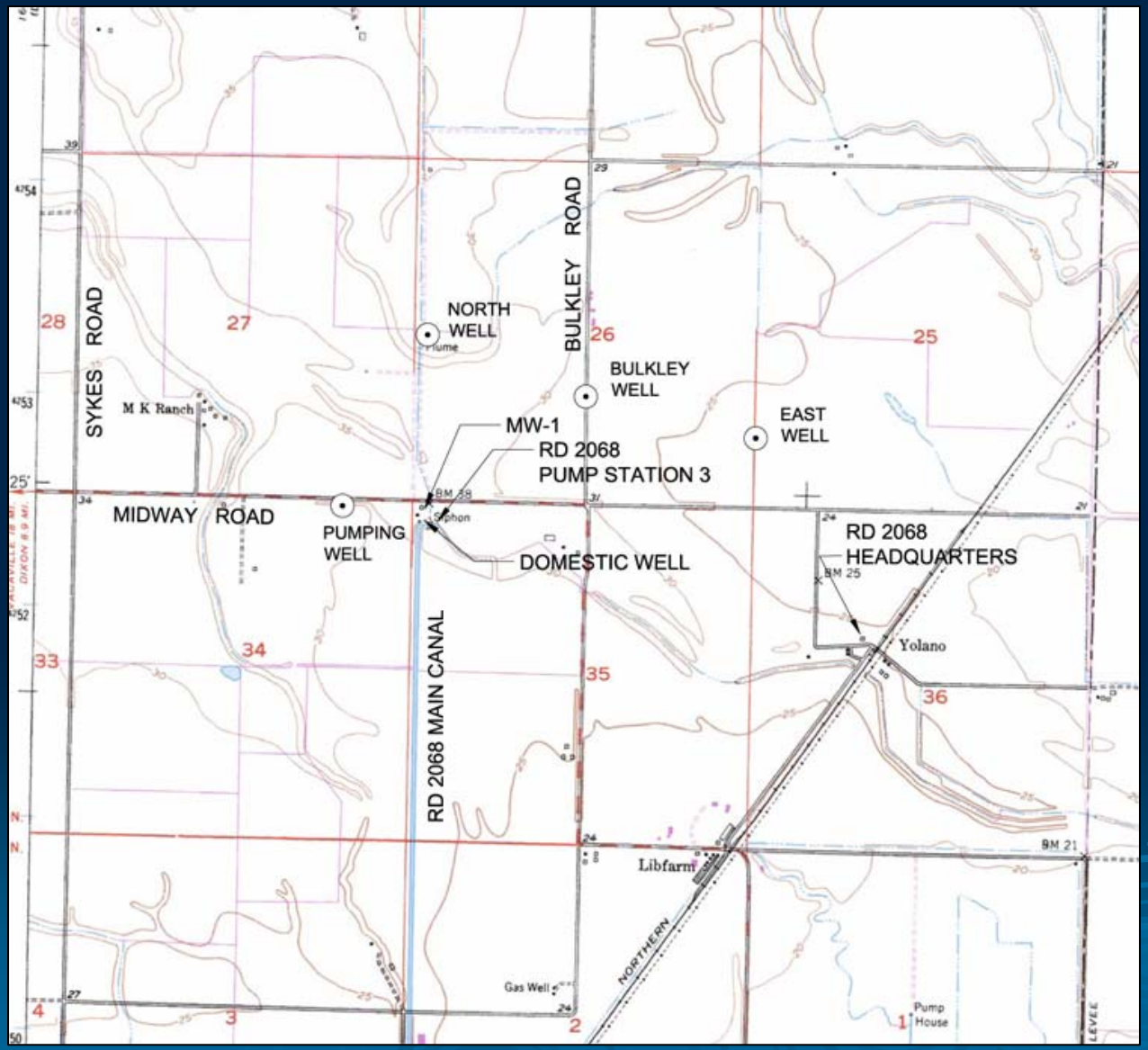
Groundwater Quality Sampling

- Groundwater Quality Samples Collected from PS 3 Monitoring Well
- Spring and Fall 2004, Fall 2005
- Groundwater Quality Suitable for Agricultural or Municipal Supply
- Meets All Water Quality Standards

Aquifer Testing at PS 3

- Quantify Aquifer Hydraulic Properties
- Estimate Lateral and Vertical Extent of Pumping Influence
- Assess Potential for Surface Water/Groundwater Interactions
- Supports Implementation of Groundwater Management Plan and Conjunctive Use

Aquifer Test Location Map



Aquifer Test

1,350 gpm Flow

Aquifer Test Conclusions

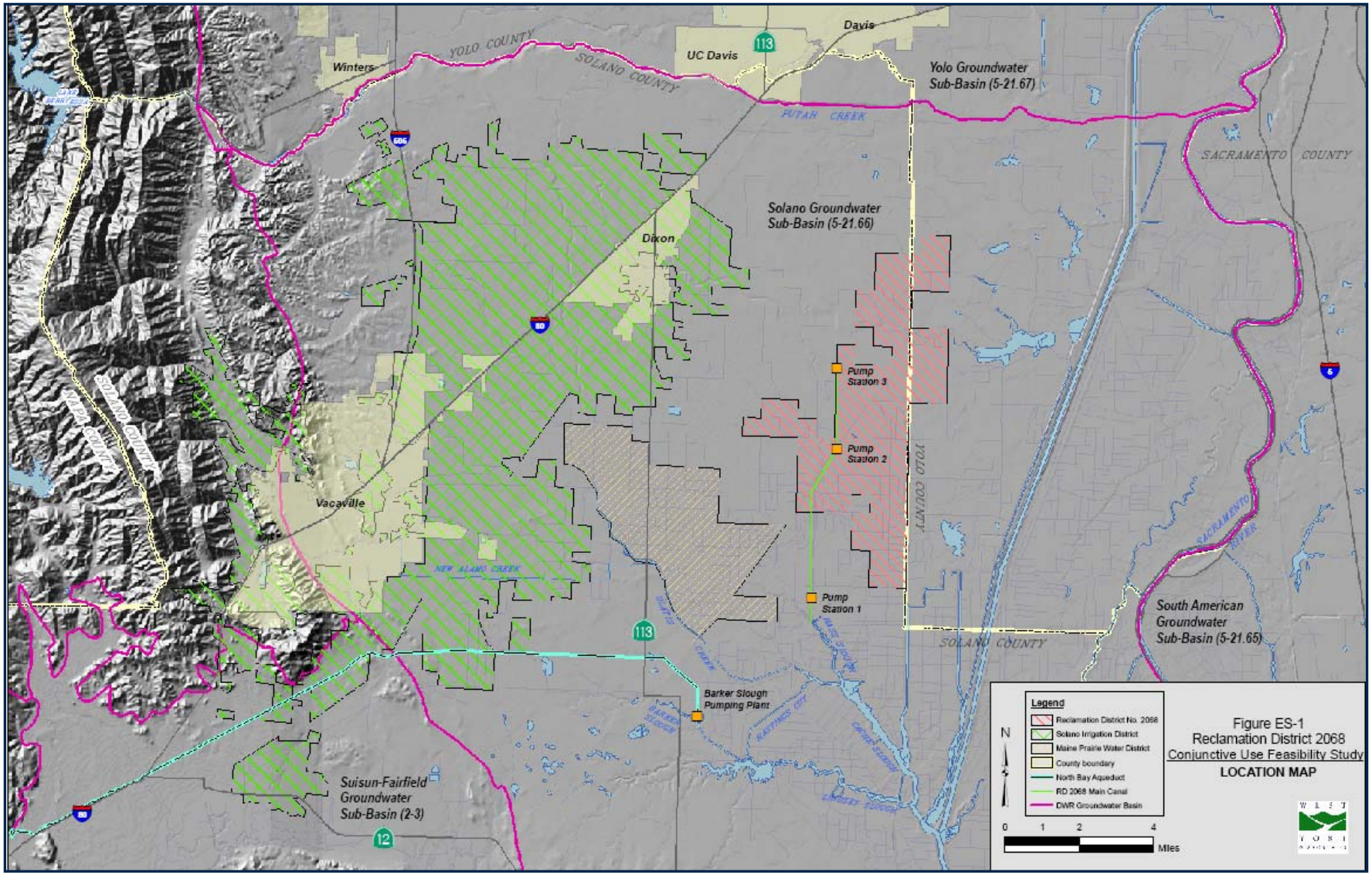
- Hydraulic Properties Typical of Region
- Lateral Influence Extended Roughly 3,000 feet
- Minimal Evidence of Surface Water/Groundwater Interaction
- 1,000-2,000 gpm per Well Appears Feasible

Conjunctive Use Feasibility Study

Conjunctive Use

- District Use of Groundwater in Dry Years Could Make Surface Water Available for Transfer/Sale
- Could Enhance Yield of Existing District Surface Water Supply
- Could Create Revenue for District
- Could Have Regional Water Supply and Environmental Benefits
- Must Be Structured to Preserve Integrity of Water Rights
- Must Provide Positive Economic Impact

RD 2068 Vicinity



Feasibility Study Components

- Technical Feasibility and Potential Impacts
  - Well yields
  - Groundwater Levels
  - Groundwater Quality
  - Inelastic Land Subsidence
  - Surface Water/Groundwater Interactions
- Economic Analysis
- Recommended Action Plan

Potential Impacts

- Favorable Site Characterization Results
  - Stable Groundwater Elevations
  - Suitable Well Yields
  - Suitable Groundwater Quality
  - No Known Subsidence
  - Limited Potential for Groundwater-Surface Water Interaction
- Monitoring for Future Impacts Addressed in Groundwater Management Plan
- Monitoring Network in Place

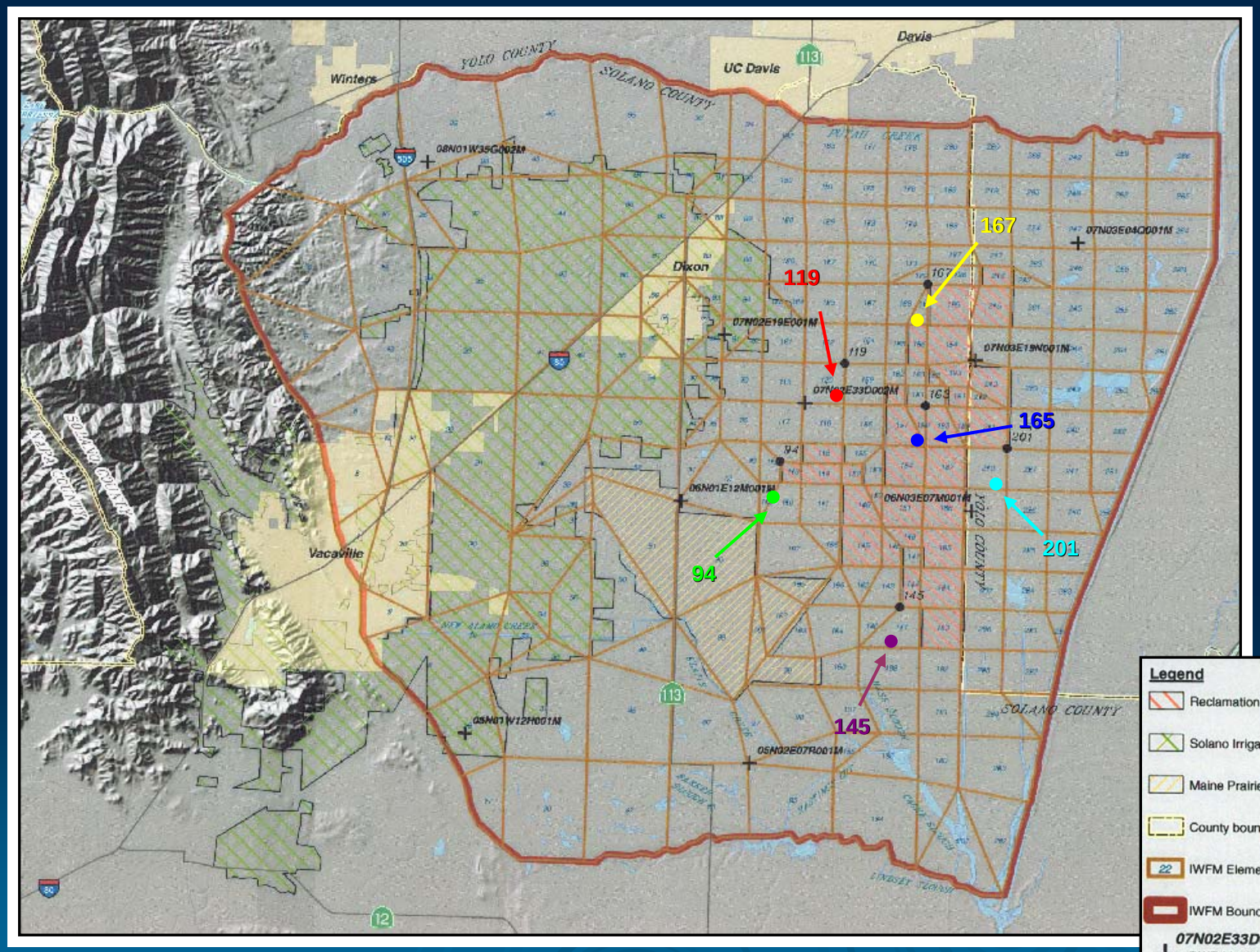
Integrated Water Flow Model

- Water Resources Management and Planning Model that Simulates:
  - Groundwater
  - Surface Water
  - Stream-Groundwater Interaction
  - Other Components of the Hydrologic System
- Well Suited to Conjunctive Use Application
- Powerful Tool for Future Analysis
- Supported by DWR

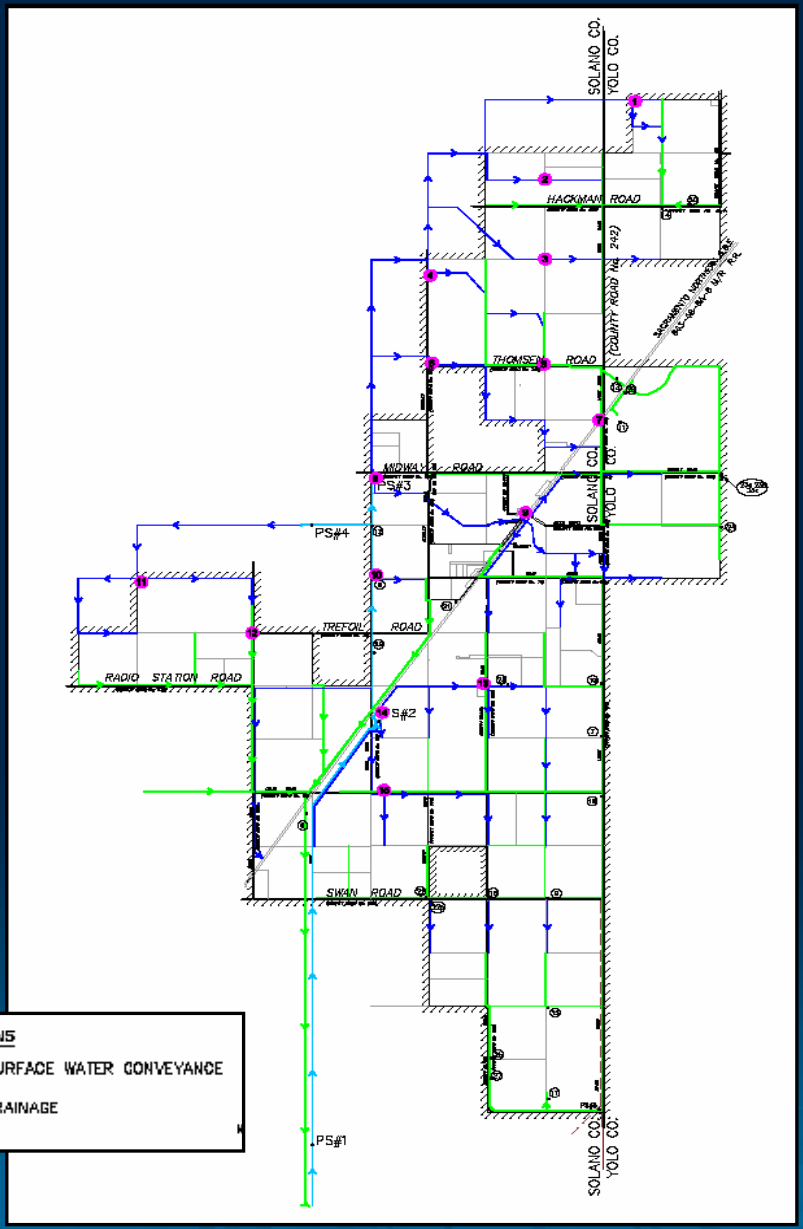
Modeling Approach

- Simulate Groundwater Conditions with and without RD 2068 Pumping
- Evaluate Groundwater Level Impacts for a Range of RD 2068 Groundwater Pumping
- Estimate Quantity of Surface Water that Could Be Transferred without Unacceptable Groundwater Level Impacts

IWFM Mesh & Boundaries



IWFM Simulated Pumping Well Locations



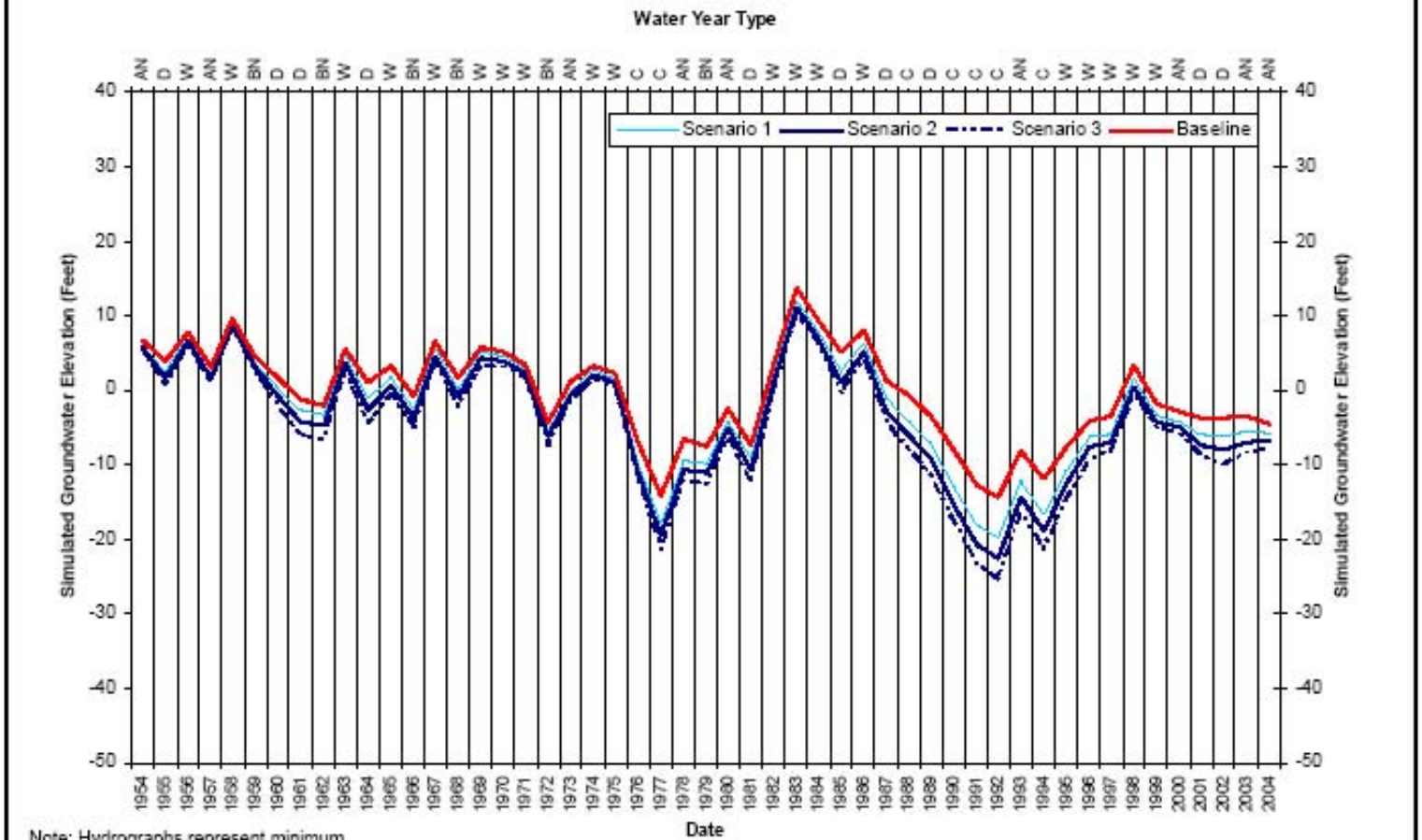
Modeling Input Parameters

- Rainfall
- Evapotranspiration
- Land Use
  - Agricultural
  - Urban
  - Native Vegetation
- Water Use
  - Surface Water Diversions
  - Groundwater Pumping
- Stream Characteristics
- Soil and Aquifer Characteristics

Modeling Process

- Calibrate Model Parameters by:
  - Achieving Reasonable Water Balances
  - Matching Observed and Simulated Groundwater Levels
- Simulate Conjunctive Use Scenarios for 40-year Period

Hydrograph of Node 94



Note: Hydrographs represent minimum annual (September) groundwater elevations simulated using IWFM.

Sacramento River Index

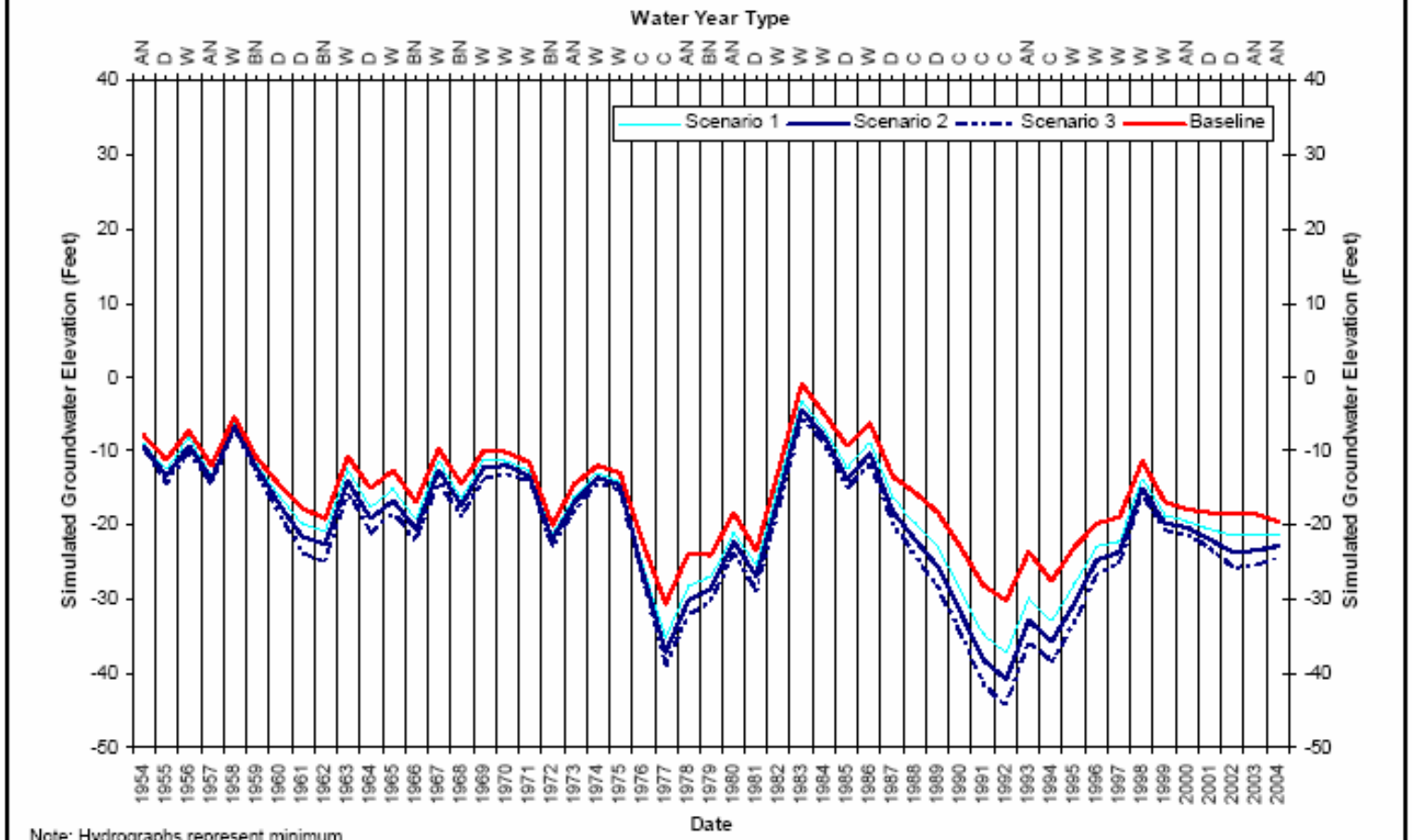
Water Year	Type
W	Wet
AN	Above Normal
BN	Below Normal
D	Dry
C	Critical

Figure 5-4

Reclamation District 2068
Conjunctive Use Feasibility Study

HYDROGRAPH OF NODE 94

Hydrograph of Node 119



Note: Hydrographs represent minimum annual (September) groundwater elevations simulated using IWFM.

Sacramento River Index

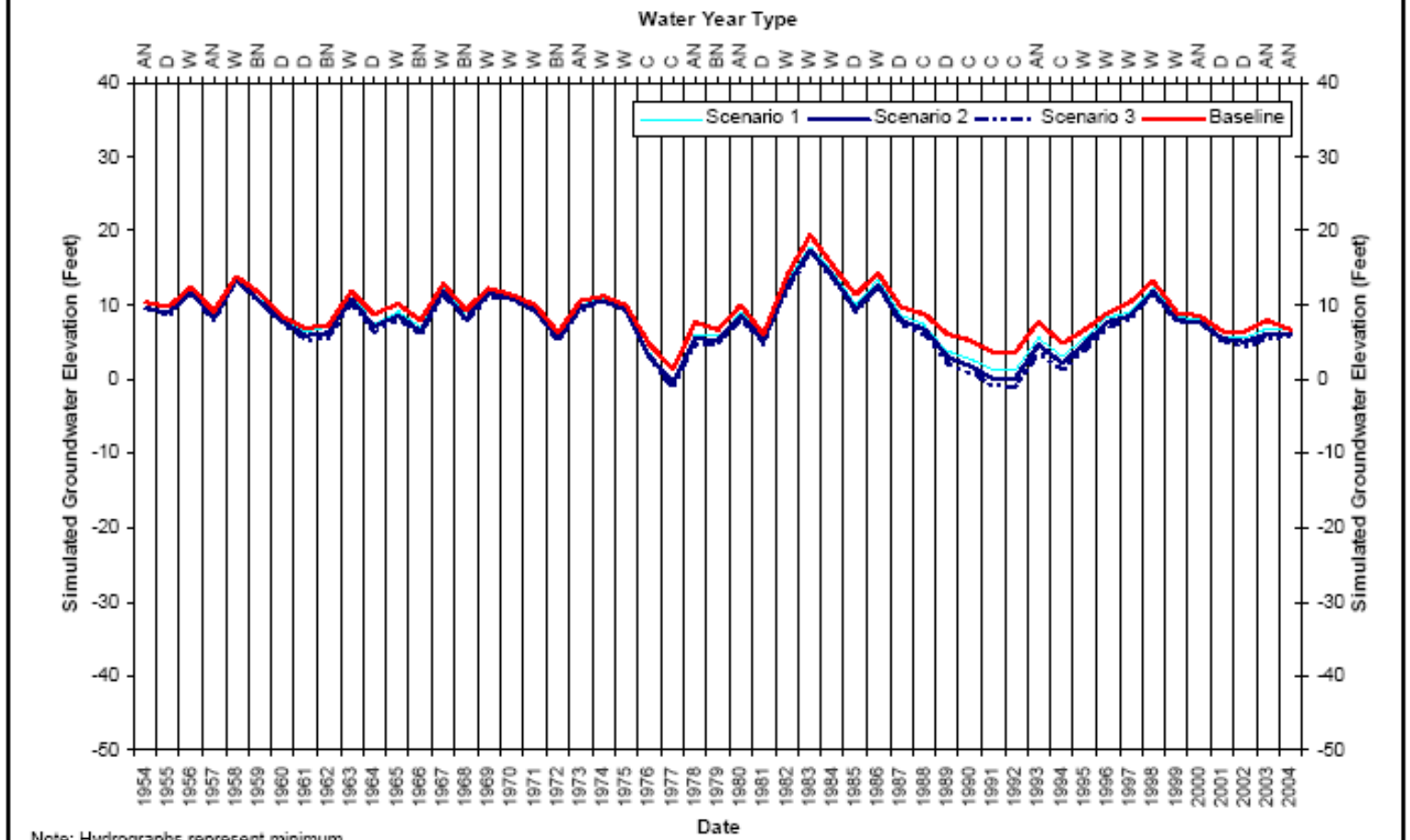
Water Year	Type
W	Wet
AN	Above Normal
BN	Below Normal
D	Dry
C	Critical

Figure 5-5

Reclamation District 2068
Conjunctive Use Feasibility Study

HYDROGRAPH OF NODE 119

Hydrograph of Node 145



Note: Hydrographs represent minimum annual (September) groundwater elevations simulated using IWFM.

Sacramento River Index

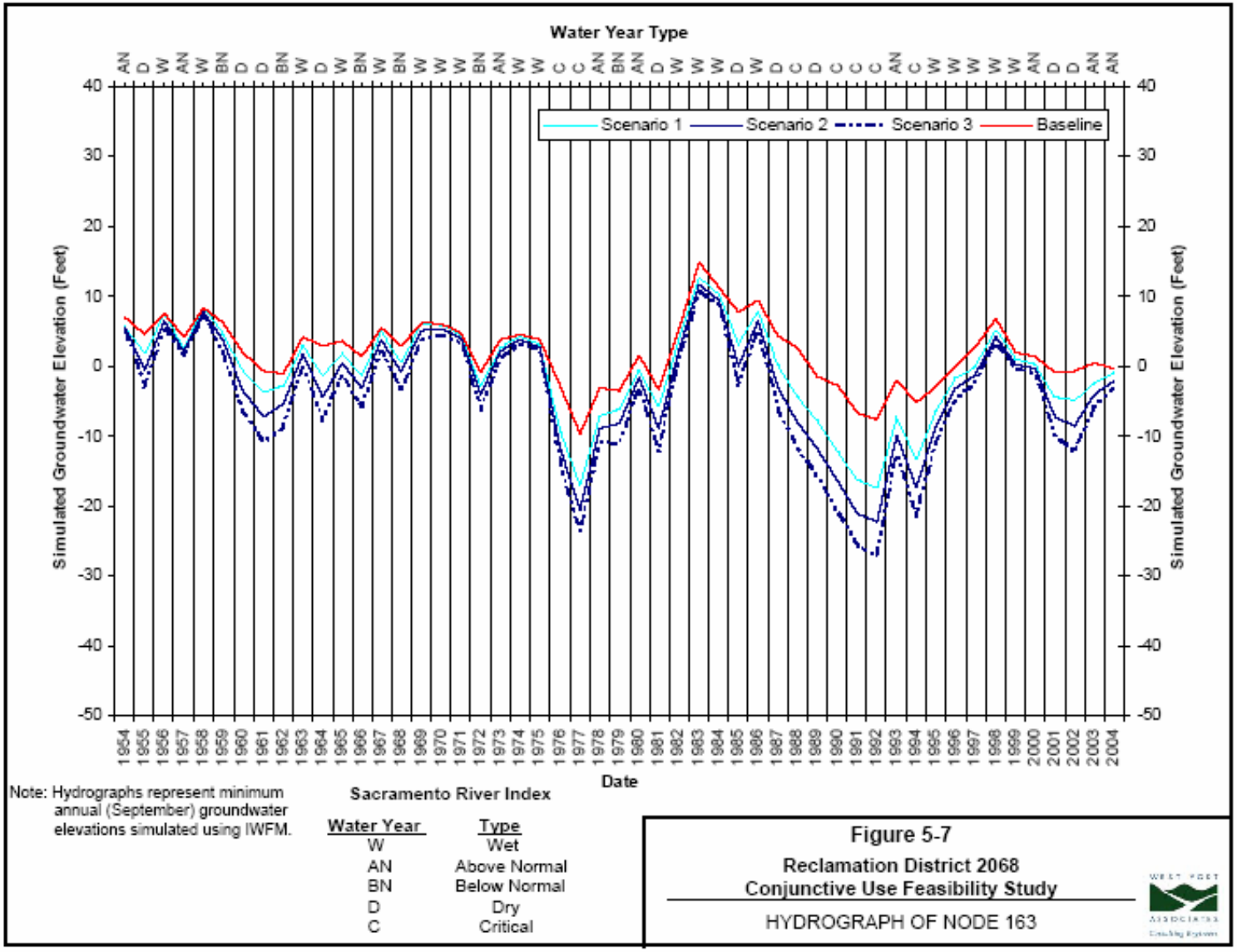
Water Year	Type
W	Wet
AN	Above Normal
BN	Below Normal
D	Dry
C	Critical

Figure 5-6

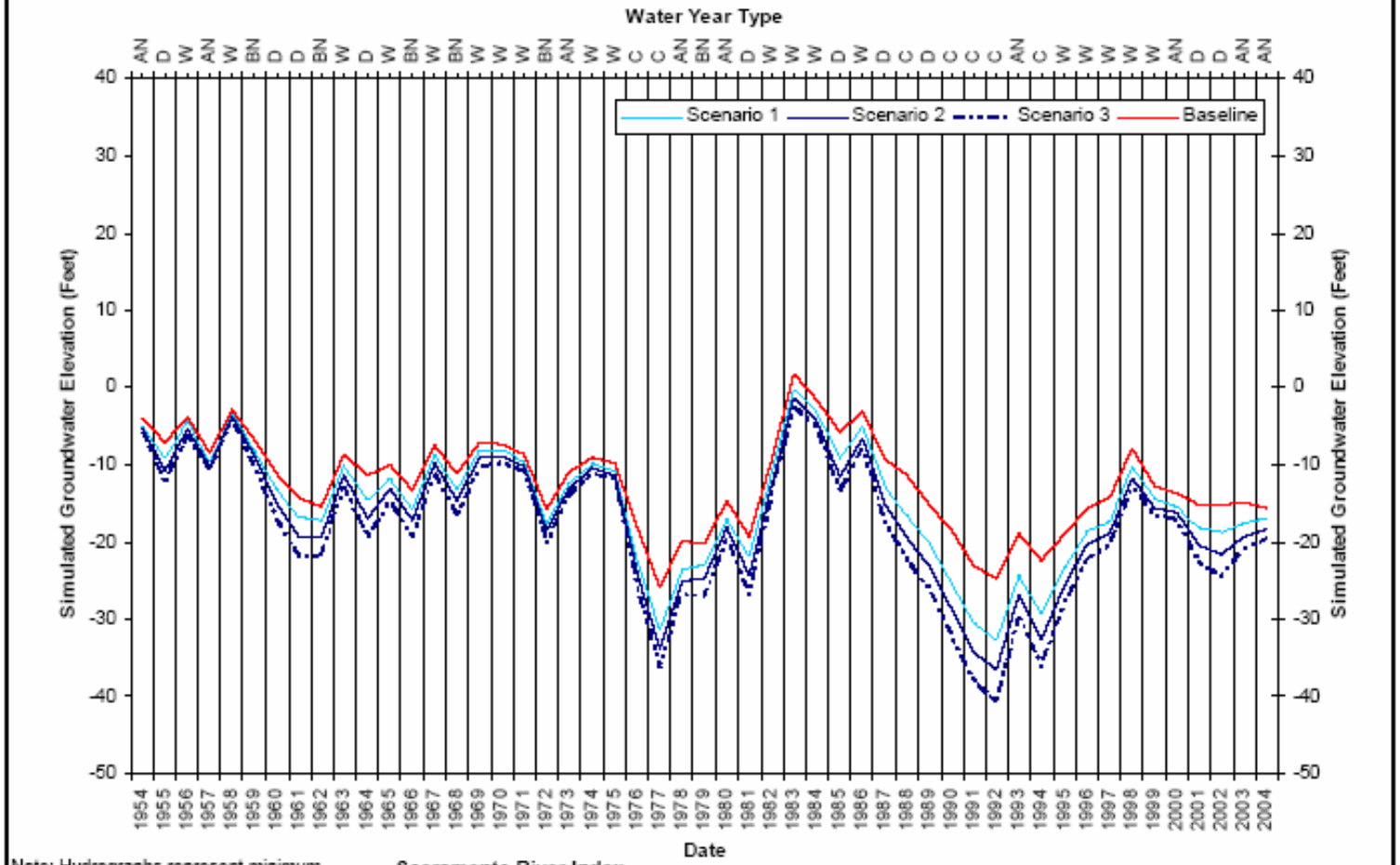
Reclamation District 2068
Conjunctive Use Feasibility Study

HYDROGRAPH OF NODE 145

Hydrograph of Node 163



Hydrograph of Node 167



Note: Hydrographs represent minimum annual (September) groundwater elevations simulated using IWFM.

Sacramento River Index

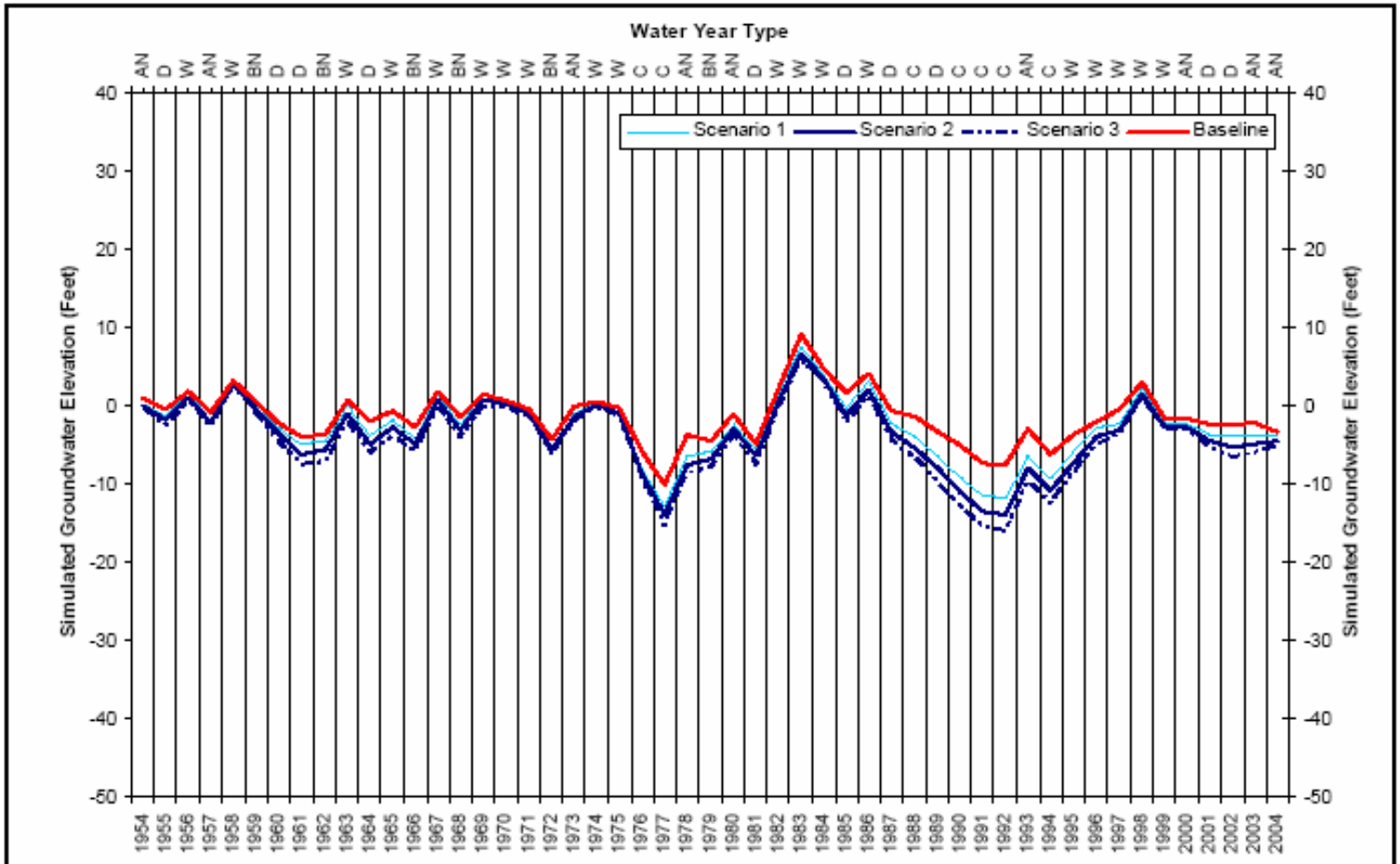
Water Year	Type
W	Wet
AN	Above Normal
BN	Below Normal
D	Dry
C	Critical

Figure 5-8

Reclamation District 2068
Conjunctive Use Feasibility Study

HYDROGRAPH OF NODE 167

Hydrograph of Node 201



Note: Hydrographs represent minimum annual (September) groundwater elevations simulated using IWFM.

Sacramento River Index

Water Year	Type
W	Wet
AN	Above Normal
BN	Below Normal
D	Dry
C	Critical

Figure 5-9

Reclamation District 2068
Conjunctive Use Feasibility Study

HYDROGRAPH OF NODE 201

Summary of Conjunctive Use Scenarios Modeled with IWFM

IWFM Scenario	Modeled Agricultural Pumping Percentage			Modeled Change in Groundwater Elevations, Feet	
	Below Normal (July 1-September 30)	Dry (June 15-October 15)	Critical (June 1-November 1)	April 1983	September 1992
Scenario 1	5	10	20	4	10
Scenario 2	10	20	30	5	18
Scenario 3	20	30	40	7	20

Basis for Water Pricing

- Based on Historical Transfers and Buyer's Demand Characteristics
  - Timing and Volume of Needs (Wet vs. Dry Year)
  - Location and Delivery Requirements
  - Conveyance Requirements
  - Environmental Considerations

Assumed Water Pricing

Year Type	Months of Availability	Value, dollars/ac-ft
Below Normal	July 1 – September 30	100
Dry	June 15 – October 15	125
Critical	June 1 – November 1	150

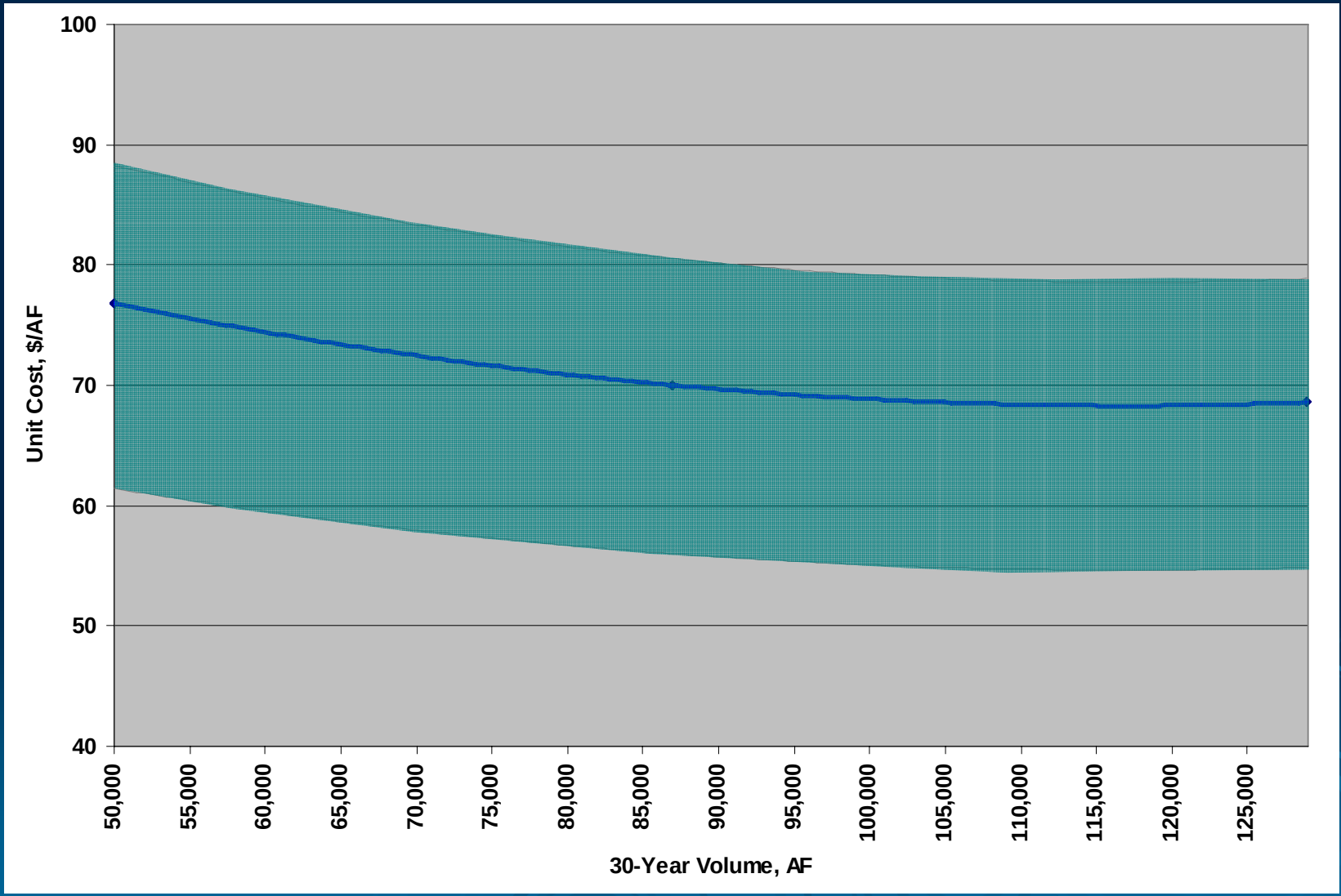
Economic Analysis

- Based on 10-15 1,500-2,000 gpm Wells Discharging to Existing Canal System
  - $175,000 per 1,500-gpm Well
  - $200,000 per 2,000-gpm Well
- Includes Standby Well
- Capital and 30 years of O&M

Present Value and Unit Cost

Scenario	1	2	3
Capital Cost, Dollars	1,750,000	2,625,000	3,000,000
Base Year O&M Cost, Dollars/Year	51,500	85,400	144,000
Present Value, Dollars	6,300,000	9,800,000	13,100,000
Total Volume, ac-ft	50,000	86,900	129,000
Unit Cost, Dollars/ac-ft	77	70	69

Unit Cost Vs. Pumping Volume



Economics Conclusion

- Unit Cost Compares Favorably to Revenue
- $69-$77 per Acre-Foot Unit Cost
- $100-$150 per Acre-Foot Revenue

Recommended Action Plan

- Continue to Implement GMP
- Conduct Pilot Test
  - Pilot Test Work Plan
  - One Full Size Well at PS 3
  - Two Additional Monitoring Wells
  - Conduct Test for at least One Year
  - Implement Trial Transfer, if Possible
- Develop Implementation and Financing Plan for Incremental Development of full Scale Program

Discussion