DOCKETED

Docket Number:	97-AFC-01C
Project Title:	High Desert Power Plant
TN #:	213740
Document Title:	Finding of No Significant Impact Upper Mojave River Groundwater Regional Recharge and Recovery Project and OGGR Project
Description:	Mojave Water Agency Water Supply Reliability and Groundwater Replenishment Program
Filer:	Deric Wittenborn
Organization:	Ellison, Schneider & Harris LLP
Submitter Role:	Applicant
Submission Date:	9/20/2016 11:59:23 AM
Docketed Date:	9/20/2016

MOJAVE WATER AGENCY
WATER SUPPLY RELIABILITY AND GROUNDWATER REPLENISHMENT PROGRAM

FINAL PROJECT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse #. 2005041103

January 2006

Mojave Water Agency
22450 Headquarters Drive
Apple Valley, CA 92307

Mojave Water Agency
Water Supply Reliability
and
Groundwater Replenishment Program

Final Project Environmental Impact Report
SCH#: 2005041103

Mojave Water Agency
22450 Headquarters Drive
Apple Valley, CA 92307-4304

January 2006

Preface

This Final EIR for the Mojave Water Agency Water Supply reliability and Groundwater Replenishment Program includes responses to comments and MWA's responses to comments received during the public comment period from October 28, 2005 through December 13, 2005 (See Appendix A). For reader convenience and coherence, responses to comments have been incorporated into the Final EIR, except where the clarifying response consisted of a reference to the analysis in the draft EIR. Minor editorial changes, such as corrections of typographical errors, are not noted.

The Final EIR therefore contains minor editorial changes, additional information intended to clarify or amplify analysis in the draft EIR, and responses to public and agency recommendations for additional mitigation. Per a commitment in the draft EIR (Section 5.4.7.2), the FEIR also includes consideration of relocation of the upstream Antelope Wash recharge basin to a downstream site to avoid and minimize impacts associated with the upstream site. Finally, it includes a designation of the environmentally superior alternative and designation of the proposed project alternative.

These changes are designated in the text with Arial typeface and their location in the Final EIR is listed following the Table of Contents.

Table of Contents

EXECUTIVE SUMMARY

CHAPTER 1: INTRODUCTION

CHAPTER 2: PROJECT PURPOSE AND NEED

CHAPTER 4: DESCRIPTION OF PROJECT ALTERNATIVES

CHAPTER 5: ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION

CHAPTER 6: Cumulative Impacts

Figures

Tables

List of Changes made to the Final EIR

CHAPTER	PAGE(S)	NATURE OF CHANGE
Executive Summary	ES-5	Listing of public comments received
	ES-8	RE: relocation of Antelope Wash recharge site
	ES-10	RE: relocation of Antelope Wash recharge site
	ES-14	Designation of environmentally superior alternative and proposed project alternative
Chapter 1	1-10	List of comments on the draft EIR
Chapter 2	2-13	Re-phrasing of Metropolitan Water District description
	2-14	Re-phrasing of Metropolitan Water District description
Chapter 3	3-14	Clarification in response to comment from Mr. Chuck Bell
Chapter 4	4-1	Deletion
	4-2	Deletion
	4-6	Change in period of record used for Metropolitan models
	4-31 - 4-33	RE: relocation of Antelope Wash recharge site, alternative description
	4-47	Addition of Metropolitan as a Responsible Agency
Chapter 5	5-1 - 5-2	Addition to general environmental setting
	5-10	RE: relocation of Antelope Wash recharge site
	5-12	RE: relocation of Antelope Wash recharge site, aesthetics
	5-15	RE: relocation of Antelope Wash recharge site, aesthetics
	5-26	RE: relocation of Antelope Wash recharge site, air quality
	5-42	Response to CDFG on Mojave fringe-toed lizard (will include in pre-construction surveys)
	5-45	Data on Pilot Project deliveries per DWR request
	5-46 - 5-47	Clarification on Unnamed Wash impacts for County DPW
	5-55 - 5-56	RE: relocation of Antelope Wash recharge site, biological resources
	5-58	RE: relocation of Antelope Wash recharge site, biological resources
	5-60	RE: relocation of Antelope Wash recharge site, biological resources
	5-64	RE: relocation of Antelope Wash recharge site, biological resources
	5-66	Response to CDFG regarding mitigation for burrowing owls, discussion of mitigation options
	5-76	RE: relocation of Antelope Wash recharge site, cultural resources
	5-90	RE: relocation of Antelope Wash recharge site, geology and soils
	5-93	RE: relocation of Antelope Wash recharge site, hazards
	5-98	RE: relocation of Antelope Wash recharge site, land use
	5-107	RE: relocation of Antelope Wash recharge site, noise
	5-113	RE: relocation of Antelope Wash recharge site, public services
	5-116	RE: relocation of Antelope Wash recharge site, recreation
	5-121	RE: relocation of Antelope Wash recharge site, traffic
	5-152 - 5-161	Clarification of groundwater quality, focused on data from wells near proposed project sites, in response to comment from DWR
	5-169	RE: relocation of Antelope Wash recharge site, water quality
	5-170	Response to Lahontan RWQCB; description of methods for characterizing soils at recharge and wells and methods for monitoring to ensure against surface water influence on groundwater quality
	5-171	Concurrence with San Bernardino County DPW comment on flood zones.

	5-179	Commitment to coordinate design of facilities in washes with County DPW to avoid obstructing flows
	5-182	Clarification of MWA's approach to regional water management in response to DWR comment
	5-183	RE: relocation of Antelope Wash recharge site, population and housing
	5-187	RE: relocation of Antelope Wash recharge site, energy use
Chapter 6	6-3	RE: relocation of Antelope Wash recharge site, cumulative impacts
Chapter 7	7-6 - 7-7	RE: relocation of Antelope Wash recharge site, summary analysis
	7-15 - 7-16	Designation of environmentally superior alternative and proposed project alternative
	Table 7-4	RE: relocation of Antelope Wash recharge site
	Table 7-8	RE: relocation of Antelope Wash recharge site
	Table 7-9	RE: mitigation commitments adopted in response to comments
Chapter 8	NO CHANGE	
Chapter 9	9-7 - 9-9	Update of public involvement discussion to reflect comments on Draft EIR
Chapter 10	NO CHANGE	
Chapter 11	NO CHANGE	
Appendix A	Added	Full comments and response to comments

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

PROJECT ENVIRONMENTAL IMPACT REPORT EXECUTIVE SUMMARY

A. INTRODUCTION

1. Background

Formed by an act of the California Legislature in 1959, the Mojave Water Agency (MWA) manages groundwater in portions of the Mojave Basin and Morongo Basin, with a service area of over 4,900 miles. MWA holds a State Water Project contract and utilizes a variety of facilities to import and distribute water to replenish groundwater basins and to meet the obligations of the Mojave Basin Area and Warren Valley judgments related to groundwater supply. MWA's function is thus to utilize available supplies in a manner consistent with California Water Code Section 79562.5(b), which outlines four elements of integrated water management planning, specifically:

- Water supply,
- Groundwater management,
- Ecosystem restoration, and
- Water quality.

MWA operates under a Regional Water Management Plan, revised in 2004 (2004 Regional Water Management Plan, see MWA 2004a), adopted on February 24, 2005 following adoption of a Final Program Environmental Impact Report (2004 PEIR; State Clearinghouse Number 2003101119) (see MWA 2004b). This Project EIR tiers off the 2004 PEIR. MWA also operates under the Mojave Basin Area Judgment (Judgment), which sets limits (Free Production Allowances) on the amount of groundwater production that can occur in each subarea without incurring an obligation to purchase imported water. These limits are based on long-term (1931-1990) averages of water supply and the highest year of production between 1986 and 90.

The 2004 Regional Water Management Plan defines MWA's overall water management objectives for the period 2004-2020:

A. Balance future water demands with available supplies, and
B. Maximize the overall beneficial use of water throughout MWA.

For purposes of management, MWA has identified six major management basins within its service area.

- Mojave River Basin
  - Alto Area
  - Oeste Area
  - Este Area
  - Centro Area
  - Baja Area
- Morongo Basin/Johnson Valley

Groundwater overdraft in these six groundwater basins and combined expected growth and associated increasing demand for water were projected to result in a groundwater recharge requirement of 59,100 acre-feet per year (af/yr) by 2020: 41,000 af/year for the Mojave Regional Aquifer, 23,000 af/yr for the Mojave Floodplain Aquifer, and 2,800 af/yr for the Morongo Basin/Johnson Valley area. About 90% of this need will be in the rapidly urbanizing Victor Valley (Alto and Oeste basins). The 2004 Plan notes that there are two fundamental actions that may be taken to address the problem of groundwater overdraft and future growth/water demand:

- Supply enhancement projects, either involving groundwater recharge or an increase in groundwater efficiency
- Management actions, involving conservation, storage agreements, and water transfers.

Between 2005 and 2020, MWA has a window of opportunity to address these problems. MWA has a State Water Project contract for a maximum 75,800 acre-feet of water per year, but from 1978 through 2001, average annual SWP deliveries were only 6,253 acre-feet, and no deliveries were made in 11 of the 24 years of record. This under-use of MWA's SWP contract supplies reflects local agency reliance on less-costly groundwater supplies. If MWA's full SWP Table A supply had been delivered over the same period of time, it would have been possible to substantially reduce (and in some instances fully offset) groundwater overdraft. MWA's ability to take delivery of its SWP Table A supply is affected by (a) lack of facilities to recharge and store this water and (b) funding limitations. The purpose of the Proposed Water Supply Reliability and Groundwater Replenishment Program is to address these two issues.

2. Relationship of 2004 PEIR to Water Supply Reliability and Groundwater Replenishment Program

The potential elements of the Proposed Project were evaluated at a programmatic level in the 2004 PEIR. The purpose of this Project EIR is to more precisely (a) define the scope and operation of various alternatives, including additional features that may be required for banking, exchange, and long-term MWA use and (b) identify and quantify the potential impacts of specific alternatives involving program elements identified in the 2004 PEIR.

B. Scope of Analysis

1. General

To accomplish its objectives and meet regional needs, MWA would (a) use existing facilities, (b) construct new facilities for groundwater recharge and extraction; and (c) modify operations to include water banking programs and water exchange programs. In this Project EIR, specific projects and operational modifications for a range of potentially feasible alternatives is evaluated. Facilities included in the various alternatives include (Figure ES-1):

- The existing Mojave River Pipeline and Morongo Basin Pipeline;
- Existing recharge basins at Hodge, Lenwood, Daggett, and Newberry Springs (Mojave River Pipeline) and the Warren Basin (Morongo Basin Pipeline);
- Additional groundwater recharge basins in the vicinity of the California Aqueduct, along the Morongo Basin Pipeline, in Oro Grande Wash, and in Antelope Wash;
- Additional wells in the vicinity of the Mojave River upstream of the Narrows, along the California Aqueduct, East Branch; along the Mojave River Pipeline, and at various locations in the vicinity of Hesperia and Victorville;
- Additional pipelines to convey water to and from recharge basins and wells;
- Temporary sand dikes in the mainstem Mojave River to enhance recharge in the reach between Mojave Forks Dam and the Narrows;
- Facilities and/or rights of way to provide for delivery of supplies from the State Water Project via the West Fork of the Mojave River and/or existing drainage washes leading from the California Aqueduct to the mainstem Mojave River; and
- Ancillary facilities associated with these potential project elements such as monitoring wells, power lines, and pumps and pump housings.

Changes to MWA operations include (a) implementation of a traditional water banking program and (b) implementation of a combined water banking and on-going water exchange program.

2. Scope of Project EIR

The Project EIR addresses the Proposed Project at three levels. First, it describes the initial effort to screen alternatives based on technical feasibility, cost, and environmental effects. Second, it defines the site specific issues related to construction and operation of each of the various potential project sites deemed potentially feasible in the screening analysis. Third, it discusses the rationale for formulation of logical alternatives for the Proposed Project that combined various facilities and evaluates the potential impacts of these alternatives. Two basic operational scenarios are examined:

- A traditional water banking program with Metropolitan Water District of Southern California (Metropolitan) which would involve Metropolitan delivery of supplies to

MWA for recharge, with MWA returning 90% of the volume delivered during dry years. Like a bank saving account, traditional water banking requires deposits before there are withdrawals.

- Combined water banking and exchange programs, which add an on-going exchange element that allows MWA and Metropolitan to exchange available SWP supplies on a flexible basis. Under such a program, MWA may pre-deliver SWP supplies in excess of its need to Metropolitan, which will then return them to MWA when it has supplies in excess of need.

The FEIR evaluates positive and/or negative effects of Proposed Project Alternatives on:

- Aesthetics,
- Air quality,
- Biological resources,
- Cultural resources,
- Geology and soils,
- Hazards and hazardous materials,;
- Land use,
- Noise,
- Public services and utilities,
- Recreation,
- Traffic,
- Utilities and Service Systems,
- Water resources (water quality and hydrology),
- Housing and population (growth), and
- Energy use and conservation.

The FEIR specifically addresses issues raised informally by various agencies prior to the CEQA Notice of Preparation and during the formal CEQA public scoping process. During presentations to the MWA Technical Advisory Committee, comments were received from:

- Guy Patterson, Baldy Mesa Water District
- Tom Billhorn, California Department of Fish and Game
- Chuck Bell, Agricultural representative, Lucerne Valley
- Jeannette Hayhurst, City of Barstow

In addition, during formal scoping, MWA received written comments from:

- Hisam Baqai, Supervising Engineer Lahontan Regional Water Quality Control Board
- Carol Gaubatz, Program Analyst, Native American Heritage Commission (NAHC)
- Naresh P. Varma, Chief Environmental Management Division, County of San Bernardino Department of Public Works

The FEIR also responds to comment received from the public and from agencies during the draft EIR review period from October 28, 2005 through December 13, 2005 (Appendix A):

INDIVIDUALS

- Mr. Chuck Bell, written comments received during the 47-day comment period;
- Mr. Jeff Bentow, Yermo Water Company, oral comments at the November 8, 2005 public meeting and the November 9, 2005 MWA Technical Advisory Committee;
- Mr. Lou Kershberg, oral comments at the November 8, 2005 public meeting;
- Mr. Guy Patterson, oral and written comments at the November 9, 2005 MWA Technical Advisory Committee
- Mr. and Mrs. Gary E. Thrasher, written comments received during the 47-day comment period;
- Mr. Mathew Woods, oral comments at the November 8, 2005 public meeting and written comments at the November 9, 2005 MWA Technical Advisory Committee
- Mr. Joseph Monroe, written comment received November 17, 2005.

AGENCIES

- California Department of Fish and Game, Habitat Conservation Program, Region 6, Ms. Denyse Racine, Supervisor;
- California Regional Water Quality Control Board, Lahontan Region, South Basin Regulatory Unit, Mr. Greg Cash, Engineering Geologist
- California Department of Water Resources, State Water Project Analysis Office, Ms. Elizabeth Patterson, by email 24 October 2005.
- County of San Bernardino, Department of Public Works, Environmental Management Division, Mr. Naresh P. Varma, Chief

In addition, MWA discussed the proposed project with staff of its potential water banking partner (Metropolitan Water District of Southern California) who unofficially suggested some minor editorial changes to the document. Finally, MWA received correspondence from the Southern California Association of Governments declining to comment on the draft EIR and from the State Clearinghouse indicating that it had not independently received comments from state agencies.

C. Project Purpose and Need

The Proposed Project is intended to provide MWA with new facilities and expanded operational opportunities to reduce the rate of overdraft and achieve a balance of water supply and consumptive use. The Proposed Project is needed because:

- Both funding and lack of off-river recharge facilities limit the potential to (a) import supplies from the SWP and (b) recharge them to replenish overdrafted groundwater. As a result, MWA has not historically imported its entire available Table A supply.
- Existing recharge in the MWA service area is focused on recharge of the Mojave River aquifer and the Warren Valley, which is constrained by (a) flood flows in the

Mojave River during the wet years when supplemental SWP supplies are most readily available and (b) by lack of adequate extraction facilities.

- Even when supplemental SWP supplies are available, MWA may not be able to import them and utilize them because of these constraints.
- Riparian enhancement goals in areas where declining groundwater levels have affected riparian forest along the river need to be addressed.

D. Formulation of Alternatives

As described in detail in Chapter 3, MWA has evaluated alternatives for meeting Proposed Project needs systematically, beginning with the 2004 PEIR. A subset of high priority facilities from the 2004 PEIR was then evaluated in a feasibility study performed for MWA by Bookman-Edmonston in 2004 and early 2005. In this feasibility analysis, a wide range of alternatives for meeting water conveyance, groundwater recharge, groundwater extraction needs were examined within the context of a 75,000 to 450,000 acre-food water banking program between MWA and Metropolitan. The feasibility analysis functioned as an alternative screening process, with various alternative sites and facilities examined in terms of the following factors:

- Engineering
- Hydrogeology
- Economics
- Water quality
- Environmental impacts
- Regulatory constraints
- Institutional considerations

The feasibility analysis evaluated specific projects in three categories:

- Existing and planned facilities for recharge and conveyance

  a. Existing MWA facilities
  b. Mojave Forks Dam
  c. VVWD's "Green Tree" recharge facility

- Potential for use of proposed City of Hesperia flood detention basins for recharge At Cedar Avenue and Ranchero Road

- Potential new facilities for recharge and conveyance

  a. Oro Grande Wash
  b. Off-channel along the Mainstem Mojave River
  c. Recharge Basins near Sheep Creek (Oeste) and the Mojave River Pipeline

(Alto)

d. Recharge basins north of the California Aqueduct in Antelope Wash
e. Release of water to the Mainstem Mojave River via an Unnamed Wash in Summit Valley
f. Injection wells
g. New spreading basins in the Lucerne Valley

The screening analysis eliminated alternatives with "fatal flaws" such as significant potential conflicts in use (Mojave Forks Dam), poor recharge conditions (such as in the immediate vicinity of sheep creek), potential water quality impacts (injection wells and areas with high potential for poor indigenous water quality), potential for high energy use and associated costs, and potential for high cultural resource impacts (near Deep Creek at Mojave Forks Dam), and high environmental impacts (arroyo toad at Mojave Forks Dam and arroyo toad and riparian habitats near Deep Creek north of Mojave Forks Dam).

At the various facility sites, thousands of acres of potential recharge basins were evaluated. Following the feasibility evaluation, a total of about 800 acres of potential recharge, and sites for up to 50 new wells were selected for detailed evaluation in the Project EIR.

E. Project Description: Facilities

Based on the feasibility study's initial screening of alternatives, MWA focused on a Proposed Project that would involve a range of facilities and operations, beginning with an alternative that would optimize use of existing facilities and minimize new facilities and associated land-use and biological resource impacts. This Minimum Facilities Alternative was thus an initial baseline alternative for evaluation. The focus of the Minimum Facilities Alternative was on optimizing use of the Mainstem Mojave River for recharge. A second alternative (Small Projects Alternative) involved adding several recharge basins to the Minimum Facilities Alternative to enhance operational flexibility and the ability to take deliveries of water more rapidly and under a wider range of conditions. The Small Projects Alternative included consideration of alternative sites for off-channel recharge basins along the Mojave River south of Rock Springs Road. A third alternative (Large Projects Alternative) was formulated to add three additional large recharge basins and additional wells to the Small Projects Alternative, giving MWA substantially greater ability to recharge the Regional Aquifer. These three alternatives represent a minimum and maximum scope for the Proposed Project. They are summarized on Table ES-1.

The Minimum Facilities Alternative would add substantial additional recharge capacity for the Mojave River Floodplain Aquifer, both as a function on-going use of low berms in the river channel to spread and slow flows and as a function of adding year-round release capacity via Unnamed Wash. The use of existing facilities and the added capability to recharge the river would mean MWA would have a total capacity to recharge over 90,000 acre-feet per year. This alternative would involve a cycle of recharge and annual extraction of water from the reach between Mojave Forks Dam and Bear Valley Road, with local water producers using water from this recharge/extraction process in lieu of using other facilities.

The Small Projects Facility would add about 300 acres of permanent off-channel recharge capacity to MWA's system, resulting in an additional 150+ acre-feet per day of recharge capacity to the Floodplain and Regional Aquifers, increasing MWA's net recharge capacity to about 120,000 acre-feet per year. Some additional wells may be constructed at the various recharge sites.

The Large Projects Alternative would add 580 acres of recharge capacity in the Regional Aquifer and substantial capacity to make returns to Metropolitan via pumping of stored groundwater to the California Aqueduct. The Large Projects Alternative adds about 230+ acre feet of daily recharge capacity, increasing MWA's net recharge capacity to about 180,000 acre-feet per year. *Per* the draft EIR, MWA also reviewed the siting of recharge at Antelope Wash as a mitigation measure to reduce aesthetics and biological resources impacts at the potential upstream Antelope Wash recharge site. Based on this review, the Large Projects Alternative in the FEIR has been modified to provide for shifting of this recharge capacity to downstream areas with substantially lower potential for aesthetics and biological resources impacts. This mitigation action consolidates proposed project recharge in the Antelope Wash to the reach from about 300 yards downstream of the new Ranchero Road embankment to about 1200-1300 yards upstream of the embankment, a total of approximately 140 acres.

These three alternatives may be considered as a continuum. They represent three logical combinations of facilities, but MWA may choose to implement elements of the alternatives individually. For example, the Minimum Facilities Alternative could be scaled back in terms of number of wells and additional wells and recharge provided by the added facilities of the Small Projects Operation may be used to achieve similar objectives. In short, the facilities alternatives were intended to describe the full range of facilities and operations for consideration by the MWA Board of Directors.

Table ES-1. Summary of Alternatives, MWA Water Supply Reliability and Groundwater Replenishment Program

FACILITY	LOCATION	TOTAL AREA OF PERMANENT NEW FACILITIES	DESCRIPTION, FEATURES, FUNCTION IN PROPOSED PROJECT
Minimum Facilities Alternative			
Existing Recharge Facilities	Hodge, Lenwood, Daggett, Newberry Springs, Morongo Basin, Oro Grande Wash at Green Tree	None	Existing MWA facilities or facilities that may be used by MWA in cooperation with others. Served by the Mojave River Pipeline and Morongo Basin Pipeline, and via releases from the California Aqueduct (Green Tree Basins). MWA would pre-deliver water for recharge and local use of banked water when returns were made to Metropolitan.
Mojave River Recharge	Mainstem Mojave River channel from Mojave Forks Dam to the Narrows	None	Annual construction of low berms in the Mojave River to retard flows of water delivered to the river for recharge. Low sand berms constructed over 200-400 acres. No recharge during periods of natural flow. Water may be delivered to the river for recharge via releases from Silverwood Lake (September 15 through February 15) and/or from MWA's Rock Springs Outlet or Unnamed Wash (see below).
Mojave River Well Field	Wells placed within about 2000 feet of the river channel along both sides of the Mojave River, from Rock Springs Road north to Bear Valley Road.	0.10-0.2 acres	Up to 25 new wells would be constructed in open space and within residential areas. Exact siting to be determined. Wells connected with buried pipelines. On the west, a small pump station would be constructed to lift water to a pipeline running within public streets or other rights-of-way along the alignment of Mesa Street, under Interstate 15, to the California Aqueduct. Main pipeline would be connected to local water delivery and storage facilities. On the east, wells would be connected to nearby existing facilities for deliveries to residents of Apple Valley.
Delivery of SWP Supplies via Unnamed Wash	Unnamed Wash runs from an outlet in the California Aqueduct in Summit Valley to the Mojave River Mainstem about 1 mile north of Mojave Forks Dam.	8-10 acres	New or expanded turnout from the California Aqueduct would be constructed, with releases into an open channel or pipeline to the head of the wash, then flow down the wash, pass under a new bridge at Arrowhead Lake Road, and then flow within low levees to the river. In the wash, a maintenance road and several drop structures would be constructed.
Small Projects Alternative (includes Minimum Facilities Alternative plus additional facilities)			
Off-Channel Mojave River	**East Site**: Approximately 2 miles south of Rock Springs Road, east of	100 acres	Recharge basins constructed at either or both sites to enhance MWA ability to recharge the Floodplain Aquifer in times when there is water

Recharge Basins	Deep Creek Road. Pipeline along Deep Creek Road. **West Site**: Approximately 3 miles south of Rock Springs Road, east of Arrowhead Lake Road. Pipeline along Calpella Avenue and Arrowhead Lake Road		available but there is natural flow in the Mainstem Mojave River. Pipelines would be constructed in public rights-of-way. New wells may be added to deliver water via the supply pipeline or connected to local systems.
Oro Grande Wash Recharge Basins	Basins to be located immediately north and/or south of the California Aqueduct	80 acres	Recharge basins constructed to take water from a turnout in the California Aqueduct. Short pipeline to deliver water. New wells may be added to deliver water via the supply pipeline or connected to local systems.
Cedar Avenue Detention Basin	Basin to be located in planned City of Hesperia Flood Detention Basin at the east end of Cedar Avenue.	60 acres	Recharge basins and a delivery pipeline to be constructed at site of proposed flood detention basin. New wells may be added to deliver water via the supply pipeline or connected to local systems.
Antelope Wash at Ranchero Road	Basin to be located in planned City of Hesperia Flood Detention Basin south of Ranchero Road.	65 acres	Recharge basins and a delivery pipeline to be constructed at site of proposed flood detention basin. New wells may be added to deliver water via the supply pipeline or connected to local systems.
Large Projects Alternative (includes Small Projects Alternative plus additional facilities)			
Oeste Recharge Basins	Located at two sites immediately north of the California Aqueduct and south of Highway 18 (Palmdale Road). One site between Beekley Road and Sheep Creek Road. One site located east and west of Oasis Road.	330 acres	Recharge basins and a delivery pipeline to be constructed at site of proposed flood detention basin. Up to 15 new wells may be added to deliver water via the supply pipeline or connected to local systems. Would add 132 acre-feet per day in recharge capacity to the Regional Aquifer.
Alto Recharge Basins	Located at several sites immediately north of the California Aqueduct and south of Highway 18 (Palmdale Road). East of Caughlin Road.	150 acres	Recharge basins and a delivery pipeline to be constructed at site of proposed flood detention basin. Up to 10 new wells may be added to deliver water via the supply pipeline or connected to local systems. Would add 60 acre-feet per day in recharge capacity to the Regional Aquifer.
Antelope Wash	Located near the California Aqueduct in open space south of the Hesperia Airport	80-100	Per the draft EIR commitment to reconsider siting of upstream Antelope Wash recharge, Recharge basins at Ranchero Road to be expanded upstream and downstream of the new Ranchero Road embankment in-lieu of recharge at the upstream site described in the FEIR. Would add up to 40 acre-feet per day in recharge capacity to the Regional Aquifer.

F. Project Description: Operations

MWA and Metropolitan may choose to implement a completely traditional banking program or a combination of banking and active water exchanges. Under a traditional banking program, Metropolitan would deliver SWP supplies to MWA, generally in wet years and in the months of February through August. In other years, generally dry-to-critically-dry years, Metropolitan would request return of some of the water it has banked. In general, Metropolitan would request no more than about 20-25% of total banked water in any given year. This water would first be returned using MWA's available SWP supplies, while local producers pump banked groundwater. If MWA's SWP supplies do not meet Metropolitan's requested return, then some banked groundwater would be pumped and returned via project facilities to Metropolitan. Metropolitan's returns would be fixed at about 90% of total deliveries, to account for evaporation losses during recharge. This "loss factor" exceeds the probable maximum evaporation during recharge by about 50%. Thus, in addition to cost-sharing for new facilities that enhance MWA's ability to recharge its own supplies, there is a probable 5% net supply benefit to MWA from traditional banking.

MWA and Metropolitan may also choose to implement an on-going exchange program, in which each agency may delivery SWP supplies to the other on an as-available-as-needed basis. For example, in any year when Metropolitan needs additional SWP supply and MWA has supply in excess of its demands, MWA may delivery this supply to Metropolitan, with Metropolitan returning the supply to MWA at some future date. This on-going exchange will generally allow each agency to utilize each other's available supplies to optimize use of available SWP supplies.

Metropolitan staff modeled the potential magnitude of banking programs using their Integrated Resources Plan models. The model analysis defined a maximum range of potential banking operations, under a variety to operational scenarios. A mid-point of this range was represented by the following conditions:

- MWA would have equal priority for deliveries among Metropolitan's various water banks;
- Metropolitan would have opportunities to deliver to MWA when other banks could not receive supplies for banking due to MWA's ability to take high volume deliveries and make returns via SWP exchange and direct pumping of groundwater;
- Average precipitation conditions would occur in the SWP watershed.

Under these operational scenarios, the magnitude of a traditional banking program would be up to:

- Minimum Facilities Alternative: 174,000 acre-feet
- Small Projects Alternative: 174,000 acre-feet
- Large Projects Alternative: 237,000 acre-feet

The addition of an on-going exchange program would add about 96,000 acre-feet of banking-exchange capacity over a 20-year period, and the resulting overall project would therefore be up to :

• Minimum Facilities Alternative:	174,000 af + 96,000 af	=	240,000 af
• Small Projects Alternative:	174,000 af + 96,000 af	=	240,000 af
• Large Projects Alternative:	237,000 af + 96,000 af	=	333,000 af

The Metropolitan modeling analysis suggests:

- Increasing recharge capacity does not increase the total magnitude of the proposed program, but allows for Metropolitan to deliver water for banking and for exchange during short periods. Thus MWA would have the advantage of receiving Metropolitan supplies during periods when Metropolitan historically delivers the highest quality water (February through July).
- About 60% to 70% of banked water can be returned to Metropolitan by exchange of SWP supplies. Some return of pumped groundwater from the Mojave River Floodplain and Regional Aquifers is likely to be needed.
- The potential for on-going exchanges is less a function of recharge capacity than it is of intra-year patterns of supply and demand. A typical intra-year exchange would involve MWA delivery of SWP supplies to Metropolitan in a transition year, such as from a dry year to a wet year. In the transition, MWA may have supply in excess of demand early in the year, before California Department of Water Resources (DWR) has officially declared a wet year. MWA could therefore deliver supplies to Metropolitan in December or January, which Metropolitan could then repay in late spring or summer.
- The primary advantage of increasing recharge capacity is that it increases MWA's ability to take delivery of its own SWP supplies more rapidly, giving MWA the opportunity to optimize water quality by scheduling its deliveries during periods when SWP supplies are of highest quality because they are under the influence of the melting Sierra snowpack.
- An incidental benefit of scheduling flexibility will be the ability to import supplies during periods when hydropower is most available, in wet years and during the spring when the melting Sierra snowpack raises reservoir levels and DWR produces peak hydropower.

G. Project Impacts

Environmental effects (summarized on Table ES-2) are discussed in detail in Chapter 5, and the summary conclusions on Table ES-2 should be viewed in light of the detailed analysis in Chapter 5.

The environmental effects of the Proposed Project generally tend to increase with project size and recharge capacity. This is particularly true of impacts associated with air quality, aesthetics, biological resources, and land use. Impacts associated with traffic, noise, public services, and other effects that are greatest in urban areas do not increase much with project magnitude because the facilities added to increase magnitude are isolated from most development. Increasing project size does not result in significant increases in impacts associated with hydrology, geology and soils, or growth. Impacts associated with water quality do not increase as the magnitude of the project increases, but decrease. This occurs because the larger projects have more recharge capacity and allow MWA and Metropolitan to deliver water at times when SWP supplies are of their best quality -- in wet years and during the months when the Sacramento-San Joaquin Delta is under the influence of the melting Sierra snowpack.

As the 2004 PEIR discusses, the project has no direct effect on growth. The enhanced facilities and banking/exchange opportunities they would provide would allow MWA to pre-deliver some of its own SWP supplies. Because MWA currently has supplies well in excess of demand, pre-delivery of supply does not directly accommodate higher than planned growth rates. As documented in local agency General Plan Environmental Impact Reports, there are substantial adverse effects of planned growth in the MWA service area, including impacts to groundwater resources. MWA's Proposed Project is a mitigation action to ameliorate some of these effects.

The Proposed Project incorporates a set of general impact avoidance and mitigation measures and a number of site-specific measures (Table ES-3). These mitigation measures will reduce potential impacts to a level of less than significant except for air quality, where daily and annual construction impacts associated with diesel emissions and with dust are in excess of MDAQMD and AVAQMD thresholds of significance. Long-term impacts to air quality are below significance thresholds and there may be long-term benefits to air quality associated with recharge basins, which are known to trap wind-blown sand and dust.

H. No Project Alternative

The No Project Alternative was defined and documented in the 2004 Regional Water Management Plan and the 2004 PEIR. Over the 15-year period from 2006-2020, MWA will import and recharge about 750,000 acre-feet of SWP supply to meet projected replacement obligations. MWA would continue to operate its existing facilities and to plan and construct new recharge and conveyance facilities on an as-needed basis to accommodate increasing deliveries of SWP supplies for recharge to meet on-going (rising) needs to deliver replacement water to water producers in the MWA service area. MWA would probably lose the opportunity to develop a cooperative banking and exchange program with Metropolitan, which would seek additional banking partners or other sources of supplemental supply.

The No Project Alternative is therefore not the existing baseline condition. Regardless of whether the Proposed Project for banking and water exchange is approved and implemented, MWA will, as documented in the 2004 PEIR, import an increasing amount of water to meet its obligations. The recharge and conveyance of this water to subarea producers will require facilities, which are described in general in the 2004 PEIR and will be developed over a period of years. It is likely that MWA would develop these facilities in cooperation with local subarea producers and, by 2025, would develop recharge and extraction facilities of similar capacity to those for the Proposed Project. It is also likely that MWA would continue to use existing recharge outside of the Alto and Oeste subareas. It is likely that MWA would develop additional recharge in the Oeste and Alto subareas. It is likely that use of various local flood detention basins for recharge would be pursued. It is likely that some additional off-channel Mojave River recharge would be pursued, as this recharge would have substantially higher recharge rates than other sites.

The No Project Alternative therefore reasonably assumes that many of the Proposed Project facilities would be pursued, consistent with the 2004 PEIR. Indeed, this Project EIR addresses the project-specific impacts of these facilities and is intended to provide the MWA Board of Directors and the public with site-specific information regarding the potential for impacts associated with these facilities. The No Project Alternative therefore contemplates development of at least a subset of the facilities described in this Project EIR at a slower rate. The difference in impact analysis for each of the facilities is therefore a function of (a) the total magnitude of impacts and (b) alternative siting, and (c) timing of construction and associated construction-related impacts. Facilities which would not be affected by future development and may be pursued without change by MWA under the No Project Alternative include:

- Instream Mojave River Recharge. No development of the Mainstem Mojave River channel is possible; MWA will probably use this recharge area to the extent that it may delivery water and maintain water levels below liquefaction thresholds.

- The Mojave River Well Field and Pipelines. These facilities require a small amount of land and right-of-way and may be integrated into the land uses proposed for the area along the Mainstem Mojave River between Rock Springs and Bear Valley Road. Without a banking program, the pipeline would not be extended to the California Aqueduct.

- Use of existing and planned flood detention basins. If local entities construct these facilities as planned, their use for groundwater recharge would be compatible with their intended flood management uses, and they may be assumed to be available for this purpose.

- Oro Grande recharge. Recharge within Oro Grande Wash would not be constrained by future development because development in this large wash would be prohibited by flood damage concerns.

- Antelope Wash recharge. Recharge within Antelope Wash would not be constrained by future development because development in this large wash would be prohibited by flood damage concerns.

- Unnamed Wash. MWA proposes to cooperate with the developer of Rancho Las Flores in siting and designing facilities for delivery of water via Unnamed Wash, and thus future development is unlikely to constrain its use for conveyance of water from the California Aqueduct to the Mainstem Mojave River. MWA's Proposed Project would also contain flood flows in the wash to the 100-year floodplain, and thus would not affect development potential in downstream reaches of the wash which are outside of Rancho Las Flores.

Future development could affect the siting and impacts of off-channel recharge along the Mainstem Mojave River and recharge at the Oeste and Alto recharge sites. The magnitude of the facilities required under the No Project Alternative would probably be similar to that required for the Proposed Project, because by 2020 and beyond, MWA will need to import and recharge its full SWP contract supply of up 75,800 acre-feet in years when this amount is available to pre-deliver supplies for storage to meet demands in dry years.

The primary differences between the No Project Alternative and the Proposed Project are (a) timing of facility development and (b) resulting potential for loss of recharge sites along the Mainstem Mojave River and at Oeste and Alto. In addition, the No Project Alternative would extend construction periods, reducing daily emissions from construction, but extending their duration.

I. Selection of an Alternative for Implementation

All significant impacts of all alternatives may be reduced to a level of less-than-significant through impact avoidance and mitigation measures, except air quality impacts. The selection of an alternative for implementation may thus be focused on a comparison of adverse construction-related air quality impacts to the quantifiable water quality benefits of the Proposed Project. Air quality impacts increase with project magnitude. Water quality benefits also increase with project magnitude. That is, increasing the area of recharge and amount of water banked and exchanged through banking and/or banking and exchange positively influences imported water quality.

Selection of the preferred alternative by MWA's Board of Directors will therefore depend on the priority placed on adverse temporary air quality impacts associated with construction compared to permanent water quality benefits (positive impacts) associated with increasing levels of recharge capacity. A high priority on air quality impacts would argue for selection of the Minimum facilities Alternative. A high priority on water quality benefits would argue for selection of the Large Projects Alternative.

Based on this evaluation in the draft EIR, the reduction of impacts associated with the Large Projects Alternative as a result of re-location of the upstream Antelope Wash recharge, and the absence of comment regarding this issue in public and agency comments, the Large Projects Alternative is designated as the environmentally superior alternative and the Proposed Project Alternative. *Per* the draft and final EIR discussion of air quality impacts and potential mitigations, MWA may phase adoption and implementation of various facilities included in the Large Projects Alternative.

Table ES-2. Impacts of the three Facilities Alternatives.

CATEGORY OF IMPACT	MINIMUM FACILITIES ALTERNATIVE	SMALL PROJECTS ALTERNATIVE	LARGE PROJECTS ALTERNATIVE
Aesthetics	Minor effects in Mainstem Mojave River and at Unnamed Wash. Well structures visible in urban areas	Minor effects in Mainstem Mojave River and at Unnamed Wash. Well structures visible in urban areas. Some levees and recharge basins will alter views from adjacent housing.	Minor effects in Mainstem Mojave River and at Unnamed Wash. Well structures visible in urban areas. Some levees and recharge basins will alter views from adjacent housing. The siting of upstream Antelope Wash recharge to a downstream location as a mitigation measure, reduces the potential aesthetic impact to a level of less-than-significant.
Air Quality	Significant if 2+ units of pipeline are constructed along with other facilities	Significant if 2+ units of any type of facility are constructed at the same time. Higher levels of impact than for other alternatives. Extended period of impact.	Significant if 2+ units of any type of facility are constructed at the same time
Bio. Resources	Loss of 7-9 acres of habitat, low potential for impacts to threatened and endangered species	Loss of about 250 acres of habitat, low potential for impacts to threatened and endangered species	Loss of about 750-800 acres of habitat, low potential for impacts to threatened and endangered species. Potential indirect effects on desert tortoise through predation.
Cult. Resources	Potential for buried resources	Potential for buried resources	Potential for buried resources
Geology and Soils	Very low potential liquefaction effects. Some erosion and sediment transport. Some construction-related erosion.	Very low potential liquefaction effects. Some erosion and sediment transport. Some construction-related erosion.	Very low potential liquefaction effects. Some erosion and sediment transport. Some construction-related erosion.
Hazards/Hazardous Materials	Potential lubricant and fuel leaks. Potential to encounter contaminated buried soils.	Potential lubricant and fuel leaks. Potential to encounter contaminated buried soils.	Potential lubricant and fuel leaks. Potential to encounter contaminated buried soils.
Land use	Compatible uses except for wells in residential.	Compatible uses except for wells in residential. Recharge is compatible with existing low-density housing and flood channel maintenance along Mainstem Mojave River.	Compatible uses except for wells in residential. Recharge is compatible with existing low-density housing and flood channel maintenance along Mainstem Mojave River. 480 acres of residential zoned land converted to recharge.

Noise	Construction noise along pipeline and well alignments	Construction noise along pipeline and well alignments. Construction noise at recharge basins.	Construction noise along pipeline and well alignments. Construction noise at recharge basins.
Public Services and Utilities	Emergency vehicles may need to detour around construction. Potential accidental damage to utilities during construction.	Emergency vehicles may need to detour around construction. Potential accidental damage to utilities during construction.	Emergency vehicles may need to detour around construction. Potential accidental damage to utilities during construction.
Recreation	Reservoir releases may affect type of recreation in West Fork. Potential construction effects on recreation along river.	Reservoir releases may affect type of recreation in West Fork. Potential construction effects on recreation along river.	Reservoir releases may affect type of recreation in West Fork. Potential construction effects on recreation along river.
Traffic	Impacts during construction in public rights of way. Some construction related traffic (crews)	Impacts during construction in public rights of way. Some construction related traffic (crews).	Impacts during construction in public rights of way. Some construction related traffic (crews).
Water Resources: Water Quality	Banking deliveries will have better water quality than average SWP. Net import of some mineral constituents; net export of others. In response to comments from Department of Water Resources, additional analysis of water quality data from wells in the vicinity of proposed recharge basins and well fields confirms this conclusion, and found that a mix of recharged SWP supplies and indigenous groundwater would generally meet current Department of Water Resources criteria for introduction of water to the California Aqueduct, although some blending from various wells might be needed in some cases.		
Water Resources: Hydrology	May reduce flood infiltration into mainstem groundwater (first storm only). No probable effects on major flows. Incised channel may be created in Unnamed Wash.	May reduce flood infiltration into mainstem groundwater (first storm only). No probable effects on major flows. Incised channel may be created in Unnamed Wash.	May reduce flood infiltration into mainstem groundwater (first storm only). No probable effects on major flows. Incised channel may be created in Unnamed Wash.
Growth	No direct effects. Project mitigates for effects of planned development.	No direct effects. Project mitigates for effects of planned development.	No direct effects. Project mitigates for effects of planned development.
Energy Use and Conservation	Use of about 290,000 gallons of diesel fuel for construction. Potential long term energy savings from lower energy use due to rising groundwater levels	Use of about 490,000 gallons of diesel fuel for construction. Potential long term energy savings from lower energy use due to rising groundwater levels	Use of about 920,000 gallons of diesel fuel for construction. Potential long term energy savings from lower energy use due to rising groundwater levels

Table ES-3. Summary of Mitigation Proposed

IMPACT	MITIGATION PROPOSED
Generally applicable actions incorporated into the Proposed Project Description	
Construction Impacts	Chapter 4.5.1: Siting near existing facilities to reduce construction-related environmental impacts Chapter 4.5.3: When constructing in an urban setting MWA would comply with applicable city encroachment permit policies that specify work schedules and work practices intended to minimize construction impacts on traffic, local businesses, local residents, storm water runoff, and utilities and public services. Compliance with State General Stormwater Permit program for Construction Activities.
Biological Impacts	Chapter 4.5.1: Siting that avoids known arroyo toad habitats and concentrates construction in the urbanizing areas of Hesperia, Victorville, Apple Valley, and Adelanto Chapter 4.5.2: Scheduling release of water from Silverwood Lake only during periods when the arroyo toad is estivating and only at rates which the 2003-2004 demonstration project showed to be fully contained within the main channel of the river Chapter 4.5.7: To prevent adverse impacts associated with wildlife incidental use of the construction area, MWA would implement the following avoidance and minimization measures where special status-species have been identified in or adjacent to the site in pre-construction surveys: a. Construction and maintenance personnel would participate in a USFWS/CDFG-approved environmental awareness program. b. Prior to initiation of construction activities, a qualified biologist would survey the area to confirm that no special-status species are present. If special-status species are present, they would be allowed to move away from construction activities.
Cultural Resource Impacts	Chapter 4.5.3: Siting that avoids known significant cultural resource sites along the Mojave River.
Aesthetic Impacts	Chapter 4.5.4: Where facilities would be visible, MWA would contain them in structures designed to be compatible with adjacent construction and in consultation with nearby residents.
Air Quality Impacts	Chapter 4.5.5: MWA would adopt best management practices per the Mojave Desert Air Quality Management District.
Noise Impacts	Chapter 4.5.6: Siting of the Proposed Project minimizes noise impacts. For areas adjacent to residential development MWA would comply with the following construction protocols: a. Permanent above-ground facilities (wells and treatment plant) would be contained within structures that would ensure that adjacent ambient noise levels are below the levels established for facilities in commercial and manufacturing areas. b. Except when more stringent standards apply to construction in the roadway, construction work would be limited to the hours from 7 AM to 7 PM, with no construction of weekends. c. Construction noise would be monitored on site by the construction contractor and portable noise attenuation barriers would be erected between construction and housing if construction noise measured at the exterior of adjacent housing exceeded 65 dBL.
Water Quality Impacts Related to Construction	Chapter 4.5.8: MWA would implement best management practices to avoid construction runoff during construction activities, including: a. Daily pre-construction inspection of all construction equipment to ensure that oil and/or gas/diesel fuel are not leaking from equipment; b. Secondary containment for fueling and chemical storage areas shall be provided during construction and Proposed Project operation; c. Secondary containment for equipment wash water shall be provided to ensure that wash water is not allowed to run off the site; d. Silt traps and/or basins would be provided to prevent runoff from the construction site; e. Materials stockpiles would be covered to prevent runoff;

	f. Loose soils would be protected from potentially erosive runoff; g. If construction equipment is used within the river channel, it will be inspected routinely and any leaks found will be repaired. If necessary, the equipment would be fitted with secondary containment materials at potential oil/fuel leakage sites; h. MWA would comply with the terms and conditions of the State's General Stormwater Permit program for construction activities. i. MWA will prepare and implement a Storm Water Pollution Prevention Plan based on the guidance in CalTrans' *Storm Water Pollution Prevention Plan and Water Pollution Control Plan Preparation Manual*, March 2003.
Specific Mitigation Commitments: Aesthetics	
Mojave River Well Field	Chapter 5.2.4.3: Wells would be enclosed in small structures designed to be consistent with structures in the immediate vicinity and/or MWA would plant screening vegetation.
Oro Grande Wash Recharge	Chapter 5.2.4.4: To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners.
Oro Grande Wash Recharge	Chapter 5.2.4.4: To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners.
Cedar Avenue Detention Basin Recharge	Chapter 5.2.4.5: To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners.
Oeste Recharge and Wells	Chapter 5.2.4.8: MWA would enclose wells in structures designed to be consistent with structures in the immediate vicinity and/or would plant screening vegetation.
Alto Recharge and Wells	Chapter 5.2.4.9: Where levee for recharge basins would be constructed adjacent to existing development, MWA would plant low vegetation on the levee berm and/or native vegetation as a screen for the levee. Wells would be sited to minimize impacts to residential areas and enclosed in small structures designed to be consistent with structures in the immediate vicinity.
Antelope Wash Recharge	Chapter 5.4.2.10: MWA would contour the outer berms of recharge facilities and would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners. Per draft EIR Section 5.4.7.2, upstream Antelope Wash recharge was re-evaluated during the public comment period, as a mitigation measure to reduce biological resources impacts. The upstream site will be relocated to an expanded recharge area in Antelope Wash at Ranchero Road.
Specific Mitigation Commitments: Air Quality	
All Facilities	Chapter 5.3.8.2: MWA will implement all of the fugitive dust control measures required by Rule 403 (Fugitive Dust): a. Use periodic watering for short-term stabilization of Disturbed Surface Area (maintaining moist disturbed surfaces); b. Take action sufficient to prevent project-related trackout onto paved surfaces; c. Cover loaded haul vehicles while operating on Publicly Maintained paved surfaces; d. Stabilize graded site surfaces upon completion of grading; e. Cleanup project-related Trackout or spills on Publicly Maintained paved surfaces within 24-hours;

	f. Reduce non-essential Earth-Moving Activity under High Wind conditions g. Feasible mitigation such as use of highway diesel fuels and use of additional pollution equipment to trap exhaust particulates or NOx would be implemented as part of the project, h.. MWA would evaluate potential for phasing of construction to reduce emissions
Specific Mitigation Commitments: Biological Resources	
Facilities habitat losses	a. Pre construction surveys for special status species. If special status species are found, avoidance and minimization protocols will be initiated. Occupied habitat will be mitigated at a 1:1 ratio. For Unnamed Wash, habitat loss will be mitigated consistent with Las Flores Ranches pending HCP or 1:1. Avoidance of Joshua trees or mitigation for habitat loss. At Antelope Wash upstream site, MWA may consider other sites. Per this commitment, upstream Antelope Wash recharge was re-evaluated during the public comment period, as a mitigation measure to reduce biological resources impacts. The upstream site will be relocated to an expanded recharge area in Antelope Wash at Ranchero Road. *b. Per* response to comments from California Department of Fish and Game, for burrowing owls, MWA will implement avoidance and minimization protocols if owls are found at facility sites or, if avoidance is not feasible provide off-setting mitigation in consultation with CDFG. c. As provided in the EIR, MWA will survey for special-status species prior to construction. *Per* response to CDFG, if Mojave fringe-toed lizards are found during such surveys, MWA will notify CDFG and initiate consultation regarding appropriate avoidance and mitigation.
Specific Mitigation Commitments: Cultural Resources	
All Facilities	Chapter 5.5.5: MWA will avoid impacts if feasible on identified cultural resources including prehistoric and historic archeological sites, locations of importance to Native Americans, human remains, and historic buildings and structures. Methods of avoidance may include, but not be limited to, project re-route or re-design, project cancellation, or identification of protection measures such as capping or fencing. MWA will retain archeological monitors during construction for ground-disturbing activities that have the potential to impact significant archeological remains as determined by a qualified archeologist. Based on this policy and the results of literature search and field surveys, MWA would implement the monitoring provision above for all facilities located adjacent to the Mainstem Mojave River, including: • The Mojave River Well Field • The Well Field Delivery Pipelines • Off-Channel Mojave River Recharge (east or west site) and the supply pipeline to this site If the eastern site is selected for Off-Channel Mojave River Recharge, MWA would also design the recharge to avoid the recently identified historic farmhouse site and/or provide for a suitable archeological testing and recovery program consistent with State of California and Federal policy. Because previously unrecorded and/or unanticipated archaeological deposits, features, and Native American burials may be encountered during implementation of the Project, the Project Archaeologist would prepare a *Construction Phase Monitoring and Cultural Resources Treatment Plan* prior to Project construction. The purpose of this *Plan* would be to clearly outline and expedite the process by which the Mojave Water Agency will resolve any significant impacts upon newly discovered, historically significant cultural resources, including consultation with the State Historic Preservation Officer (SHPO), thereby eliminating untimely

	and costly delays in construction. Specifically, the *Plan* would outline the process by which cultural resource discovery notifications are made and treatment plans are implemented, describe the cultural resource classes anticipated during Project construction, describe the treatment options for each cultural resource class, and detail procedures for implementing treatment. In addition, the *Plan* would summarize the Native American involvement in the Project (including a sample Native American Burial Agreement), outline the procedures for curation of materials recovered during site treatment (including a proposed Archaeological Curation Agreement with a facility that meets California curation standards), and address report requirements. This *Plan* would be submitted to the SHPO for review and comment prior to Project construction.
Specific Mitigation Commitments: Geology and Soils	
Mojave River Recharge, Hesperia, Lenwood, and Hodge	Chapter 5.6.4.2: MWA will monitor existing well levels and establish an additional system of shallow monitoring wells to track changes in groundwater levels as the plume of recharged water moves downstream to the extraction well field. These wells will allow real-time management of recharge rates to minimize the potential for groundwater levels under developed areas to rise to within 20 feet of the surface.
All recharge areas	Chapter 5.6.3.3: To mitigate for the potential for short-term declines in local wells as a result of the project, MWA will monitor groundwater levels at all project-related extraction sites and at adjacent sites. If MWA determines that water levels at these adjacent wells have declined as a result of MWA extractions, MWA will either (a) reduce extractions or (b) compensate the owner of the affected well for the increased energy costs associated with the decline in well level.
All facilities	Chapter 5.6.4.4: To ensure minimization of potential leaks at facilities due to seismic events and provide for rapid repair, MWA will maintain a small stockpile of rock at each recharge facility where levee damage might result in minor flooding of adjacent property to ensure that any levee damage can be rapidly patched to reduce potential for erosive flows.
Unnamed Wash	Chapter 5.6.4.6: Drop structures will be constructed as part of the Proposed Project to reduce excess erosion and sediment transport. Levees will be placed along the edge of the 100-year floodplain to contain releases.
Facilities in a Flood Zone	*Per* response to comments from San Bernardino County DPW Water Resources Division, MWA will coordinate with the County Flood Control District and local flood control officials during design to ensure that facilities within a flood zone do not conflict with Master Plans of Drainage and County/Local flood management. If necessary, permits will be requested from the Flood Control District and U.S. Army Corps of Engineers. MWA will inform County Flood Control of any substantial changes in the proposed project.
Specific Mitigation Commitments: Hazards and Hazardous Materials	
All excavations	Chapter 5.7.3.2: Prior to construction all sites will be evaluated to identify past uses that may have resulted in soil contamination. If the site assessment identifies a potential for contaminated soils, MWA would conduct further analysis to confirm this finding and would either (a) re-site or redesign the area to avoid impacts of (b) remediate the contamination to meet Regional Water Quality Control Board standards. During construction of pipelines in areas that cannot be assessed prior to construction, MWA would provide for monitoring of excavated soils and construction contracts will specify monitoring procedures and proper procedures for reporting and responding to potentially contaminated soils. Excavated materials containing hazardous waste will be handled, transported, and disposed of in accordance with applicable regulations.
All activities	Chapter 5.7.3.4: To reduce the potential for the project to affect emergency response plans or evacuation plans, MWA will implement traffic management that minimizes potential for traffic delays.
Specific Mitigation Commitments: Land Use	
Unnamed Wash	Chapter 5.8.1.2: MWA would continue to coordinate with Rancho Las Flores to ensure

	compatibility of the Unnamed Wash feature of the Minimum Facilities Alternative with the proposed development;
General	Chapter 5.8.1.2: MWA would coordinate with city and town officials to develop methods for ensuring long-term compatibility of recharge and associated facilities with planned existing development; and design of facilities to minimize adverse indirect effects on noise, and other factors that may affect perceived incompatibility of such facilities with residential and commercial development.
Specific Mitigation Commitments: Noise	
All facilities as applicable	Chapter 5.9.4.2: MWA will restrict construction to daylight time periods consistent with local ordinances; construction along roads in developed areas will therefore be practically limited to the period from 8:30 am to 4:30 pm. MWA will require construction contractors to utilize available noise management technology (muffling) and to maintain noise suppression equipment on construction machinery to ensure that noise emissions are minimized at the source. Equipment not in use for more than 5 minutes will be turned off. If pile driving equipment is necessary, pile holes will be pre-drilled if feasible and vibratory pile driving equipment will be used whenever possible. MWA will require construction contractors to locate fixed construction equipment such as generators as far as possible from noise-sensitive receptors. During construction of wells, pipelines, and associated facilities such as pump stations and chloramination facilities in areas where construction is within 400 feet of a residence or business, construction noise will be periodically monitored on site and at the residence or business. If noise levels are found to exceed those mandated by local ordinance, MWA will, to the extent feasible and in consultation with the resident or business, install temporary noise barriers along the boundary of the construction site to further reduce noise impacts. Barriers may be installed along the boundary of the construction zone or on private property, depending on conditions and the permission of the landowner/resident. In addition, once construction areas for fixed location construction such as well drilling pads have been cleared and construction can commence, MWA will install temporary noise barriers around the construction site, to the extent feasible, to block noise transmission. At recharge basin sites where there is adjacent development, MWA will initially construct outer levees along the boundary with adjacent development. This will allow construction of inner levees and basins behind a mound of earth, which will reduce noise levels for adjacent residents and businesses. MWA will notify residents and noise-sensitive receptors in the affected areas several weeks in advance of operations that would generate noise in excess of local standards. Information distributed will describe the operations and duration of the project. All stationary equipment will be designed, constructed, and operated to comply with all local noise ordinances.
Specific Mitigation Commitments: Public Services	
Minimum Facilities	Chapter 5.10.4.2: For the Well Field Delivery Pipeline system, MWA would implement traffic controls (as noted in the discussions of traffic and noise impacts). In addition, MWA would

Alternative	coordinate with providers of public services prior to initiating construction to ensure that police, fire, and emergency service providers were aware of the location of any construction activities in the public right of way. During construction in roads, this coordination would occur daily to precisely define the areas where traffic delays might occur.
Specific Mitigation Commitments: Recreation	
Minimum Facilities Alternative	Chapter 5.11.3.2: MWA will notify recreation providers along the West Fork of the Mojave River when deliveries from Silverwood Lake will be made and will ramp such deliveries up in 50-cfs increments to avoid sudden increases in downstream flow rates. A similar program will be developed for deliveries made via Unnamed Wash. MWA will coordinate siting of the potential Mojave River Well Field and associated facilities with local governments and the owners of private local facilities to minimize the effects and wells and pipelines on recreational activities along the river in this area (Bear Valley Road to Rock Springs).
Specific Mitigation Commitments: Traffic	
All facilities	Chapter 5.12.4.2: To minimize potential traffic effects associated with construction and operation of facilities, MWA will comply with all local encroachment permit requirements. In addition, MWA will: a. Schedule hauling of construction equipment (and water, if feasible) to and from the various construction sites prior to or following rush hours; b. Use off-road rights-of-way (road shoulders and sidewalks) for construction to the extent feasible; c. Encourage construction crews to carpool to construction sites; d. Identify and clearly mark emergency access routes around sites where construction takes place within the public right-of-way; e. On a daily basis, inform local emergency services of the location of all sites involving construction in the public right-of-way; and f. Jack and bore under Interstate 15.
Specific Mitigation Commitments: Water Resources (Water Quality)	
All Facilities	Chapter 5.13.8: To address potential for groundwater recharge to percolate through clay and fine-grained soils and result in leaching of minerals into indigenous groundwater, water quality in production and monitoring wells will be monitored to detect such potential influences. Wells will also be monitored for potential surface water influence, and recharge will be managed to reduce any effects identified. As noted in draft EIR Section 5.13.8 and in MWA's clarifying response to comments from the Lahontan Regional Water Quality Control Board and San Bernardino County DPW Water Resources Division: a. MWA will analyze corings from proposed recharge and/or well field sites to ensure that these facilities are not sited in areas where significant clay and fined-grained soils could result in substantial leaching of minerals into indigenous groundwater. Water quality will also be monitored routinely to detect any influence associated with leaching of minerals during recharge. b. Water quality in monitoring wells and all production wells will be monitored routinely in accordance with applicable regulations. c. For the Mojave River Well Field element of the Proposed Project, MWA will follow DHS guidance for evaluating the potential for these wells to be under the influence of surface water. d. If groundwater levels are detected rising to levels where recharge may cause water to become under the influence of surface water, MWA will divert deliveries to other facilities, or increase ground water extraction at the site, as appropriate.

Specific Mitigation Commitments: Water Resources (Hydrology)	
Mojave River Recharge	Chapter 5.14.5: MWA will monitor groundwater levels in the Mojave River Well Field for evidence of high groundwater levels in the floodplain outside of the mainstem channel. If there is substantial evidence that recharge is raising these levels to within 20 feet of the surface at the beginning of the storm season, then MWA could adjust operations by diverting some banked supplies to other recharge facilities. As noted in the draft EIR and in responses to comments from San Bernardino County DPW Water Resources Division, to reduce potential for in-channel/in-wash recharge operations to affect flood flows, MWA has sited these facilities in areas where existing and planned embankments would exert substantial control over flood flows and the effects of small temporary berms should be minimal. MWA will also coordinate design and construction of in-channel/in-wash facilities with San Bernardino County Flood Control, and will obtain permits from the Flood Control District and the U.S. Army Corps of Engineers, as appropriate. In general, per response to comments from San Bernardino County DPW Water Resources Division regarding local Master Plans of Drainage, MWA will also work with local communities during design, construction, and implementation of the proposed project facilities to avoid effects to drainage plans. Regarding Unnamed Wash, per response to comments from San Bernardino County DPW Water Resources Division and as provided for in the Proposed Project description, MWA will incorporate rock energy dissipation structures into the design of the channel at Unnamed Wash to minimize erosion and channel incision.
SPECIFIC MITIGATION COMMITMENTS: USE OF ENERGY	
Best management practices associated with mitigation of air quality impacts will also serve to reduce potential construction and operation use of energy.	

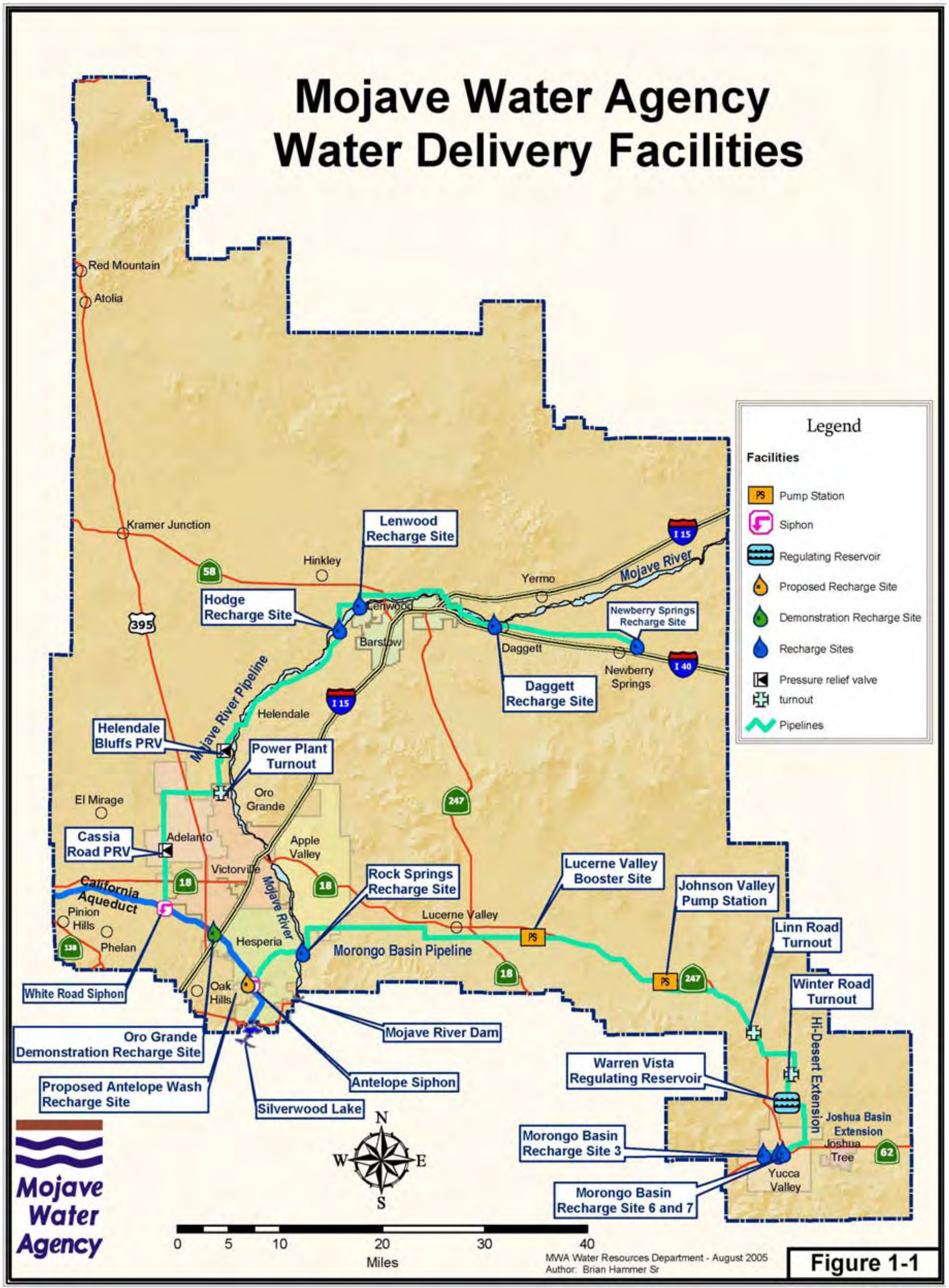


Figure 1-1. MWA service area and water delivery facilities.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 1: INTRODUCTION

1.1 Legal Basis for this Project EIR

In 1959, the Mojave Water Agency (MWA) was formed by an act of the California Legislature and activated by a vote of the residents in 1960 to manage declining groundwater levels in the Mojave Basin, Lucerne Valley, and El Mirage Basin. The Morongo Basin and Johnson Valley areas were annexed in 1965. MWA covers over 4,900 miles (Figure 1-1). Within the region served by MWA, 30 local water supply agencies and many individuals rely almost entirely on groundwater supply. Seven of these local agencies have developed Urban Water Management Plans. MWA does not supply water directly to local customers or regulate local-agencies' development of groundwater supply. Rather, MWA holds a State Water Project contract and utilizes a variety of facilities to import and distribute water to replenish groundwater basins and to meet the obligations of the Mojave Basin Area and Warren Valley judgments related to groundwater supply.

MWA's function is thus to utilize available supplies in a manner consistent with California Water Code Section 79562.5(b), which outlines four elements of integrated water management planning, specifically:

- Water supply,
- Groundwater management,
- Ecosystem restoration, and
- Water quality.

MWA operates under a Regional Water Management Plan, initially adopted in 1994 and revised in 2004, adopted by the Board of Directors of MWA on February 24, 2005 (2004 Regional Water Management Plan, see MWA 2004a) following adoption of a Final Program Environmental Impact Report (2004 PEIR; State Clearinghouse Number 2003101119) (see reference MWA 2004b). This Project EIR tiers off the 2004 PEIR.

MWA also operates under the Mojave Basin Area Judgment (Judgment), which sets limits (Free Production Allowances) on the amount of groundwater production that can occur in each subarea without incurring an obligation to purchase imported water. These limits are based on long-term (1931-1990) averages of water supply and the highest year of production between 1986 an 1990. The Judgment requires reductions in Free Production Allowances of 5% per year in each subarea until each subarea is in balance with the available water supply. Production in excess of the Free Production Allowance must be replaced with either (a) supplemental water from MWA or (b) use of unused Free Production Allowance from another party to the Judgment.

1.2 Purpose of the Project EIR

Within this context, MWA's role is to provide reliable supplemental water supplies to the Judgment to (a) replace supplies produced in excess of an agency's Free Production Allowance and/or (b) to replenish the region's overdrafted groundwater basins. The 2004 Regional Water Management Plan defines MWA's overall water management objectives for the period 2004-2020:

A. Balance future water demands with available supplies recognizing the need to:

- Stabilize the groundwater basin storage balance over long-term hydrologic cycles;
- Protect and restore riparian habitat areas identified in Exhibit H of the Mojave Basin Area Judgment and California Department of Fish and Game (CDFG) management plan required by Exhibit H;
- Limit the potential for well dewatering, land subsidence, and migration of poor quality water;
- Maintain a sustainable water supply through extended drought periods; and
- Select projects with the highest likelihood of being implemented.

B. Maximize the overall beneficial use of water throughout MWA by:

- Supplying water in quantity and quality suitable to the various beneficial uses;
- Addressing issues throughout the MWA service area recognizing the interconnection and interaction between different areas;
- Distributing benefits that can be provided by MWA in an equitable and fair manner;
- Ensuring that costs incurred to meet beneficial uses provide the greatest potential return to beneficiaries of the project(s);
- Avoiding redirected impacts; and
- Identifying sustainable funding sources including consideration of affordability.

The region is divided into two major surface water drainage areas, the Mojave River Area and the Morongo Basin/Johnson Valley Area. These two hydrologically separate surface water basins overlie separate groundwater basins, which themselves are divided into distinct subareas and (as defined by the California Department of Water Resources) 22 specific groundwater basins. For purposes of management, MWA has identified six major management basins within its service area (Figure 1-2):

- Mojave River Basin
  - Alto Area
  - Oeste Area
  - Este Area
  - Centro Area
  - Baja Area
- Morongo Basin/Johnson Valley

To meet its obligations to parties to the Judgment and local agencies in these six areas, MWA operates by (a) making releases of supplemental supplies to the Mojave River mainstem for direct recharge to the river aquifer and/or (b) using a network of pipelines to deliver supplemental supplies to local groundwater replenishment facilities (recharge basins). At present, discharges to the Mojave River mainstem from Silverwood Reservoir are limited to periods when the endangered southwestern arroyo toad is not breeding or active in the channel.

The 2004 Plan and 2004 PEIR note that one of the key problems to be addressed in order to meet these objectives is the substantial historic overdraft of groundwater basins within MWA's Service area. Groundwater overdraft in these six groundwater basins (Figure 1-2) and combined expected growth and associated increasing demand for water were projected to result in a groundwater recharge requirement of 59,100 acre-feet per year by 2020 (Table 1-1). The Mojave Floodplain Aquifer is the aquifer in the immediate vicinity of the Mojave River, and the Mojave Regional Aquifer is the aquifer underlying the (much larger) area outside of the direct influence of the Mojave River Floodplain.

Table 1-1. Summary of estimated MWA recharge requirements 2020), by aquifer (From 2004 PEIR, Section 2.8; See Figure 2 for location of Subareas).

PRINCIPAL AQUIFER	**SUBAREA**	**PROBLEMS**		**ESTIMATED RECHARGE REQUIREMENT**
		Overdraft	**Growth**	
Mojave Regional Aquifer	Alto	High	High	41,000
	Baja	High	Low	
	Centro	NA	NA	
	Este	Low-Moderate	Moderate	
	Oeste	Moderate	Moderate	
Mojave Floodplain Aquifer	Alto	High	High	23,000
	Baja	High	High	
	Centro	Low	Low	
Morongo Basin/Johnson Valley	Este/Lucerne	Low	Low	2,800
	Johnson Valley	Low	Low	
	Copper Mountain	Moderate	Moderate	
	Means/Ames	High	NA	
	Warren Valley	Low	Moderate	

Estimated recharge requirements shown on Table 1-1 are based on estimates of annual natural supply compared to current levels of consumptive use. Based on the 2004 PEIR, about 93% of the supply deficit occurs in the Alto and Baja subareas. These areas have the highest concentrations of development (Victorville/Hesperia and Barstow areas respectively). Areas with the highest historic overdraft and highest projected growth are shaded on Table 1-1, which shows that the most serious historic and potential problems are located in the Alto and Baja regions, where historic overdraft has been high. The 2004 Regional Water Management Plan identifies these regions as "High Priority" for action.

The significance of these problems is addressed in the 2004 Regional Water Management Plan and 2004 PEIR, which note, in summary, that:

- By 2020, projected demand exceeds supply by from 59,100 acre-feet per year to 81,500 acre-feet per year;
- Groundwater quality is affected by arsenic, nitrates, iron, manganese, chromium VI, total dissolved solids (TDS), total petroleum hydrocarbons (TPH), and volatile organic compounds (VOCs);
- Overdraft occurs in all areas, and this can cause wells to go dry, water quality to be degraded, land to subside, and riparian habitats to be affected;
- All but the Oeste and Morongo Basin/Johnson Valley subareas have riparian ecosystem maintenance problems;
- Wastewater discharges affect aquifer water quality;
- Activities in each subarea may be affected by activities in adjacent subareas;

The 2004 Plan notes that there are two fundamental actions that may be taken to address the problem of groundwater overdraft and future growth/water demand:

- Supply enhancement projects, either involving groundwater recharge or an increase in groundwater efficiency; and
- Management actions, involving conservation, storage agreements, and water transfers.

Between 2005 and 2020, MWA has a window of opportunity to address these problems, particularly to initiate banking and exchange programs. MWA has a State Water Project contract for a maximum 75,800 acre-feet of water per year, but from 1978 through 2001, average annual SWP deliveries were only 6,253 acre-feet, and no deliveries were made in 11 of the 24 years of record. This under-use of MWA's SWP contract supplies reflects local agency reliance on less-costly groundwater supplies. If MWA's full SWP Table A supply had been delivered over the same period of time, it would have been possible to substantially reduce (and in some instances fully offset) groundwater overdraft.

MWA's ability to take delivery of its SWP Table A supply is affected by (a) lack of facilities to convey, recharge, and store this water and (b) funding limitations. The purpose of the Proposed Water Supply Reliability and Groundwater Replenishment Program is to address these two issues.

1.3 Mojave Water Agency 2004 Regional Water Management Plan PEIR

1.3.1 Scope

The 2004 Regional Water Management Plan and 2004 PEIR evaluated available water supplies and concluded, in summary, that:

- Most groundwater in the Mojave Basin is the result of infiltration of water from the Mojave River and/or local streams from the San Bernardino Mountains.
- Infiltration rates from the mountains to the Regional Aquifer are low, and groundwater in the Regional Aquifer may be the result of slow long-term recharge.
- Infiltration associated with precipitation in the Mojave Basin itself is minimal, due to the low annual precipitation and high rates of evapotranspiration.
- Groundwater extraction in excess of natural replenishment results in overdraft that is not rapidly replaced from natural resources.
- Groundwater levels in the regional aquifer were once higher than those in the Floodplain Aquifer, but overdraft has reversed this trend and the Mojave Floodplain Aquifer now recharges the Regional Aquifer.

Given these overall conclusions, the 2004 PEIR notes that correcting overdraft and managing water supplies in the future will require additional sources of supply and facilities to recharge this supply to the MWA groundwater basins. The 2004 PEIR identified 43 potential supply enhancement projects and management actions and evaluated (a) their priority for meeting defined regional needs and (b) their probable environmental effects at a programmatic level. These projects included a number of programs for water conservation:

- Non-native plant eradication (tamarisk),
- Agricultural water conservation programs, and
- Urban water conservation programs,

MWA determined that these conservation approaches were "high" priority and is in the process of implementing these programs as part of its overall approach to water management. The highest priority water supply enhancement projects are listed on Table 1-2.

Table 1-2. Summary of "high" priority water supply enhancement projects from the 2004 PEIR. Project numbers refer to Table 2-2, 2004 PEIR.

PROJECT #	PROJECT: LOCATION	AREA AFFECTED
4	RECHARGE: Oro Grande Wash	Mojave Regional Aquifer, Alto West
5	RECHARGE: Cedar Street Detention Basins	Mojave Regional Aquifer, Alto Mid l
6	RECHARGE: Antelope Wash	Mojave Regional Aquifer, Alto Mid l
11	RECHARGE: HDWD Recharge Basin 3, Warren Valley	Morongo Basin/Johnson Valley
13	RECHARGE: Newberry Springs	Mojave Floodplain Aquifer, Baja
18	RECHARGE: Rock Springs Release	Mojave Floodplain Aquifer, Alto
19	RECHARGE: Hesperia Lakes	Mojave Floodplain Aquifer, Alto
20	RECHARGE: South of Rock Springs	Mojave Floodplain Aquifer, Alto
21	RECHARGE: Release from Silverwood Lake to Mojave River	Mojave Floodplain Aquifer, Alto
42	SUPPLY: Pre-delivery of SWP Water	All areas
43	SUPPLY: Water entitlement exchanges	All areas

1.3.2 Program Level Analysis

The 2004 PEIR defined the existing condition, identified probable environmental effects, and addressed approaches to mitigation for the suite of 43 potential projects identified in the 2004 PEIR. The 2004 PEIR addressed the following categories of potential effect:

- Water Resources
- Biological Resources
- Land Use
- Public Services and Utilities
- Recreation
- Aesthetics
- Air Quality
- Cultural Resources
- Geology and Soils
- Hazards and Hazardous Materials
- Noise
- Traffic
- Growth
- Cumulative Impacts

For each of these categories, the 2004 PEIR identified the type of impacts, the general magnitude of these impacts, and a programmatic approach to avoidance, minimization, and mitigation for impacts. The approach to avoidance, minimization, and mitigation specified the type of environmental survey and analysis required, the type of mitigation if impacts were identified, and subsequent general monitoring protocols. The 2004 PEIR provides a systematic and integrated perspective on regional-level environmental conditions and impacts.

Based on proposed avoidance, minimization, and mitigation measures proposed, the2004 PEIR concluded:

> "Numerous impacts are identified as less-than-significant with no mitigation required. Impacts to air quality associated with construction and secondary effects of growth supported by the Plan were found to be significant and unavoidable. All other impacts were either less than significant or reduced to less than significant levels through implementation of mitigation measures."

1.3.3 Relationship of 2004 PEIR to Water Supply Reliability and Groundwater Replenishment Program

The potential elements of the Water Supply Reliability and Groundwater Replenishment Program were identified and evaluated at a programmatic level in the 2004 PEIR, including both facilities and their operations. The purpose of this Project EIR is to (a) more precisely define the scope and operation of various alternatives, including additional features that may be required for banking, exchange, and long-term MWA use and (b) more precisely identify and quantify the potential impacts of specific alternatives involving various combinations of the 43 potential projects identified in the 2004 PEIR and to propose specific mitigation to reduce these impacts to a level of less than significant, to the extent feasible, in accordance with the 2004 PEIR.

1.4 Scope of Analysis

1.4.1 General

To accomplish its objectives and meet regional needs, MWA would (a) use existing facilities, enhance existing facilities and/or construct new facilities to increase capacity for groundwater recharge and extraction; and (b) modify its current operations to include water banking programs and water exchange programs to enhance operational flexibility and water supply reliability. Although new facilities and operational flexibility may result in water banking and exchange opportunities among various agencies, MWA is specifically evaluating a potential water banking and exchange program with Metropolitan Water District of Southern California (Metropolitan) as part of the Proposed Project. MWA will also evaluate the potential for using the proposed facilities to conduct water banking programs with other entities.

In this Project EIR, MWA has not selected a Proposed Project. Rather, MWA has conducted a detailed engineering feasibility analysis to identify a suite of potentially feasible facilities and operational scenarios for detailed consideration. These facilities and operations have been combined to form seven potential alternatives with four varying levels of facilities combined with three operations scenarios. The EIR will (a) describe the feasibility analysis and (b) address this range of potentially feasible alternatives.

Facilities which are included in the various alternatives include:

- The existing Mojave River Pipeline and Morongo Basin Pipeline (and modifications to these facilities);
- Existing recharge basins at Hodge, Lenwood, Daggett, and Newberry Springs (Mojave River Pipeline) and the Warren Basin (Morongo Basin Pipeline);
- Additional groundwater recharge basins in the vicinity of the California Aqueduct, along the Morongo Basin Pipeline, in Oro Grande Wash, and in Antelope Wash;
- Additional wells in the vicinity of the Mojave River upstream of the Narrows, along the California Aqueduct, East Branch; along the Mojave River Pipeline, and at various locations in the vicinity of Hesperia and Victorville;
- Additional pipelines to convey water to and from recharge basins and wells;
- Temporary sand dikes in the mainstem Mojave River to enhance recharge in the reach between Mojave Forks Dam and the Narrows;
- Facilities and/or rights of way to provide for delivery of supplies from the State Water Project via the West Fork of the Mojave River and/or existing drainage washes leading from the California Aqueduct to the mainstem Mojave River; and
- Ancillary facilities associated with these potential project elements such as monitoring wells, power lines, and pumps and pump housings.

Changes to MWA operations include (a) implementation of a traditional water banking program and (b) implementation of a combined water banking and on-going water exchange program.

1.4.2 Public Scoping Comments and Known Areas of Controversy

The 2004 PEIR documents public comments and concerns about the overall 2004 Plan. In addition, at a Scoping Meeting of the MWA Technical Advisory Committee (TAC), six members of the TAC provided input to the scope of the Project EIR. Public comments were also received at a public meeting of the TAC, at a Scoping Meeting in the City of Barstow, at a Scoping Meeting in the Yucca Valley, and following publication of the Draft 2004 PEIR. Review of these comments shows areas of public concern were:

- Assurance that mitigation would be implemented;
- Growth;
- Enforcement of the standards in the 2004 Plan;
- Consistency with the Mojave Basin Area Judgment;
- The need for a cost-benefit analysis;
- Whether Old Woman Springs Ranch would be part of the 2004 PEIR analysis;
- Water Quality problems in a variety of subareas;
- Potential for use of above ground storage;
- Coordination with local agencies to avoid duplication of effort;
- Consistency with CDFG agreements with Victor Valley Wastewater Authority

- Water quality issues associated with recharge: washdown, upwelling, silt, TDS, and dissolved VOCs to be addressed at a site level;
- Positive impacts of recharge are balanced against negative impacts;
- The need to remediate historic overdraft;
- Identification of current uses that are not beneficial;
- Water reclamation outside of the Alto Basin should be considered;
- Need to consult with CDFG on issues of land, mitigation measures, listed species impacts, and direct, indirect, and cumulative impacts;
- Structures should not alter drainage or affect downstream properties;
- Enforcement of FEMA floodplain regulations;
- Need for permit before work in the floodplain is initiated;
- Need to cite Southern California Association of Governments policies and address them;
- Need to address water quality issues, including: salinity, contamination of soils, nutrients from recycled water, waste brine from treatment plants, herbicides, disinfection byproducts, and emergent chemicals in wastewater;
- Risk associated with filtrate pollution;
- Concern about alternative formulation in the Joshua Tree area;
- MWA's technical, legal, and physical ability to do the 2004 Plan;
- Cost of SWP water and profit to MWA;
- Whether supply and growth projections are accurate given climate change;
- Loss of Pacific Flyway habitat at Hinkley;
- Objective: to meet demand or recover groundwater;
- Ability of MWA to meet needs with projected growth (Hinkley);
- Use of natural recharge basins in Lucerne Valley to obtain multiple benefits;
- Need for water quality treatment in Lucerne Valley; and
- Consistency with the County General Planning effort.

Comments at the April 27, 2005 TAC Meeting on the Project EIR (Chapter 9) indicated concern about the following issues:

- Connection of proposed facilities to the City of Adelanto;
- Need to ensure and adequately document that there is no net loss of water associated with water banking;
- Need to discuss how the Proposed Project is consistent with the Mojave Basin Area Judgment;
- Need for sensitivity analyses to deal with the potential range of effects;
- Is the project basin-wide;
- Need to consider making return deliveries from water banking via a pipeline/canal from Lucerne Valley to the Colorado Aqueduct; and
- How the project would affect the Transition Zone at the Narrows, which is an issue for CDFG.

The FEIR also responds to comment received from the public and from agencies during the draft EIR review period from October 28, 2005 through December 13, 2005 (Appendix A):

INDIVIDUALS

- Mr. Chuck Bell, written comments received during the 47-day comment period;
- Mr. Jeff Bentow, Yermo Water Company, oral comments at the November 8, 2005 public meeting and the November 9, 2005 MWA Technical Advisory Committee;
- Mr. Lou Kershberg, oral comments at the November 8, 2005 public meeting;
- Mr. Guy Patterson, oral and written comments at the November 9, 2005 MWA Technical Advisory Committee
- Mr. and Mrs. Gary E. Thrasher, written comments received during the 47-day comment period;
- Mr. Mathew Woods, oral comments at the November 8, 2005 public meeting and written comments at the November 9, 2005 MWA Technical Advisory Committee
- Mr. Joseph Monroe, written comment received November 17, 2005.

AGENCIES

- California Department of Fish and Game, Habitat Conservation Program, Region 6, Ms. Denyse Racine, Supervisor;
- California Regional Water Quality Control Board, Lahontan Region, South Basin Regulatory Unit, Mr. Greg Cash, Engineering Geologist
- California Department of Water Resources, State Water Project Analysis Office, Ms. Elizabeth Patterson, by email 24 October 2005.
- County of San Bernardino, Department of Public Works, Environmental Management Division, Mr. Naresh P. Varma, Chief

In addition, MWA discussed the proposed project with staff of its potential water banking partner (Metropolitan Water District of Southern California) who unofficially suggested some minor editorial changes to the document. Finally, MWA received correspondence from the Southern California Association of Governments declining to comment on the draft EIR and from the State Clearinghouse indicating that it had not independently received comments from state agencies. MWA's responses to these comments involved (a) clarifications of data provided in the draft EIR and (b) acceptance of additional mitigation recommendations, as documented in Appendix A.

1.4.3 Scope of Project EIR

This Project EIR describes the full scope of alternative formulation and evaluation, beginning with initial feasibility analyses and ending with formulation and evaluation of Proposed Project alternatives. First, it describes the initial effort to screen alternatives based on technical feasibility, cost, and environmental effects. Second, it describes the results of screening and the elimination of some alternatives. Third, it discusses the rationale for formulation of Proposed Project alternatives combining various facilities, and evaluates the potential impacts of these alternatives. The Project EIR addresses both construction and long-term operation and maintenance of the various alternatives.

Each Proposed Project alternative may involve traditional water banking and a modified banking program that includes on-going water exchanges between Metropolitan and MWA:

- Traditional water banking involves construction of facilities to receive water supplies (deposits) from various sources and to store them in a groundwater "bank." These supplies are then returned to the original "depositor" at a later date, minus a percentage to account for loss during recharge and storage. The costs of facilities needed to accomplish the banking program are shared by the partners in the program. As a result, MWA would be able to accelerate development of some facilities needed for accomplishment of its objectives. Traditional water banking generally involves deposits in wet years and returns during dry years. Under a traditional water banking operation with Metropolitan, MWA would be able to make returns by (a) delivering a portion of its SWP supply to Metropolitan and/or (b) pumping stored groundwater into the California Aqueduct.

- Water banking combined with an on-going exchange program involves traditional water banking, combined with on-going water exchanges such as the exchange program MWA currently operates with Solano County Water Agency. The exchange component of such a program involves each partner's exchange of available SWP supplies when the other partner may need them or have capacity to store them; no direct return of stored groundwater is involved in this element of the program. Combining such programs allows for management of supplies on a flexible basis, including short-term banking and exchange of supplies among multiple agencies, depending on water availability and availability of storage within each agency's service area.

The development of new facilities, the modification of existing facilities, changes in operations of facilities, and changes in the timing and amount of water delivered to and returned from MWA as a result of banking and exchange may have positive and/or negative effects on the following environmental resources:

- Aesthetics, including effects related to facilities constructed in the viewshed of residential development;
- Air quality, including dust and emissions from construction equipment and from equipment used during operation of facilities;
- Biological resources, including temporary and permanent loss of habitat, potential take of threatened and endangered species, and potential enhancement of habitat associated with higher groundwater levels;
- Cultural resources, including potential construction effects on buried historic and pre-historic resources;
- Geology and soils, including potential for erosion in areas of recharge, compaction of soils, and effects associated with sediment build up in recharge areas;
- Hazards and hazardous materials, including potential for fuel and lubricant spills during construction and operation of facilities;

- Land use, including use of over 500 acres of land for recharge basins and/or wells;
- Noise, including construction noise and noise from operation of new and existing facilities;
- Public services and utilities, including temporary interruptions in utility service during construction;
- Recreation, including reduced access to the mainstem Mojave River and/or local washes proposed for use as recharge facilities and or conveyance for flows to the mainstem Mojave River and including potential for incidental use of some facilities for low-impact recreational purposes such as jogging, hiking, and biking;
- Traffic, including temporary traffic delays during construction; and
- Water resources, including potential changes in groundwater levels and groundwater quality when compared to the baseline condition and/or the without-project condition.

As noted above, the Project EIR does not identify a preferred alternative, but rather carries a number of potential alternatives forward for consideration by MWA's Board and discusses the key environmental factors to be weighed in an MWA Board decision making process. Each of these alternatives is described as a Potential Proposed Project, and is fully evaluated.

1.4.4 Report Organization

The Final Project EIR is organized into the following Sections:

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program
SC# 2005041103
Final Environmental Impact Statement

APPENDIX A
RESPONSES TO PUBLIC AND AGENCY COMMENTS

As a result of this agency and public review of the Draft EIR, MWA received oral and written comments. Comments and responses are provided in the following order:

1. Mr. Chuck Bell, written comments received during the 47-day comment period
2. Mr. Jeff Bentow, Yermo Water Company, oral comments at the November 8, 2005 public meeting and the November 9, 2005 MWA Technical Advisory Committee
3. Mr. Lou Kershberg, oral comments at the November 8, 2005 public meeting
4. Mr. Guy Patterson, written and oral comments at the November 9, 2005 MWA Technical Advisory Committee
5. Mr. and Mrs. Gary E. Thrasher, written comments received during the 47-day comment period
6. Mr. Mathew Woods, oral comments at the November 8, 2005 public meeting and written comments at the November 9, 2005 MWA Technical Advisory Committee
7. Mr. Joseph Monroe, written comment received November 17, 2005.
8. California Department of Fish and Game, Habitat Conservation Program, Region 6, Ms. Denyse Racine, Supervisor;
9. California Regional Water Quality Control Board, Lahontan Region, South Basin Regulatory Unit, Mr. Greg Cash, Engineering Geologist
10. California Department of Water Resources, State Water Project Analysis Office, Ms. Elizabeth Patterson, by email 24 October 2005.
11. County of San Bernardino, Department of Public Works, Environmental Management Division, Mr. Naresh P. Varma, Chief

In addition, the Southern California Association of Governments responded to the draft EIR indicating that they would not comment and the State Clearinghouse sent notification that it had not received comments from State of California agencies.

1. Written comments from Mr. Chuck Bell provided at the November 9, 2005 meeting of the MWA Technical Advisory Committee.

Comment: Project's potential use of Morongo Pipeline could dilute its capacity to convey water for recharge in Este for Este's future use (albeit a long-term/not short-term need). Is this an issue?

Response: Deliveries under this program to the Morongo Basin area would occur in cooperation with and utilizing the capacity available to the current Morongo Basin Pipeline participants. Consequently, no impact to the Este area under the scenario you describe is anticipated.

By email, December 4, 2005

Comment: Matthew Woods noticed a statement in the Draft EIR - P. 9-5 - Table 9-1 - Summary of Comments, April 27, 2005 TAC Meeting.

He stated that I suggested that State Water be stored in Este for MWD with eventual return to MWD. I didn't know what he was referring to until I saw a copy of the draft EIR in the LV library. He was right. It was there. (Quote c. "MWA should consider recharge in the Morongo Basin/Lucerne valley area, with returns to Metropolitan via a canal or pipeline to the Colorado Aqueduct").

Under no circumstances that I can imagine would I recommend that the Lucerne Basin be recharged for any purpose other than for OUR own use. From a hydrological, fiscal and common sense perspective, it would make no sense.

I succinctly remember the meeting and my comments. The consultant misinterpreted my comments.

I asked if the Program would include recharge of State Water (preferably cheaper surplus water when and if available) into basins other than Alto.

In a separate statement, in response for alternative options for returning Met. water to Met., I suggested the EIR (strictly for purposes of including other "paper alternatives"- far fetched as they may be) - could include an analysis of retaining the Met. water in Alto that had been recharged (stored), and conveying to Met. its fair share out of our entitlement from the aqueduct via the Morongo pipeline to Morongo - and through a pipeline (constructed by Met.) from Morongo down-gradient to Met.'s aqueduct in the Coachella Valley. (This of course assumes available capacity in the Morongo Pipeline).

The consultants ran the two issues together, thus misconstruing my comment. Easy to understand because it is an off-the-wall idea - but most EIR alternatives are. (They are mostly used to make the "preferred project" look good).

I request that this misunderstanding be corrected in the final EIR.

Response: MWA concurs that the reference in the EIR was in error, the result of combining two separate ideas into a single comment. MWA's CEQA consultant specifically apologizes to Mr. Bell for this misinterpretation. The FEIR has been revised to reflect the above comment.

2. Mr. Jeff Bentow, Yermo Water Company

Verbal comments at the public meeting at MWA headquarters on November 8, 2005, and at the November 9, 2005 meeting of the MWA Technical Advisory Committee.

Comment: Could SWP take local water?

Response: No. The SWP is not authorized to appropriate local water supplies. The proposed project involves banking of SWP supplies and then return of these supplies, either via exchange or via direct pumping of supplies back to the California Aqueduct. Because there is a "loss factor" applied to the banking and exchange program, the net effect of the proposed project will always be to increase groundwater supplies. No net take of local supplies will occur.

Comment: What are the implications of the projections that 390,000 acre-feet of water could be involved in banking?

Response: This means that over a period of 20 to 25 years, the probable maximum amount of water delivered to Mojave Water Agency from Metropolitan would be 390,000 acre-feet.

Comment: How is Unnamed Wash to be used in the project? Can this be developed further?

Response: MWA would use the Unnamed Wash to deliver water to the Mojave River. In the short-term, water would be diverted from the California Aqueduct into a temporary channel and then allowed to run down the natural wash channel, which would be minimally improved. Water would then flow under local roads and into the river. When Rancho Las Flores finalizes its plans for the area, MWA would then modify the diversion in cooperation with the developer.

3. Mr. Lou Kershberg, verbal comments at the public meeting at MWA headquarters on November 8, 2005.

Mr. Kershberg asked a number of questions related to general water supply and water quality management on the State Water Project and in the Lucerne Valley. Although many of these were not specifically related to the proposed project, MWA has responded to several specific questions below. In addition, MWA's hydrogeologist has contacted Mr. Kershberg to address his concerns about water supply and water quality in the Lucerne Valley, which would not be affected by the proposed project, regardless of alternative selected.

The two questions Mr. Kershberg directed to MWA regarding the proposed project are answered below.

Comment: Why is there a restriction on deliveries from Lake Silverwood? We need an alternative route for the SWP deliveries.

Response: The deliveries from Lake Silverwood directly to the West Fork of the Mojave River are restricted by the USFWS and CDFG from February 15 through September 15 to avoid impacts to the endangered arroyo toad. The proposed project includes an alternative delivery point (unnamed wash) for SWP supplies that would avoid this restriction.

Comment: How are we assured that the SWP won't take our water supplies?

Response: The proposed project includes a provision that returns from banking will be less than the amount delivered. This "loss factor" is applied to ensure that the amount of water banked exceeds the amount withdrawn from the bank. The agreement between MWA and any banking partner will specify this loss factor. The loss factor applied to most banking agreements has been 10%, and MWA anticipates a loss factor that fully protects local water supplies will be incorporated into any banking agreement.

4. Mr. Guy Patterson
Written comments at the November 9, 2005 MWA Technical Advisory Committee meeting.

Comment: Are there any proposals for using reclaimed water in re-charge basins, especially during the winter when reclaimed will not be needed for irrigation purposes?

Response: The proposed project does not include provisions for introduction of reclaimed water into the recharge areas described. To pursue this option, additional studies would be required to ensure that this type of use would not compromise water quality and MWA's ability to make returns to Metropolitan or other banking partners. This would require an independent CEQA review.

Comment: The super well chart and map should be revised to reflect pipeline extending to Adelanto and SCLA.

Response: The proposed project does not include new pipeline connections to Adelanto because MWA has assumed delivery to this area (as described in the Project Description) via existing connections to the new facilities described in the DEIR. If additional new pipelines are needed, they may be addressed in a separate CEQA document.

5. Mr. and Mrs. Gary E. Thrasher
14024 Sunflower Lane
Oro Grande, CA 92368
Written comment dated December 13, 2005

Comment: The concept and practice of replenishing the groundwater in the Mojave River Alto Basin is now in progress. A relatively small amount of Water (compared to the proposed amount in the afore mentioned MWA Draft project EIR) is currently being released from Silverwood Lake into the mainstem of the Mojave River. This foreign water is flowing from the release point at Cedar Springs to well past the Vista Road Bridge that spans the Mojave River at Helendale California. This flow demonstrates that foreign water discharged into the Mojave River will not all be absorbed into the upper reaches of the channel and will therefore add to and amplify the risk of flooding. The additional flood risk will be caused by the expansion of the existing Riparian Habitat areas and the raising of the riverbed floor from the materials washed downstream when floodwaters destroy the proposed water retention berms in the river channel.

Response: These releases are part of MWA's two-year pilot project. As the EIR notes, flow in the Mojave River is generally underground and this underground flow naturally wells up and becomes surface flow at the Mojave Narrows, where subsurface flow is blocked. The flow between the Mojave Narrows and Helendale is thus a result of this upwelling and occurs routinely. MWA staff have monitored the referenced releases and to date have tracked the surface flow to an area upstream of the Mojave Narrows Regional Park near Bear Valley Road. The released water is in fact being absorbed by the River channel several miles upstream of the area you mention.

The EIR (page 4-15) also notes that, in the portion of the river upstream of the Mojave Narrows, there is substantial lateral movement of water from the channel to the regional aquifer underlying Hesperia, Victorville, Apple Valley, and other areas along the river. The proposed project includes a potential well field along the river to extract this water after it has moved away from the channel. This extraction process would essentially draw groundwater levels down at each well and create a "cone of depression" into which recharged water would flow. Given that extractions from the well field are matched to the recharge rate, the net subsurface flow downstream to the narrows will be a small component of overall flow in the river. In short, groundwater flow analyses by the United States Geological Service and Bookman-Edmonston and monitoring performed by the MWA suggest that most of the recharged water will, indeed, be absorbed in the upper reaches of the river.

It is important to remember that MWA is a Party to the Mojave Basin Area Judgment. As a Party, MWA is prohibited from interfering with flood flows and has explicit responsibilities to bring supplemental water supplies into the adjudicated area to meet water supply obligations under the Judgment. These requirements are clearly articulated in the MWA Regional Water

Management Plan and the Draft EIR for the Water Supply Reliability and Groundwater Replenishment Program, which demonstrate MWA efforts to meet these responsibilities.

In addition, the berms that will be constructed in the mainstem channel will be constructed with materials from the channel itself. There will be no new material added to the channel and thus no increase in the elevation of the channel bed. The temporary berms thus do not pose a new or additional flood risk.

As a result of intercepting of most recharged flow upstream of the Narrows, the proposed project will have little effect on flows within the Narrows and downstream. The analysis of flooding (EIR Section 5-14) suggests that major floods spread out above the Narrows and there is substantial recharge occurring even during repeated floods.

Comment: Much of the existing Riparian Habitat areas were created by the discharge of treated sewage water from the VVWRA facility to the Mojave River Mainstem. This Riparian Habitat area has historically (since 1985) prevented routine flood control clearing by San Bernardino County Flood Control. In 1998 my neighbors and I sent certified letters to San Bernardino County Flood Control, requesting channel maintenance in the Oro Grande area. Mr. Jim Borcuk of San Bernardino County Transportation/Flood Control in a letter addressed to me (Gary Thrasher) on August 10, 1998, responded thusly, he wrote, *"As a result of increasingly stringent environmental regulations, the San Bernardino County Flood Control District (District) is no longer able to routinely perform clearing operations in the Mojave River as it has in the past" (italics and underscore added).* Expansion of the existing Riparian Habitat area and creation of new Riparian Habitat areas in the Mojave River Channel caused by discharge of foreign water into the channel will further hamper and degrade Flood Control operations.

Response: In Chapter 3, the EIR recognizes the general concern that recharge may raise groundwater levels above 20-40 feet and that this could affect riparian vegetation, including growth of nuisance plants such as tamarisk. However, the general capacity of recharge in the mainstem channel was defined based on a desire to avoid seismic liquefaction effects associated with high groundwater levels, and thus project operations will be managed to keep groundwater levels below those associated with liquefaction. The area described in the DEIR is also located in the Upper Mojave River channel south of Bear Valley Road and not within the area you are describing.

Comment: The "Reservoir Regulation Manual for the Mojave River Dam" http://www.spl.usace.army.mil/resreg/htcdocs/Mojave/Text.pdf (Last Revised September 1985), page 4 section 10 (DOWNSTREAM CHANNEL) spells out San Bernardino County's commitment to maintain the Mojave River Channel. After the devastating Mojave River flood event of January 11, 2005 that endangered lives, destroyed homes, county roads, and private property -- Wendy Lou, a hydraulics engineer with the U.S. Army Corps of Engineers said, "The Corps of Engineers monitored record levels of up to

16,600 cubic feet of water flowing out of the dam (Quotation from the Daily Press Dispatch newspaper dated January 16, 2005 - pages A1 &A6 -- "FLOOD VICTIMS SEARCH FOR ANSWERS" by Emily Berg). The 16,600 cfs recorded by the U.S. Army Corps of Engineers represents only about 70% of the 23,500 cfs channel flow capacity that the county assured the Army Corps of Engineers they would maintain (see the Reservoir regulation Manual for the Mojave River Dam, page 4, section 10, Downstream Channel) demonstrating that the currently un-maintained river channel is not capable of handling increased flows that could be generated by the discharge of foreign water into the mainstem of the un-maintained Mojave River Channel.

Response: The potential for the proposed project to affect flood flows is evaluated in the EIR, in Section 5.14, using data from the floods of 1983. This analysis demonstrates that, even after a flow of 11,700 cfs and an extended period of flow over 1,000 cfs, channel flows at Hesperia were 100 to 500 cfs higher than channel flows at the Lower Narrows. This indicates that, even following a major flood event, the channel continues to recharge from 200 to 1000 acre-feet of supply per day. The EIR concluded that that project recharge operations would thus not affect recharge capacity in the upstream channel or flooding in the channel downstream of the Narrows.

The EIR also notes that recharge would not occur when there was substantial natural flow in the channel, and thus recharge operations will not occur *during* periods of flooding. In fact, as the EIR explains, Metropolitan generally tends to focus its recharge operations on the period from February through July, when it is possible to predict water supply availability with some accuracy. Assuming that there was no natural flow in the Mojave River during this period, and assuming that Metropolitan delivered 48,800 acre-feet to MWA via the mainstem channel over a 6 month period, the average rate of delivery would be 271 cfs. MWA anticipates that on-going extraction of groundwater in the Mojave River Well Field will result in no net substantial increase of flow downstream of the well field and into the Narrows. In short, the effect of the proposed recharge in the Mojave River mainstem would be so small that it would be within the measurement error of the flow gauges at the Lower Narrows. The project would not therefore have a measurable effect on channel capacity during a major flood.

Comment: The afore mentioned MWA Draft Project EIR assumes that the Mojave River Channel is being maintained (see MWA Draft Project EIR @ 5.14.4.1, Significance Thresholds, page 5-163, next to last paragraph, ("<u>the floodway maintained by San Bernardino County Flood Control</u>") and could handle increased flows created by the discharge of foreign water into the channel, when in fact --- an emergency flood hazard situation already exists!

Response: The reference to San Bernardino County maintenance of the floodway was made to address the potential for off-channel recharge basins to affect the floodway in the upstream portion of the river (3 miles upstream of Rock Springs), not to address downstream issues. The point was that the recharge basins would not extend into the existing channel, which in this reach is maintained by San Bernardino County Flood Control.

Comment: Urbanization is occurring at an alarming rate, each new rooftop, driveway, parking lot and paved road is destroying the soils ability to absorb water and therefore increasing runoff load into the un-maintained Mojave River Channel. Maintaining and creating water supply for the rapidly populating Victor Valley area must be coordinated with flood control. The MWA Draft Project EIR should contain language clearly stating that MWA will coordinate with San Bernardino County Flood Control to resume and maintain routine Mojave River channel clearing operations in all portions of the channel that any discharged foreign water could conceivably reach at any time of any given year.

Response: Mr. Thrasher is correct regarding the runoff and flooding effects associated with development. MWA, however, has no authority to regulate growth and is mandated to provide supplemental supplies to local producers, who themselves operate under approved water management plans. In the Draft EIR, MWA has committed to monitoring groundwater levels in the recharge area at the beginning of the storm season and to adjusting recharge when groundwater levels rise to 20 feet below the channel surface. In addition. MWA will not be recharging when there is substantial natural flow in the river upstream of Rock Springs. Recharge cannot thus directly affect surface flows.

Most importantly, the MWA analysis in Section 5.14 shows that, even following very high flood flows, the channel upstream of the Mojave Narrows continues to recharge. Flow downstream of the Narrows is substantially lower than flow at Hesperia, demonstrating that there is substantial recharge capacity even when the channel has been thoroughly saturated. Thus, MWA does not anticipate that normal recharge operations will affect downstream flooding.

6. Mr. Mathew Woods, CBC, Inc, Lucerne Valley, CA 92356, verbal comments at the Public Meeting held at MWA Headquarters, 6-9 p.m., November 8, 2005 and written comments received at the November 9, 2005 Technical Advisory Committee meeting.

Comment: Lucerne Valley residents had not been informed of the availability of the DEIR.

Response: MWA published Notice of the Availability of the DEIR in the regional newspapers and mailed copies of the DEIR to parties which had previously indicated an interest in receiving the document.

Comment: Could MWA send a representative to discuss the water management issues in the Lucerne Valley to a December meeting?

Response: The proposed project does not involve Lucerne Valley. MWA would be pleased to receive an invitation from the Lucerne Valley Municipal Advisory Committee to attend its meetings to discuss MWA projects and issues relevant to the mission of the MWA.

Comment: How do you do an exchange?

Response: See the initial discussion of operations in Chapter 4 of the DEIR. An exchange would involve Metropolitan delivery of water to MWA, which MWA would then recharge to groundwater. When Metropolitan requested return of this banked water, MWA would rely on this banked groundwater to meet local supply needs and would give Metropolitan a portion of MWA's available State Water Project supply.

Comment: How do you monitor?

Response: All State Water Project deliveries to and from MWA are monitored continuously by MWA and California Department of Water Resources, using flow gauges.

Comment: Will the overall quality of the water table be compromised by adding so much aqueduct water?

Response: The addition of SWP supplies to the groundwater basins involved in the proposed project will in general improve water quality. See DEIR Section 5-13.

Comment: What are the cumulative impacts, long term, of the growth induced by the implementation of these recharge basins? This will dramatically impact and attract many large industrial facilities and high density projects. There is much concern of the impact will have on the lifestyle of the High Desert.

Response: Growth impacts are discussed in Section 5-15. In this discussion, MWA notes that there is no evidence that water availability drives growth in southern California, but that water availability may accommodate growth. The DEIR notes that analysis of water supply and growth data show no relationship between growth and water supply. In addition, the proposed project does not increase available supply. Rather, it provides for increased storage of groundwater that may later be used to (a) meet demands during drought and (b) extend the time period before projected demand exceeds MWA's ability to meet it with existing supplies.

Comment: The cultural resources: Why omit "people" -- our families, our lifestyle [should be] considered a cultural resource? The question is: "What is culture? I would like to see your definition as applied?

Response: Cultural resources are defined in California and Federal law, and MWA has used these definitions. For clarification, under the California Environmental Quality Act (CEQA Guidelines Section 15064.5), cultural resources are defined as:

"(a) For purposes of this section, the term "historical resources" shall include the following:

(1) A resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the California Register of Historical Resources (Pub. Res. Code SS5024.1, Title 14 CCR, Section 4850 et seq.).

(2) A resource included in a local register of historical resources, as defined in section 5020.1(k) of the Public Resources Code or identified as significant in an historical resource survey meeting the requirements section 5024.1(g) of the Public Resources Code, shall be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.

(3) Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be an historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record. Generally, a resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing on the California Register of Historical Resources (Pub. Res. Code SS5024.1, Title 14 CCR, Section 4852) including the following:

(A) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;

(B) Is associated with the lives of persons important in our past;

(C) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or

(D) Has yielded, or may be likely to yield, information important in prehistory or history.

(4) The fact that a resource is not listed in, or determined to be eligible for listing in the California Register of Historical Resources, not included in a local register of historical resources (pursuant to section 5020.1(k) of the Public Resources Code), or identified in an historical resources survey (meeting the criteria in section 5024.1(g) of the Public Resources Code) does not preclude a lead agency from determining that the resource may be an historical resource as defined in Public Resources Code sections 5020.1(j) or 5024.1.

(b) A project with an effect that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment.
(1) Substantial adverse change in the significance of an historical resource means physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired."

7. Written Comment from Mr. Joseph W. Monroe, November 17, 2005

Comment: The Program has been well thought out and presented to the water community. In particular, have been concerned about the East Alto Basin, but I see that there are provisions made from the top to the lower end.

Response: MWA appreciates Mr. Monroe's comment regarding staff efforts to cover the Alto East Basin area comprehensively.

8. Ms. Denyse Racine, Supervisor
Habitat Conservation Program
California Department of Fish and Game
Eastern Sierra-Inland Deserts -- Region 6
Bishop Field Office
Habitat Conservation Program
407 West Line Street
Bishop, CA 93514
Letter dated December 12, 2005

1. Comment: Project locations could include

- **Existing MWA facilities**
- **Mojave Forks Dam**
- **VVWD's "Green Tree" recharge facility**
- **Proposed City of Hesperia flood detention basins at Cedar Avenue and Hesperia Road**
- **Oro Grande Wash**
- **Off-Channel along the Mainstem Mojave River**
- **Recharge Basins near Sheep Creek and the Mojave River Pipeline**
- **Recharge basins south of the California Aqueduct in Antelope Wash**
- **Release of water to the Mainstem Mojave River via an unnamed wash in Summit Valley,**
- **New spreading basins in the Lucerne Valley**

Response: MWA initially considered facilities at Mojave Forks Dam and the possibility that Lucerne Valley could be involved. These potential sites were eliminated from consideration due to environmental and technical screening conducted during early phases of the program and are not included in the Proposed Project Description, Chapter 4.

2. Comment: Table 5-13. Mojave fringe-toed lizard should be included since it is found along the river in sandy areas and often in areas with mesquite. It is also a California State Species of Special Concern.

Response. We initially reviewed distribution data for the Mojave fringe-toed lizard, which shows known distribution well to the north and east of proposed project areas. In addition, according to the California R015California Wildlife Habitat Relationships System (California Department of Fish and Game California Interagency Wildlife Task Group): "The Mojave fringe-toed lizard occurs in desert regions of Inyo, San Bernardino, Los Angeles, and Riverside cos. It is restricted to fine, loose, wind-blown deposits in sand dunes, dry lakebeds, riverbanks, desert washes, sparse alkali scrub and desert shrub habitats."

Given that CDFG mistakenly included the Lucerne Valley in its list of potential project locations, we can understand CDFG's concern about this California species of special concern. There are areas near the Lucerne valley where Mojave fringe-toed lizards have been found. There would also be potential habitat for the species in this area, where there is suitable fine, loose, windblown sand. However, the elimination of the Lucerne Valley as a potential site means that the sites actually being considered for project construction and operation are a considerable distance outside of the known range for this species.

In addition, MWA has explicitly avoided siting recharge basins in areas with the fine, wind-blown sands required for the species to escape high daytime temperatures. Sandy habitats in the Mojave River channel that will be affected by in-channel recharge are coarse and subject to surface flow, as well as being upstream of the historic distribution of the Mojave fringe-toed lizard, which was primarily between Helendale and Camp Cady (West Mojave Plan Working Group, 1999). No dune-type habitats will be affected by the project. The creosote scrub habitats that may be affected by the project have been chosen to avoid fine sandy areas such as the wash at Sheep Creek, because these areas may also be associated with subsurface layers of fines and clays, which are not suitable for groundwater recharge.

In short, there is no reasonable potential for the proposed project to affect Mojave fringe-toed lizards because (a) none of the proposed sites are within the known range of the species and (b) groundwater recharge is optimized where there are coarse sands and sandy loams, and the selection of such sites probably eliminates potential for the Mojave fringe-toed lizard. Nevertheless, as provided in the EIR, we will survey for special-status species prior to construction. If Mojave fringe-toed lizards are found during such surveys, we will notify CDFG and initiate consultation regarding appropriate avoidance and mitigation.

3. Comment: Section 5.4.1.2 -- Second paragraph. Tortoises [desert tortoise] have been found within the "no Survey Zone" of the West Mojave Plan within the past two years. Several of those sites are in Victorville. And Section5.4.1.2 -- Desert Tortoise -- The Department concurs that desert tortoise surveys will need to be conducted, pending the outcome of an approved West Mojave Plan.

Response: Based on its review of available literature, MWA was aware of the recent desert tortoise observations in north Victorville. These observations are clearly identified on Map 3-10 of the West Mojave Plan FEIR/EIS (attached). The EIR therefore explicitly referenced Highway 18 as being an apparent distributional breaking point for desert tortoise in the region (see attached Figure 3-9 from the West Mojave Plan FEIR/EIS). We could find no records in the literature of recent desert tortoise observations south of Highway 18, except for several observations near Highway 247, which is about 20 km to 30 km from potential project sites. All of the proposed facilities are south of Highway 18.

MWA also notes that since 1988 very few surveys have been conducted south of Highway 18, primarily because few tortoises have been found south of this apparent range boundary. The EIR Cites LePre (2004) regarding the apparent paucity of desert tortoise south of this highway.

Based on these considerations, MWA does not expect to find desert tortoise in pre-construction surveys, and does not anticipate that the proposed project will cause take of desert tortoise. Nevertheless, MWA appreciates CDFG's concern for this species and has committed in the EIR to perform pre-construction surveys prior to construction.

4. Comment: Section 5.4.1.2 -- Second paragraph. This section refers to the West Mojave Plan and proposed mitigation measures. At this time, the Department has not determined that the mitigation measures as proposed in the WMP are adequate to reduce impacts to less than significance, as required by CEQA. Neither has the department determined that the mitigation measures as proposed in the WMP meet the "fully mitigated" standard as required by the California Endangered Species Act (CESA).

Response: MWA concurs. The cited paragraph is in the Environmental Setting portion of the discussion of biological resources. The purpose of the reference was to note that the West Mojave Plan is a useful technical compendium of the available scientific data for the region. MWA therefore used these data as part of its impact analysis.

5. Comment: Section 5.4.1.2 -- Mohave Ground squirrel -- There was a Mohave ground squirrel (MGS) trapped this year just north of the aqueduct and west of Highway 395. Protocol surveys and trapping would need to be conducted for MGS.

Response: MWA became aware of this recent trapping during the public comment period. It does not alter the conclusions of the EIR in Section 5.4.7.1 and 5.4.7.2, which note that the species is rare in this portion of its range but that protocol surveys will be conducted prior to construction and results reported to CDFG and USFWS.

6. Comment: Section 5.4.1.3 -- Mojave fringe-toed lizard should be added to this section.

Response: See response numbered "2" above.

7. Comment: Section 5.4.5.2 -- Oro Grande Recharge Basin -- See also Comment 5 above regarding likelihood of MGS being present.

Response: As noted in the EIR Section 5.4.2.2, during drought, MGS are known to suffer local extinctions and recolonization is a feature of their life history. The proposed Oro Grande Wash recharge sites are isolated by major highways, development, and the California Aqueduct. Recolonization is unlikely, given the rarity of the MGS south of Highway 18. MWA does not anticipate MGS at this site, but notes that pre-construction surveys will be conducted.

8. Comment: Section 5.4.5.2 --page 53 --Top of Page -- See comment 3 above [Comment 4 in this list].

Response: MWA concurs. See response to comment 4.

9. Comment: Section 5.4.7.2. Second paragraph. If desert tortoise or MGS are impacted, the project will need an Incidental Take Permit from the Department.

Response: If listed threatened or endangered species are found in pre-construction surveys, MWA will report this to CDFG (and USFWS) and (a) either provide for avoidance of take or (b) initiate necessary processes to obtain an Incidental Take Permit.

10. Comment: No mitigation has been offered for impacts to burrowing owl. Burrowing owls, their nests and eggs are protected under Fish and Game Code Section 3503.5. Since they are also considered a State Species of Special Concern, with declining population levels and a diminishing range within California, impacts to their foraging, nesting, and brood-rearing habitat must also be disclosed and mitigated pursuant to CEQA. The following mitigation measures should be incorporated into the DEIR.

1.) As compensation for the direct loss of burrowing owl nesting and foraging habitat, the project proponent should mitigate by acquiring and permanently protecting known burrowing owl nesting and foraging habitat at the following ratio:

> ***a) Replacement of occupied habitat with occupied habitat at 1.5 times 6.5 acres per pair or single bird;***
>
> ***b) Replacement of occupied habitat with habitat contiguous with occupied habitat at 2 times 6.5 acres per pair or single bird; and/or***
>
> ***c) Replacement of occupied habitat with suitable unoccupied habitat at 3 times 6.5 acres per pair or single bird.***

2) The project proponent should establish a non-wasting endowment account for the long-term management of the preservation site for burrowing owls. The site shall be managed for the benefit of burrowing owls. The preservation site, site management, and endowment shall be approved by the Department.

3) All owls associated with active burrows, that will be directly impacted (temporarily or permanently) by the project, should be relocated and the following measures shall be implemented to avoid take of owls:

> ***a) Occupied burrows shall not be disturbed during the nesting season of February 1 through August 31, unless a qualified biologist can verify through non-invasive***

methods that either the owls have not begun egg laying and incubation or that juveniles from occupied burrows are foraging independently and are capable of independent flight.

b) Owls must be passively relocated by a qualified biologist from any occupied burrows that will be impacted by project activities. Passive relocation is used to exclude owls from their burrows by installing one-way doors in burrow entrances. These one-way doors allow the owl to exit the burrow, but not enter it. Suitable habitat must be available adjacent to or near the disturbance site or artificial burrows will need to be provided nearby. Once the biologist has confirmed that the owls have left the burrow, burrows should be excavated using hand tools and refilled to prevent reoccupation.

Response: MWA is aware of the protection for burrowing owls as provided in Fish and Game Code section 3503.5. ("It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto.")

MWA was also aware that the mitigation guidelines cited in CDFG's comment were being prepared by University of California at Santa Cruz (Santa Cruz Predatory Bird Research Group at www2.ucsc.edu/scpbrg/owls.htm). MWA was, however, unaware that these guidelines had been formally adopted by CDFG and could not locate explicit reference to them on CDFG's web site.

MWA will conduct pre-construction surveys for burrowing owls to determine if there are occupied habitats for the species. If burrowing owls are found in the potential area of effect, MWA would consult with Ms. Rebecca Jones, CDFG Environmental Scientist (as directed by Comment 12, below). In consultation with Ms. Jones, MWA may then choose to take action to avoid impacts to burrowing owls (such as constructing outside of the nesting season and/or establishing a buffer zone between construction activity and any active nest). Recharge basins have not proved incompatible with burrowing owls (there is occupied burrowing owl habitat adjacent to recharge areas at Kern Water Bank, for example). If, in consultation with Ms. Jones, MWA finds that the impacts of its facilities would be inconsistent with the protections provided under Fish and Game Code Section 3503.5, MWA would consider feasible avoidance, minimization, and mitigation, including the above protocol, and would implement the appropriate actions.

11. Comment: In addition, a Streambed Alteration Agreement may be necessary for some of the activities proposed. The Department must be contacted to determine if a Streambed Alteration Agreement will be needed.

Response: MWA concurs and noted in the EIR that a Streambed Alteration Permit could be required.

**12.	Comment: Thank you for this opportunity to comment. Questions regarding this letter and further coordination on these issues should be directed to Ms. Rebecca Jones, Environmental Scientist, (661) 285-5867.**

Response: MWA appreciates CDFG's comments and looks forward to working with Ms. Jones to ensure project compliance with the California Fish and Game Code.

9. Mr. Greg Cash
Engineering Geologist
South Basin Regulatory Unit
California Regional Water Quality Control Board, Lahontan Region
14440 Civic Drive, Suite 200
Victorville, CA 92392
Written comment by letter dated December 9, 2005

1. Comment: The Draft EIR provided information regarding the existing arsenic levels in groundwater, and indicated that MWA will also designate areas of "lower" arsenic soil concentrations versus "higher" arsenic concentrations, in delineating where recharge will be proposed. The Draft EIR needs to address how the delineation of the soil types (with lower and higher arsenic concentrations) in the recharge areas will be investigated. The Draft EIR will need to include mitigation monitoring pursuant to Public Resources Code Section 21081.6 and California Code of Regulations, Title 14, Section 15097.

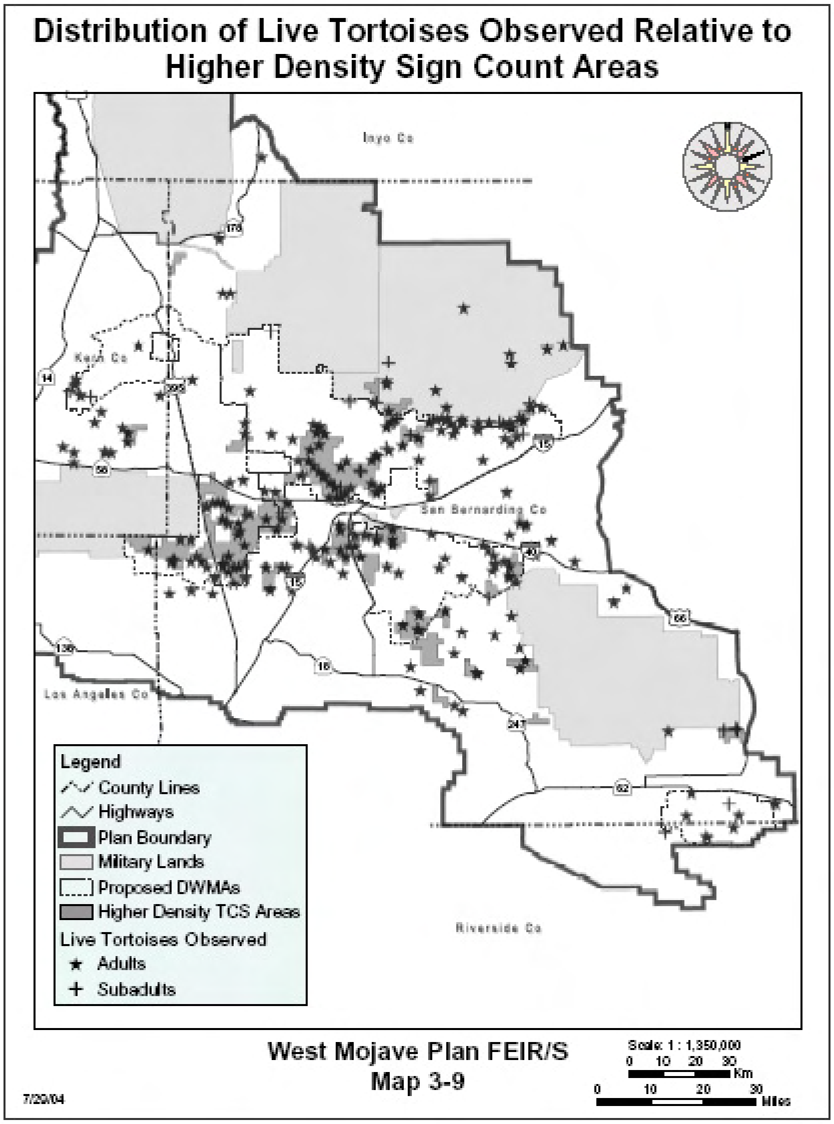
Response: Based on preliminary geotechnical analyses, MWA selected a number of potential recharge basin sites, focusing on areas with characteristics likely to avoid areas with high arsenic concentrations in subsurface soils. These evaluations included analysis of groundwater data from wells in the vicinity of the proposed recharge sites, including evaluations as part of MWA pilot projects at Oro Grande Wash. MWA will confirm these analyses during pre-design and construction geotechnical analyses, when corings at potential well sites will be made and cores examined to ensure that subsurface soil conditions do not result in recharge to areas with high potential arsenic concentrations. If corings identify high arsenic concentrations in soils, then MWA may evaluate and select recharge sites in adjacent areas.

2. Comment: During periods of natural flooding in the Mojave River, there may be potential for groundwater and surface water to come in contact with each other. The DEIR indicates that MWA will adjust the recharge levels adjacent to the Mojave River to keep the groundwater at a depth of 20 feet or lower than the ground surface, to keep groundwater and surface water from contacting each other. There is no mention in the Draft EIR on how this will be accomplished or how the recharge/injection system will be adjusted to prevent commingling. There is no mention of installing piezometers, monitoring wells or other devices that will be utilized to determine this 20-ft separation, or where they will be placed. The Draft EIR needs to address this issue as to how commingling of groundwater and surface water will be prevented. If installing monitoring devices is a proposed mitigation measure, then the Draft EIR clearly needs to propose such monitoring, which is required pursuant to Public Resources Code Section 21081.6 and California Code of Regulations, Title 14, Section 15097.

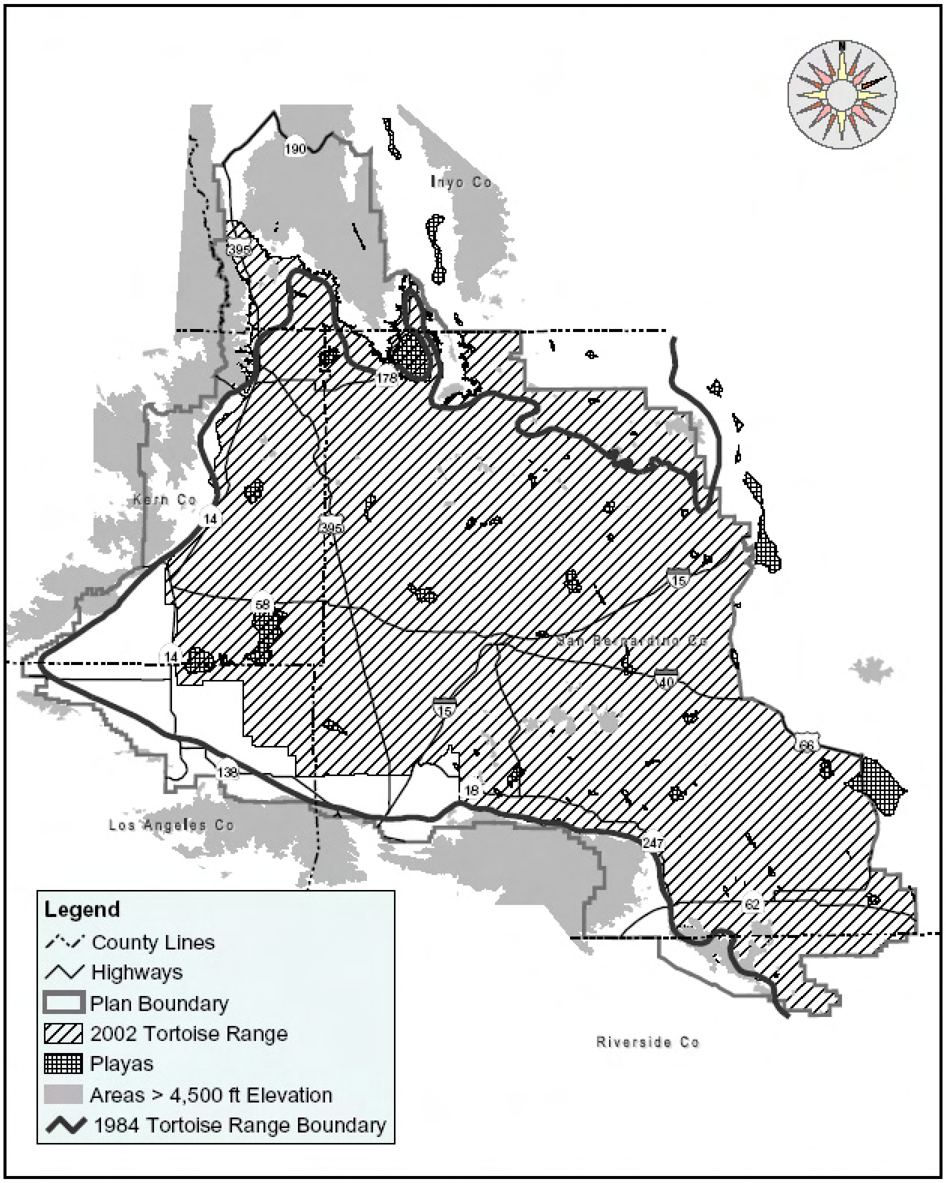
Response: The Project Description notes that MWA would not recharge in the Mainstem Mojave River during periods of significant natural flow. Thus the proposed project would not affect natural flows directly.

The DEIR, Section 5.14.5 notes how MWA would respond to rising groundwater levels during recharge by "diverting some banked supplies to other recharge facilities." To clarify, MWA will have numerous existing and new off-channel recharge facilities which will receive water for banking. If monitoring of groundwater recharge operations in the mainstem channel detects groundwater rising to within 20 feet of the channel surface prior to the wet season, then MWA will divert flow to these other facilities. DEIR Section 5.6.4.2 also describes this monitoring and mitigation.

Finally, MWA notes that there are already numerous monitoring and production wells along the Mojave River in the proposed project area. These wells are routinely monitored by local producers. New wells associated with the proposed Mojave River Well Field would deliver raw water to local producers, who would cooperate with MWA in monitoring water quality parameters. In all, the proposed project, if fully implemented, would result in a system of over 30 existing and new wells, monitoring of which will provide a coherent view of the effects of the proposed project on groundwater. MWA also notes that there are existing assessment and monitoring protocols for wells that may come under the influence of surface waters, described in detail in the Department of Health Services (DHS) "*Drinking Water Source Assessment for Surface Water Sources*" August 18, 2000. As described in this DHS publication, there are a number of different protocols for assessing whether a well is under surface water influence. DHS may request various assessment techniques, depending on their judgment of the potential for a well to be under surface water influence. These protocols, or any updated DHS protocols, will be implemented, as appropriate, in consultation with local producers, the County of San Bernardino, and DHS.


Distribution of Live Tortoises Observed Relative to
Higher Density Sign Count Areas
Inyo Co
Kern Co
San Bernardino Co
Los Angeles Co
Riverside Co
Legend
County Lines
Highways
Plan Boundary
Military Lands
Proposed DWMAs
Higher Density TCS Areas
Live Tortoises Observed
Adults
Subadults
West Mojave Plan FEIR/S
Map 3-9
Scale 1 : 1,350,000
0 10 20 30 Km
0 10 20 30 Miles
7/29/04

2002 Tortoise Range Map



West Mojave Plan FEIR/S
Map 3-10

Scale: 1 : 1,750,000
0 10 20 30 Km
0 10 20 30 Miles

7/29/04

10. Department of Water Resources, State Water Project Analysis Office (SWPAO), Ms. Elizabeth Patterson. By email, Monday, 24 October 2005

The following comments apply to an administrative draft provided to DWR's SWPAO. Pagination may differ slightly from that in the DEIR.

General Comment A: My overall impression is that the admin. draft EIR is thorough, and presents information of sufficient detail to address potential impacts. The document is well written and provides a wealth of documentation for the reader.

Response: We appreciate DWR's response to our efforts and the specific comments received (below), especially DWR's noting opportunities for us to clarify the Draft EIR.

General Comment B: The most important point to make to MWA is the need for a discussion of the operation of the SWP and its maintenance. There is good information about water quality although there could be a more detailed discussion of the effect of the banked water introduction into the California Aqueduct. [The water quality discussion is very informative and demonstrates the benefits of SWP water for arsenic currently in the groundwater.] This must be discussed and there will be comments on the draft EIR by Operations. For instance, there should be a discussion of the approval necessary from DWR/SWPAO regarding scheduling of water process.

Response: The DEIR notes that a variety of permits may be required from DWR, but we are pleased to provide more detail to clarify these permits. First, the banking and exchange elements of the proposed project may require a point of delivery agreement from DWR or may be managed through DWR water delivery scheduling procedures. At times, Metropolitan will request that DWR deliver its Table A or other supplies to MWA; at other times MWA will request that its supplies be delivered to Metropolitan. DWR will review these requests to ensure that they are consistent with the proposed project and the MWA/MWD water supply contracts with DWR.

Second, if MWA decides to deliver supplies via the Unnamed Wash, MWA will request permission to construct a new turnout and/or modify an existing turnout from the California Aqueduct to accomplish this task.

Third, to the extent that MWA makes returns to Metropolitan using supplies pumped from groundwater, it will need to ensure that these supplies meet any DWR requirements for introduction to the California Aqueduct. The data to address the potential for introduction of groundwater is generally provided in the DEIR, but we appreciate DWR's suggestion that we clarify this issue. As the DEIR notes in Chapters 3 and 4, the project could involve pump-back to the California Aqueduct from the Mojave River Aquifer upstream of the Mojave Narrows and from wells sited adjacent to potential groundwater recharge facilities. Proposed operations at these sites would generally involve import and recharge of SWP supplies and MWA would seek to optimize the water quality of the supplies delivered through scheduling. Given that wells would be located within about 0.5 miles of the river and within about 0.25 miles from the inland groundwater recharge basins, a vast majority of the supply returned to the California Aqueduct for delivery to Metropolitan via direct pump back would be a mix of SWP supply and indigenous groundwater with some potential for leaching of minerals during recharge.

Deliveries to the California Aqueduct would, however, probably be dominated by exchange, and groundwater pumped back would be monitored and managed to ensure that resulting water quality in the Aqueduct was not degraded. The mix of SWP water and indigenous water in the Mojave River Aquifer (see Table 5-41 of the DEIR) would enhance water quality when compared to that in the Aqueduct for some constituents. For other constituents, there would be potential lowering of water quality. A 50-50 mix of SWP and indigenous groundwater from this aquifer would routinely result in a blend that meets DHS drinking water standards for mineral constituents because the water quality of both sources is good.

Pump-back of a mix of SWP water and indigenous groundwater from the Alto and Oeste portions of the Regional Aquifer (Table 5-41 of the DEIR) would be of marginally poorer quality, given general levels of some mineral constituents in this aquifer, including arsenic. However, recharge basins have been sited to avoid soil types that contain high levels of arsenic, and indigenous groundwater quality in these areas would be less affected by arsenic as a result. It is thus likely that a mix of SWP water and indigenous groundwater at these recharge sites would result in a blend that would meet DHS drinking water standards for mineral constituents.

The water quality criteria for acceptance of non-project water into the State Water Project are discussed in the *Interim Department of Water Resources Water Quality Criteria for Acceptance of Non-Project Water Into the State Water Project* (dated March 1, 2001) and *Implementation Procedures for the Review of Water Quality from Non-Project Water Introduced into the State Water Project* (dated March 14, 2001). Under these criteria, the quality of the non-SWP water is compared to the ambient water quality of SWP water for the period 1988 through 2004. The criteria reflect that the ambient quality can vary by season and by year-type. If the water is accepted, then monitoring is required to confirm that the water continues to meet the requirements.

DWR has used a two-tier approach for accepting non-project water into the California Aqueduct. Tier 1 programs have a “no adverse impact” criteria and are tied to historical water quality levels in the California Aqueduct. Programs meeting the Tier 1 criteria would likely be approved by DWR. Tier 2 programs would have water quality levels that exceed the historical water quality levels in the California Aqueduct for at least one or more constituents, and so could cause adverse impacts to state water contractors. Tier 2 programs would be referred to a state water contractor facilitation group, which would review the program and make recommendations for DWR’s consideration of the project. Under Tier 1, all constituents of non-project water should be within the historical water quality levels measured at the O’Neill Forebay Outlet (formerly measured at Check 13) on the SWP as measured by DWR’s water quality monitoring program.

The DEIR analysis was based on aggregate groundwater quality data from a number of local wells in the Mojave River Floodplain Aquifer and the adjacent Alto Regional Aquifer. The DEIR notes that data from wells located adjacent to groundwater recharge basins is likely to be of better quality, primarily because the proposed recharge sites have been sited to avoid areas with known soils/mineral problems. To clarify this point, MWA has identified a number of wells in the vicinity of the proposed project facilities and has evaluated recent (2004 and 2005) water quality data for these wells. The results of this evaluation are discussed below, with an explicit comparison between current DWR water quality criteria and Department of Health Services drinking water standards. See Tables A through G, attached, for details.

Indigenous groundwater quality compared to DWR criteria and DHS drinking water standards.

a. Oeste Recharge Basins

Data on indigenous water quality from two wells located about 1 mile downgradient from the proposed Oeste recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). Only one data point (a maximum value for manganese at well number 05N07W28L01) was in excess of DHS drinking water criteria. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 1. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies. These data are the only representative data currently available nearby. Development of any recharge locations would necessarily entail addition geohydrologic site investigations, including site-specific water quality analysis.

Table 1.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	1	100
Antimony (ug/l)	3	1	5	**6**	**6**
Arsenic (ug/l)	2	1	4	2	2
Barium (ug/l)	50	37	68	**40**	**100**
Beryllium (ug/l)	1	1	1	1	1
Bromide (ug/l)	NA	NA	NA	NA	NA
Cadmium (ug/l)	4	1	5	1	1
Chromium (ug/l)	5	1	11	**10**	**15**
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	**0.17**	0.32
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	**180***
Mercury (ug/l)	0.8	0.2	1	**1**	1
Nickel (ug/l)	1	1	4	**10**	**10**
Nitrate (mg/l)	3.5	0.6	9.6	1	7.9
Selenium (ug/l)	1	1	2	**5**	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	1.9	**184**
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

* Exceeds DHS MCL

b. Alto Recharge Basins

Data on indigenous water quality from one well located to the west and downgradient about a mile from the proposed Alto recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were exceeded in one sample for arsenic. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 2. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 2.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	2	**14***
Barium (ug/l)	50	37	68	0	100
Bromide (ug/l)	NA	NA	NA	NA	NA
Beryllium (ug/l)	1	1	1	0	1
Cadmium (ug/l)	4	1	5	0	1
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	**0.38**	**0.8**
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	0.95	3.9
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	31	87.4
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

* Exceeds DHS MCL

c. Oro Grande Recharge Basins

Data on indigenous water quality from four wells located in the general vicinity of the proposed Oro Grande Recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). Wells were located upstream (H01), downstream (M01 and E08) and in a developed area to the east (13J01). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 3. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies, although bromides were evaluated at several of the Oro Grande wells.

Table 3.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	60
Antimony (ug/l)	3	1	5	ND	0
Arsenic (ug/l)	2	1	4	1.6	**5.7**
Barium (ug/l)	50	37	68	0	8.4
Beryllium (ug/l)	1	1	1	ND	0
Bromide (ug/l)	0.21	0.05	0.54	0.16	0.5
Cadmium (ug/l)	4	1	5	ND	0
Chromium (ug/l)	5	1	11	0	**42.9**
Copper (ug/l)	5	2	28	ND	0
Fluoride (mg/l)	0.11	0.01	0.55	0.2	**27**
Iron (ug/l)	47	5	416	0	127
Manganese (ug/l)	10	3	60	0	**161**
Mercury (ug/l)	0.8	0.2	1	0	0
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	0.02	0.52
Selenium (ug/l)	1	1	2	ND	0
Silver (ug/l)	4	1	5	0	0
Sulfate (mg/l)	43	17	99	3	34
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	ND	0

d. Cedar Avenue Detention Basin

Data on indigenous water quality from a well located about 1.5 miles downslope and to the west of the proposed Cedar Avenue Recharge basin were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 4. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 4.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	0	**10**
Barium (ug/l)	50	37	68	0	**100**
Beryllium (ug/l)	1	1	1	0	**1.8**
Bromide (ug/l)	0.21	0.05	0.54	0	0
Cadmium (ug/l)	4	1	5	0	1.75
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	0.08	0.4
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	0.5	3.2
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	1.8	10.8
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**70**

e. Antelope Wash recharge Basins

Data on indigenous water quality from a well located about a mile downgradient and to the west of the proposed Antelope Wash recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	0
Antimony (ug/l)	3	1	5	0	0
Arsenic (ug/l)	2	1	4	0	0
Barium (ug/l)	50	37	68	0	0
Beryllium (ug/l)	1	1	1	0	0
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	0
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	0
Fluoride (mg/l)	0.11	0.01	0.55	0.1	0.2
Iron (ug/l)	47	5	416	0	0
Manganese (ug/l)	10	3	60	0	0
Mercury (ug/l)	0.8	0.2	1	0	0
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	4	6
Selenium (ug/l)	1	1	2	0	0
Silver (ug/l)	4	1	5	0	0
Sulfate (mg/l)	43	17	99	3.7	3.9
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	0

f. Green Tree Recharge Basin

Data on indigenous water quality from a well located within the site of the proposed Green Tree recharge basin were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 6. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 6.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	50
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	0	**8**
Barium (ug/l)	50	37	68	0	**100**
Beryllium (ug/l)	1	1	1	0	1
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	1
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	0.1	0.12
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	2.1	2.7
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	6.7	8.7
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

g. Mojave River Well Field

Data on indigenous water quality from 3 wells located near the proposed Mojave River Well Field were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 7. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 7.

CONSTITUENT	SWP WQ 1988-2004 (GUIDELINES)			INDIGENOUS WATER QUALITY	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	0
Arsenic (ug/l)	2	1	4	0	**10***
Barium (ug/l)	50	37	68	0	**500***
Beryllium (ug/l)	1	1	1	0	0
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	5
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50***
Fluoride (mg/l)	0.11	0.01	0.55	**0.23***	0.4
Iron (ug/l)	47	5	416	0	110
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	0.7	9.33
Selenium (ug/l)	1	1	2	0	**5***
Silver (ug/l)	4	1	5	0	**10***
Sulfate (mg/l)	43	17	99	3	16.1
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50***

* Values from Well 04N04W24G01, south and a mile inland from the river channel.

<u>Discussion.</u>

The summary data on Tables 1-7 are detailed on Tables A through G (attached). The data on the detailed tables suggest (a) there is substantive variation in indigenous groundwater quality from well site to well site. For example, all of the values in excess of current DWR pump-back criteria shown on Table 7 (Mojave River Well Field) are from a well a mile inland from the Mainstem River and at the southern boundary of the probable well field. These data are probably not representative of the water quality likely from the Mojave River Well Field; based on the data from the two wells closer to the river and further downstream, water in the Mojave River Well Field is of consistently better quality (See Table G attached).

The data also show that indigenous groundwater quality in the vicinity of the major washes (Oro Grande and Antelope Wash) is of better quality, probably reflecting the influence of natural recharge of good quality runoff from the mountains through a sandy substrate.

The data also show that, with only three exceptions, the indigenous water quality in existing wells near the proposed recharge basins is equal to or better than Department of Health Services drinking water criteria. In addition, indigenous water quality is equal to or better than DWR historic water quality at O'Neal Forebay (1988-2004) from many constituents. This is particularly true for the Mojave River Well Field and Antelope Wash. It is also notable (see Tables A through G, attached) that indigenous water quality in the Floodplain and Alto Regional aquifers has consistently low levels of hydrocarbon constituents such as petroleum products and pesticides and herbicides.

In general, these data are consistent with the more generalized findings in the DEIR. They suggest that indigenous groundwater at the proposed sites is of generally better quality than the SWP pump-back guidelines for aluminum, cadmium, iron, manganese, mercury, nitrate, and sulfate and may generally exceed pump-back guidelines for antimony, barium, copper, fluoride, nickel, selenium, silver, and zinc. The well data suggest that maximum concentrations of mineral constituents are the primary issue related to pump-back operations.

These data suggest that pump-back of water from the Antelope Wash and Mojave River Well Field would meet or exceed pump-back guidelines. Water from these sources may be blended with water from other recharge areas to bring overall pump-back into compliance with current pump back guidelines. It should also be noted that wells would be sited to intercept recharged groundwater and that much of the water pumped back to the California Aqueduct would be a mix of indigenous groundwater and banked SWP supplies. It is likely that mixing of SWP and indigenous water supplies would result in a lower potential for maximum levels of various constituents to be in excess of current pump-back guidelines.

As noted in the Project Description, MWA would site wells to optimize water supply and quality and would routinely monitor groundwater quality. Where stored supplies may be used for pump-back of supplies to the California Aqueduct, this monitoring would include monitoring for all relevant constituents identified by DWR as water quality criteria for acceptance of Non-Project Water Into the State Water Project. Based on this monitoring, MWA believes that it could operate to supply a blend of supply to the California Aqueduct that would meet current and future DWR pump back criteria or guidelines.

Comment 1. I suggest that you use the CEQA process for incorporated referenced documents. See CEQA guidelines. This is particularly true when referencing the PEIR for Mojave Water Management.

Response: The DEIR is intended to stand on its own, and we have thus not routinely incorporated referenced documents. We have cited references in the same manner that such references are cited in scientific reports to explain the source and basis for data and analysis. We have not incorporated references as a whole because (a) there is irrelevant data in many of the references and incorporation of these data would be potentially confusing and (b) we do not necessarily concur with all aspects of the cited references. For example, we slightly modified the PEIR methods for evaluation of Air Quality impacts, using a different mix of construction equipment and making reference to additional approaches to estimating air quality effects. Thus, incorporating referenced documents, even the PEIR, would result in minor inconsistencies.

Comment 2: CEQA requires an executive summary.

Response: The early administrative draft you received did not include the executive summary, but this has been provided in the Draft EIR submitted to the State Clearinghouse on October 28, 2005.

Comment 3: At page 1-1, first paragraph, it should explain why only 7 of the local agencies have done UWMP (3,000 hookup threshold is the most common reason why not. In the case of no UMP, then some discussion of rural, ag. Water Efficiency Plan (one time plan) should be discussed.

Response: Only 8 local agencies within MWA's service area have prepared UWMP's and the reason is that only 8 have more than 3000 hookups.

MWA's Regional Water Management Plan discusses agricultural Water Efficiency Plans and their operations are reflected in the water supply projections discussed in Chapter 2. The data on Table 2-2 incorporate two agricultural water use scenarios, including a scenario reflecting increased agricultural water conservation. The specifics of these plans were not discussed in the DEIR because they are functionally irrelevant to the operation of the Proposed Project.

Comment 4: Same page, water reliability should not be done on an annual basis but rather on a water year basis.

Response: MWA is probably unique in its approach to water supply reliability because virtually all water delivered to producers in MWA's service area is stored groundwater. MWA delivers only about 5,000 acre-feet of surface supply per year. In addition, MWA maintains groundwater supplies in excess of average annual demand. In normal-to-wet years, MWA may therefore import and recharge water, some of which may be used in the year of delivery and some of which will not be used until a dry year deficit occurs. As a result, considerations of water year versus calendar year and considerations of water year type are less important in MWA's operations than in the operations of most State Water Project contractors. However, MWA average native water supply determinations are made on a water year basis and are compiled in their RWMP and reported that way to the Court in the Mojave Basin Area.

Comment 5: Page 2-3, paragraph 3. Last line is missing words.

Response: We apologize for this typographical error. The last eight words in the sentence should be deleted and the sentence should read: "Carryover supplies may be acquired by transfer or exchange." The Final EIR has been so revised.

Comment 6: Page 2-7, first paragraph. There should be a discussion of "hardening" of water demand. I think that is what is meant by balance. This makes it very hard to find water during critically dry years, especially if that water is committed to urban uses. The water management needs should include a buffer for this.

Response: MWA's approach to water supply management is different from most users because almost all water used in the service area is groundwater and MWA recharges all but about 5,000 acre-feet of all supplies available to it. Thus, MWA seeks a long-term "balance" of total supply and that is what the analysis in Chapter 2 seeks to describe. Any water delivered in excess of MWA's obligations thus necessarily is stored for future uses, providing the buffer that DWR refers to in this comment. The potential effects of this buffer are described in pages 5-146 and 147, where we note that the primary effect of increasing storage is to extend the period during which MWA will be able to meet its obligations to local producers. See also DEIR Table 5-43. See also response to Comment 4.

Comment 7: Same page. Under costs, there is a reference to acre-foot costs and a discussion of different permutations. Please continue to express things in cost/acre-foot so the reader can understand the point of the comparison. Also, I don't quite get the discussion on the costs and you may want to expand that so the "average" reader understands the process.

Response: We shifted from a discussion of costs per acre-foot to gross costs in millions of dollars so that the average reader, who may not understand the concept of acre-feet of water and its application to average use per capita or per family, could understand the magnitude of the costs associated with the import of supplies.

Comment 8: Page 2-8, first paragraph. I suggest you quantify this discussion. Choose three water years, including 2005 and compare what this means for management purposes.

Response: We did not quantify this discussion over a period of years because the conflict between in-river natural flow and in-river recharge has not been documented. To clarify the intent of this paragraph, we would note that, as described later, no artificial recharge would occur during periods of substantial natural flow in the Mojave River. The implication of this problem, discussed in later sections related to the benefits and impacts of the proposed project, is that off-channel recharge facilities are needed to accommodate SWP deliveries in years when there is substantial flow in the Mojave River.

Comment 9: At page 2-10, maybe the document could nuance the "full use of Table A" as not for consumption, but for water management which would include the aforementioned buffer in case of critically dry years (5 to 7 years for planning purposes).

Response: Chapter 2 was intended to define needs, and MWA therefore deferred the discussion of the proposed project to provide a buffer against dry years for the impacts analysis. However, we take this opportunity to thank DWR for this clarifying suggestion and we note that full use of MWA's Table A and other available supplies would significantly enhance MWA's ability to manage water supplies now and in the future, including planning for supply during periods of drought.

Comment 10. I don't get a good picture of this environmental setting. It is introduced in a physically built environment rather than the ecological niche or niches it represents. I think the reader will want to understand how the ecology of the area works. The words seem to be in various paragraphs, but I think an introductory paragraph of the "way it was ecologically" would help see how things are connected and what the functions are.

Response: As you note in a later comment, the base case for the environmental setting is the existing condition, but we appreciate your suggestion that we provide a clarifying summary of the historical ecological context, as follows:

"The MWA service area incorporates much of the south-central Mojave Desert, an area of low precipitation and long periods of high temperature and low humidity. The basin consists of a series of valleys formed as a result of uplift, volcanic activity, and seismic activity along the San Andreas Fault and related earthquakes. These valleys tend to be hydrologically and hydrogeologically isolated. Most of the water available to people and wildlife is derived from runoff from the mountains to the west and south, and the various basins are crossed by desert washes that lead to dry lake beds. Runoff percolates rapidly into groundwater when it reaches the valley floor and runoff reaching dry lakes accumulates and then dries out rapidly. Surface water quality tends to deteriorate with distance from the mountains. Along the Mojave River, water flows under the channel and is forced to the surface at several sites where seismic activity has created blocks to sub-surface flow.

Wildlife in the Mojave Basin show various typical adaptations to an environment characterized by seasonally extreme hot and dry conditions and periodically more severe and extended drought. For plants, these adaptations include deep roots, waxy/oily leaves, creation of plant/soil "crusts" that reduce erosion of the very thin topsoils, and loss of leaves during drought conditions. Animal adaptations include burrowing, estivation or hibernation during dry periods, special physiological adaptations to drought, and/or the ability to recolonize marginal habitat where localized extinctions may occur during extreme droughts. These adaptations make desert ecosystems relatively sensitive to human disturbance, particularly disturbance that affects soil integrity and fragments habitat."

Comment 11: At page 5-37. I suggest that the EIR incorporate by reference the West Mojave Plan.

Response: The West Mojave Plan includes a compendium of the available scientific data useful for overall planning in the Mojave Basin. We have referenced some of that data and some of the conclusions and recommendations of the scientists who helped prepare it. However, the West Mojave Plan has not been adopted and is considered by man to be a "work in progress." In their comment letter, CDFG noted that they were not yet willing to accept elements of the West Mojave Plan as binding on CDFG. Given CDFG's hesitance to accept elements of the West Mojave Plan, we do not think it is appropriate to incorporate the plan into the EIR by reference, as it may change. We would not want our EIR to effectively codify elements of the West Mojave Plan that may change in the future (which would then require the Lead Agencies for the West Mojave Plan to address discrepancies between their plan and the EIR).

Comment 12: At page 5-44, second full paragraph, add the water amounts released during the pilot project.

Response: The 2003-2005 Pilot Project is on-going, and thus we did not provide total amounts released. The material point of the discussion was also that releases of up to 400-500 cfs did not affect Arroyo Toad estivation habitat and thus could be continued during operation of the proposed project. Based on data to date, 2003 deliveries to MWA were 24,874 acre-feet and in 2005 were approximately 20,000 acre-feet.

Comment 13: At page 5-64, regarding endowed management, there are non governmental agencies who do this, such as the Center for Natural Lands Management. The DEIR may want to provide some choices.

Response: MWA will consider non-governmental agencies as potential mitigation managers. We avoided mentioning potential management partners in order to avoid the appearance of favoritism. Selection of an agency to assist in mitigation will require decisions based on both qualifications and cost, and this public funding process should not give the appearance of prejudgment.

Comment 14: At page 5-152, first text paragraph, 3rd line typo "gown" should be "down."

Response: Correct. We apologize for the typographical error.

Comment 15: At page 5-155, paragraph 5.13.6. replace "seawater intrusion" with "tidally influenced water." By the time it gets there, it is brackish, not sea water.

Response: We completely agree that the water is brackish by the time it reaches the Delta; we used "seawater intrusion" because we thought that this term would be better understood by the average reader, as it is the term we have often seen used in media reports. DWR is correct that the water has salt levels much lower than those of pure seawater.

Comment 16: RE: Population, housing and growth. What would improve this intelligently presented section is a reference to the California Water Plan and its 25 strategies for water supply. See page 5-169, where it is stated, ". . . MWA does not have authority to implement mitigation actions for these effects." There needs to be connection of the dots of watershed planning, land use, and water supply. Basically, the goal is to have a watershed level of understanding of the "carrying capacity" of a region. The draft correctly points out that in Southern California, development occurs regardless of the water supply with the notable exception of Owens Valley. The water supplier should help bridge the gap between the use planners and water use (supply). For indirect effects, MWA has opportunities to identify the mitigation measures that the land use jurisdiction should implement to avoid or reduce the impacts associated with land use dependent on future imported water supplies. The essential point here is that the pattern of land use will affect the amount of water needs. By using more compact urban site planning, the impacts to the resources listed at the top of page 5-169 could be less affected (the watershed management concept benefits all of these plus commercial building).

Response: MWA entirely agrees with DWR regarding the need to connect the dots in water management planning. This was accomplished in the recently adopted MWA Regional Water Management Plan. To clarify, we would add the following discussion to the "Environmental Setting."

"In the Regional Water Management Plan adopted by MWA's Board of Directors in early 2005, MWA describes its legally-mandated role in regional planning and its coordination with local and regional governments to address issues related to water supply and growth. As noted in Chapter 1 of the DEIR (Introduction), MWA's mandate is to provide supplemental supplies for use by local producers throughout the Agency. Further the Mojave Basin Area Judgment imposes restrictions on local groundwater production and requirements that local producers purchase supplemental supplies when these restrictions are exceeded. Given the cost of imported supplemental supplies (see Chapter 2), this requirement constitutes a substantial economic incentive to conserve and to manage growth and water supply intelligently.

As the agency designated to provide supplemental supply, MWA is working with local governments, water purveyors, educational institutions, and local community groups to address water conservation. For example, MWA has on-going cooperative programs to promote urban and agricultural water conservation, providing funds to the local RCD. MWA also lends assistance to, and participates in, local programs to enhance water supply through source protection and blending, to eradicate non-native plants that adversely affect supply and native riparian areas, and to monitor groundwater supply and water quality. MWA provides educational materials and economic incentives for water conservation programs.

These activities are described in detail in the Regional Water Management Plan and have been incorporated into the supply/demand projections in the Regional Water Management Plan that are referenced in the DEIR."

MWA did not specifically reference the California Water Plan because the plan has not been formally approved. We note that the Regional Water Management Plan addresses many of the strategies for water supply and that the proposed project would be consistent with strategies in the Draft California Water Plan related to Recharge Area Protection, Conjunctive Management and Groundwater Storage, and Water Transfers.

Finally, MWA appreciates DWR's kind words regarding our effort to describe the factors that seem to drive growth in Southern California.

ATTACHMENTS (RE General Response B): Tables A-G

Table A. Comparison of recently collected water quality data from two wells in the vicinity of the proposed Oeste Recharge Basins to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Wells 05N07W28L01 (north of the Oeste west site), 05N07W24D0 3 (northeast of the Oeste east site). Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs. MCL's from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03.* Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (Bold = Official MCL or Guideline, other constituents are monitored but no official standard exists)	UNITS	MCL	SWP 1988-2004			MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES			
			Mean	Min	Max	OESTE WEST SITE		OESTE EAST SITE	
						MIN	MAX	MIN	MAX
1,1,1,2-Tetrachloroethane	ug/l							0	0
1,1,1-Trichloroethane	ug/l	200						0	0.1
1,1,2,2-Tetrachloroethane	ug/l	1						0	0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200						0	0
1,1,2-Trichloroethane	ug/l	5						0	0.1
1,1-Dichloroethane	ug/l	5						0	0.1
1,1-DICHLOROETHYLENE	ug/l	6						0	0.2
1,1-Dichloropropane	ug/l							0	0
1,1-Dichloropropene	ug/l							0	0
1,2,3-Trichlorobenzene	ug/l							0	0
1,2,3-Trichloropropane	ug/l							0	0
1,2,4-Trichlorobenzene	ug/l	5						0	0
1,2,4-Trimethylbenzene	ug/l							0	0
1,2-Dichlorobenzene	ug/l	600						0	0.4
1,2-Dichloroethane	ug/l	0.5						0	0.1
1,2-Dichloropropane	ug/l	5						0	0.1
1,3,5-Trimethylbenzene	ug/l							0	0

1,3-Dichlorobenzene	ug/l							0	0.4
1,3-Dichloropropane	ug/l							0	0
1,3-Dichloropropene (Total)	ug/l	0.5						0	0
1,4-Dichlorobenzene	ug/l	5						0	0.4
1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l							0	0
2,2-Dichloropropane	ug/l							0	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30							
2,4,5-TP (Silvex)	ug/l	50						0	0.01
2,4-D	ug/l	70						0	0.1
2-Chloroethyl vinyl ether	ug/l							0	0.5
2-Chlorotoluene	ug/l							0	0
3-HYDROXYCARBOFURAN	ug/l								
4-Chlorotoluene	ug/l							0	0
Alachlor	ug/l	2						0	1
Aldicarb	ug/l								
ALDICARB SULFONE	ug/l								
Aldicarb sulfoxide	ug/l								
Aldrin	ug/l								
Alkalinity, Total	mg/l							17	76
Aluminum	ug/l	200	30	4	527	1	1	20	100
Antimony	ug/l	6	3	1	5			**6**	**6**
Arsenic (USEPA)	ug/l	10	2	1	4			2	2
Asbestos	MFL[1]	7							
Atrazine	ug/l	1						0	1
Barium	ug/l	1000	50	37	68			**40**	**100**
Bentazon	ug/l	18						0	0
Benzene	ug/l	1						0	0.2
Benzo(a)pyrene	ug/l	0.2							
Beryllium	ug/l	4	1	1	1			1	1
Bicarbonate Alkalinity as CACO3	mg/l							70	82
bis-(2-Chloroethyl)ether	ug/l							0.4	0.4
Boron	ug/l	600				20	22	0	30
Bromacil	ug/l							0	10

Bromobenzene	ug/l							0	0
Bromochloromethane	ug/l							0	0
Bromodichloromethane	ug/l							0	6.3
Bromoform	ug/l							0	0.2
Bromomethane	ug/l							0	1.3
Butachlor	ug/l							0	0
Cadmium	ug/l	5	4	1	5			1	1
Calcium	mg/l							13	26.6
Carbaryl	ug/l							0	0
Carbofuran	ug/l	18						0	5
Carbon tetrachloride	ug/l	0.5						0	0.2
Carbonate Alkalinity as CACO3	mg/l							0	1
Chlordane	ug/l	0.1						0	0
Chloride	mg/l	250				0.9	4.67	2.9	22
Chloroethane	ug/l							0	0.6
Chloroform	ug/l							0	49.4
Chloromethane	ug/l							0	0.1
Chlorothalonil	ug/l							0	0
Chromium	ug/l	50	5	1	11			**10**	**15**
Chromium, Hexavalent	ug/l	50				25	25	2	21
cis-1,2-Dichloroethene	ug/l	6						0	0
Color	unit	15						0	3
Copper	ug/l	1000	5	2	28			0	**50**
Cyanide	ug/l	150						100	100
Dalapon	ug/l	200						0	0
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400						0	0
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4						0	0
Diazinon	ug/l							0	1
Dibromochloromethane	ug/l							0	1.6
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2						0	0.02
Dibromomethane	ug/l							0	0
Dicamba	ug/l								
Dichlorodifluoromethane	ug/l							0	2

Dichloromethane	ug/l	5						0	0.3
Dieldrin	ug/l								
Dimethoate	ug/l							0	1
Di-n-butyl phthalate	ug/l								
Dinoseb	ug/l	7						0	0
DIQUAT	ug/l	20							
DIURON	ug/l							1	1
ENDOTHALL	ug/l	100							
Endrin	ug/l	2						0	0/006
Ethylbenzene	ug/l	300						0	0.2
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05						0	0.02
ETHYL-TERT-BUTYL ETHER	ug/l							0	0
Fluoride	mg/l	2.0	0.11	0.01	0.55			**0.17**	0.32
FOAMING AGENTS (MBAS)	ug/l	500						0	0.5
GLYPHOSATE	ug/l	700						0	0
GROSS ALPHA	pC/L							0	7.7
GROSS ALPHA COUNTING ERROR	pC/L							0.56	2.7
Hardness (as CaCO3)	mg/l					200	200	33	90
Heptachlor	ug/l	0.01						0	0
Heptachlor epoxide	ug/l	0.01						0	0
Hexachlorobenzene	ug/l	1						0	0
Hexachlorobutadiene	ug/l							0	0
Hexachlorocyclopentadiene	ug/l	50						0	0
Hydroxide Alkalinity as CACO3	ug/l							0	1
Iron	ug/l	300	47	5	416	7	10	0	100
Isopropylbenzene	ug/l							0	0
Lead	ug/l	15						5	5
LINDANE	ug/l	0.2						0	0.004
m,p-Xylene (Sum of Isomers)	ug/l							0	0
Magnesium	mg/l							1.2	18
Manganese	ug/l	50	10	3	60	2.5	**180**	0	30
Mercury	ug/l	2	.8	.2	1			**1**	1
Methomyl	ug/l								

Methoxychlor	ug/l	30						0	0.1
METHYL ETHYL KETONE	ug/l							0.4	0.4
METHYL ISOBUTYL KETONE	ug/l							0.4	0.4
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5						0	5
Metolachlor	ug/l							0	0
Metribuzin	ug/l							0	0
MOLINATE	ug/l	20						0	2
MONOCHLOROBENZENE	ug/l	700						0	0.2
Naphthalene	ug/l							0	0
n-Butylbenzene	ug/l							0	0
Nickel	ug/l	100	1	1	4			**10**	**10**
Nitrate	mg/l	45	3.5	0.6	9.6			1	7.9
NITRATE + NITRITE (AS N)	mg/l	10						0.79	0.79
NITRITE (AS N)	mg/l	1						0	0.59
Nitrogen, Nitrate (as N)	ug/l							0.1	2.8
ODOR THRESHOLD @ 60 C	Ton	3						0	1
Oxamyl	ug/l	50						0	0
o-Xylene	ug/l							0	0
Pentachlorophenol	ug/l	1						0	0
Perchlorate	ug/l	6						0	5
Picloram	ug/l	500						0	0
P-ISOPROPYLTOLUENE	ug/l							0	0
POLYCHLORINATED BIPHENYLS (TOTAL PCB'S)	ug/l	0.5						0	0
Potassium	mg/l							3	6.6
PROMETRYN	ug/l							0	1
Propachlor	ug/l								
sec-Butylbenzene	ug/l							0	0
Selenium	ug/l	50	1	1	2			**5**	**5**
Silver	ug/l	100	4	1	5			0	**10**
Simazine	ug/l	4						0	1
Sodium	mg/l							53	83
SOURCE TEMPERATURE C	C							20	31.5

Specific Conductance	us	900				37	546	67	560
Styrene	ug/l	100						0	0
Sulfate	mg/l	250	43	17	99	1.9	**133**	2	**184**
tert-Amyl methyl ether	ug/l							0	0
tert-Butyl alcohol	ug/l							0	0
tert-Butylbenzene	ug/l							0	0
Tetrachloroethene	ug/l	5						0	0.1
Thallium	ug/l	2						1	1
THIOBENCARB	ug/l	1						0	0.8
Toluene	ug/l	150						0	0.2
Total Dissolved Solids	mg/l	500				344	350	310	370
Total Trihalomethanes	ug/l	100						0	57.3
Toxaphene	ug/l	3						0	0.24
trans-1,2-Dichloroethene	ug/l	10						0	0.1
Trichloroethene	ug/l							0	0.2
Trichloroethylene	ug/l	5							
Trichlorofluoromethane	ug/l	150						0	0.2
Turbidity	NTU	5						0.23	0.4
Vanadium	ug/l							24	27
Vinyl chloride	ug/l	0.5						0	0.2
Xylenes	ug/l	1750						0	0.4
Zinc	ug/l	5000	9	5	21			0	**50**

NOTES

1. MFL = millions of fibers per liter

Table B. Comparison of recently collected water quality data from a well west and down gradient of the proposed Alto Recharge Basins to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Well number 05N06W35G01. Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs. MCL's from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03.* Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (BOLD = OFFICIAL MCL OR GUIDELINE, OTHER CONSTITUENTS ARE MONITORED BUT NO OFFICIAL STANDARD EXISTS)	**UNITS**	**MCL**	**SWP 1988-2004**			**MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES**	
			MEAN	**MIN**	**MAX**	**MIN**	**MAX**
1,1,1,2-Tetrachloroethane	ug/l					0	0
1,1,1-Trichloroethane	ug/l	200				0	0
1,1,2,2-Tetrachloroethane	ug/l	1				0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200				0	0
1,1,2-Trichloroethane	ug/l	5				0	0
1,1-Dichloroethane	ug/l	5				0	0
1,1-DICHLOROETHYLENE	ug/l	6				0	0
1,1-Dichloropropane	ug/l					0	0
1,1-Dichloropropene	ug/l					0	0
1,2,3-Trichlorobenzene	ug/l					0	0
1,2,3-Trichloropropane	ug/l					0	0
1,2,4-Trichlorobenzene	ug/l	5				0	0
1,2,4-Trimethylbenzene	ug/l					0	0
1,2-Dichlorobenzene	ug/l	600				0	0
1,2-Dichloroethane	ug/l	0.5				0	0
1,2-Dichloropropane	ug/l	5				0	0.02
1,3,5-Trimethylbenzene	ug/l					0	0
1,3-Dichlorobenzene	ug/l					0	0
1,3-Dichloropropane	ug/l					0	0
1,3-Dichloropropene (Total)	ug/l	0.5				0	0
1,4-Dichlorobenzene	ug/l	5				0	0

1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l					0	0
2,2-Dichloropropane	ug/l					0	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30				0	0
2,4,5-TP (Silvex)	ug/l	50				0	0
2,4-D	ug/l	70				0	0
2-Chloroethyl vinyl ether	ug/l					0	0
2-Chlorotoluene	ug/l					0	0
3-HYDROXYCARBOFURAN	ug/l					0	0
4-Chlorotoluene	ug/l					0	0
Alachlor	ug/l	2				0	0
Aldicarb	ug/l					0	0
ALDICARB SULFONE	ug/l					0	0
Aldicarb sulfoxide	ug/l					0	0
Aldrin	ug/l					0	0
Alkalinity, Total	mg/l					76	104
Aluminum	ug/l	200	30	4	527	0	100
Antimony	ug/l	6	3	1	5	0	**6**
Arsenic (USEPA)	ug/l	10	2	1	4	2	**14**
Asbestos	MFL[1]	7					
Atrazine	ug/l	1				0	0
Barium	ug/l	1000	50	37	68	0	100
Bentazon	ug/l	18				0	0
Benzene	ug/l	1				0	0
Benzo(a)pyrene	ug/l	0.2				0	0
Beryllium	ug/l	4	1	1	1	0	1
Bicarbonate Alkalinity as CACO3	mg/l					52	110
bis-(2-Chloroethyl)ether	ug/l					0	0
Boron	ug/l	600				0	30
Bromacil	ug/l					0	0
Bromobenzene	ug/l					0	0
Bromochloromethane	ug/l					0	0
Bromodichloromethane	ug/l					0	0
Bromoform	ug/l					0	0

Bromomethane	ug/l					0	0
Butachlor	ug/l					0	0
Cadmium	ug/l	5	4	1	5	0	1
Calcium	mg/l					3.2	16
Carbaryl	ug/l					0	0
Carbofuran	ug/l	18				0	0
Carbon tetrachloride	ug/l	0.5				0	0
Carbonate Alkalinity as CACO3	mg/l					1	24
Chlordane	ug/l	0.1				0	0
Chloride	mg/l	250				3	16
Chloroethane	ug/l					0	0
Chloroform	ug/l					0	0
Chloromethane	ug/l					0	0
Chlorothalonil	ug/l					0	0
Chromium	ug/l	50	5	1	11	0	10
Chromium, Hexavalent	ug/l	50				2.7	3
cis-1,2-Dichloroethene	ug/l	6				0	0
Color	unit	15				0	10
Copper	ug/l	1000	5	2	28	0	**50**
Cyanide	ug/l	150				0	100
Dalapon	ug/l	200				0	0
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400				0	0
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4				0	0
Diazinon	ug/l					0	0
Dibromochloromethane	ug/l					0	0
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2				0	0
Dibromomethane	ug/l					0	0
Dicamba	ug/l					0	0
Dichlorodifluoromethane	ug/l					0	0
Dichloromethane	ug/l	5				0	0
Dieldrin	ug/l					0	0
Dimethoate	ug/l					0	0
Di-n-butyl phthalate	ug/l					0	0

Dinoseb	ug/l	7				0	0
DIQUAT	ug/l	20				0	0
DIURON	ug/l					0	0
ENDOTHALL	ug/l	100				0	0
Endrin	ug/l	2				0	0
Ethylbenzene	ug/l	300				0	0
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05				0	0
ETHYL-TERT-BUTYL ETHER	ug/l					0	0
Fluoride	mg/l	2.0	0.11	0.01	0.55	**0.38**	**0.8**
FOAMING AGENTS (MBAS)	ug/l	500				0	0.05
GLYPHOSATE	ug/l	700				0	0
GROSS ALPHA	pC/L					0	0.4
GROSS ALPHA COUNTING ERROR	pC/L					0.52	2
Hardness (as CaCO3)	mg/l					10	48
Heptachlor	ug/l	0.01				0	0
Heptachlor epoxide	ug/l	0.01				0	0
Hexachlorobenzene	ug/l	1				0	0
Hexachlorobutadiene	ug/l					0	0
Hexachlorocyclopentadiene	ug/l	50				0	0
Hydroxide Alkalinity as CACO3	ug/l					0	3
Iron	ug/l	300	47	5	416	0	100
Isopropylbenzene	ug/l					0	0
Lead	ug/l	15				0	5
LINDANE	ug/l	0.2				0	0
m,p-Xylene (Sum of Isomers)	ug/l					0	0
Magnesium	mg/l					0	2.88
Manganese	ug/l	50	10	3	60	0	30
Mercury	ug/l	2	.8	.2	1	0	1
Methomyl	ug/l					0	0
Methoxychlor	ug/l	30				0	0
METHYL ETHYL KETONE	ug/l					0	0
METHYL ISOBUTYL KETONE	ug/l					0	0
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5				0	5

Metolachlor	ug/l					0	0
Metribuzin	ug/l					0	0
MOLINATE	ug/l	20				0	0
MONOCHLOROBENZENE	ug/l	700				0	0
Naphthalene	ug/l					0	0
n-Butylbenzene	ug/l					0	0
Nickel	ug/l	100	1	1	4	0	**10**
Nitrate	mg/l	45	3.5	0.6	9.6	0.95	3.9
NITRATE + NITRITE (AS N)	mg/l	10				0.578	1.818
NITRITE (AS N)	mg/l	1				0	0.4
Nitrogen, Nitrate (as N)	ug/l					573	573
ODOR THRESHOLD @ 60 C	Ton	3				1	1
Oxamyl	ug/l	50				0	0
o-Xylene	ug/l					0	0
Pentachlorophenol	ug/l	1				0	0
Perchlorate	ug/l	6				0	0
Picloram	ug/l	500				0	0
P-ISOPROPYLTOLUENE	ug/l					0	0
POLYCHLORINATED BIPHENYLS	ug/l	0.5				0	0
Potassium	mg/l					0	1.7
PROMETRYN	ug/l					0	0
Propachlor	ug/l					0	0
sec-Butylbenzene	ug/l					0	0
Selenium	ug/l	50	1	1	2	0	**5**
Silver	ug/l	100	4	1	5	0	**10**
Simazine	ug/l	4				0	0
Sodium	mg/l					55.2	69
SOURCE TEMPERATURE C	C					21.1	29.6
Specific Conductance	us	900				280	650
Styrene	ug/l	100				0	0
Sulfate	mg/l	250	43	17	99	31	87.4
tert-Amyl methyl ether	ug/l					0	0
tert-Butyl alcohol	ug/l					0	0

tert-Butylbenzene	ug/l					0	0
Tetrachloroethene	ug/l	5				0	0
Thallium	ug/l	2				0	0.1
THIOBENCARB	ug/l	1				0	0
Toluene	ug/l	150				0	0
Total Dissolved Solids	mg/l	500				175	292
Total Trihalomethanes	ug/l	100				0	0
Toxaphene	ug/l	3				0	0
trans-1,2-Dichloroethene	ug/l	10				0	0
Trichloroethene	ug/l					0	0
Trichloroethylene	ug/l	5					
Trichlorofluoromethane	ug/l	150				0	0
Turbidity	NTU	5				0.1	1.8
Vanadium	ug/l					54	75
Vinyl chloride	ug/l	0.5				0	0
Xylenes	ug/l	1750				0	0
Zinc	ug/l	5000	9	5	21	0	**50**

NOTES

1. MFL = millions of fibers per liter

Table C. Comparison of *aggregate* water quality data from four wells in the general vicinity of the proposed Oro Grande Wash Basins to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Not all water quality elements were evaluated in the samples. Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs. MCL's from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03.* Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (Bold = Official MCL or Guideline, other constituents are monitored but no official standard exists)	**UNITS**	**MCL**	**SWP 1988-2004**			**MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES (By well number)**							
						MIN				**MAX**			
			MEAN	**MIN**	**MAX**	**13J01**	**M01**	**H01**	**E08**	**13J01**	**M04**	**H01**	**E08**
1,1,1,2-Tetrachloroethane	ug/l												
1,1,1-Trichloroethane	ug/l	200											
1,1,2,2-Tetrachloroethane	ug/l	1											
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200											
1,1,2-Trichloroethane	ug/l	5											
1,1-Dichloroethane	ug/l	5											
1,1-DICHLOROETHYLENE	ug/l	6											
1,1-Dichloropropane	ug/l												
1,1-Dichloropropene	ug/l												
1,2,3-Trichlorobenzene	ug/l												
1,2,3-Trichloropropane	ug/l												
1,2,4-Trichlorobenzene	ug/l	5											
1,2,4-Trimethylbenzene	ug/l												
1,2-Dichlorobenzene	ug/l	600											
1,2-Dichloroethane	ug/l	0.5											
1,2-Dichloropropane	ug/l	5											
1,3,5-Trimethylbenzene	ug/l												
1,3-Dichlorobenzene	ug/l												
1,3-Dichloropropane	ug/l												
1,3-Dichloropropene (Total)	ug/l	0.5											
1,4-Dichlorobenzene	ug/l	5											

1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l												
2,2-Dichloropropane	ug/l												
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30											
2,4,5-TP (Silvex)	ug/l	50											
2,4-D	ug/l	70											
2-Chloroethyl vinyl ether	ug/l					0				0			
2-Chlorotoluene	ug/l												
3-HYDROXYCARBOFURAN	ug/l												
4-Chlorotoluene	ug/l												
Alachlor	ug/l	2											
Aldicarb	ug/l												
ALDICARB SULFONE	ug/l												
Aldicarb sulfoxide	ug/l												
Aldrin	ug/l												
Alkalinity, Total	mg/l					80		100		89			100
Aluminum	ug/l	200	30	4	527	0		1.5		60			10
Antimony	ug/l	6	3	1	5	0		ND		0			ND
Arsenic (USEPA)	ug/l	10	2	1	4	3	**1.6**		**5.7**	**5**	**5.7**		**5.7**
Asbestos	MFL[1]	7											
Atrazine	ug/l	1											
Barium	ug/l	1000	50	37	68	0	7.3		8.4	0	7.3		8.4
Bentazon	ug/l	18											
Benzene	ug/l	1											
Benzo(a)pyrene	ug/l	0.2											
Beryllium	ug/l	4	1	1	1	0			ND	0			ND
Bicarbonate Alkalinity as CACO3	mg/l					93		20		110			20
bis-(2-Chloroethyl)ether	ug/l					0				0			
Boron	ug/l	600					54				54		
Bromacil	ug/l												
Bromide	mg/l		0.21	0.05	0.540		0.16	0.2			0.5	0.3	
Bromobenzene	ug/l												
Bromochloromethane	ug/l												

Bromodichloromethane	ug/l												
Bromoform	ug/l												
Bromomethane	ug/l												
Butachlor	ug/l												
Cadmium	ug/l	5	4	1	5	0			ND	0			ND
Calcium	mg/l					7	23.2		6.2	8	23.2		6.2
Carbaryl	ug/l												
Carbofuran	ug/l	18											
Carbon tetrachloride	ug/l	0.5											
Carbonate Alkalinity as CACO3	mg/l					3	120		80	3	120		80
Chlordane	ug/l	0.1											
Chloride	mg/l	250				8	26	0.5	14	14	60	6.4	14
Chloroethane	ug/l												
Chloroform	ug/l												
Chloromethane	ug/l												
Chlorothalonil	ug/l												
Chromium	ug/l	50	5	1	11	0	**42.9**		ND	0	**42.9**		ND
Chromium, Hexavalent	ug/l	50											
cis-1,2-Dichloroethene	ug/l	6											
Color	unit	15				3			<1	3			<1
Copper	ug/l	1000	5	2	28	0			ND	0			ND
Cyanide	ug/l	150				0				0			
Dalapon	ug/l	200											
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400											
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4											
Diazinon	ug/l												
Dibromochloromethane	ug/l												
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2											
Dibromomethane	ug/l												
Dicamba	ug/l												
Dichlorodifluoromethane	ug/l												
Dichloromethane	ug/l	5											

Dieldrin	ug/l												
Dimethoate	ug/l												
Di-n-butyl phthalate	ug/l												
Dinoseb	ug/l	7											
DIQUAT	ug/l	20											
DIURON	ug/l												
ENDOTHALL	ug/l	100											
Endrin	ug/l	2											
Ethylbenzene	ug/l	300											
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05											
ETHYL-TERT-BUTYL ETHER	ug/l					0				0			
Fluoride	mg/l	2.0	0.11	0.01	0.55		11	0.2	0.39		**27**	1.5	0.39
FOAMING AGENTS (MBAS)	ug/l	500				0.05				0.05			
GLYPHOSATE	ug/l	700											
GROSS ALPHA	pC/L												
GROSS ALPHA COUNTING ERROR	pC/L												
Hardness (as CaCO3)	mg/l					20			22	26			22
Heptachlor	ug/l	0.01											
Heptachlor epoxide	ug/l	0.01											
Hexachlorobenzene	ug/l	1											
Hexachlorobutadiene	ug/l												
Hexachlorocyclopentadiene	ug/l	50											
Hydroxide Alkalinity as CACO3	ug/l					3			0	3			0
Iron	ug/l	300	47	5	416	0	127		ND	0	127		ND
Isopropylbenzene	ug/l												
Lead	ug/l	15				0			ND	0			ND
LINDANE	ug/l	0.2											
m,p-Xylene (Sum of Isomers)	ug/l												
Magnesium	mg/l						13.3		1.5		13.3		1.5
Manganese	ug/l	50	10	3	60	0	**161**		ND	0	**161**		ND
Mercury	ug/l	2	.8	.2	1	0			ND	0			ND
Methomyl	ug/l												
Methoxychlor	ug/l	30											

METHYL ETHYL KETONE	ug/l					0				0			
METHYL ISOBUTYL KETONE	ug/l					0				0			
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5				0				0			
Metolachlor	ug/l												
Metribuzin	ug/l												
MOLINATE	ug/l	20											
MONOCHLOROBENZENE	ug/l	700											
Naphthalene	ug/l												
n-Butylbenzene	ug/l												
Nickel	ug/l	100	1	1	4	0			ND	0			ND
Nitrate	mg/l	45	3.5	0.6	9.6			0.02				0.52	
NITRATE + NITRITE (AS N)	mg/l	10											
NITRITE (AS N)	mg/l	1				0	0.03	0.02	0.86	0	0.03	0.02	0.86
Nitrogen, Nitrate (as N)	ug/l												
ODOR THRESHOLD @ 60 C	Ton	3				1				1			
Oxamyl	ug/l	50											
o-Xylene	ug/l												
Pentachlorophenol	ug/l	1											
pH, laboratory	units					8.6	8.1		9.67	8.8	8.3		9.67
Perchlorate	ug/l	6											
Picloram	ug/l	500											
P-ISOPROPYLTOLUENE	ug/l												
POLYCHLORINATED BIPHENYLS (TOTAL PCB'S)	ug/l	0.5											
Potassium	mg/l					1	5.26		3.6	2	5.26		3.6
PROMETRYN	ug/l												
Propachlor	ug/l												
sec-Butylbenzene	ug/l												
Selenium	ug/l	50	1	1	2	0			ND	0			ND
Silver	ug/l	100	4	1	5	0				0			
Simazine	ug/l	4											
Sodium	mg/l					37	52.6		56	41	52.6		56

SOURCE TEMPERATURE C	C													
Specific Conductance	us	900				230	390	8		240	502	233	
Styrene	ug/l	100											
Sulfate	mg/l	250	43	17	99	5.8		3	34	6.1		36	34
tert-Amyl methyl ether	ug/l					0				0			
tert-Butyl alcohol	ug/l												
tert-Butylbenzene	ug/l												
Tetrachloroethene	ug/l	5											
Thallium	ug/l	2				0			ND	0			ND
THIOBENCARB	ug/l	1											
Toluene	ug/l	150											
Total Dissolved Solids	mg/l	500				150			200	170			200
Total Trihalomethanes	ug/l	100											
Toxaphene	ug/l	3											
trans-1,2-Dichloroethene	ug/l	10											
Trichloroethene	ug/l												
Trichloroethylene	ug/l	5											
Trichlorofluoromethane	ug/l	150											
Turbidity	NTU	5				0.11			0.1	1.7			0.1
Vanadium	ug/l												
Vinyl chloride	ug/l	0.5											
Xylenes	ug/l	1750											
Zinc	ug/l	5000	9	5	21	0			ND	0			ND

NOTES

1. MFL = millions of fibers per liter

Table D. Comparison of water quality data from a well in the vicinity of the proposed Cedar Avenue Basin to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Not all water quality elements were evaluated in the samples. Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs. MCLs from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03.* Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (Bold = Official MCL or Guideline, other constituents are monitored but no official standard exists)	**UNITS**	**MCL**	**SWP 1988-2004**			**MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES**	
			MEAN	**MIN**	**MAX**	**MIN**	**MAX**
1,1,1,2-Tetrachloroethane	ug/l					0	0
1,1,1-Trichloroethane	ug/l	200				0	0
1,1,2,2-Tetrachloroethane	ug/l	1				0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200				0	0
1,1,2-Trichloroethane	ug/l	5				0	0
1,1-Dichloroethane	ug/l	5				0	0
1,1-DICHLOROETHYLENE	ug/l	6				0	0
1,1-Dichloropropane	ug/l					0	0
1,1-Dichloropropene	ug/l					0	0
1,2,3-Trichlorobenzene	ug/l					0	0
1,2,3-Trichloropropane	ug/l					0	0
1,2,4-Trichlorobenzene	ug/l	5				0	0
1,2,4-Trimethylbenzene	ug/l					0	0
1,2-Dichlorobenzene	ug/l	600				0	0
1,2-Dichloroethane	ug/l	0.5				0	0
1,2-Dichloropropane	ug/l	5				0	0
1,3,5-Trimethylbenzene	ug/l					0	0
1,3-Dichlorobenzene	ug/l					0	0
1,3-Dichloropropane	ug/l					0	0
1,3-Dichloropropene (Total)	ug/l	0.5				0	0
1,4-Dichlorobenzene	ug/l	5				0	0
1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l					0	0

2,2-Dichloropropane	ug/l					0	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30				0	0
2,4,5-TP (Silvex)	ug/l	50				0	1
2,4-D	ug/l	70				0	10
2-Chloroethyl vinyl ether	ug/l					0	0
2-Chlorotoluene	ug/l					0	0
3-HYDROXYCARBOFURAN	ug/l						
4-Chlorotoluene	ug/l					0	0
Alachlor	ug/l	2				0	0
Aldicarb	ug/l						
ALDICARB SULFONE	ug/l						
Aldicarb sulfoxide	ug/l						
Aldrin	ug/l						
Alkalinity, Total	mg/l					60	92
Aluminum	ug/l	200	30	4	527	0	100
Antimony	ug/l	6	3	1	5	0	**6**
Arsenic (USEPA)	ug/l	10	2	1	4	0	**10**
Asbestos	MFL[1]	7				1	1
Atrazine	ug/l	1				0	1
Barium	ug/l	1000	50	37	68	0	**100**
Bentazon	ug/l	18				0	0
Benzene	ug/l	1				0	0
Benzo(a)pyrene	ug/l	0.2					
Beryllium	ug/l	4	1	1	1	0	1.8
Bicarbonate Alkalinity as CACO3	mg/l					72	102.5
bis-(2-Chloroethyl)ether	ug/l					0	0
Boron	ug/l	600					
Bromacil	ug/l					0	0
Bromide	mg/l		0.21	0.05	0.540	0	0
Bromobenzene	ug/l					0	0
Bromochloromethane	ug/l					0	0
Bromodichloromethane	ug/l					0	0
Bromoform	ug/l					0	0

Bromomethane	ug/l					0	0
Butachlor	ug/l						
Cadmium	ug/l	5	4	1	5	0	1.75
Calcium	mg/l					10	13.9
Carbaryl	ug/l						
Carbofuran	ug/l	18				0	5
Carbon tetrachloride	ug/l	0.5				0	0
Carbonate Alkalinity as CACO3	mg/l					0	3
Chlordane	ug/l	0.1				0	0
Chloride	mg/l	250				6	28
Chloroethane	ug/l					0	0
Chloroform	ug/l					0	0
Chloromethane	ug/l					0	0
Chlorothalonil	ug/l						
Chromium	ug/l	50	5	1	11	0	10
Chromium, Hexavalent	ug/l	50					
cis-1,2-Dichloroethene	ug/l	6				0	0
Color	unit	15				3	5
Copper	ug/l	1000	5	2	28	0	**50**
Cyanide	ug/l	150				0	100
Dalapon	ug/l	200					
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400					
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4					
Diazinon	ug/l					0	0
Dibromochloromethane	ug/l					0	0
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2				0	0.01
Dibromomethane	ug/l					0	0
Dicamba	ug/l						
Dichlorodifluoromethane	ug/l					0	0
Dichloromethane	ug/l	5				0	0
Dieldrin	ug/l						
Dimethoate	ug/l					0	0
Di-n-butyl phthalate	ug/l						

Dinoseb	ug/l	7					
DIQUAT	ug/l	20					
DIURON	ug/l						
ENDOTHALL	ug/l	100					
Endrin	ug/l	2				0	0.01
Ethylbenzene	ug/l	300				0	0
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05				0	0.02
ETHYL-TERT-BUTYL ETHER	ug/l					0	0
Fluoride	mg/l	2.0	0.11	0.01	0.55	0.08	0.4
FOAMING AGENTS (MBAS)	ug/l	500				0.002	0.3
GLYPHOSATE	ug/l	700				0	25
GROSS ALPHA	pC/L					0.2	1.4
GROSS ALPHA COUNTING ERROR	pC/L					1.0	1.2
Hardness (as CaCO3)	mg/l					27	40.8
Heptachlor	ug/l	0.01				0	0
Heptachlor epoxide	ug/l	0.01				0	0
Hexachlorobenzene	ug/l	1					
Hexachlorobutadiene	ug/l					0	0
Hexachlorocyclopentadiene	ug/l	50					
Hydroxide Alkalinity as CACO3	ug/l					0	3
Iron	ug/l	300	47	5	416	0	100
Isopropylbenzene	ug/l					0	0
Lead	ug/l	15				0	7
LINDANE	ug/l	0.2				0	0.4
m,p-Xylene (Sum of Isomers)	ug/l					0	0
Magnesium	mg/l					0.7	1.5
Manganese	ug/l	50	10	3	60	0	30
Mercury	ug/l	2	0.8	0.2	1	0	1
Methomyl	ug/l						
Methoxychlor	ug/l	30				0	10
METHYL ETHYL KETONE	ug/l					0	0
METHYL ISOBUTYL KETONE	ug/l					0	0
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5				0	0

Metolachlor	ug/l						
Metribuzin	ug/l						
MOLINATE	ug/l	20				0	2
MONOCHLOROBENZENE	ug/l	700				0	0
Naphthalene	ug/l					0	0
n-Butylbenzene	ug/l					0	0
Nickel	ug/l	100	1	1	4	0	**10**
Nitrate	mg/l	45	3.5	0.6	9.6	0.5	3.2
NITRATE + NITRITE (AS N)	mg/l	10				0.400	0.712
NITRITE (AS N)	mg/l	1				0.4	0.55
Nitrogen, Nitrate (as N)	ug/l						
ODOR THRESHOLD @ 60 C	Ton	3				1	1
Oxamyl	ug/l	50				0	0
o-Xylene	ug/l						
Pentachlorophenol	ug/l	1					
pH, laboratory	units					7.6	8.4
Perchlorate	ug/l	6					
Picloram	ug/l	500				0	0
P-ISOPROPYLTOLUENE	ug/l						
POLYCHLORINATED BIPHENYLS (TOTAL PCB'S)	ug/l	0.5					
Potassium	mg/l					1	7.2
PROMETRYN	ug/l					0	0
Propachlor	ug/l						
sec-Butylbenzene	ug/l					0	0
Selenium	ug/l	50	1	1	2	0	**5**
Silver	ug/l	100	4	1	5	0	**10**
Simazine	ug/l	4				0	1
Sodium	mg/l					23	29.2
SOURCE TEMPERATURE C	C					22	23.9
Specific Conductance	us	900				176	200
Styrene	ug/l	100				0	0
Sulfate	mg/l	250	43	17	99	1.8	10.8

tert-Amyl methyl ether	ug/l					0	0
tert-Butyl alcohol	ug/l						
tert-Butylbenzene	ug/l					0	0
Tetrachloroethene	ug/l	5				0	0
Thallium	ug/l	2				0	1
THIOBENCARB	ug/l	1				0	0.8
Toluene	ug/l	150				0	0
Total Dissolved Solids	mg/l	500				101	123
Total Trihalomethanes	ug/l	100				0	0
Toxaphene	ug/l	3				0.0	0.5
trans-1,2-Dichloroethene	ug/l	10				0	0
Trichloroethene	ug/l						
Trichloroethylene	ug/l	5				0	0
Trichlorofluoromethane	ug/l	150				0	0
Turbidity	NTU	5				0.09	0.24
Vanadium	ug/l						
Vinyl chloride	ug/l	0.5				0	0
Xylenes	ug/l	1750				0	0
Zinc	ug/l	5000	9	5	21	0	**70**

NOTES

1. MFL = millions of fibers per liter

Table E. Comparison of water quality data from a well in the vicinity of the proposed Antelope Wash Basin (downgradient) to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Not all water quality elements were evaluated in the samples. Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs. MCL's from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03.* Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (Bold = Official MCL or Guideline, other constituents are monitored but no official standard exists)	**UNITS**	**MCL**	**SWP 1988-2004**			**MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES**	
			MEAN	**MIN**	**MAX**	**MIN**	**MAX**
1,1,1,2-Tetrachloroethane	ug/l					0	0
1,1,1-Trichloroethane	ug/l	200				0	0
1,1,2,2-Tetrachloroethane	ug/l	1				0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200				0	0
1,1,2-Trichloroethane	ug/l	5				0	0
1,1-Dichloroethane	ug/l	5				0	0
1,1-DICHLOROETHYLENE	ug/l	6				0	0
1,1-Dichloropropane	ug/l					0	0
1,1-Dichloropropene	ug/l					0	0
1,2,3-Trichlorobenzene	ug/l					0	0
1,2,3-Trichloropropane	ug/l					0	0
1,2,4-Trichlorobenzene	ug/l	5				0	0
1,2,4-Trimethylbenzene	ug/l					0	0
1,2-Dichlorobenzene	ug/l	600				0	0
1,2-Dichloroethane	ug/l	0.5				0	0
1,2-Dichloropropane	ug/l	5				0	0
1,3,5-Trimethylbenzene	ug/l					0	0
1,3-Dichlorobenzene	ug/l					0	0
1,3-Dichloropropane	ug/l					0	0
1,3-Dichloropropene (Total)	ug/l	0.5					
1,4-Dichlorobenzene	ug/l	5				0	0
1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l					0	0

2,2-Dichloropropane	ug/l					0	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30					
2,4,5-TP (Silvex)	ug/l	50					
2,4-D	ug/l	70					
2-Chloroethyl vinyl ether	ug/l					0	0
2-Chlorotoluene	ug/l					0	0
3-HYDROXYCARBOFURAN	ug/l						
4-Chlorotoluene	ug/l					0	0
Alachlor	ug/l	2					
Aldicarb	ug/l						
ALDICARB SULFONE	ug/l						
Aldicarb sulfoxide	ug/l						
Aldrin	ug/l						
Alkalinity, Total	mg/l					60	92
Aluminum	ug/l	200	30	4	527	0	0
Antimony	ug/l	6	3	1	5	0	0
Arsenic (USEPA)	ug/l	10	2	1	4	0	0
Asbestos	MFL[1]	7					
Atrazine	ug/l	1					
Barium	ug/l	1000	50	37	68	0	0
Bentazon	ug/l	18					
Benzene	ug/l	1				0	0
Benzo(a)pyrene	ug/l	0.2					
Beryllium	ug/l	4	1	1	1	0	0
Bicarbonate Alkalinity as CACO3	mg/l					120	120
bis-(2-Chloroethyl)ether	ug/l					0	0
Boron	ug/l	600					
Bromacil	ug/l						
Bromide	mg/l		0.21	0.05	0.540	NA	NA
Bromobenzene	ug/l					0	0
Bromochloromethane	ug/l					0	0
Bromodichloromethane	ug/l					0	0.5
Bromoform	ug/l					0	0

Bromomethane	ug/l					0	0
Butachlor	ug/l						
Cadmium	ug/l	5	4	1	5	0	0
Calcium	mg/l					25	25
Carbaryl	ug/l						
Carbofuran	ug/l	18					
Carbon tetrachloride	ug/l	0.5				0	0
Carbonate Alkalinity as CACO3	mg/l					3	3
Chlordane	ug/l	0.1				0	0
Chloride	mg/l	250				7	8
Chloroethane	ug/l					0	0
Chloroform	ug/l					0	0
Chloromethane	ug/l					0	0
Chlorothalonil	ug/l						
Chromium	ug/l	50	5	1	11	0	10
Chromium, Hexavalent	ug/l	50					
cis-1,2-Dichloroethene	ug/l	6				0	0
Color	unit	15				3	3
Copper	ug/l	1000	5	2	28	0	0
Cyanide	ug/l	150				0	0
Dalapon	ug/l	200					
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400					
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4					
Diazinon	ug/l						
Dibromochloromethane	ug/l					0	0.5
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2				0	0
Dibromomethane	ug/l					0	0
Dicamba	ug/l						
Dichlorodifluoromethane	ug/l					0	0
Dichloromethane	ug/l	5				0	0
Dieldrin	ug/l						
Dimethoate	ug/l						
Di-n-butyl phthalate	ug/l						

Dinoseb	ug/l	7					
DIQUAT	ug/l	20					
DIURON	ug/l						
ENDOTHALL	ug/l	100					
Endrin	ug/l	2				0	0.01
Ethylbenzene	ug/l	300				0	0
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05				0	0.02
ETHYL-TERT-BUTYL ETHER	ug/l					0	0
Fluoride	mg/l	2.0	0.11	0.01	0.55	0.1	0.2
FOAMING AGENTS (MBAS)	ug/l	500				0.05	0.05
GLYPHOSATE	ug/l	700				0	25
GROSS ALPHA	pC/L					0.2	1.4
GROSS ALPHA COUNTING ERROR	pC/L					1.0	1.2
Hardness (as CaCO3)	mg/l					83	83
Heptachlor	ug/l	0.01					
Heptachlor epoxide	ug/l	0.01					
Hexachlorobenzene	ug/l	1					
Hexachlorobutadiene	ug/l					0	0
Hexachlorocyclopentadiene	ug/l	50					
Hydroxide Alkalinity as CACO3	ug/l					3	3
Iron	ug/l	300	47	5	416	0	0
Isopropylbenzene	ug/l					0	0
Lead	ug/l	15				0	0
LINDANE	ug/l	0.2					
m,p-Xylene (Sum of Isomers)	ug/l					0	0
Magnesium	mg/l					5	5
Manganese	ug/l	50	10	3	60	0	0
Mercury	ug/l	2	.8	.2	1	0	0
Methomyl	ug/l						
Methoxychlor	ug/l	30					
METHYL ETHYL KETONE	ug/l					0	0
METHYL ISOBUTYL KETONE	ug/l					0	0
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5				0	0

Metolachlor	ug/l						
Metribuzin	ug/l						
MOLINATE	ug/l	20					
MONOCHLOROBENZENE	ug/l	700				0	0
Naphthalene	ug/l					0	0
n-Butylbenzene	ug/l					0	0
Nickel	ug/l	100	1	1	4	0	00
Nitrate	mg/l	45	3.5	0.6	9.6	4	6
NITRATE + NITRITE (AS N)	mg/l	10					
NITRITE (AS N)	mg/l	1				0	0
Nitrogen, Nitrate (as N)	ug/l						
ODOR THRESHOLD @ 60 C	Ton	3				1	1
Oxamyl	ug/l	50					
o-Xylene	ug/l					0	0
Pentachlorophenol	ug/l	1					
pH, laboratory	units					7.9	8.0
Perchlorate	ug/l	6					
Picloram	ug/l	500					
P-ISOPROPYLTOLUENE	ug/l					0	0
POLYCHLORINATED BIPHENYLS (TOTAL PCB'S)	ug/l	0.5					
Potassium	mg/l					1	1
PROMETRYN	ug/l						
Propachlor	ug/l						
sec-Butylbenzene	ug/l					0	0
Selenium	ug/l	50	1	1	2	0	0
Silver	ug/l	100	4	1	5	0	0
Simazine	ug/l	4					
Sodium	mg/l					16	17
SOURCE TEMPERATURE C	C					22	23.9
Specific Conductance	us	900				230	240
Styrene	ug/l	100				0	0
Sulfate	mg/l	250	43	17	99	3.7	3.9

tert-Amyl methyl ether	ug/l					0	0
tert-Butyl alcohol	ug/l						
tert-Butylbenzene	ug/l					0	0
Tetrachloroethene	ug/l	5				0	0
Thallium	ug/l	2				0	0
THIOBENCARB	ug/l	1					
Toluene	ug/l	150				0	0
Total Dissolved Solids	mg/l	500				150	150
Total Trihalomethanes	ug/l	100				0	1
Toxaphene	ug/l	3				0.0	0.5
trans-1,2-Dichloroethene	ug/l	10				0	0
Trichloroethene	ug/l						
Trichloroethylene	ug/l	5				0	0
Trichlorofluoromethane	ug/l	150				0	0
Turbidity	NTU	5				0.12	0.16
Vanadium	ug/l						
Vinyl chloride	ug/l	0.5				0	0
Xylenes	ug/l	1750				0	0
Zinc	ug/l	5000	9	5	21	0	0

NOTES

1. MFL = millions of fibers per liter

Table F. Comparison of water quality data from a well at the proposed Green Tree Basin to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Not all water quality elements were evaluated in the samples. Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs. MCL's from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03*. Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (Bold = Official MCL or Guideline, other constituents are monitored but no official standard exists)	**UNITS**	**MCL**	**SWP 1988-2004**			**MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES**	
			MEAN	**MIN**	**MAX**	**MIN**	**MAX**
1,1,1,2-Tetrachloroethane	ug/l					0	0
1,1,1-Trichloroethane	ug/l	200				0	0
1,1,2,2-Tetrachloroethane	ug/l	1				0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200				0	0
1,1,2-Trichloroethane	ug/l	5				0	0
1,1-Dichloroethane	ug/l	5				0	0
1,1-DICHLOROETHYLENE	ug/l	6				0	0
1,1-Dichloropropane	ug/l					0	0
1,1-Dichloropropene	ug/l					0	0
1,2,3-Trichlorobenzene	ug/l					0	0
1,2,3-Trichloropropane	ug/l					0	0
1,2,4-Trichlorobenzene	ug/l	5				0	0
1,2,4-Trimethylbenzene	ug/l					0	0
1,2-Dichlorobenzene	ug/l	600				0	0
1,2-Dichloroethane	ug/l	0.5				0	0
1,2-Dichloropropane	ug/l	5				0	0
1,3,5-Trimethylbenzene	ug/l					0	0
1,3-Dichlorobenzene	ug/l					0	0
1,3-Dichloropropane	ug/l					0	0
1,3-Dichloropropene (Total)	ug/l	0.5				0	0
1,4-Dichlorobenzene	ug/l	5				0	0
1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l					0	0

2,2-Dichloropropane	ug/l					0	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30					
2,4,5-TP (Silvex)	ug/l	50					
2,4-D	ug/l	70					
2-Chloroethyl vinyl ether	ug/l					0	0
2-Chlorotoluene	ug/l					0	0
3-HYDROXYCARBOFURAN	ug/l						
4-Chlorotoluene	ug/l					0	0
Alachlor	ug/l	2				0	0
Aldicarb	ug/l						
ALDICARB SULFONE	ug/l						
Aldicarb sulfoxide	ug/l						
Aldrin	ug/l						
Alkalinity, Total	mg/l					88	94
Aluminum	ug/l	200	30	4	527	0	50
Antimony	ug/l	6	3	1	5	0	**6**
Arsenic (USEPA)	ug/l	10	2	1	4	0	**8**
Asbestos	MFL[1]	7					
Atrazine	ug/l	1				0	0
Barium	ug/l	1000	50	37	68	0	**100**
Bentazon	ug/l	18					
Benzene	ug/l	1				0	0
Benzo(a)pyrene	ug/l	0.2					
Beryllium	ug/l	4	1	1	1	0	1
Bicarbonate Alkalinity as CACO3	mg/l					107	109
bis-(2-Chloroethyl)ether	ug/l						
Boron	ug/l	600				0	0
Bromacil	ug/l					0	0
Bromide	mg/l		0.21	0.05	0.540	NA	NA
Bromobenzene	ug/l					0	0
Bromochloromethane	ug/l					0	0
Bromodichloromethane	ug/l					0	0
Bromoform	ug/l					0	0

Bromomethane	ug/l					0	0
Butachlor	ug/l					0	0
Cadmium	ug/l	5	4	1	5	0	1
Calcium	mg/l					12	15
Carbaryl	ug/l						
Carbofuran	ug/l	18					
Carbon tetrachloride	ug/l	0.5				0	0
Carbonate Alkalinity as CACO3	mg/l					0	1
Chlordane	ug/l	0.1					
Chloride	mg/l	250				7.4	8.9
Chloroethane	ug/l					0	0
Chloroform	ug/l					0	0
Chloromethane	ug/l					0	0
Chlorothalonil	ug/l						
Chromium	ug/l	50	5	1	11	0	10
Chromium, Hexavalent	ug/l	50					
cis-1,2-Dichloroethene	ug/l	6				0	0
Color	unit	15				3	3
Copper	ug/l	1000	5	2	28	0	**50**
Cyanide	ug/l	150				0	100
Dalapon	ug/l	200					
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400					
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4					
Diazinon	ug/l					0	0
Dibromochloromethane	ug/l					0	0
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2				0	0
Dibromomethane	ug/l					0	0
Dicamba	ug/l						
Dichlorodifluoromethane	ug/l					0	0
Dichloromethane	ug/l	5				0	0
Dieldrin	ug/l						
Dimethoate	ug/l					0	0
Di-n-butyl phthalate	ug/l						

Dinoseb	ug/l	7					
DIQUAT	ug/l	20					
DIURON	ug/l						
ENDOTHALL	ug/l	100					
Endrin	ug/l	2					
Ethylbenzene	ug/l	300				0	0
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05				0	0
ETHYL-TERT-BUTYL ETHER	ug/l					0	0
Fluoride	mg/l	2.0	0.11	0.01	0.55	0.1	0.12
FOAMING AGENTS (MBAS)	ug/l	500				0	0.02
GLYPHOSATE	ug/l	700					
GROSS ALPHA	pC/L					0.8	1.5
GROSS ALPHA COUNTING ERROR	pC/L					0.7	0.9
Hardness (as CaCO3)	mg/l					39.6	63.2
Heptachlor	ug/l	0.01					
Heptachlor epoxide	ug/l	0.01					
Hexachlorobenzene	ug/l	1					
Hexachlorobutadiene	ug/l					0	0
Hexachlorocyclopentadiene	ug/l	50					
Hydroxide Alkalinity as CACO3	ug/l					1000	1000
Iron	ug/l	300	47	5	416	0	100
Isopropylbenzene	ug/l					0	0
Lead	ug/l	15				0	5
LINDANE	ug/l	0.2					
m,p-Xylene (Sum of Isomers)	ug/l					0	0
Magnesium	mg/l					1.7	8.1
Manganese	ug/l	50	10	3	60	0	30
Mercury	ug/l	2	.8	.2	1	0	1
Methomyl	ug/l						
Methoxychlor	ug/l	30				0	0
METHYL ETHYL KETONE	ug/l						
METHYL ISOBUTYL KETONE	ug/l						
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5					

Metolachlor	ug/l						
Metribuzin	ug/l					0	0
MOLINATE	ug/l	20				0	0
MONOCHLOROBENZENE	ug/l	700				0	0
Naphthalene	ug/l					0	0
n-Butylbenzene	ug/l					0	0
Nickel	ug/l	100	1	1	4	0	**10**
Nitrate	mg/l	45	3.5	0.6	9.6	2.1	2.7
NITRATE + NITRITE (AS N)	mg/l	10				0.587	0.610
NITRITE (AS N)	mg/l	1				0.4	0.4
Nitrogen, Nitrate (as N)	ug/l						
ODOR THRESHOLD @ 60 C	Ton	3				1	1
Oxamyl	ug/l	50					
o-Xylene	ug/l					0	0
Pentachlorophenol	ug/l	1					
pH, laboratory	units					7.73	8.46
Perchlorate	ug/l	6					
Picloram	ug/l	500					
P-ISOPROPYLTOLUENE	ug/l					0	0
POLYCHLORINATED BIPHENYLS (TOTAL PCB'S)	ug/l	0.5					
Potassium	mg/l					1	1.5
PROMETRYN	ug/l					0	0
Propachlor	ug/l						
sec-Butylbenzene	ug/l					0	0
Selenium	ug/l	50	1	1	2	0	**5**
Silver	ug/l	100	4	1	5	0	**10**
Simazine	ug/l	4				0	0
Sodium	mg/l					22	31
SOURCE TEMPERATURE C	C					22	24.4
Specific Conductance	us	900				208	210
Styrene	ug/l	100				0	0
Sulfate	mg/l	250	43	17	99	6.7	8.7

tert-Amyl methyl ether	ug/l					0	0
tert-Butyl alcohol	ug/l						
tert-Butylbenzene	ug/l					0	0
Tetrachloroethene	ug/l	5				0	0
Thallium	ug/l	2				0	1
THIOBENCARB	ug/l	1				0	0
Toluene	ug/l	150				0	0
Total Dissolved Solids	mg/l	500				116	130
Total Trihalomethanes	ug/l	100				0	0
Toxaphene	ug/l	3					
trans-1,2-Dichloroethene	ug/l	10				0	0
Trichloroethene	ug/l						
Trichloroethylene	ug/l	5				0	0
Trichlorofluoromethane	ug/l	150				0	0
Turbidity	NTU	5				0.08	0.1
Vanadium	ug/l					25	25
Vinyl chloride	ug/l	0.5				0	0
Xylenes	ug/l	1750				0	0
Zinc	ug/l	5000	9	5	21	0	**50**

NOTES

1. MFL = millions of fibers per liter

Table G. Comparison of water quality data from three domestic water wells in the vicinity of the proposed Mojave River Well Field to SWP pump-back criteria (rows with shading) and drinking water standards (MCL's). Wells numbered 04N04W24G01 (south of the well field, 1-mile inland on the west bank), 04N04W01A02 (northern field, east bank) and 04N03W09E01 (east bank). Not all water quality elements were evaluated in the samples. Values shown in **Bold** indicate that the water quality in the well samples was in excess of SWP values. Values shown in bold and dark shading indicate water quality in excess of DHS MCLs.   MCL's from Department of Health Services 2003, *Comparison of Federal and State MCLs, updated 09/12/03.* Also *July 29, 2005 amended Secondary Water Standards Table 64449-A.*

CONSTITUENT (Bold = Official MCL or Guideline, other constituents are monitored but no official standard exists)	**UNITS**	**MCL**	**SWP 1988-2004**			**MINIMUM AND MAXIMUM VALUES IN WELL SAMPLES (By Well Number)**					
			MEAN	**MIN**	**MAX**	**MIN**			**MAX**		
						G01	**A02**	**E01**	**G01**	**A02**	**E01**
1,1,1,2-Tetrachloroethane	ug/l					0	0	0	0.5	0	0
1,1,1-Trichloroethane	ug/l	200				0	0	0	0.5	0	0
1,1,2,2-Tetrachloroethane	ug/l	1				0	0	0	0.5	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/l	1200						0			0
1,1,2-Trichloroethane	ug/l	5				0	0	0	0.5	0	0
1,1-Dichloroethane	ug/l	5				0	0	0	0.5	0	0
1,1-DICHLOROETHYLENE	ug/l	6				0	0	0	0.5	0	0
1,1-Dichloropropane	ug/l					0	0	0	0	0	0
1,1-Dichloropropene	ug/l					0		0	0		0
1,2,3-Trichlorobenzene	ug/l					0	0	0	0	0	0
1,2,3-Trichloropropane	ug/l					0	0	0	0	0	0
1,2,4-Trichlorobenzene	ug/l	5				0	0	0	5	0	0
1,2,4-Trimethylbenzene	ug/l					0	0	0	0	0	0
1,2-Dichlorobenzene	ug/l	600				0	0	0	0.5	0	0
1,2-Dichloroethane	ug/l	0.5				0	0	0	0.5	0	0
1,2-Dichloropropane	ug/l	5				0	0	0	0.5	0	0
1,3,5-Trimethylbenzene	ug/l					0	0	0	0	0	0
1,3-Dichlorobenzene	ug/l					0	0	0	0.5	0	0
1,3-Dichloropropane	ug/l					0	0	0	0	0	0
1,3-Dichloropropene (Total)	ug/l	0.5				0	0	0	0	0	0

1,4-Dichlorobenzene	ug/l	5				0	0	0	0.5	0	0
1-PHENYLPROPANE (N-PROPYLBENZENE)	ug/l					0	0	0	0	0	0
2,2-Dichloropropane	ug/l					0	0	0	0	0	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/l	30					0	0		0	0
2,4,5-TP (Silvex)	ug/l	50				1	1	0	1	1	0
2,4-D	ug/l	70				1	10	0	10	10	0
2-Chloroethyl vinyl ether	ug/l					0.5	0	0	0.5	0	0
2-Chlorotoluene	ug/l					0	0	0	0	0	0
3-HYDROXYCARBOFURAN	ug/l						0			0	0
4-Chlorotoluene	ug/l					0	0	0	0	0	0
Alachlor	ug/l	2				1	0		1	0	
Aldicarb	ug/l						0			0	
ALDICARB SULFONE	ug/l						0			0	
Aldicarb sulfoxide	ug/l						0			0	
Aldrin	ug/l					0.5			0.5		
Alkalinity, Total	mg/l					68	73	74	70.6	73	74
Aluminum	ug/l	200	30	4	527	0	0	0	100	0	0
Antimony	ug/l	6	3	1	5		0	0		0	0
Arsenic (USEPA)	ug/l	10	2	1	4	**10**	0	2.2	**10**	0	2.2
Asbestos	MFL[1]	7									
Atrazine	ug/l	1				0.4	0		1	0	
Barium	ug/l	1000	50	37	68	**100**	0	0	**500**	0	0
Bentazon	ug/l	18					2			2	
Benzene	ug/l	1				0		0	0.5		0
Benzo(a)pyrene	ug/l	0.2					0	0		0	0
Beryllium	ug/l	4	1	1	1		0			0	
Bicarbonate Alkalinity as CACO3	mg/l					82	89	90.3	86	89	90.3
bis-(2-Chloroethyl)ether	ug/l										
Boron	ug/l	600					0			0	
Bromacil	ug/l					1	0		1	0	
Bromide	mg/l		0.21	0.05	0.540	NA	NA	NA	NA	NA	NA
Bromobenzene	ug/l					0		0	0		0

Bromochloromethane	ug/l					0		0	0		0
Bromodichloromethane	ug/l					0		0	0.5		0
Bromoform	ug/l					0	0.6	0	0.5	0.6	0
Bromomethane	ug/l					0		0	0.5		0
Butachlor	ug/l						0			0	
Cadmium	ug/l	5	4	1	5	1	0	0	5	0	0
Calcium	mg/l					16	26.3	14.1	24	26.3	14.1
Carbaryl	ug/l						0			0	
Carbofuran	ug/l	18					0			0	
Carbon tetrachloride	ug/l	0.5				0	0	0	0.5	0	0
Carbonate Alkalinity as CACO3	mg/l					0	0.23	0	0	0.23	0
Chlordane	ug/l	0.1									
Chloride	mg/l	250				4.2	14.8	8.1	8.2	14.8	8.1
Chloroethane	ug/l					0	0	0	0.5	0	0
Chloroform	ug/l					0	0	0	0.5	0	0
Chloromethane	ug/l					0	0	0	0.5	0	0
Chlorothalonil	ug/l										
Chromium	ug/l	50	5	1	11	**10**	0	0	10	0	0
Chromium, Hexavalent	ug/l	50					0			0	
cis-1,2-Dichloroethene	ug/l	6					0			0	
Color	unit	15				5	0		5	0	
Copper	ug/l	1000	5	2	28	**10**	0	0	**50**	0	0
Cyanide	ug/l	150					0	0		0	0
Dalapon	ug/l	200					10			10	
DI(2-ETHYLHEXYL)ADIPATE	ug/l	400					0			0	
DI(2-ETHYLHEXYL)PHTHALATE	ug/l	4					0			0	
Diazinon	ug/l					0.02	0		1	0	
Dibromochloromethane	ug/l					0	0	0	0.5	0	0
DIBROMOCHLOROPROPANE (DBCP)	ug/l	0.2				0.01	0		0,01	0	
Dibromomethane	ug/l					0	0	0	0	0	0
Dichlorodifluoromethane	ug/l					0	0	0	0.5	0	0
Dicamba	ug/l						1.5			1.5	

Dichloromethane	ug/l	5				0	0	0	0.5	0	0
Dieldrin	ug/l					0.5	0		0.5	0	
Dimethoate	ug/l					1	0		1	0	
Di-n-butyl phthalate	ug/l										
Dinoseb	ug/l	7				0.5	2		0.5	2	
DIQUAT	ug/l	20					4			4	
DIURON	ug/l					1	0		1	0	
ENDOTHALL	ug/l	100					45			45	
Endrin	ug/l	2				0.01	0		0.5	0	
Ethylbenzene	ug/l	300				0	0	0	0.5	0	0
ETHYLENE DIBROMIDE (EDB)	ug/l	0.05				0.02			0.02		
ETHYL-TERT-BUTYL ETHER	ug/l						0	0		0	0
Fluoride	mg/l	2.0	0.11	0.01	0.55	0.26	0.23	0.4	0.4	0.23	0.4
FOAMING AGENTS (MBAS)	ug/l	500				0.02	0	0	0.1	0	0
GLYPHOSATE	ug/l	700					25			25	
GROSS ALPHA	pC/L					0.8			3		
GROSS ALPHA COUNTING ERROR	pC/L					1			2		
Hardness (as CaCO3)	mg/l					50	88		70	88	
Heptachlor	ug/l	0.01									
Heptachlor epoxide	ug/l	0.01									
Hexachlorobenzene	ug/l	1					0			0	
Hexachlorobutadiene	ug/l					0	0	0	0	0	0
Hexachlorocyclopentadiene	ug/l	50					0			0	
Hydroxide Alkalinity as CACO3	ug/l					0	0.007	0	0	0.007	0
Iron	ug/l	300	47	5	416	**100**	0	0	110	0	0
Isopropylbenzene	ug/l					0	0	0	0	0	0
Lead	ug/l	15				5	0	0	10	0	0
LINDANE	ug/l	0.2				0.1	0		1	0	
m,p-Xylene (Sum of Isomers)	ug/l					0	0	0	0	0	0
Magnesium	mg/l					0.9	5.5	8.9	7.9	5.5	8.9
Manganese	ug/l	50	10	3	60	10	3.4	0	30	3.4	0
Mercury	ug/l	2	.8	.2	1	1	0	0	1	0	0
Methomyl	ug/l						0			0	

Methoxychlor	ug/l	30				1	0		10	0	
METHYL ETHYL KETONE	ug/l					1	0	0	20	0	0
METHYL ISOBUTYL KETONE	ug/l					1	0	0	20	0	0
METHYL-TERT-BUTYL-ETHER (MTBE)	ug/l	5					0	0		0	0
Metolachlor	ug/l						0			0	
Metribuzin	ug/l						0			0	
MOLINATE	ug/l	20				2	0		2	0	
MONOCHLOROBENZENE	ug/l	700				0	0	0	0.5	0	0
Naphthalene	ug/l					0			0		
n-Butylbenzene	ug/l					0	0	0	0	0	0
Nickel	ug/l	100	1	1	4		0	0		0	0
Nitrate	mg/l	45	3.5	0.6	9.6	0.7	6.7	5.83	7	9.33	6.2
NITRATE + NITRITE (AS N)	mg/l	10					2.12			2.12	
NITRITE (AS N)	mg/l	1					0	0		0	0
Nitrogen, Nitrate (as N)	ug/l										
ODOR THRESHOLD @ 60 C	Ton	3				0	1		0	1	
Oxamyl	ug/l	50					0			0	
o-Xylene	ug/l					0	0	0	0	0	0
Pentachlorophenol	ug/l	1					0			0.2	
pH, laboratory	units					6.97	7.6	7.33	8.2	7.6	7.33
Perchlorate	ug/l	6									
Picloram	ug/l	500					1			1	
P-ISOPROPYLTOLUENE	ug/l					0	0	0	0	0	0
POLYCHLORINATED BIPHENYLS (TOTAL PCB'S)	ug/l	0.5									
Potassium	mg/l					1	1.5	1.8	1.4	1.5	1.8
PROMETRYN	ug/l					1	0		1	0	
Propachlor	ug/l						0			0	
sec-Butylbenzene	ug/l					0	0	0	0	0	0
Selenium	ug/l	50	1	1	2	**5**	0	0	**5**	0	0
Silver	ug/l	100	4	1	5	**10**	0	0	**10**	0	0
Simazine	ug/l	4				0.4	0		1	0	

Sodium	mg/l					8.3	14.5	13.4	14.6	14.5	13.4
SOURCE TEMPERATURE C	C					12.9			12.9		
Specific Conductance	us	900				150	240	204	290	240	204
Styrene	ug/l	100				0	0	0	0	0	0
Sulfate	mg/l	250	43	17	99	3	16.1	9.3	10	16.1	9.3
tert-Amyl methyl ether	ug/l						0	0		0	0
tert-Butyl alcohol	ug/l						0	0		0	0
tert-Butylbenzene	ug/l					0	0	0	0	0	0
Tetrachloroethene	ug/l	5				0.5	0	0	0.5	0	0
Thallium	ug/l	2					0	0		0	0
THIOBENCARB	ug/l	1				0.8	0		0.8	0	
Toluene	ug/l	150				0	0	0	1	0	0
Total Dissolved Solids	mg/l	500				100	140		290	140	
Total Trihalomethanes	ug/l	100				0	0.6	0	0.5	0.6	0
Toxaphene	ug/l	3				0.5			10		
trans-1,2-Dichloroethene	ug/l	10				0.5	0	0	0.5	0	0
Trichloroethene	ug/l						0			0	
Trichloroethylene	ug/l	5				0	0	0	0.5	0	0
Trichlorofluoromethane	ug/l	150				0	0	0	0.5	0	0
Turbidity	NTU	5				0.05	0.3		4	0.3	
Vanadium	ug/l										
Vinyl chloride	ug/l	0.5				0	0	0	1	0	0
Xylenes	ug/l	1750				0	0	0	4	0	0
Zinc	ug/l	5000	9	5	21	**10**	0	0	**50**	0	0

NOTES

1. MFL = millions of fibers per liter

11. San Bernardino County
Department of Public Works
Naresh P. Varma, Chief
Environmental Management Division
825 East Third Street
San Bernardino, California 92415
Letter dated December 12, 2005

1. Comment: According to the most recent FEMA Flood Insurance rate Maps, the proposed project may cross areas within Zone A, special flood hazard areas which may be inundated by a 100-year storm event, and zone X.

Response: MWA concurs that certain elements of the project may take place within such zones.

2. Comment: The Environmental Management Division, Flood Control Storm Water Program Section has reviewed the DEIR and believes these points need to be addressed.

Response: Comments are addressed, in sequence, below.

2a: Water transfers, using the Mojave River or other natural or unimproved drainage course as a conveyance, should evaluate the potential erosion and sediment transport impacts that are likely to occur. Water transfers should also consider habitat alteration or degradation. The presence of water in larger volumes, for longer periods, and at times not consistent with the existing hydrologic regime, may also modify plant communities and facilitate invasive species.

Response: MWA concurs that these changes may occur in association with some of the proposed project facilities. The DEIR Section 5.14.2 specifically notes that such changes may occur, specifically in Oro Grande Wash, Antelope Wash, Unnamed Wash, and the mainstem Mojave River. Accordingly, in detailed design of facilities, MWA will coordinate the development of facilities in natural or unimproved drainage courses with local and county flood control authorities.

In regard to recharge operations in the mainstem Mojave River, MWA has conducted a 2-year pilot study involving releases from Lake Silverwood, in coordination with County Flood Control and under permits issued by the U.S. Army Corps of Engineers and the California Department of Fish and Game. MWA constructed temporary sand berms in the channel, using soil from the channel, and noted that these berms were rapidly removed by the first moderate natural flow in the river in the fall-winter of 2004-2005. In short, these temporary berms did not constitute a barrier to natural flows. MWA notes that in periods of flood flows, bed erosion would naturally occur, and sediment transport would occur as a result. It is not likely that the temporary berms, constructed of native materials and completely obliterated during the first substantial natural flow of the season, would have a significant effect on bed movement during periods of high flow.

In Oro Grande Wash and Antelope Wash, the DEIR notes that recharge basins would also be constructed using soils excavated from the wash and that high flows will rapidly erode and redistribute these materials. Because there will be no net fill of these washes, MWA does not predict significant effects related to the construction of these temporary berms. Such berms are a common feature of in-channel recharge systems (for example, at Santa Clara Valley Water District). In addition, MWA notes that the proposed site for recharge in Oro Grande Wash is upstream of a substantial cross-channel berm for the California Aqueduct and the sites for recharge at Antelope Wash will be upstream of an improved road crossing and flood detention basin structure at Ranchero Road. The low berms MWA would construct at these sites would thus be constructed in areas where flows will already be significantly constrained by downstream structures that effectively create flood detention basins. No significant effect from project facilities on flood passage at these sites is thus anticipated.

Off-channel recharge facilities along the Mojave River will also be constructed using soil from the basin site, and will be off the County-maintained flood control channel below Mojave Forks Dam. Design and construction of these facilities will be coordinated with County Flood Control.

The DEIR acknowledges that there may be incidental vegetation growth associated with recharge operations, but also notes that MWA will routinely maintain recharge basins, which will involve removal of in-basin vegetation and fine soils that may accumulate in the basins. MWA also has an on-going cooperative program for removal of invasive phreatophytes along the Mojave River.

2.b: The DEIR states that the unnamed wash may convey up to 500 cfs for extended periods of time (5.14.3) and impacts are described as follows.

> **"Where this flow crosses sands and gravels, there will be erosion and an incised channel will be formed. Once this channel has been formed, erosion will be minimal. Deliveries from the California Aqueduct will be suspended during periods of substantial natural runoff, and thus there will be no change in the peak flow down the channel as a result of the project. The incised channel will contain relatively high flows and reduce the potential for sheet flow across the floodplain. Such sheet flow occurs infrequently and changes in sheet flow distribution should not affect vegetation communities, which consist of desert scrub."**

This description suggest that the erosion and incision would not constitute a significant impact and that once the incised channel was formed, it would be a stable channel configuration. However, basic principles of fluvial geomorphology suggest that the incision will cease only when a base level has been reached, or when the resistance of the bank toe unit becomes less than the bed material, at which point the channel will begin to widen.

Further evaluation, by specialists in fluvial geomorphology, is warranted. An incised channel is not a stable feature, and is a significant impact.

Response: MWA concurs, but notes that the discussion cited in Section 5.14.3 was primarily related to the potential for the project to affect flooding. In this context, the proposed releases down Unnamed Wash do not appear to MWA to constitute a significant effect. In addition, the proposed project description calls for potential channel erosion to be managed by installation of rock energy dissipation structures in areas where flows will have high energy and erosion potential. These structures will be designed with full consideration of fluvial geomorphologic principles.

2c. The evaluation of the effects on plant communities is also inadequate. Some plant species depend on periodic overbank flows to propagate new seedlings. The potential for enhancing habitat for invasive species is not addressed in this section.

Response: These issues are not addressed in this section because they are addressed in Section 5.4.5.2, which includes the following analysis:

> "Approximately 6 to 8 acres of desert wash and desert scrub habitats will be permanently affected by construction of the proposed turnout, canal/or pipeline, drop structures to control erosion, unpaved access and maintenance roads, and small bridges. There will also be a short term loss of non-native grasslands associated with construction of the bridge under Arrowhead Lake Road and the low levees downstream of this road. It is anticipated that long-term operation of the turnout will increase the frequency of flow down the wash and increase the area affected by flow, and that an incised channel may form as a result of more frequent inundation. Deliveries of SWP supplies would occur for extended periods of time, providing surface water and raised groundwater levels adjacent to the centerline of the wash. The result will probably be creation of a permanent sandy-rock bottomed channel with adjacent desert wash shrub habitats. Routine maintenance will be minimal, but the channel will be maintained to exclude vegetation, such as tamarisk, that may result in restrictions in channel flow. The channel and the open space to be conserved by Rancho Las Flores will provide a movement linkage between the Mainstem Mojave River and remaining habitat in the wash and upstream of the wash. The loss of 6 to 8 acres of desert wash habitat resulting from drop structures and maintenance roads would be considered a significant impact."

In addition to drop structures which are a feature of the proposed project to control erosion of the channel, MWA proposes appropriate offsetting mitigation for these effects on desert wash habitat.

With regard to the issue of overbank flow, the draft EIR Section 5.4.5.1 "SWP Delivery via Unnamed Wash" also provides the findings of habitat characterizations based on field surveys of the project in 2005: "Unnamed Wash is good quality desert scrub habitat with some elements of desert wash. The watershed is quite small, flows are infrequent and of short duration, and thus significant desert wash habitats do not now exist." Based on the field surveys of existing habitat conditions, there is no evidence of existing overbank flooding at a level that creates conditions for an wide area of desert wash habitat. Wash habitat is intermittent and confined to a small area about 15-30 feet wide. The adjacent habitat is desert scrub, a community that does not depend on periodic overbank flows for plant propagation. In addition, as noted above, more sustained flows from recharge operations would likely raise groundwater levels adjacent to the channel. This would be more likely to marginally promote some expansion of wash, rather than restricting it.

2d. The potential water quality impacts to groundwater must be fully evaluated, including potential contamination of stormwater from urban activities or land uses. Additionally, the infiltration of surface water in new areas may leach compounds from the existing sediment and pose a groundwater threat (see recent research by the US Geological Survey).

Response: These potential project effects are addressed in substantial detail, with specific reference to recent USGS findings related to leading of minerals during groundwater recharge, in Section 5.13.3 of the DEIR (Water Quality). The DEIR notes that the interaction of SWP supplies with local groundwater basin soils is likely to be beneficial in terms of potential arsenic leaching due to the pH and dissolved oxygen characteristics of State Water Project supplies; comments received from California Department of Water Resources generally concur with this finding. See also additional clarifying information regarding monitoring in the response to comments from the Lahontan Regional Water Quality Control Board.

2e. While these potential impacts are evaluated, and groundwater monitoring is proposed as a mitigation measure, the DEIR does not specify how the project would respond in the event excessive groundwater impacts were detected by monitoring. This response should be specified in the DEIR.

Response: It would not be appropriate or feasible for MWA to attempt to define a management response to an as-yet-to-be defined problem. Because increases in groundwater levels in the Mojave River mainstem are predictable, MWA does address specific response to potential rising groundwater levels in and adjacent to the Mainstem Channel, providing for (a) no in-stream recharge during periods of natural flow and (b) diversion of supplies to off-channel recharge facilities if groundwater levels adjacent to the channel approach 20 feet below channel invert. Management responses to localized effects on groundwater quality will be coordinated with the Lahontan and Colorado RWQCBs, depending on the nature of the monitoring data and the watershed area affected.

3. Comment: Due to the nature of the project, the comments from Water Resources Division made here are general in nature and subject to change when more detailed plans are submitted.

Response: MWA looks forward to working with the Water Resources Division to address design and management of the proposed facilities.

3a: In general, it appears that the DEIR has identified the major concerns of the Flood Control District.

Response: We appreciate DPW's response.

3b: Many of the cities and communities listed above have Flood Control District approved Master Plans of drainage (MPD). We recommend that these MPDs be utilized to protect the alignment of future drainage and flood control facilities.

Response: MWA will work with local communities during design, construction, and implementation of the proposed project facilities.

3c: We recommend that any underground pipes be constructed in a manner not to alter the direction, elevation or capacity of any existing drainage course, and that the line be placed below all drainage course scour depths.

Response: MWA will coordinate with WRD during design and construction of pipelines as appropriate to address these issues.

3d: We recommend that no temporary or permanent obstructions be placed in any drainage course.

Response: Proposed project includes provisions for construction of earthen berms in-channel/in-drainage to spread water across the recharge area. MWA believes that, given the siting of proposed recharge areas, and in coordination with WRD and local agencies, this can be accomplished in a manner such that these berms will not constitute an "obstruction" within a drainage course.

3e: It is assumed that the local agencies will establish adequate provisions for intercepting and conducting the accumulated drainage around or through each site in a manner that will not adversely affect adjacent or downstream properties.

Response: MWA will cooperate with local communities to accomplish this objective.

3f: We recommend that the project incorporate, and the local agencies enforce, the most recent FEMA regulations.

Response: MWA will cooperate with local agencies to comply with FEMA regulations for the proposed project, but has no authority to incorporate FEMA regulations into the proposed project description or enforce those regulations.

3g: If any encroachment on Flood Control District right of way is anticipated, a permit shall be obtained from the District's Flood Control Operations Division, Permit Section. Other on-site or off-site improvements may be recommended which cannot be determined at this time.

Response: As it has in the past, MWA will coordinate with the District to obtain appropriate permits for work within District right-of-way.

3h: Corps of Engineers approval may also be required for work along the Mojave River and Oro Grande Wash. Information regarding this item can be obtained from the Flood Control Operations Division, Permit Section.

Response: MWA will coordinate with Flood Control Operations Division, Permit Section during efforts to obtain all relevant permits for the project.

4. Comment: Should there be any changes to this project, please notify our Department so that we may have the opportunity to comment on the changes.

Response: MWA will inform County DPW of any substantive changes in the proposed project.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 2: PROJECT PURPOSE AND NEED

2.1 Approach to Needs Analysis

Projects are a response to purposes and needs, and their evaluation must take place in the context of a well defined purpose and need. In analyzing the need for a proposed project, it is critical to:

- Define the goal of the project;
- Demonstrate that the goal of the project is not currently being met (if goals are being met, then there is no need for the project);
- Define the magnitude of the discrepancy between goal and the current condition (the importance of the project);
- Identify the factors that are responsible for not meeting the goal (the causes of the problem); and
- Based on these factors, define the criteria for formulation and evaluation of alternatives.

Following this logic, it is then possible to develop a series of alternatives to meet project needs and solve problem associated with these needs. The planning criteria provide a basis for initial screening of alternatives, selection of alternatives to carry forward for detailed evaluation, for refining alternatives, and for ensuring that a full range of feasible alternatives are considered.

The Water Supply Reliability and Groundwater Replenishment Project is intended to be a cooperative project, potentially involving a number of water agencies in water exchanges and water banking. In particular, MWA and the Metropolitan Water District of Southern California (Metropolitan) have undertaken a demonstration project to determine how Metropolitan's State Water Project (SWP) supplies may be delivered via Silverwood Lake to recharge areas in the Mojave River and to recharge facilities at Hodge, Lenwood, and Daggett. MWA and Metropolitan are cooperating in the development of data for this EIR. Assuming that Metropolitan would be one of MWA's potential partners, the EIR addresses MWA's purpose and needs and Metropolitan's purpose and needs. Because Metropolitan is an umbrella agency for its 27 member agencies, the discussion of Metropolitan's purpose and needs would be generally applicable to these individual agencies.

2.2 MWA

2.2.1 MWA Purposes

As noted in Chapter 1 (Introduction), MWA's fundamental goal is to manage declining groundwater levels in the Mojave Basin, Lucerne Valley, El Mirage Basin, and Morongo Basin/Johnson Valley. MWA is obligated under this mandate to attempt to reduce and/or reverse the regional long-term and unsustainable trend towards groundwater overdraft. Under its authorizing legislation, and California Water Code Section 79562.5(b), which outlines four elements of integrated water management planning, MWA is to manage to accomplish four general objectives:

- Water supply,
- Groundwater management,
- Ecosystem restoration, and
- Water quality

2.2.2 Existing Conditions and Constraints: Water Supply, Water Use in the Mojave Water Agency Service Area

2.2.2.1 Natural and Supplemental Water Supply

The Mojave Basin is a desert separated from the more temperate coastal environment of the Los Angeles Basin by the San Gabriel and San Bernardino mountains, which reach elevations near 10,000 feet above mean sea level. Storms approaching the California coast from the west drop most of their moisture on the western slopes of the mountains, and average annual precipitation at Victorville (about 10 miles north of the crest of the mountains) is about 6.9 inches, about 40% of the average annual precipitation falling in the Los Angeles Basin.

The MWA service area consists of two major drainage basins: the Mojave River Basin and the Morongo Basin/Johnson Valley area (Morongo Basin). The Mojave River Basin encompasses about 3,800 square miles, much of which receives less annual precipitation than Victorville. Hot, dry, and windy conditions create high evapotranspiration rates throughout the basin, and most of the about 800,000 to 1,000,000 acre-feet of annual precipitation in the basin evaporates directly or is taken up by plants and transpired. This is also true for the Morongo Basin. Given unreliable surface water supplies, producers in the MWA service area rely on groundwater, which is derived primarily from recharge via the Mainstem Mojave River, from local washes, and from groundwater migrating downslope from the mountains to the south and southwest (mountainfront recharge).

The Mojave River and the smaller drainages to the Morongo Basin are dry during most months of most years, and surface flow is an unreliable source of water except in infrequent intense storm periods. As a result, water users in the MWA service area rely almost entirely on groundwater, which since 1978 has been periodically supplemented by deliveries of water from the State Water Project (SWP). The large regional aquifer which underlies and is adjacent to the Mojave River aquifer receives water via runoff that concentrates and infiltrates along local washes along the interfaces at the mountain front, but this constitutes only about 20% of total infiltration to the basin, or about 13,000 acre-feet per year on average (USGS 2001). This supply moves slowly through the basin and USGS (2001) notes that water in the regional aquifer under the Mojave River aquifer first entered the basin about 20,000 years ago. There is some documented recharge of the Regional Aquifer from the River Aquifer, and this has accelerated as Regional Aquifer overdraft has lowered water levels. Throughout the MWA service area, natural groundwater replenishment from sources other than the Mojave River is therefore slow and only about 20% of average annual replenishment. The regional aquifer receives replenishment from the Mojave River.

A comparison of average annual supply and current levels of consumptive use within MWA's service area (2004 PEIR Section 3.2) shows that year 2000 consumptive use exceeded average annual water supply from natural sources by 42,300 acre-feet. That is, under current conditions, MWA would need to import 42,300 acre-feet of supplemental water per year to ensure that consumptive uses for water were met without net groundwater overdraft.

MWA has access to various supplemental water supplies through the SWP. First, MWA has a fixed allocation of SWP supply under its contract with the Department of Water Resources. This so-called "Table A" allocation is 75,800 acre-feet per year. The actual amount of Table A water available in any year may be lower, depending on weather in Northern California. Average annual SWP supply is currently estimated at 58,400 acre-feet per year.

Second, MWA may purchase additional supplies from the SWP. These additional supplies, generally available only in wet years and in the winter-spring, become available in two ways. First, the Article 21 water program allows a contractor to take delivery of water over the approved and scheduled Table A amount. Second, SWP contractors that use carryover (re-scheduled) storage capacity at the SWP San Luis Reservoir near Los Banos must take delivery of these supplies (or lose them) if natural runoff into San Luis Reservoir causes the reservoir to fill or spill. Again, this generally occurs during wet years, and supplies are available for only a short term. Carryover supplies may be acquired via transfer or exchange.

Average water supply available from natural sources and MWA's Table A SWP allocation is 123,900 acre-feet per year for the period 2000-2020. If it is feasible to acquire, import, and recharge Article 21 and/or carryover (rescheduled) supplies in wet years during the next 15 years, an additional 100,000 to 150,000 acre-feet of supply might be realized over this period of time.

2.2.2.2 Current and Projected Consumptive Use

The 2004 Regional Water Management Plan and its 2004 PEIR document existing use of water supplies from all sources, by area and project use for the period from 2005 through 2020. These projections reflect several key trends:

- Population growth from 1990 to 2000, while substantial, was marginally lower than projected in the 1994 Regional Water Management Plan;
- During the same period, declines in agricultural water use more than offset increases in urban water use.

Population projections for 2000 through 2020 were based on actual 2000 populations and on data provided by the Southern California Association of Governments (SCAG). The potential for variable agricultural consumptive use was accounted for by assuming (a) no change in agricultural consumptive use as projected in 2000 (high estimate) and (b) a 5% per year decrease in agricultural consumptive use until a balance of production rights and available supply was reached. These projections show an annual increase in population of 2.7% in the Mojave Basin Area and 2.6% in the Morongo Basin Area. Based on these population projections, the 2004 Regional Water Management Plan projected water use for agriculture and urban purposes, using two agricultural use scenarios (Table 2-1).

Table 2-1. Current and Projected Consumptive Use of Water in MWA's Service Area, 2000-2020 under two different assumptions about agricultural consumptive use. (Source: 2004 Regional Water Management Plan).

DEMAND CATEGORY	AVERAGE ANNUAL DEMAND IN ACRE-FEET				
	2000	**2005**	**2010**	**2015**	**2020**
High Demand Estimate (Year 2000 Level Agricultural Water Use)					
Urban (Mojave Basin)	70,300	79,800	87,300	96,100	107,600
Urban (Morongo Basin)	2,700	3,100	3,200	3,700	4,000
Agricultural	34,900	34,900	34,900	34,900	34,900
TOTAL	107,900	117,800	125,400	134,700	146,500
Low Demand Estimate (5% per year Decline In Agricultural Demand until supply = production rights)					
Urban (Mojave Basin)	70,300	79,800	87,300	96,100	107,600
Urban (Morongo Basin)	2,700	3,100	3,200	3,700	4,000
Agricultural (low)	34,900	32,400	21,400	15,300	12,500
TOTAL	107,900	115,300	111,900	115,100	124,100

2.2.2.3 Supply Surplus and Deficit, 2000 - 2020

An estimate of supply surplus and deficit can be made under a set of relatively simple assumptions:

- Consumptive use would be as shown on Table 2-1;
- Consumptive use would be met with natural supply and SWP supplemental supply;

- MWA would import SWP supplemental supplies to the extent needed to achieve a balance of supply and demand;
- Average annual SWP supplies would be available over the period 2005 through 2020, although there would be some variation in supply availability, and
- No overdraft would occur.

The assumption of no overdraft is essential in determining the net supply versus consumptive use water balance. Overdraft is simply water that must be replaced at a later date; assuming no overdraft therefore assumes that available supplies would be applied to meet the goals and objectives of the 1996 adjudication, which is to bring the system into a sustainable balance. Given these assumptions, a net water balance for MWA's service area can be projected (Table 2-2). Table 2-2 reflects four different planning scenarios related to supply and consumptive use:

- Scenario 1: Average annual natural supply and average annual SWP supply, with high agricultural consumptive use;
- Scenario 2: Average annual natural supply and average annual SWP supply, with low agricultural consumptive use;
- Scenario 3: Average annual natural supply and reduced average annual SWP supply due to multiple drought years, with high agricultural consumptive use; and
- Scenario 4: Average annual natural supply and reduced average annual SWP supply due to multiple drought years, with low agricultural consumptive use.

These scenarios provide a good estimate of the potential range of supply-consumptive use relationship.

The water balance analysis (Table 2-2) suggests that, if MWA is able to take all of its average annual SWP supply, there is a potential for substantial annual surplus to be available between 2005 and 2020, if the current trend towards declining agricultural water use continues. Under all other basic supply-consumptive use scenarios, there is a net supply deficit, which must be addressed via (a) increased supply, (b) reduced consumptive use, or (c) continued groundwater overdraft.

Table 2-2. Water balance (supply versus projected consumptive use) for MWA's service area, 2005 through 2020, based on four planning scenarios. Consumptive use from Table 2-1.

ELEMENT	SUPPLY/CONSUMPTIVE USE IN ACRE FEET BY YEAR			
	2005	**2010**	**2015**	**2020**
Scenario 1: Average Annual Supply + High Agricultural Consumptive Use				
SWP Average Annual	58,400	58,400	58,400	58,400
Natural Supply	65,500	65,500	65,500	65,500
Consumptive use	-117,800	-125,400	-134,700	-146,500
SURPLUS (+) OR DEFICIT (-)	**+6,100**	-1,500	-10,800	-22,600
Scenario 2: Average Annual Supply + Low Agricultural Consumptive Use				
SWP Average Annual	58,400	58,400	58,400	58,400
Natural Supply	65,500	65,500	65,500	65,500
Consumptive Use	-115,300	-111,900	-115,100	-124,100
SURPLUS (+) OR DEFICIT (-)	**+8,600**	**+12,000**	**+8,800**	-200
Scenario 1: Drought Reduced Annual Supply + High Agricultural Consumptive Use				
SWP Drought Reduced Supply	43,200	43,200	43,200	43,200
Natural Supply	65,500	65,500	65,500	65,500
Consumptive use	-117,800	-125,400	-134,700	-146,500
SURPLUS (+) OR DEFICIT (-)	-9,100	-16,700	-26,000	-37,800
Scenario 1: Drought Reduced Annual Supply + Low Agricultural Consumptive Use				
SWP Drought Reduced Supply	43,200	43,200	43,200	43,200
Natural Supply	65,500	65,500	65,500	65,500
Consumptive Use	-115,300	-111,900	-115,100	-124,100
SURPLUS (+) OR DEFICIT (-)	-6,600	-3,200	-6,400	-15,400

Consistent with the Mojave Water Agency Act that established MWA, MWA's 2004 Regional Water Management Plan provides for the continued and expanded implementation of 14 water demand management measures:

- Water survey programs for single-family and multi-family customers,
- Residential plumbing retrofit,
- System water audits, leak detection, and repair,
- Metering and commodity rates for new connections and retrofit of existing connections,
- Large landscape conservation programs and incentives,
- High-efficiency washing machine rebate programs,
- Public information programs,
- School education programs,
- Conservation programs,
- Wholesale agency programs,
- Conservation pricing,
- Water conservation,
- Water waste prohibition,
- Residential ultra-low-flush toilet replacement programs

As noted in the 2004 Regional Water Management Plan, responsibility for implementation of these programs lies with the various purveyors of drinking water supplies within MWA's service area. To date, member agencies have implemented numerous aspects of the above programs. The potential reductions in consumptive demand associated with the full implementation of the 14 water demand management programs is not precisely predictable, but the goal of these programs is to reduce per capita consumptive use by 10 percent by 2010 and 15 percent by 2015 (5 percent in the Morongo Basin). Accomplishment of this goal would (a) substantially increase net surplus supply availability under Scenario 2 (Table 2-2) and (b) increase the potential for supply surplus under other operating scenarios. Sometime after 2020, however, available supply and consumptive use would be balanced even under the most favorable supply-consumptive use scenario (Scenario 2, Table 2-2).

As noted in the discussion of supplemental water supplies, MWA could have access to additional supplies from the State Water Project, including Article 21 supplies and supplies made available as a result of carryover (rescheduled) water in San Luis Reservoir. These supplies would be available intermittently.

2.2.3 Constraints on MWA's Water Supply

MWA's ability to obtain and use supplemental supplies from the SWP is affected by both cost and the ability to recharge supplies into the regional and Mojave River aquifer. These factors are discussed below.

2.2.3.1 Cost

The SWP variable cost (the cost to transport water from the SWP facilities in the Sacramento-San Joaquin Delta at Tracy to MWA) is approximately $160 per acre-foot (2004 Regional Water Management Plan). This is the cost of energy and operations only. Not including costs for recharge facility operations and management, the actual SWP supplemental supply delivered to subarea producers in 2000 was 11,362 acre-feet, at a cost of $2,274,400. The cost to fully offset the year 2000 deficit of 42,300 acre feet (consumptive use minus natural supply) would have been $8,460,000. The cost to convey 100% of MWA's 75,800 acre-foot SWP contract supply (if it were available) would be $12,128,000.

The costs associated with addressing balance of supply and consumptive use pales when compared to the cost of restoring groundwater levels to pre-1940 levels. This would require the import of about 2.5 million acre-feet of water in excess of consumptive use. Over a 25-year period, this would mean that MWA would need to import 100,000 acre-feet per year in excess of the 42,300 acre-feet per year needed to meet current consumptive uses. Even if adequate supply and recharge capacity was available, the cost to address long-term overdraft, at an energy cost of $160/acre-foot, would be $16,000,000 per year for 25 years or a total of $400,000,000.

2.2.3.2 Limitations on recharge

Assuming that supplies could be purchased and transported to MWA, MWA's ability to recharge them for later use is further constrained by the limited pipeline and recharge facilities. MWA has two existing primary systems for transport and recharge: The Mojave River Pipeline and the Morongo Basin Pipeline. Capacities of these existing MWA facilities are shown on Table 2-3. Because much of the active recharge at existing facilities is associated with recharge to the Mojave River itself, these nominal capacities are affected by flow in the river. For example, in 2005, flows in the Mojave River would have reduced MWA's ability to recharge at Hodge and Daggett, where recharge facilities were inundated by natural flows. Artificial recharge may therefore be constrained during the years when it is wet in both northern California and southern California, as it was in 2005. Wet conditions in northern California do not necessarily correspond to wet conditions in southern California, and recharge is likely to be available in the MWA service area at many times when there are wet conditions in the north.

The magnitude of the existing facility constraints on MWA ability to transport and recharge supplemental supplies in a above-normal year can be illustrated using data from the California Department of Water Resources for the year 2000 (DWR Operations 2005). In 2000, SWP Table A allocations were about 90% of the nominal Table A allocation. Also, 308,257 acre-feet of Article 21 water were made available. In addition, about 220,000 acre-feet of extended carryover and carryover supply was stored in San Luis Reservoir. An estimate of MWA facility constraints can be made making the following assumptions (Table 2-2):

- MWA would take its full Table A allocation (0.90 x 75,800 = 68,220 af) in 12 equal monthly deliveries of 5,685 acre-feet per month;
- MWA would purchase and take delivery of 10% of the Article 21 water available, in three fall-winter months at a rate of 10,000 acre-feet per month. Article 21 water is not absolutely tied to Table A allocations and it is reasonable to assume that in a 75% year, MWA could have access to this water;
- San Luis would be filled and MWA and/or its partner Metropolitan would have substantial carryover at San Luis, to be delivered in a period of 2 winter months at a rate of 11,000 acre-feet per month;
- Deliveries to the Mojave River Mainstem via release from Lake Silverwood would be constrained by the need to protect the endangered arroyo toad, and releases from Lake Silverwood would be limited to the five months from September 15 through February 15; and
- Actual ability to deliver supplies to recharge would be approximately 80% of the rated facility capacity shown on Table 2-3 due to maintenance and repair, and further reduced by 1,000 acre-feet per month in winter months when surplus Article 21 and/or carryover water might be available.

Table 2-3. Existing MWA facilities for transport and recharge of water (monthly capacity calculated as annual capacity in 2004 Regional Water Management Plan divided by 12.

FACILITY AND DESCRIPTION	MONTHLY CAPACITY
Transport-Recharge System 1: Mojave River Pipeline (94 cfs)	
AVEK Recharge, Recharge basin for power plant	115 acre-feet
Hodge Recharge Basin	750 acre-feet
Lenwood Recharge Basin	750 acre-feet
Daggett Recharge Basin	1400 acre-feet
Subtotal for Mojave River Pipeline	**3015 acre-feet**
Transport-Recharge System 2: Morongo Basin Pipeline (110 cfs)	
Rock Springs Recharge Basin, recharge directly to the Mojave River	3,333 acre-feet
Warren Valley, recharge in Morongo Basin	290 acre-feet
Subtotal for Morongo Basin Pipeline	**3,623 acre-feet**
Mojave River Mainstem; Releases from Lake Silverwood	
Recharge directly to the Mojave River Mainstem, September 15 through February 15, with ramping of flows in 50 cfs increments, average 250 cfs, estimated 25,000 acre-feet per 5 month period.	**5,000 acre-feet**
TOTAL (Maximum)	**11636 (Sept 15 -Feb 15)** **6636 (Mar - Sep)**

Table 2-4. Estimated potential SWP supplemental supply for the year 2000.

MONTH	SOURCE AND SUPPLY (ACRE-FEET)			TOTAL	RECHARGE CAPACITY (at 80% of rated capacity)	CAPACITY DEFICIT
	Table A	Article 21	San Luis Carryover			
JAN	5,685	10000	0	15,685	8309	7,376
FEB	5,685	0	11000	16,685	8309	8,376
MAR	5,685	0	11000	16,685	4308	12,337
APR	5,685	0	0	5,685	5308	377
MAY	5,685	0	0	5,685	5308	377
JUN	5,685	0	0	5,685	5308	377
JUL	5,685	0	0	5,685	5308	377
AUG	5,685	0	0	5,685	5308	377
SEP	5,685	0	0	5,685	5308	377
OCT	5,685	0	0	5,685	9309	0
NOV	5,685	10000	0	15685	9309	6,376
DEC	5,685	10000	0	15685	8309	7,376
TOTAL	68,220	**30,000**	**22000**	**120,220**	**79,701**	**44,103**

Under a reasonably conservative set of operations assumptions, lack of recharge facilities alone would therefore limit MWA's ability to import and recharge about 37% of the potentially available SWP supply in a marginally above-normal. In a wet year, with SWP Table A allocations of 75,800 acre-feet (6,316 acre-feet per month) the deficit would be more substantial. In short, additional recharge capacity is necessary for MWA to fully utilize its SWP Table A allocations, in addition to using available Article 21 water and other available supplies.

2.2.4 Historic Groundwater Overdraft

The natural groundwater recharge for the MWA service area is highly variable, and responds to year-to-year variation in precipitation and to longer-term trends in regional precipitation. Wet-dry cycles create periods of high and low recharge in the Mojave River aquifer. For example, the wet decade of 1940-1950 resulted in natural recharge somewhat in excess of water use but the subsequent 50 years have been dryer with the exception of brief wet periods, and natural recharge has generally been lower than water use (USGS 2001). As a result, net groundwater storage in the MWA storage area declined by about 2.5 million acre-feet from 1950 to 2000 (USGS 2001), with the greatest overdraft occurring in the Centro and Baja portions of the MWA service area (USGS 2001), where the largest cities have been developed (Victorville, Hesperia, Adelanto, and Apple Valley). Overdraft has resulted in declining groundwater levels. Since the 1940's, water levels have declined by from 50 to 75 feet in the Alto subarea and in the Centro and Baja subareas by about 100 feet (USGS 2001).

2.2.5 Geology and the Interconnections of Groundwater Basin Subareas

The Mojave Basin is a seismically active area adjacent to the San Andreas Fault and associated smaller fault zones. As a result, the subareas of the groundwater basins in the MWA service area are affected by a complex of local fault zones, rock intrusions, and areas of uplift. These affect the slow migration of groundwater from subarea to subarea, but there is general connectivity of subarea regional groundwater basins. Given that infiltration rates to the regional aquifer are relatively low and movement of groundwater within the regional aquifer is slow, it is thus the Mojave River aquifer that provides the major natural connection among basin subareas. Flow in this aquifer is forced to the surface at the Narrows in Victorville, becomes surface flow for a short reach, becomes groundwater flow again below the Lower Narrows, and the resurfaces at Afton Canyon. Since 1895, July streamflow at the USGS stream gauge at the Lower Narrows has declined from about 30-40 cfs in the early 20th century to about 2-7 cfs in 1995-2004 (2004 PEIR, Section 3.2-4).

2.2.6 1996 Mojave Basin Area Adjudication

MWA was formed to manage the declining groundwater levels in its service area, with its primary tool for management being the import of supplemental water supplies from the State Water Project. From 1978 to 2001, MWA imported approximately 150,000 acre-feet of SWP supply, equivalent to about 1.4 years of year 2000 total consumptive use. As noted in the 2004 PEIR, the native waters of the Mojave River and underlying groundwater are insufficient to meet current and projected future consumptive uses. Local agency concerns related to this fundamental water management issue led to a 1996 water rights adjudication, which established local water rights and defined MWA responsibilities in terms of acquisition and delivery of supplemental water supplies. A "Physical Solution" to the problem was established as "a fair and equitable basis for satisfaction of all water rights in the Mojave Basin Area."

The physical solution divided water producers in the Mojave Basin Area into five subareas; each subarea and producer was then allocated a "Free Production Allowance" derived from historic production which was to decline by 5% per year until the available production in each subarea was in balance with the available water supply. If a producer within a subarea utilized more than its share of the Free Production Allowance, the producer would incur a "Replacement Obligation," which would be met through the purchase of supplemental water from the Watermaster (initially designated as MWA). MWA was then obligated to provide supplemental supplies at a reasonable cost. The physical solution further provided for phasing in of the monetary obligations necessary to obtain supplemental water. The effect of the 1996 water rights adjudication is thus to provide a mechanism by which, at some point in the future:

Consumptive use = Natural supply + Supplemental supply

At some point in the future, then, the 1996 water rights adjudication may help eliminate on-going overdraft through conservation and the purchase of supplemental supplies; but there is no provision for addressing the long-term deficit/overdraft of about 2.5 million acre-feet.

2.2.7 Distribution of Supply

MWA is obligated under the 1996 water rights adjudication to provide supplemental water to help subarea producers meet Replacement and Makeup Obligations. The adjudication allows MWA to pre-purchase supplies and place them in groundwater subareas for subsequent use. It is thus necessary for MWA to have facilities for distribution and recharge that allow deliveries to groundwater in proportion to consumptive use for supplies to meet Replacement and Makeup Obligations.

2.2.8 Appropriately-Sited Facilities for Extraction of Groundwater

Although there is substantial capacity for groundwater recharge in the Mojave River Mainstem between Silverwood Lake and the Narrows, routine recharge in this reach is constrained by limited extraction capacity. Water recharged into this reach of the river percolates into the shallow Mojave River Aquifer and spreads downstream as an underground river before it reaches the Narrows, where an area of uplifted rock forces the water to the surface. The river then flows downstream through the Narrows before percolating again into groundwater.

Because MWA is obligated under the 1996 adjudication to supply water in proportion to the demands for water to meet "Replacement and Makeup Obligations," it is important that recharge be managed in a way that ensures a balanced distribution of recharged supplies, and that MWA member agencies be able to extract supplies in proportion to their water supply needs. In addition, it is important for MWA to ensure that water purchased under MWA Ordinance 9 of the Improvement District "M" Agreement by its member agencies is available to them.

In the Mojave River reach south of the Narrows, there is inadequate extraction capacity along the river. Thus, water recharged in this reach will eventually spill through the Narrows, creating an uneven distribution of supply. In addition, if supplemental water is provided by an outside agency such as Metropolitan as part of a water banking and water exchange program, the loss of this water to reaches downstream would mean that return of the water would require costly wells and pipelines between downstream sites and the California Aqueduct which would be used to return banked supplies to Metropolitan. Without additional extraction facilities south of the Narrows to provide for return of banked water, MWA's ability to use this reach of the river for on-going recharge would be limited and the net difference between available supply and MWA's capability of importing and recharging this supply would increase from the level shown on Table 2-4.

2.2.9 Local Issues of Concern

In addition to issues related to cost and the equitable distribution of the benefits of water exchange and banking programs, there is strong local concern regarding export of groundwater from the MWA service area, even if it is water previously provided by another agency under a water banking/exchange agreement. Because of prohibitions against export within the Mojave Basin Area Judgment, it will be necessary to review the program with the Presiding Judge. Pumping of groundwater for export to another basin is a concern for a number of reasons. First, such pumping may occur in a dry period and result in locally-lowered groundwater levels, resulting in higher local pumping costs. Second, use of groundwater for exchange may result in changes in groundwater quality. If water recharged to the groundwater basin is of poorer quality than then the indigenous groundwater, and a mix of this water is pumped to provide returns from a groundwater bank, then there may be a net degradation of local groundwater. For these and other reasons, there is a need to design banking and exchange programs that minimize the use of pumped groundwater as a part of banking and exchange.

2.2.10 Ecological Restoration

The 1996 adjudication recognizes a need to address declining groundwater levels and their effects on riparian vegetation and the wildlife communities that depend on them. This is particularly an issue in the mainstem north of Mojave Forks Dam, the Narrows, and Lower Narrows, where declining water levels have affected the quality of riparian habitats.

2.2.11 Summary

The 1996 water rights adjudication provides several mechanisms by which local water producers and MWA may reduce the rate of overdraft and achieve a balance of water supply and consumptive use. However:

- Both funding and lack of off-river recharge facilities limit the potential to (a) import supplies from the SWP and (b) recharge them to replenish overdrafted groundwater. As a result, MWA has not historically imported its entire available Table A supply.
- Existing recharge in the MWA service area is focused on recharge of the Mojave River aquifer and the Warren Valley, and this may be constrained by (a) flood flows in the Mojave River during the wet years when supplemental SWP supplies are most readily available and (b) by lack of adequate extraction facilities.
- Even when supplemental SWP supplies are available, MWA may not be able to import them and utilize them because of these constraints.
- In addition, there is a need to minimize the use of pumped groundwater as a part of banking and exchange.
- Finally, there is a need to meet riparian enhancement goals in areas where declining groundwater levels have affected riparian forest along the river.

2.3 Metropolitan

~~Like MWA, Metropolitan's fundamental purpose is to provide supplemental water supplies to meet the needs of all customers within its service area. Metropolitan determines these overall needs and the need for storage options to provide supplemental dry-year supplies from programs such as water banking based on an analysis of demand, feasible conservation to reduce demand, and available supply from existing and projected sources. Metropolitan evaluates these issues using an integrated model that projects normal demand based on the most recent and reliable official demographic information from regional planning agencies. The model then accounts for projected conservation and rationing during drought to project dry-year demand. Metropolitan then evaluates existing, projected, and target supply from six major resource programs: (1) water recycling and groundwater recovery, (2) storage within the Metropolitan service area, (3) State Water Project, (4) Colorado River, (5) Central Valley transfers and groundwater banking, and (6) ocean desalination. Supply projections from each of these resources are based on historic data adjusted to reflect known trends. Three categories of supply are evaluated: firm existing supply; projected supply from currently planned programs, and target supplies from each resource area, based on the probability of developing programs in these areas in the future.~~

Like MWA, Metropolitan's fundamental purpose is to provide supplemental water supplies to meet the needs of all customers within its service area. Metropolitan determines these overall needs using a suite of planning models that evaluate projected demands, feasible conservation to reduce demands, and available supply from existing and projected sources. Metropolitan's demand projections are based on the most recent and reliable official demographic information from regional planning agencies. Metropolitan evaluates supplies from six major resource programs: (1) water recycling and groundwater recovery, (2) storage within the Metropolitan service area, (3) State Water Project, (4) Colorado River, (5) Central Valley transfers and groundwater banking, and (6) ocean desalination. Supply projections are based on existing supplies; projected supplies from currently planned programs, and target supplies from each resource area, based on the probability of developing programs in these areas in the future.*

To ensure a reasonable probability of meeting minimal (post-conservation) demands, the sum of these projected supplies should equal or slightly exceed the post-conservation demand for defined future dates. From an urban perspective, enhanced management of wet-year supplies is also critical to ensuring that minimum needs are met during dry years.

To ensure a reasonable probability of meeting minimal (post-conservation) demands, the sum of these projected supplies should equal or slightly exceed the post-conservation demand for defined future dates. From an urban perspective, enhanced management of wet-year supplies is also critical to ensuring that minimum needs are met during dry years.

Metropolitan has focused attention on programs to better manage available wet-year supplies and better conserve supplies in all years, so that available supplies may be stretched and set aside for dry-year use. In recent years, Metropolitan has added 800,000 acre-feet of storage capacity at Diamond Valley Lake and is working with its 26 member agencies to enhance in-basin groundwater storage. Because this in-basin storage will be less than 60 percent of the needed additional storage, Metropolitan has also embarked on a number of groundwater banking projects, such as the Arvin Edison Water Bank and Kern Delta Water Banking Program. In addition, during the last decade, Metropolitan and its member agencies contributed about $190 million to conservation programs involving retrofitting more than 4 million plumbing fixtures, generating a permanent reduction in demand of about 560,000 acre-feet per year. Metropolitan projects that its programs will save an additional 500,000 acre-feet per year by year 2020. In calculating the need for additional dry-year supply, Metropolitan reduces gross projected future demand to reflect the additional conservation efforts that will be undertaken between now and 2020.

Since 1988, Metropolitan has conducted annual analyses of water supply and water quality reliability, reflecting changes in demand such as the 1987 to 1992 drought, which altered some patterns of water use in Southern California permanently. Using population projections from regional planning agencies and DWR, Metropolitan's annual demand projections take into account demographic projections (population growth and the distribution of population in the service area) and include consideration of the need to blend supplies from a variety of sources to meet water quality standards. Metropolitan reduces its estimates of demand based on trends in conservation and projected water savings from continued implementation of existing programs and implementation of new programs.

**. This simplification of Metropolitan's methods for projecting water demand and supply reflects the latest language from official Metropolitan sources.*

Based on this analysis, and projecting that demands will be reduced during dry years by an *additional* 13 percent *per capita* or 500,000 acre-feet per year over current levels of conservation, Metropolitan has determined that it will need approximately 4.6 million and 5.08 million acres feet of dry year supply in 2010 and 2020 (respectively). This includes municipal, industrial, and agricultural demands. Table 2-5 shows that current yield from all water supply sources, assuming full implementation of all programs, is approximately 3,494,000 acre-feet.

Table 2-5 Existing and Target Annual Dry-Year Yield from All Sources Metropolitan Water District of Southern California Year 2020 Projections

YEAR	Existing Annual Yield (Acre-Feet)	New Program Annual Yield (Acre-Feet)	Net Annual Dry-Year Supply (Acre-Feet)	Dry Year Need	Net Dry-Year surplus or Deficit
2010	3,494,000	1,444,000	4,938,000	4,600,000	+338,000
2020	3,494,000	1,444,000	4,938,000	5,080,000	-144,000

* Sources include State Water Project, Colorado River, in-basin storage, groundwater recovery, Central Valley banking, local surface and groundwater, and the Los Angeles Aqueduct.

As Table 2-5 indicates, Metropolitan may meet all of its 2010 dry-year needs if it implements the proposed supply enhancement and storage/banking programs, but supply will fall slightly short of dry-year demands by 2020, even with all planned and projected programs implemented.

In addition to a projected dry-year supply deficit of 144,000 acre-feet by 2020, Metropolitan and its member agencies utilize local groundwater supplies in-lieu of SWP supplies, and there is often significant capacity to store groundwater within Metropolitan's service area. Metropolitan's ability to deliver water to groundwater storage is often constrained by pipeline capacity and utilization rates and by local agency use of recharge basins. As a result, member agencies may utilize local groundwater, with resulting declines in groundwater levels. Seasonally and annually fluctuating groundwater levels in, for example, the coastal basins of Los Angeles and Orange Counties often result in groundwater levels well below the level of adjacent sea water, with resulting seawater intrusion. Management of groundwater in Metropolitan's service area would therefore be enhanced by actions which would allow local agencies to take additional supplemental supplies and either (a) recharge them into groundwater or (b) use them in-lieu of extracting groundwater. Either of these options would (a) reduce seasonal and annual declines in groundwater and the costs of extracting groundwater from deeper levels and (b) reduce sea water intrusion and resulting degradation of coastal groundwater quality.

2.4 Project Planning Criteria

Potential projects must be formulated and evaluated in terms of their ability to meet the needs of the various entities involved in planning them. To meet the MWA needs identified above, potential projects should be formulated based on their ability to address:

- **Net enhancement of MWA ability to import and utilize SWP supplies.** Projects should, if feasible, result in the development of facilities and of water management agreements that will (a) increase MWA facility capacity to take and recharge SWP supplies and (b) result in an actual increase in the amount of water available for recharge.
- **Water cost.** Projects should be formulated to minimize MWA's costs for supplemental water.
- **Recharge capacity**. Projects should result in enhancements of recharge capacity, with an emphasis on off-stream capacity in areas where overdraft has been high and MWA deliveries to meet Makeup Obligations can be made.
- **Distribution of benefits.** Projects should be formulated to provide benefits throughout the MWA service area.
- **Extraction capacity.** Projects should provide appropriately-sited extraction capacity so that exchanged and banked water can be delivered to MWA users and/or returned to MWA exchange/banking partners in a timely and efficient manner.
- **Minimization of Groundwater Pumping.** To the extent feasible, exchange and banking programs should not rely heavily on pumping and transport of groundwater supplies from MWA to exchange/banking partners. MWA should use its SWP entitlements for exchange/banking to the extent feasible.
- **Riparian Restoration**. Projects should include components that will enhance the potential for historic riparian areas to recover.

To meet Metropolitan's needs in evaluating potential water exchange and water banking programs, potential projects should be formulated based on their ability to address:

- **Program reliability and magnitude.** Metropolitan's management of several million acre-feet of water per year using its massive infrastructure requires that (a) cooperative programs be reliable so that water exchanges and banking can be scheduled without affecting other operations and (b) programs be adequate in scope so that the difficulties of adjusting system management are offset by the level of benefits from the program.
- **Water quality**. Water for exchange and water returned from banking programs must be of high enough quality that it is suitable for its intended uses.
- **Recharge capacity**. For banking elements of projects, soils in the banking area must be suitable for rapid recharge of the basin when water is available in wet years.
- **Proximity to the California Aqueduct**. The cost of banking and water exchanges increases significantly for projects that require extensive new facilities because the

bank site is many miles from the California Aqueduct. Both capital costs and pumping costs increase with distance from the aqueduct.

- **Ability to return banked water**. For both water banking and water exchange elements of cooperative programs, it is important that both agencies participating in banking programs have the ability to guarantee that banked water may be returned in a timely manner.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Project

CHAPTER 3
INITIAL SCREENING OF ALTERNATIVES AND FORMULATION OF PROJECT ALTERNATIVES FOR DETAILED EVALUATION

3.1 Initial Screening of Alternative Facilities

3.1.1 Potential Alternative Facilities

As noted in the Chapter I, the 2004 Regional Water Management Plan identified a suite of high priority facilities for groundwater recharge and supply (for convenience, these are presented below as Table 3-1).

Table 3-1. Potential high priority recharge and water supply facilities, from the 2004 Regional Water Management Plan and 2004 PEIR.

FACILITY #	FACILITY FUNCTION AND LOCATION	AREA AFFECTED
4	RECHARGE: Oro Grande Wash	Mojave Regional Aquifer, Alto Mid-Regional
5	RECHARGE: Cedar Street Detention Basins	Mojave Mid-Regional Aquifer,
6	RECHARGE: Antelope Wash	Mojave Mid-Regional Aquifer,
11	RECHARGE: HDWD Recharge Basin 3, Warren Valley	Morongo Basin/Johnson Valley
13	RECHARGE: Newberry Springs	Mojave Floodplain Aquifer, Baja
18	RECHARGE: Rock Springs Release	Mojave Floodplain Aquifer, Alto
19	RECHARGE: Hesperia Lakes	Mojave Floodplain Aquifer, Alto
20	RECHARGE: South of Rock Springs	Mojave Floodplain Aquifer, Alto
21	RECHARGE: Temporary sand berms in the Mojave River to accommodate releases from Silverwood Lake to Mojave River	Mojave Floodplain Aquifer, Alto

A majority of these high priority facilities are located in the Alto subarea of MWA's service area, reflecting rapid growth and the need to address groundwater overdraft in this most urbanized portion of the MWA service area. The facilities shown on Table 3-1 were the starting point for the development of fully formed Project Alternatives that would meet Proposed Project objectives and the planning criteria discussed in Chapter II.

By themselves, these facilities do not constitute a project. Under CEQA, all aspects of a project that may affect the physical environment must be included in the project description. For groundwater recharge and storage, there are a number of elements that may affect the physical environment:

- The recharge facilities;
- Facilities for conveying water to the recharge facilities;
- Facilities for extracting water from the recharge facilities and conveying it to users;
- Operational features, such as the source of the water, the amount of water, the quality of water, the timing of delivery, facilities for monitoring the project, and so forth.

The basic characteristics of each element of groundwater recharge and exchange programs are described briefly below.

3.1.2 Recharge facilities

In formulating alternatives, both instream and off-stream recharge facilities were considered, including use of MWA's existing recharge facilities in combination with any or all of the nine potential facilities listed on Table 3-1. Recharge involves the conveyance of water to broad, flat basins where it spreads out and percolates into the ground. Once in the groundwater basin, recharged water tends to mound below the recharge site and to move laterally. Lateral movement is generally more rapid towards areas with the lowest groundwater levels. Extraction wells are therefore sited within and "downslope" from recharge basins, so that they extract water from the mound, which is higher than adjacent water levels, and thus reduce pumping costs.

The recharge process results in some loss of water during conveyance due to canal and pipe seepage, evaporation of water as it spreads out and percolates into the ground, and during extraction and distribution for use. To ensure that there is no net loss of water associated with banking, water banking programs generally include a conservative loss factor of 10%. Thus, if an agency delivers 100,000 acre-feet of water to a groundwater bank, it receives only 90,000 acre-feet in return. Except for releases down Unnamed Wash, MWA deliveries to existing and new groundwater basins would be via buried pipelines. Any seepage via Unnamed Wash will become part of the groundwater flowing into the Mojave River Floodplain Aquifer. Thus, no seepage losses will occur. Similarly, MWA returns of banked groundwater would be via closed pipelines. Losses are thus limited to those associated with evaporation during recharge. In MWA's service area, surface evaporation rates are, at maximum, about 110 inches per year or about an average of 0.30 inches per day (Lichvar et al 2002, for evaporation of playa lakes at Edwards AFB). Given a conservative infiltration rate of 6" per day during recharge, recharge operations would have a maximum evaporation rate of 5%. Actual evaporation during recharge is likely to be somewhat lower because (a) recharge rates in the Mainstem Mojave River and at several other sites are likely to be much higher than 6" per day and (b) recharge is most likely during winter and spring, when evaporation rates are lowest. A 10% loss factor is therefore at least double the maximum projected loss due to evaporation and evapotranspiration.

3.1.3 Facilities for conveying water to the recharge facilities

Before it can be recharged, water must be delivered to recharge facilities. This can be accomplished via pipelines and canals, via existing river channels, or via any combination of these methods. The type and location of conveyance facilities depends on the type and location of the recharge facility. In areas where rivers routinely dry out during the summer, recharge directly into the riverbed means that the river itself can function as a conveyance facility. Off-stream recharge basins require pipelines, canals, and associated pumping and power transmission facilities.

3.1.4 Groundwater extraction and conveyance facilities

Water stored in groundwater basins must be pumped to the surface and then distributed to users or conveyed directly to the banking entity. This requires wells and associated infrastructure to extract groundwater. Groundwater extraction facilities would depend on the location and size of recharge facilities and on the volumes of water to be recharged and extracted.

Water can be moved to users via pipelines and/or canals, with associated pumps and other infrastructure, to convey water to and from recharge areas to MWA service areas as well as to make return deliveries to water banking partners such as Metropolitan. The number and size of water conveyance facilities would depend on the location of recharge and on the proposed operational elements of each alternative. The length of pipelines or canals would depend on the distance of recharge facilities from areas where water would be used. The size of pipelines and canals would depend on the volumes of water to be stored and extracted. The number of pumping plants and the energy require to pump would depend on the elevation of groundwater compared to the elevation of the area to which groundwater was conveyed.

3.1.5 Operational features

3.1.5.1 Proposed Project Magnitude

Physical facilities may be operated in a number of different ways, depending on project goals and available methods for ensuring that water quality, water supply, and water distribution are managed in a manner consistent with the 1996 adjudication and with MWA policies. An initial consideration is the potential volume of water to be banked and returned. The total volume of water to be conveyed, recharged, and returned, or to be exchanged independent of banking operations, depends on the available supply, the needs of the cooperating parties, and the physical capacity of the groundwater basins to be used. Based on preliminary agreements, MWA and Metropolitan have agreed to evaluate water banking/exchange programs involving as little as 75,000 acre-feet of total supply/return/exchange. The maximum volume of water that could be involved in a cooperative water banking program between MWA and Metropolitan is much greater, potentially greater than 450,000 acre-feet over a period of 15-20 years. The actual magnitude of the Proposed Project banking element will thus probably fall within this range.

The Proposed Project facilities will, of course, be utilized by MWA for delivery and recharge of its own supplies, including SWP Table A contract supplies and other supplies such as those available under SWP Article 21. Even in years when Metropolitan is not making deliveries, MWA would use the added recharge and conveyance capacity provided by Proposed Project facilities to meet current and future obligations. Thus, operations of Proposed Project facilities will involve deliveries and extractions in excess of those required for a banking and exchange program. Over the next 15 years (2006-2020), MWA imported water deliveries will average about 47,000 acre-feet per year (MWA 2004b). Assuming MWA also pre-delivers some SWP supplies during this period for later use, total volume of MWA non-banking recharge in existing and new facilities could be 750,000 acre-feet or higher.

MWA deliveries to meet demands will necessarily involve greater imports of SWP supplies in above-normal-to-wet years, because MWA will need to import supplies in those years for storage and later use in dry years. Additional recharge basins, pipelines and other conveyance facilities, and production wells would mean MWA could bring these needed supplies into its service area more rapidly. This will help MWA optimize the water quality of the SWP supplies it imports by allowing MWA to focus on delivery in months when water quality is highest, rather than having to deliver supplies at a steady rate throughout the year.

In addition to banking and exchange, MWA's need for new facilities is highest in the Alto subarea, where growth is highest. Therefore banking facilities need to be sized to accommodate on-going MWA use, with a focus on the Alto subarea.

3.1.5.2 Recharge and extraction locations

The intent of traditional water banking is to provide for temporary storage of supplies in a groundwater basin. Active banking involves delivery of these supplies to a recharge facility where they are allowed to percolate into the groundwater basin. These supplies build up a mound under the recharge area and are then extracted from the immediate vicinity of the recharge area and returned. Essentially, recharge and extraction take place in the same location. Using the "savings account" concept, this is equivalent to making all deposits and withdrawals from the same branch office of a bank.

A variation on the traditional banking concept involves decoupling of recharge and extraction locations. Under this concept, water can be recharged at one location and extracted for direct return can be made elsewhere within the same groundwater basin. Under this approach, water producers within a given groundwater basin agree to use water extracted from the vicinity of the recharge basin in lieu of using wells at other locations. This approach is undertaken when (a) there is a significant distance between suitable recharge/extraction areas and the return point for direct return of banked water and (b) it is feasible for producers in the banking area to utilize water from the recharge area in lieu of extracting water from groundwater near the return point for return of banked water. Using the "saving account" concept, this approach is equivalent to depositing funds in a branch office and withdrawing them at any other office owned by the same bank. There are opportunities to apply this concept to the Proposed Project.

In MWA's service area, direct return of banked groundwater would probably be made to the California Aqueduct. If water is recharged to the Mojave River Mainstem, a direct return of this water to the California Aqueduct would require pumping water out of the aquifer and then uphill to the aqueduct. This would require new or modified pipelines and the use of significant energy. The facility and energy costs associated with direct return might be lowered if it were feasible for producers in Hesperia, Victorville, and Adelanto to utilize groundwater from the Mojave River Aquifer in-lieu of pumping from the Regional Aquifer in areas near the California Aqueduct. In these areas near the California Aqueduct, groundwater would be allowed to rise naturally and/or be recharged artificially while producers were taking recharged water from other locations. MWA could then utilize new or existing wells nearer to the aqueduct to make a portion of required direct returns to Metropolitan. In such a scenario, all of the cooperating agencies could benefit from lower energy costs for groundwater extraction conveyance.

Another key operational element of the Proposed Project is that banking supplies may be delivered to recharge areas that are some distance from the California Aqueduct. Direct return of this water is infeasible because of the long distances involved, lack of suitable pipelines for return, and the high energy costs of pumping water back to the California Aqueduct. MWA may, however, deliver banked supplies to these locations and then return banked supply via exchange. Under this type of operation, the producers in the vicinity of the Hodge, Lenwood, Daggett, Newberry Springs, Morongo Basin, and other sites far from the California Aqueduct would pump banked water in-lieu of MWA delivery of new supply from the SWP. Returns to Metropolitan would never exceed the volume banked less the 10% loss factor. This type of operation would result in higher groundwater levels in wet years when banked water would be delivered. The net effect of such operations on groundwater levels would always be positive because the 10% loss factor provided for in banking ensures that there will be at least a 5% increase in net deliveries versus returns. Thus, banking in these locations that are 30-50 miles from the California Aqueduct can be accomplished via an exchange program that will result in a steady build-up of groundwater supplies.

3.1.5.4 Water banking and water exchange concepts

Under the 1996 adjudication, MWA is explicitly authorized to enter into a storage agreement with the Mojave Basin Area Watermaster to acquire and store water that may later be used to satisfy MWA's obligations to supply supplemental water. The 1996 adjudication does not specify the nature of these projects. For purposes of alternative formulation, then, both water banking and exchange programs are feasible under the 1996 adjudication.

Traditional Water Banking: In the "traditional" water banking program proposed, Metropolitan would deliver water to MWA, which would store the water and then return it to Metropolitan at a later date, less the 10% loss factor. This type of program operates like a standard savings account: Metropolitan (or any other agency banking water with MWA) would put water into the bank before it could withdraw water, and it could not withdraw more than it had deposited. The traditional savings account concept also generally involves return of banked supplies via pumping and direct return of stored water. From the perspective of Metropolitan, traditional banking is about saving water available in a wet year to meet needs in a dry year. For MWA, the benefits of traditional banking are (a) groundwater levels are temporarily raised and this reduces pumping costs and (b) the cost of the facilities needed for banking would be subsidized by Metropolitan. For MWA, banking is thus a means of paying for facilities that it can use for its own water supply management.

<u>Modified Water Banking:</u> The traditional savings account banking concept can be modified. Cooperating agencies can agree to exchange supplies depending on their needs and the availability of supplies. Such exchanges are called "time-shift" exchanges. Each cooperating agency may have supply available to it at a time when it does not, in fact, need the supply or have the ability to take delivery of it -- when there is a temporary surplus condition. Each agency may also experience periods when needs temporarily exceed supply. Under a time-shift exchange, one agency delivers its surplus to the other when the other needs it; the water is returned when the second agency has a temporary surplus. Such water exchanges may be made for any beneficial use. Exchanges may be made to meet immediate customer demand, to provide for storage of supplies by the cooperating parties, or for any combination of these uses.

Time-shift exchange programs do not operate under "savings account" rules. The cooperating agencies enter into an agreement to receive and return water on an ongoing basis. The net balance of this program may shift monthly, seasonally, or annually. The only condition is that at the end of the program, the exchanges are balanced.

A combined water banking and exchange program between MWA and Metropolitan would be operated by creating two separate accounts: a groundwater banking account and an exchange account. The groundwater banking account would operate under "savings account" rules. The exchange account would operate under more flexible rules; either agency could have a positive balance at any given time. Under such a rule, MWA could pre-deliver SWP supplies to Metropolitan for its storage or use; when Metropolitan later delivered supplies to MWA for banking, the Metropolitan balance would be reduced to reflect MWA's previous deliveries under the exchange account. A conceptual operations scenario is shown on Table 3-2.

Table 3-2. Conceptual water banking and exchange account for MWA and Metropolitan Water District of Southern California, involving a sequence of deliveries over time. Deliveries from Metropolitan to MWA are net (90% of nominal delivery).

DELIVERIES (IN SEQUENCE)	OVERALL PROGRAM BANK BALANCE (ACRE-FEET)		CHANGE IN MWA GROUNDWATER STORAGE
	MWA	Metropolitan	
MWA: 20,000 acre-feet SWP supply to Metropolitan	+20,000	-20,000	0
Metropolitan: 15,000 acre-feet to MWA	+5,000	-5,000	15,000
Metropolitan: 27,000 acre-feet to MWA	-22,000	+22,000	27,000
MWA: 12,000 acre-feet SWP supply to Metropolitan	-10,000	+10,000	0
MWA: 22,000 acre-feet SWP supply to Metropolitan	+12,000	-12,000	0
Metropolitan: 45,000 acre-feet to MWA	-33,000	+33,000	45,000
MWA: 12,000 acre-feet SWP supply to Metropolitan	-21,000	+21,000	0
MWA: 19,000 acre-feet SWP supply to Metropolitan	-2,000	+2,000	0
Metropolitan: 35000 acre-feet to MWA	-37,000	+37,000	35,000
MWA: 20,000 acre feet SWP and 5000 acre-feet Direct Return from groundwater	-17,000	+17,000	-5,000
MWA: 20,000 acre-feet SWP supply to Metropolitan	+3,000	-3,000	0
Metropolitan: 45,000 acre-feet to MWA	-42,000	+42,000	45,000
MWA: 17,000 acre-feet SWP supply to Metropolitan	-25,000	+25,000	0
MWA: 27,000 acre-feet SWP supply to Metropolitan	+2,000	-2,000	0
Metropolitan: 35,000 acre-feet to MWA	-33,000	+33,000	33,000
MWA: 12,000 acre-feet SWP supply to Metropolitan	-21,000	+21,000	0
MWA: 24,000 acre-feet SWP supply to Metropolitan	+3,000	-3,000	0
Metropolitan: 28000 acre-feet to MWA	-25,000	+25,000	28,000
MWA: 20,000 acre feet SWP and 5000 acre-feet Direct Return from groundwater	0	0	-5,000
Subtotal			**+218,000**
Plus 5% net groundwater storage from 10% loss factor			**+10,900**
NET CHANGE	**0**	**0**	**+228,900**

The conceptual scenario shown on Table 3-2 reflects the potential for a combined banking and exchange program to yield a net increase in groundwater storage in MWA's service area. This potential net increase in groundwater storage would be a result of a result of several factors:

- Metropolitan has substantial groundwater and surface water storage within its service area. Much of this supply is used annually during high demand months and replenished during low demand months. When Metropolitan has storage and MWA has supply in excess of needs, MWA could deliver its excess supply to Metropolitan for either storage or used in lieu of using stored water.
- As SWP contractors, both MWA and Metropolitan have access to supplemental water from the SWP under Article 21 and other programs.
- From 2005 through about 2020, MWA will have SWP Title A supplies that it would not normally take due to restrictions on recharge capacity, funds, and/or demands for makeup

and replacement water from subarea producers. Delivery of these supplies to Metropolitan as part of a time-shift exchange would thus have no effect on MWA supplies and deliveries of groundwater to subarea producers.

- Pre-delivery of supplies to Metropolitan would reduce the bank balance to be returned in dry years, thus reducing the potential need for direct delivery of banked groundwater.
- All deliveries from Metropolitan to MWA would be recharged. The net change in stored groundwater is thus equal to the total volume of water delivered to Metropolitan plus a percentage of the 10% loss factor.

The approach taken to banking, exchanges, and returns from banking is a significant variable in determining Proposed Project magnitude, feasibility, cost, and impacts. Facility size, capacity, and use will vary based on whether a traditional banking program is adopted or whether elements of on-going water exchanges are included in the program. Local agency participation will also help determine the feasibility of using an in-lieu approach to any required direct return.

3.1.6 Riparian Restoration Features

The 1996 adjudication provides for efforts to restore riparian vegetation directly and through water management that may incidentally enhance natural habitats. For example, removal of tamarisk may reduce groundwater use by this non-native weed and incidentally allow for recolonization of the riverbank by willows and cottonwoods, which provide superior habitat and use less water than tamarisk. In addition, groundwater banking may raise groundwater levels to the root zone of willows and cottonwoods, thereby enhancing potential for the restoration of riparian vegetation.

3.1.7 Summary

Each Proposed Project alternative will represent a mix of physical facilities and operational elements. Given the large number of "high" priority recharge and water supply projects identified in the 2004 Regional Water Management Plan and 2004 PEIR, it is evident that there are numerous ways in which these various projects and operations elements could be combined into alternatives. In addition, during scoping of this EIR, the public suggested an additional approach to water conveyance, specifically to conveyance of water supplies from MWA to Metropolitan through construction and operation of a pipeline/canal from the Morongo Basin to the Colorado River Aqueduct.

3.2 Initial Screening of Facility Alternatives

3.2.1 A General Summary of the Screening Process

3.2.1.1 Rationale for focusing on facilities

The Proposed Project's objectives would logically lead to a program that includes operational elements of traditional water banking and modified water banking that includes water exchanges. For practical purposes, both water banking and exchange require available storage, the ability to convey water to this storage, and the ability to return and/or utilize the stored water. MWA does not have access to surface storage, so it must use the overdrafted groundwater basins within its service area for this purpose. Under both banking and exchange scenarios, MWA also does not currently deliver water directly to subarea producers (with the exception of the City of Victorville). This would require construction and operation of a treatment plant. Under all circumstances, the Proposed Project will thus require new facilities for recharge, for conveyance of water, for extraction and distribution, and for return of banked water to Metropolitan or another partner.

3.2.1.2 Approach to facility screening

The location and capacity of facilities to a large extent determines the potential for direct exchange, for banking, for direct return, and for programs involving local use of banked supplies in-lieu of using SWP supplies. Facility siting and analysis of facility capacity and cost are thus a logical initial step in the formulation of alternatives. Accordingly, the first phase of alternative screening was undertaken by Bookman-Edmonston in Association with Science Applications International Corporation (B-E 2004a, B-E 2004b, B-E 2004c, and B-E 2005a, B-E 2005b, and B-E 2005c). In various phases of the initial screening, the following issues were addressed:

- Hydrogeology and water quality
- Environmental and Regulatory Constraints
- Capital and Operations Costs
- Land Use

The initial screening involved meetings with MWA's Technical Advisory Committee and with key local agencies (agencies in the vicinity of the California Aqueduct and thus able to participate actively in banking and exchange). Agencies specifically consulted during the screening (B-E 2004c) were:

- Hesperia Water District
- Victor Valley Water District
- Baldy Mesa Water District
- San Bernardino County Special Districts 70J and 70L.

The first phase of initial alternatives screening was focused on the full range of facility options described in the 2004 Regional Water Management Plan and its 2004 PEIR. These alternative facilities were examined to determine whether there were "fatal flaws" associated with their functioning as part of a long-term water banking and exchange program. Alternative sites for facilities were eliminated if they:

- Would be sites in an area of inappropriate soil conditions such that recharge and extraction of recharged water would be impractical;
- Would involve significant adverse impacts to threatened or endangered species;
- Would not be feasible institutionally; and/or
- Would violate the principles and terms of the 1996 adjudication or the Warren Valley Basin Judgment.

Facility alternatives that were not eliminated based on fatal flaws were next evaluated in terms of their capital cost and their capacity (their ability to meet a substantial portion of the Proposed Project need). This secondary screening was focused on facilities for recharge, which were ranked based on:

- Annual capacity for recharge;
- Cost range (total cost and cost per acre-foot);
- Ability to receive large volumes of water in a short period of time;
- Proximity to the California Aqueduct;
- Operational flexibility; and
- Potential for multiple use and thus for cost-sharing.

Each recharge facility was evaluated based on its practical capacity to receive and store supplemental water supplies. For example, the potential for recharge in the Morongo Basin was evaluated based on the capacity of the existing Morongo Basin Pipeline.

Facilities for water extraction and for return of supplies to any MWA banking partner such as Metropolitan were then evaluated (Bookman-Edmonston 2004a). Infrastructure requirements were evaluated under the assumption that MWA would retain a minimum of 12,000 acre-feet per year of its Table A SWP water for use in the MWA service area, even in dry years. The remaining Table A SWP supply would therefore be available to exchange, thus reducing the need to pump groundwater and return it back to the California Aqueduct. The screening evaluation assumed that MWA would, on average, have about 40,000 acre-feet of SWP Table A supply in years when Metropolitan requested a return of banked water. Thus, on average, there would be 28,000 acre-feet per year of SWP supply available to make returns of banked water. The use of MWA's SWP Table A supplies as a means for returning banked water to Metropolitan therefore minimized the size and cost of facilities for direct pumping and return of groundwater.

Using this process, a variety of extraction and return scenarios were evaluated based on conceptual MWA/Metropolitan banking/exchange programs of different magnitude. The evaluation initially focused on defining the amount of water which would need to be pumped and returned to Metropolitan in any given year of the conceptual project, based on the following assumptions:

- Net supply would be from 75,000 to 450,000 acre-feet.
- Metropolitan would request equal annual returns from the bank over a 5-year period. Returns would therefore range from 18,000 acre-feet/year to 90,000 acre feet/year.
- To the extent that during dry years returns could not be made via exchange, MWA would need to pump groundwater and return it to the California Aqueduct.

Actual operation of the banking program would vary from these assumptions, but they provided a basis for comparing the relative capital and operations costs associated with extraction of groundwater and conveyance of this water to the California Aqueduct for return to Metropolitan. Using this methodology, the extraction and conveyance costs associated with four potentially feasible recharge areas were evaluated:

- Alternative T1. Extraction and conveyance from recharge basins along the Mojave River Pipeline between Baldy Mesa Road and Coughlin Road north of the California Aqueduct in the Alto subarea, with conveyance via the Mojave River Pipeline;
- Alternative T2. Extraction and conveyance from recharge basins along the Morongo Basin Pipeline east of the Mojave River, with conveyance via the Morongo Basin Pipeline;
- Alternative T3. Extraction and conveyance from a series of recharge basins in Hesperia and within the Mainstem Mojave River, with conveyance via (a) existing municipal pipelines and (b) new pipelines directly to the California Aqueduct;
- Alternative T4. Extraction and conveyance from recharge basins in the Oeste subarea along the California Aqueduct north of Phelan. Recharge basins were considered both north and south of the California Aqueduct in the 8.8-miles from Caughlin Road to Oasis Road, with conveyance directly from wells to the California Aqueduct via new pipelines;

In addition, the screening evaluation addressed the potential for MWA to meet a requested return with its SWP Table A supply. This analysis assumed that in an average year when Metropolitan might request return of some banked water, MWA would have about 40,000 acre-feet of available SWP Table A supply. The assumption was also made that MWA would retain about 12,000 acre-feet for use within its service area, making 28,000 acre-feet available each year. The Bookman-Edmonston/SAIC screening evaluation concluded by combining various recharge and extraction facilities and comparing net costs for recharge, extraction wells, conveyance pipelines and canals, and operations/energy costs:

- Eleven small projects (75,000 acre-feet of banked supply)
- Twenty-two small-to-medium-sized projects (150,000 acre-feet of total banked supply);
- Sixteen medium-sized projects (225,000 acre-feet of total banked supply);
- Twenty medium-to-large sized projects (300,000 acre-feet of supply); and
- Fifteen large-scale projects (450,000 acre-feet of total banked supply).

These combinations of facilities were evaluated to obtain information about the relative costs of small, medium, and large projects and to determine some of the key factors responsible for these costs.

3.2.1.3 Screening based on Water Quality

As a final step in alternative screening, the 2004 Regional Water Management Plan and its 2004 PEIR were reviewed to evaluate the water quality implications of potential recharge and extraction sites. Water quality is an important issue for both MWA and Metropolitan. State Water Project water has different characteristics than the indigenous groundwater of MWA's service area. These differences in water quality may affect the suitability of water for use. In addition, there are general non-degradation policies in effect for both (a) water delivered to MWA and (b) water returned to Metropolitan via the California Aqueduct.

3.2.2 Screening Variables: Hydrogeology and Water Quality

Groundwater recharge is generally not suitable in areas with extensive layers (lenses) of clay soils, because these soils slow down the movement of water through the soil (percolation rates) and often contain minerals that may leach out of the soil during recharge, resulting in contamination of groundwater. Screening to avoid such sites was therefore an important element of the alternative screening process. Also, with low percolation rates, water to be recharged remains on the surface and evaporates. Therefore, areas of the Regional Aquifer known to have clay soils were eliminated from consideration for recharge and extraction facilities. Other factors included in the hydrogeologic screening were:

- Storage Capacity: The groundwater basin must have capacity to receive the anticipated quantities of supplemental water.
- Lateral Movement: The soils must allow for movement of groundwater laterally towards locations where it will be extracted. Faults and other hydrogeologic barriers should not impede this movement.
- Geochemical Compatibility: The chemicals in the SWP supply and the groundwater must not interact to cause minerals to come out of solution (precipitation) and clog the aquifer.

The supplemental water brought into the MWA service area for recharge under the Proposed Project will be from SWP or other Central Valley supplies (if available). These SWP supplies are of generally good quality, with total dissolved solids (TDS) of about 200 to 400 mg/l (average about 280 mg/l). The indigenous groundwater in some parts of the MWA service area is of marginally better quality, particularly the Mojave River Aquifer in the Alto subarea from Mojave Forks Dam to the Narrows. In the Regional Aquifer and in the Mojave River Aquifer downstream from the Narrows, water quality is frequently worse than SWP supplies. This pattern generally holds for a variety of constituents, although SWP water is almost always lower in arsenic (average 2 µg/l or 2 parts per billion) than the groundwater in the MWA service area, where average arsenic levels range from about 1.7 µg/l to over 70µg/l. The trend is reversed for nitrates, where SWP nitrate concentrations almost always exceed those of the MWA groundwater. Supplemental water delivered to groundwater may therefore marginally increase total dissolved solids, depending on the season in which it is imported, but will almost universally reduce concentrations of arsenic.

Water quality is a concern for both MWA and its potential partner, Metropolitan. MWA would prefer to import low-TDS water supplies, which will dilute the higher concentrations of TDS and arsenic in lower-basin water supplies. Metropolitan would be concerned about return supplies from areas where indigenous groundwater is very high in TDS, chromium VI and arsenic.

3.2.3 Screening Variables: Regulatory Constraints

The primary constraints on facility siting for water banking and exchange are (a) the presence of the endangered arroyo toad and (b) the 1996 adjudication. The endangered arroyo toad has been found in the West Fork of the Mojave River and in the vicinity of Mojave Forks Dam. It breeds and its young require slow moving pond habitat to mature from early spring through late September to early October. Rapidly flowing water may adversely affect this species. The 1996 adjudication obligates MWA to attempt to equitably distribute supplemental supplies to the various subareas. All parties to the 1996 adjudication are enjoined from "transporting water hereafter Produced from the Basin Area to areas outside the Basin Area." There are also Regional Water Quality Control Board policies governing potential degradation of groundwater.

3.2.4 Screening Variables: Costs

Under the 1996 adjudication, MWA is obligated to secure supplemental water and to establish "fair and equitable prices for Supplemental Water delivered to the Watermaster." Consideration of cost was therefore a basis for an initial screening of facility alternatives. These analyses examined the construction and operations costs of recharge, extraction, and conveyance facilities, both new and existing, within the context of a hypothetical water banking program between MWA and Metropolitan. Passive recharge facilities were evaluated; injection wells were not given detailed evaluation due to water quality concerns (injected water is judged to require treatment to drinking water standards prior to injection). Development of a large regional water treatment plant was also evaluated. Cost categories included:

- Land and rights-of-way. Land and right-of-way costs were based on current data from land sales within the general areas evaluated.
- Construction. Capital costs of facilities were evaluated based on typical industry costs.
- Energy. Energy costs were evaluated based on $0.12/kWh.

Combined capital and energy costs in excess of $200 to $300 per acre-foot were considered prohibitive, as the cost of SWP supply is currently at about $160 per acre-foot.

3.2.5 Screening Variables: Land Use

Portions of MWA's service area are undergoing relatively rapid development, particularly in the Hesperia, Victorville, Apple Valley, and Adelanto areas, as well as in the Barstow area. In these areas, siting of recharge and other facilities would be constrained by existing and planned development. Siting of large recharge basins could potentially divide existing and planned communities in these areas.

3.3 Results of Initial Facility Screening

Except for facilities with "fatal flaws," the purpose of initial screening was not to eliminate facilities or operations options, but to provide insight to assist in formulating alternatives that could reasonably be expected to meet Proposed Project objectives in a cost-effective manner. A fundamental assumption of the Proposed Project is that all subareas will have an opportunity to participate in water banking and exchange under the Proposed Project. The screening evaluation affects the formulation of facility and operational elements in the various subareas.

3.3.1 Fatal Flaws: Use of Mojave Forks Dam

Use of Mojave Forks Dam for recharge would probably not be feasible given potential high impacts to the endangered arroyo toad, high evaporation rates, and regulatory/management issues associated with conversion of this flood control facility to a dual-purpose facility. The Corps of Engineers indicated that conversion of this facility from flood control to a dual-purpose facility would require a local agency to assume full operating costs. These costs would be prohibitive and San Bernardino Flood Control District indicated that it would be unable to assume these costs. Permitting would also be virtually impossible given the status of the endangered arroyo toad. Use of Mojave Forks Dam for water supply was eliminated from further analysis.

3.3.2 Post-Screening Analysis of a Facility Alternative not evaluated in the General Screening Process

~~During the initial 30-day period of public scoping comments following issuance of the Notice of Intent to Prepare an Environmental Impact Report, a new approach to return of banked water to Metropolitan was proposed at the April 27, 2005 meeting of the MWA Technical Advisory Committee.~~ *

** The above has been deleted per response to comment from Mr. Chuck Bell, who noted that (a) MWA had misinterpreted his comments and (b) it was not his intention to suggest the alternative that is described in the following analysis. This editorial change does not affect the analysis below, which concluded that the alternative is not feasible.*

The initial screening analysis (see below) had tentatively concluded that banked water from Metropolitan (or other partners) could be recharged in the Johnson Valley and Morongo Basin areas, but that the costs of pumping this groundwater and returning it directly to Metropolitan via the California Aqueduct would be prohibitive. In addition, the volume of water which could be delivered via the Morongo Basin Pipeline would not make up a significant part of the total return to Metropolitan. The initial screening analysis also noted that the inability to directly return water to Metropolitan would not affect the potential for Producers in these areas to participate in the banking program, because during years when MWA was returning banked water to Metropolitan, they could pump groundwater and use this banked water in-lieu of receiving SWP supplies, which would then be available for MWA to exchange with Metropolitan.

The suggested new alternative would involve delivery of banking supplies to the Morongo Basin/Lucerne Valley, where they could be recharged in existing recharge basins and then stored until needed. When Metropolitan requested return of banked supplies, they could be returned directly from the Lucerne Valley via the Morongo Basin Pipeline and/or a new pipeline to the Colorado River Aqueduct. At its nearest point to the terminus of the Morongo Basin Pipeline, the Colorado River Aqueduct is in tunnel. A connection could be made following the alignment of State Highway 62, which intersects the Colorado River Aqueduct about 10 miles from the terminus of the Morongo Basin Pipeline.

This alternative was evaluated assuming:

- A new 24" pipeline connecting the Morongo Basin recharge basins to the Colorado River Aqueduct would cost approximately $126 per linear foot. This is about 1.5 times the cost of pipelines in the Alto Basin because the pipeline would be a high pressure pipe. The cost of the pipeline to the Colorado River Aqueduct would be about $6,650,000;
- Metropolitan's delivery of water to be banked would occur in 3 out of 10 years, during wet years, and the water would be delivered to Morongo Basin over a period of 6 months;
- Deliveries of Metropolitan water for banking in the Morongo Basin recharge areas would be at a rate of 15 cfs, or 30 acre-feet per day. With 15% down time for maintenance and repair, this would result in 155 days of delivery for a total of 4,650 acre-feet x 3 years = 13,950 acre-feet of total banked storage in Morongo Basin.
- Assuming a standard conveyance and recharge holdback of 10%, the total volume of banked water in the Morongo Basin would be 12,550 acre-feet.
- Return of banked water supplies would take place over a period of 3 years, at a rate of about 4,180 acre-feet per year, to be delivered over 9 month period;
- Total extraction capacity in the Morongo Basin is about 1,200 acre-feet per year. Additional wells capable of extracting 2,920 acre-feet per year would be required, an additional 3-4 production wells would be required at a cost of about $500,000 each.
- There would be no energy cost associated with returns from the Morongo Basin to the Colorado River Aqueduct.

Based on these assumptions, the capital costs of delivering 12,550 acre-feet of banked water in the Morongo Basin to Metropolitan via a pipeline to the Colorado River Aqueduct would be:

- Pipeline cost: $6,650,000
- Well cost: $2,000,000
- Total cost: $8,650,000
- Cost per acre-foot: $689

This cost does not include operation and maintenance or the cost of energy. A per-acre-foot cost of about $700 is approximately 2.7 times the current cost of banked water from the three primary Metropolitan cooperative water banking programs in Kern County. It is also approximately 4.5 times the cost of delivering exchange water to Metropolitan and allowing Producers in the Morongo Basin to utilize banked water in-lieu of taking SWP supplies. For these reasons, return of banked supplies via a new pipeline from the Morongo Basin to the Colorado River Aqueduct was eliminated from consideration.

3.3.3 Morongo Basin/Johnson Valley

3.3.3.1 Hydrogeology and Water Quality

The Morongo Basin/Johnson Valley area has existing and planned groundwater basins and there is conveyance to these facilities via the Morongo Basin Pipeline, which has capacity to deliver about 15 cfs (30 acre-feet per day or a maximum of 10,950 acre-feet in a 365-day year). Conveyance capacity exceeds existing recharge capacity, and is approximately 4 times the estimated annual need for supplemental supply/recharge in this area (2004 Regional Water Management Plan and 2004 PEIR). While it may be feasible to deliver supplemental water supplies to the Morongo Basin, some areas appear to have unsuitable soils for active recharge. Specifically, conditions for recharge in some parts of the Lucerne Valley are poor with clay layers in the soils that would prevent effective recharge or result in high evaporation losses during recharge.

Water quality in the Morongo Basin is variable, but generally meets drinking water standards, although in Johnson Valley average levels of sulfates are marginally higher than those allowed under drinking water standards. Comparing average levels of water quality constituents in SWP water to the levels of the same constituents in indigenous groundwater (2004 PEIR) suggests that recharge of SWP supplies would dilute concentrations of some constituents in some indigenous groundwater basins and increase concentrations in other areas (Table 3-3).

Table 3-3. Difference between average indigenous water quality and average SWP water quality in the 4 subareas of the Morongo Basin/Johnson Valley area. Bold face type indicates that average SWP water is superior to indigenous groundwater.

WATER QUALITY CONSTITUENT	DIFFERENCE BETWEEN AVERAGE INDIGENOUS WATER QUALITY AND AVERAGE SWP WATER QUALITY (%)			
	Copper Mountain	Johnson Valley	Means/Ames	Warren Valley
Calcium	**23%**	**289%**	**42%**	**26%**
Magnesium*	174%	**386%**	163%	207%
Sulfate	**23%**	**825%**	**43%**	71%
Chloride	239%	**94%**	282%	211%
Fluoride	**1500%**	**1250%**	**1280%**	**418%**
Manganese	**348%**	20%	Same	**6%**
Iron	**160%**	**204%**	73%	10%
Arsenic	**145%**	5%	**90%**	**115%**
Boron	27%	**210%**	7%	177%
TDS	17%	**224%**	2%	28%
Nitrates	**187%**	5%	**685%**	**1005%**

Average SWP supply is better than indigenous groundwater supply in 25 of 44 cases, and is of worse quality in 18 of 44 cases. In no case would average year SWP supplies have concentrations of water quality constituents in excess of drinking water standards. The use of SWP supplies would result in improved water quality in Copper Mountain and Johnson Valley subareas, but in Means/Ames and Warren Valley supplemental supplies would have mixed effects. Based on these results, it was concluded that water quality would not preclude delivery of SWP supplemental supplies to the Morongo Basin.

3.3.3.2 Regulatory Constraints

The 1996 adjudication "is intended to provide for delivery and equitable distribution to the respective Subareas by MWA of the best quality of Supplemental Water reasonably available." MWA is obligated "to develop conveyance and other facilities to deliver Supplemental Water [to subareas] unless prevented by forces outside its reasonable control such as an inability to secure financing consistent with sound municipal financing practices and standards." Further, MWA is authorized to pre-deliver and recharge supplemental supplies, which may then be used to meet replacement and makeup obligations at a later date.

Finally, the 1996 adjudication provides that "Except upon further order of the Court, each and every Party, its officers, agents, employees, successors and assigns, is ENJOINED AND RESTRAINED [emphasis in adjudication language] from transporting water hereafter Produced from the Basin Area to areas outside the Basin Area."

Although the 1996 adjudication makes a distinction between produced water, replacement water, and supplemental water, pumping of groundwater to meet return obligations from banking is somewhat constrained by the 1996 adjudication. Pumping of banked groundwater for direct return should be limited to ensure that the ability of sub areas to produce groundwater supplies is not affected. In the Morongo Basin, the potential for local area effects, such as declining groundwater levels from pumping large quantities of stored groundwater out of the subarea, could conflict with Judgment for the Warren Valley Basin (Town of Yucca Valley and Hi-Desert Water District area).

3.3.3.3 Cost and Land Use

Land use and value were not considered constraints in the Morongo Basin, but the cost of pumping water from the Morongo Basin back to the California Aqueduct or to the Colorado River Aqueduct for return to Metropolitan would be prohibitive, both because of the need for additional pumping and conveyance facilities and because of high energy cost to pump supplies upgrade over long distances.

Morongo Basin could participate in water exchange and water banking programs through an in-lieu program. Supplemental water in excess of demands could be delivered, stored, and accounted for by the MWA under their storage account with Watermaster. In years when exchanges or returns from water banking required use of MWA's SWP Table A supplies, this stored water could then be pumped and used by subarea Producers in-lieu of receiving supplemental SWP supplies.

3.3.4 Mojave Basin

3.3.4.1 Hydrogeology and Water Quality

Soils: Soils and recharge conditions vary in the Mojave Basin Regional Aquifer. Soils in the southern portion of the Alto and Oeste subareas were considered suitable for recharge, with estimated recharge rates of about 0.5 feet per day. In the northern portion of the Alto subarea, near George Air Force Base and the City of Adelanto, lenses of clay soils would limit recharge, these lenses of clay potentially extending to areas south of the High Desert Power Project.

Soils in the bed of the Mojave River Mainstem and in the immediate floodplain contain high sand and gravel content and recharge rates for the Mojave River Aquifer were conservatively estimated to be 2 to 3 feet per day. The MWA 2003-2004 demonstration project documented recharge of the Mojave River Mainstem at a rate of up to 350 to 400 cfs, or 700 to 800 acre-feet per day. Equivalent recharge at an Alto or Oeste subarea Regional Aquifer site (at an estimated 0.5 feet per day) would require a recharge basin with a useable capacity of 1400 to 1600 acres, or about 2000 total acres). In the Mojave River Transition Zone downstream of the Narrows, the floodplain aquifer has clay and silt layers of low permeability and would not be suitable for large volume recharge. In the Baja and Centro areas, there are existing and planned recharge basins in the floodplain aquifer.

Soils in Alto and Oeste subarea washes leading to the Mojave River have been investigated and MWA has conducted a pilot project in Oro Grande Wash that demonstrates suitable recharge conditions.

Basin Storage Capacity: Throughout the Mojave Basin, historic overdraft has lowered groundwater levels by as much as 100 feet and there is substantial capacity in the Regional and the Mojave River Aquifer. Most of the overdraft occurred in the Centro and Baja subareas, which had 750,000 and 1.1 million acre-feet of overdraft, respectively (USGS 2001). Historic overdraft has been lowest in the Este and Oeste subareas. The Mojave River Aquifer immediately below the river channel has limited storage capacity because groundwater moves downslope to the Narrows where it is forced to the surface. The initial screening analysis estimated that, at any given time, storage in the Mojave River Aquifer between Mojave Forks Dam and the Narrows is about 61,000 acre-feet. Storage in excess of this would flow to the Alto Transition Zone.

Basin Water Quality: Water quality in the various aquifers of the Mojave Basin is also a concern. The 2004 PEIR provides data on water quality by subarea and aquifer. Table 3-4 summarizes these data in terms of whether groundwater quality meets California drinking water standards. Downstream from the Alto Transition Zone to the Baja subarea, water quality in the Mojave River Aquifer declines rapidly. A similar trend is seen in water quality in the Regional Aquifer. The magnitude of some of the deviations from drinking water standards is great, and data from the 2004 PEIR also show deviations from the average quality of water from the State Water Project. In the Alto and Oeste Regional aquifers and the Mojave River Aquifer south of the Narrows there is only one violation of an average standard (the 18% violation of average arsenic standards in the Alto Regional Aquifer). Blending of low-arsenic supplies from the SWP could have dilution effects related to arsenic; blending the otherwise good quality indigenous groundwater with SWP supplies could have beneficial effects on the quality of banked water directly returned to the California Aqueduct.

In addition to average water quality within each region that may violate drinking water standards, various wells in each area may have much higher levels of constituents such as arsenic, boron, manganese, and TDS.

Table 3-4. Average California Drinking Water Quality standards violated by groundwater in subareas of the Mojave Basin. (2004 PEIR)

SUBAREA	AVERAGE DRINKING WATER QUALITY STANDARDS VIOLATED In mg/l (parts per million) or µg/l (parts per billion)		
Alto	None		
Alto Narrows	None		
Oeste Regional	None		
	Constituent	Standard (Maximum Limit)	Average Concentration
Alto Transition	Arsenic	5 µg/l	12.6 µg/l
	TDS	500 mg/l	518 mg/l
Centro Floodplain	Manganese	50 µg/l	147 µg/l
	Boron	600 µg/l	771.6 µg/l
	TDS	500 mg/l	785 mg/l
Baja Floodplain	Arsenic	5 µg/l	10.4 µg/l
	Boron	600 µg/l	931 µg/l
Alto Left	Arsenic	10 µg/l	11.8 µg/l
Centro Regional	Arsenic	10 µg/l	13.4 µg/l
	Boron	600 µg/l	1351 µg/l
Baja Regional	Arsenic	10 µg/l	73.9 µg/l
	Boron	600 µg/l	1124.7 µg/l
	TDS	500 mg/l	529.5 mg/l

3.3.4.2 Regulatory Constraints

The principal regulatory constraints on water banking and exchange programs in the Mojave Basin were:

- Arroyo toad.

The presence of the arroyo toad in the West Fork of the Mojave River and near Mojave Forks Dam would limit delivery of supplies to the Mojave River Mainstem from Silverwood Lake to the months of October through February.

- 1996 Adjudication

The 1996 adjudication "is intended to provide for delivery and equitable distribution to the respective Subareas by MWA of the best quality of Supplemental Water reasonably available." MWA is obligated "to develop conveyance and other facilities to deliver Supplemental Water [to subareas] unless prevented by forces outside its reasonable control such as an inability to secure financing consistent with sound municipal financing practices and standards." Further, MWA is authorized to pre-deliver and recharge supplemental supplies, which may then be used to meet makeup obligations at a later date.

Finally, the 1996 adjudication provides that "Except upon further order of the Court, each and every Party, its officers, agents, employees, successors and assigns, is ENJOINED AND

RESTRAINED [emphasis in adjudication language] from transporting water hereafter Produced from the Basin Area to areas outside the Basin Area."

Although the 1996 adjudication makes a distinction between produced water, replacement water, and supplemental water, pumping of groundwater to meet return obligations from banking is somewhat constrained by the 1996 adjudication. Pumping of banked groundwater for direct return should be limited to ensure that the ability of subarea producers to maintain their allowed production under the 1996 adjudication is maintained.

3.3.4.3 Capital and Energy Costs

The final screening of various potential combinations of facilities and operations scenarios yielded costs per acre-foot of supply of from $0 to $765, with the range of prices varying by project size:

- Small projects: $0 to $568
- Small to medium sized projects: $196 to $765
- Medium sized projects: $343 to $595
- Medium to large sized projects: $376 to $629
- Large-sized projects: $420 to $737

Several trends were evident in these cost data. First, only alternatives involving exchange of MWA SWP Table A supplies to return banked supplies to Metropolitan resulted in net project costs of less than $300 per acre-foot. Second, use of existing facilities for recharge and use of exchange as a means of returning water to Metropolitan resulted in facility and operations combinations that resulted in the lowest cost. Third, facility and operations costs associated with groundwater extraction and direct return of groundwater to Metropolitan increased rapidly with total project size due the need for proportionally greater use of direct return as project size increased. The initial screening assumed that from 10,000 to 28,000 acre-feet of MWA SWP Table A water would be available for exchange in-lieu of pumping water from the bank and returning it directly to the California Aqueduct. Project costs therefore increased rapidly when the volume of banked water to be returned to Metropolitan exceeded 10,000 acre-feet per year (low threshold) or 28,000 acre-feet per year (high threshold).

Fourth, capital costs for land acquisition in the vicinity of Hesperia, Victorville, Adelanto, and Apple Valley were also a significant component in the cost of larger projects. There is only minimal capital and operational cost for using the Mojave River Mainstem, and recharge rates in this area are 4 to 6 times higher than those in areas outside of the river floodplain. High land costs also led to the conclusion that alternatives involving facilities in these areas should therefore make maximum possible use of recharge in the Mojave River Mainstem, along local washes, and where multi-agency objectives can be met (such as at offstream flood detention basins).

Finally, capital and energy costs were higher for all facilities located at a distance of about 3 to 5 miles from the California Aqueduct, because returning water would necessarily require pumping uphill. For these facilities, the cost of well, pipelines, pumps, and energy to return stored water to the California Aqueduct significantly exceeded the cost of using exchange to return banked supplies to Metropolitan Capital and energy costs were lower for recharge/extraction sites near the California Aqueduct, but costs for land and facilities construction remained a substantial portion of overall cost. Energy costs for pumping water from deep groundwater basins in the Regional Aquifer were a substantial component of overall project costs associated with facilities in the Oeste and Alto subareas.

3.3.5 Water Treatment Plant Alternative

A water treatment plant to replace current reliance on groundwater by allowing for treatment and direct use of exchange/banking supplies would not be feasible as an element of a water exchange and/or banking program because treatment plants require a steady delivery rate and water exchange and banking programs are based on the need to capture the variable component of water supply. If the experience of water banks in the Central Valley is representative, then Metropolitan (and other banking partners) would deliver supplies to MWA in relatively large quantities over relatively short periods of time.

A water treatment plant was not eliminated from future consideration, but was determined not to be a suitable approach to an exchange and banking program the function of which is to optimize use of variable supplies. For example, a water treatment plant would not be able to accommodate high-volume short-term deliveries of Metropolitan supplies from San Luis Reservoir or from purchase of Article 21 supplies.

3.4 Formulation of Alternatives for Detailed Consideration

The results of screening provided a quantitative basis for formulation of a final array of Proposed Project alternatives, based on the following conclusions:

1. High energy costs and limited capacity in existing facilities would make direct return from the areas served by the Morongo Basin Pipeline infeasible from a cost perspective. In addition, additional conveyance facilities would not be needed because these areas have relatively low supplemental recharge needs (2004 PEIR) and existing conveyance capacity substantially exceeds the projected supplemental recharge need. These areas have significant potential for groundwater recharge at existing facilities and could participate fully in the Proposed Project with banked supplies returned via water exchanges.

2. Based on the screening analysis, it is apparent that from a hydrogeologic perspective that the best sites for recharge (high percolation rates) and for groundwater quality (fewest and least significant violations of water quality standards) are in the Alto and Oeste areas. Recharge rates and water quality are best in the Alto portion of the Mojave River Aquifer south of the Narrows. Direct return of banked water from these areas is potentially feasible.

3. High facility and energy costs, along with lesser water quality in the Mojave River Aquifer and the Regional Aquifer in the Alto Transition, Centro, and Baja subareas would probably preclude direct return of banked supply from these areas to the California Aqueduct. Participation of these subareas in banking would thus require return via water exchanges.

4. In the Regional Aquifer, low groundwater permeability results in a need for large recharge basins and numerous wells ($750,000 each). Facility costs in the Regional Aquifer in the Alto and Oeste areas would be high because land costs are rapidly rising and because of the number of wells required to extract banked groundwater.

5. The capacity of the Mojave River Aquifer between Mojave Forks Dam and the Narrows was estimated at 61,000 acre feet. In addition, water stored in the Mojave River Aquifer in this reach eventually spills into the Narrows, passing downstream to areas with poor water quality and limited ability to provide for recharge. To make full use of this aquifer would require MWA and local agencies to develop a well field along the river above the narrows to withdraw banked water for use in Hesperia, Victorville, Apple Valley, and Adelanto (including George Air Force Base). The water provided in this manner would be used in lieu of pumping at sites in the Regional Aquifer. In addition, off-stream recharge along the Mojave River in this reach could potentially increase net storage in the aquifer and increase the ability of the aquifer to receive and treat water received from the SWP.

6. Because of high land costs, recharge in the Alto and Oeste aquifers should be focused on (a) use of multi-purpose sites, such as proposed floodwater detention basins along local washes and (b) use of recharge sites immediately adjacent to the California Aqueduct.

7. Traditional banking operations should be combined, to the extent feasible, with a program of water exchanges so that MWA can (a) optimize use of its existing SWP Title A supplies and any supplemental SWP supplies available to it and (b) by pre-delivering water to Metropolitan, minimize the magnitude of return requirements in dry years, which would minimize direct return from groundwater and thus reduce facility costs.

8. Use of the Mojave River Aquifer between Mojave Forks Dam and the Narrows as a primary recharge area would raise groundwater levels in this reach and enhance re-growth of riparian vegetation along the channel. There would be accompanying water losses to evapotranspiration by such vegetation, and these losses would need to be accounted for in analysis of alternatives. To the extent that MWA's Proposed Project would incidentally result in lower water diversions from the Narrows reach of the Mojave River, there would also be benefits to riparian vegetation in this reach. Recharge associated with banking of supplies would be intermittent, and such benefits would therefore be inconsistent and unpredictable.

3.5 Alternatives Carried Forward for Detailed Evaluation

The initial screening process effectively eliminated from consideration a suite of sites with (a) high costs, (b) important water quality problems, (c) conveyance problems, (d) environmental impacts associated with take of threatened and endangered species and riparian habitats, and (e) operational constraints unsuitable for a banking program. Based on the screening evaluation, it was also clear that benefits and costs of alternatives would increase incrementally, with the lowest costs, yields, and impacts associated with smaller projects that utilized existing facilities, the capacity of the Mojave River Mainstem, and water exchanges to make returns of banked water. As the volume of banked and exchanged water increases, there is a corresponding need for (a) additional facilities to increase recharge and extraction rates and (b) optimizing of the potential for use of water exchanges.

Based on the initial screening, then, MWA concluded that it was appropriate to develop a continuum of alternatives. The Notice of Preparation initially described a potential alternative involving only use of existing facilities, but this alternative was eliminated from individual consideration based on findings of the 2004 PEIR that additional recharge in the Alto subarea was a high priority. This continuum of new facility components was therefore broken into three distinct facility alternatives for the purpose of evaluating relative impacts of logical increments of facility development and to accommodate modeling of the water management aspects of the Proposed Project. However, throughout the EIR, impacts have been described in terms of each increment of facility development so that the relative impacts of any combination of facilities could be rapidly determined by the Mojave Water Agency Board of Directors. The logical progression represented by the three groupings of facilities -- from the Minimum Facilities Alternative with permanent effects to land use of less than 20 acres to the Large Projects Alternative with permanent effects to land use of over 800 acres -- provides MWA's Board of Directors with a set of choices with progressively greater benefits and associated impacts. The largest-scale alternative includes the elements of the smaller-scale alternatives.

Following the intensive screening program that eliminated many alternative facilities and approaches to meeting MWA needs, this incremental approach to alternative formulation is intended to help the MWA Board of Directors identify an optimal mix of recharge and associated facilities:

- No Project Alternative

  Under this alternative, no banking and exchange program would occur. MWA would continue to operate its existing facilities and to plan and construct new recharge and conveyance facilities on an as-needed basis to accommodate increasing deliveries of SWP supplies for recharge to meet on-going (rising) needs to deliver imported water to water producers in the MWA service area.

  The No Project Alternative was defined in the context of MWA's on-going obligations to provide imported water for producers in the various subareas of MWA's service area. As noted above and documented in the 2004 Regional Water Management Plan and the 2004 PEIR, over the 15-year period from 2006-2020, MWA will import and recharge about 750,000 acre-feet of SWP supply to meet projected water supply needs.

The No Project Alternative is therefore not the existing baseline condition. Regardless of whether the Proposed Project for banking and water exchange is approved and implemented, MWA will, as documented in the 2004 PEIR, import an increasing amount of water to meet these water supply needs. The recharge and conveyance of this water to subarea producers will require facilities, which are described in general in the 2004 PEIR and will be developed over a period of years. It is likely that MWA would develop these facilities in cooperation with local subarea producers and, by 2025, would develop recharge and extraction facilities of similar capacity to those for the Proposed Project. It is likely that MWA would continue to use existing recharge outside of the Alto and Oeste subareas. It is likely that MWA would develop additional recharge in the Oeste and Alto subareas. It is likely that use of various local flood detention basins for recharge would be pursued. It is likely that some additional off-channel Mojave River recharge would be pursued, as this recharge would have substantially higher recharge rates than other sites.

The No Project Alternative therefore reasonably assumes that many of the Proposed Project facilities would be pursued, consistent with the 2004 PEIR. Indeed, this Project EIR addresses the project-specific impacts of these facilities and is intended to provide the MWA Board of Directors and the public with site-specific information regarding the potential for impacts associated with these facilities. The banking and exchange elements of the Proposed Project accelerate the need for these facilities and increase the volume of water deliveries to them. Under the Proposed Project, the magnitude of facilities required to meet combined banking and MWA uses of facilities may be greater than under the No Project Alternative.

The No Project Alternative therefore contemplates development of at least a subset of the facilities described in this Project EIR or their equivalent in capacity; it assumes only that these facilities would be developed at a slower rate. The difference in impact analysis for each of the facilities is therefore a function of (a) the total magnitude of impacts and (b) alternative siting, and (c) timing of construction and associated construction-related impacts.

On a facility-by-facility basis, the magnitude of impacts would not be changed significantly. Changes in impact may occur under the No Project Alternative if the sites evaluated in this Project EIR were rendered unavailable by future conditions, such as by development of the site. In this case, alternative sites would have to be developed. It is unlikely that future development would affect the following elements of the Proposed Project:

(1) Instream Mojave River Recharge (Use of the Mainstem river for recharge would not be constrained by future development because no development of the Mainstem Mojave River channel is possible.)

(2) The Mojave River Well Field and Pipelines. (Construction and use of these facilities would not be constrained by future development because these facilities require a small amount of land and right-of-way and may be integrated into the land uses proposed for the area along the Mainstem Mojave River between Rock Springs and Bear Valley Road. Without a banking program, the pipeline would not be extended to the California Aqueduct.)

(3) Use of existing and planned flood detention basins. (Use of planned flood detention basins would not be constrained by future development because if local entities construct these facilities as planned, their use for groundwater recharge would be compatible with their intended flood management uses, and they may be assumed to be available for this purpose.)

(4) Oro Grande recharge. (Recharge within Oro Grande Wash would not be constrained by future development because development in this large wash would be prohibited by flood damage concerns.)

(5) Antelope Wash recharge. (Recharge within Antelope Wash would not be constrained by future development because development in this large wash would be prohibited by flood damage concerns.)

(6) Unnamed Wash. (MWA proposes to cooperate with the developer of Rancho Las Flores in siting and designing facilities for delivery of water via Unnamed Wash, and thus future development is unlikely to constrain its use for conveyance of water from the California Aqueduct to the Mainstem Mojave River. MWA's Proposed Project would also contain flood flows in the wash to the 100-year floodplain, and thus would not affect development potential in downstream reaches of the wash which are outside of Rancho Las Flores.)

There is, however, potential for future development to affect the siting of recharge basins and associated facilities for off-channel recharge along the Mainstem Mojave River and at the Oeste and Alto recharge sites. Under the No Project Alternative, these facilities might not be developed immediately and re-siting of these facilities could be required by prior development. To meet local needs, it is assumed that extraction wells at these sites would continue to be necessary, but pipelines to the California Aqueduct would not be required.

The ultimate magnitude of the facilities required under the No Project Alternative would probably be similar to that required for the Proposed Project, because by 2020-2025, MWA will need to import and recharge its full SWP contract supply of up to 75,800 acre-feet in years when this amount is available and any Article 21 water that it could obtain as well. This may be necessary to pre-deliver supplies for storage to meet demands in dry years. Following 2020-2025, MWA may also need to acquire and recharge additional supplies to meet increasing demands. This volume of import and recharge would be approximately equal to that of combined MWA and Metropolitan deliveries to banking during the period 2006 through 2015. In addition, greater recharge capacity is important to MWA in order to optimize delivery during periods when SWP water quality is best.

Timing of facility development would also be different under the No Project Alternative. Facilities may be brought on line in an incremental or phased manner over a decade or more, whereas the Proposed Project may require more rapid development of facilities to accommodate the combination of Metropolitan and MWA delivery and recharge of SWP supplies for both banking and to meet in-basin water demands.

- Minimum Facilities Alternative:

The Minimum Facilities Alternative would represent the lowest cost and lowest direct environmental impact approach. It combines optimal banking use of existing facilities and use of the Mainstem Mojave River for recharge. This alternative would be evaluated in terms of both a traditional water banking program and a program that optimized the use of available MWA supplies in an on-going exchange program with Metropolitan.

- Small Projects Alternative:

A Small Projects Alternative was formulated to include all aspects of the Minimum Facilities Alternative and the development of the most cost-effective additional recharge and groundwater extraction facilities identified in the screening evaluation. Again, this alternative would be evaluated in terms of both a traditional water banking program and a program that optimized the use of available MWA supplies in an on-going exchange program with Metropolitan.

- Large Projects Alternative

For this alternative, an additional increment of recharge and extraction capacity would be added to the Small Projects Alternative by developing some of the larger recharge facilities explored in the screening evaluation, specifically large recharge areas along the California Aqueduct in the Alto and Oeste areas. Again, this alternative would be evaluated in terms of both a traditional water banking program and a program that optimized the use of available MWA supplies in an on-going exchange program with Metropolitan.

This incremental approach to alternative formulation (Table 3-5), allows analysis of Proposed Project benefits, costs, and environmental effects in an incremental manner. Each of the larger-scale alternatives builds on the baseline of the initial Minimum Facilities Alternative. As a result, it will be possible to evaluate the incremental benefits and impacts of adding facilities to the existing MWA water management system. The effects of each additional set of facilities can be evaluated in terms of the effect on the functioning of a traditional water bank and on the potential to optimize water management through an on-going water exchange program.

Table 3-5. Proposed Project alternatives, Mojave Water Agency Water Supply Reliability and Groundwater Replenishment Program (Modified from the April 2005 Notice of Preparation of an Environmental Impact Report)

FACILITIES	RETURN METHOD
Minimum Facilities Alternative	
Mojave River Pipeline (existing)	NA
Morongo Basin Pipeline (existing)	NA
Existing recharge basins at Hodge, Lenwood , Daggett, and Newberry Springs, and Green Tree detention basin (existing or already planned)	Exchange
Morongo Basin recharge basins at Warren Basin (existing)	Exchange
Mojave River mainstem (in river berms)	Direct Return & Exchange
Mojave River Well Field and Pipelines (new)	Direct Return & Exchange
Delivery of SWP supplies to Mojave River via an Unnamed Wash west of the Mojave River	Direct Return & Exchange
Small Projects Alternative: Minimum Facilities Alternative plus Small Projects	
Oro Grande Wash recharge (2 sites)	Direct Return & Exchange
Cedar Avenue Flood Control Detention recharge	Direct Return & Exchange
Antelope Wash Detention Basin (Ranchero Road) recharge	Direct Return & Exchange
Off-channel Mojave River Recharge (2 potential sites)	Direct Return & Exchange
Large Projects Alternative: Small Projects Alternative Plus Major New Recharge Basins	
Oeste Recharge Basins, Pipelines and Wells along the California Aqueduct north of Phelan	Direct Return & Exchange
Alto Recharge Basins, Pipelines and Wells along the California Aqueduct	Direct Return & Exchange
Antelope Wash Recharge downstream of the California Aqueduct	Direct Return & Exchange

Given that each facility alternative will be subjected to evaluation in terms of a traditional water banking program and an on-going water exchange program, a total of six alternatives will be evaluated. By evaluating a full range of alternatives and their environmental effects on a facility-by-facility basis, and addressing the full range of operational possibilities, the EIR will provide the public and the MWA Board of Directors with a comprehensive view of the benefits and impacts of a full range of alternatives. The Board of Directors may then make findings regarding the six alternatives and/or alternatives involving variations of the facilities and operational concepts.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 4
DESCRIPTION OF PROJECT ALTERNATIVES

4.1 Basic Operational Scenarios

All of the potential Project Alternatives are based on two potential operational scenarios: (a) traditional water banking and (b) a modified water banking and exchange program. The operational scenarios assume a 20-30-year cooperative banking and exchange program between MWA and Metropolitan, but the basic principles apply to MWA banking and exchange programs which might be undertaken involving other parties. ~~Under both traditional water banking and a modified water banking and exchange program, Metropolitan would assume the conveyance costs of all water supplies it delivers to MWA and receives from MWA.~~* The magnitude of potential programs (the volume of deliveries, storage, and returns) would not be fixed except that:

- It could not exceed Metropolitan's ability to deliver supplies to MWA over the term of the banking agreement, and
- It could not exceed MWA's ability to provide returns equal to 90% of banked supplies delivered by Metropolitan.

Within these constraints, the magnitude of potential programs would vary by alternative and depend on the capacity of existing and proposed MWA facilities to accept and return deliveries.

For both traditional water banking and a modified banking and exchange program, it may be assumed that Metropolitan would utilize its available SWP and Colorado Aqueduct supplies to meet its current demands and to fill storage within its service area before making deliveries to MWA for banking or repayment of MWA pre-deliveries of SWP exchange water. In general, Metropolitan has pursued a strategy of maximizing storage within its service area, including construction of Diamond Valley Lake, to ensure that it has reliable supply in-basin in the event of service interruptions due to earthquake damage to the California Aqueduct and/or Colorado River Aqueduct.

* *The above sentence was removed because, at time of the FEIR, this aspect of financial arrangements between Metropolitan and MWA had not been finalized. The issue is also financial and not a CEQA concern.*

This general approach to water reliability management means that Metropolitan would generally deliver supplies during years classified by the SWP as above-normal to wet (see Chapter 11 for definitions). Some deliveries may occur in other year types, because excess reservoir storage from a wet year may be available to meet demands in a subsequent dry to normal year. Nevertheless, deliveries in normal to below normal years are less likely. For example, from 1993 through 2003, Metropolitan delivered SWP supplies to three Kern County water banks in only one below-normal water year, that being 2003 when there was substantial supply available from the previous very wet 2002 winter (DWR 2005).

The Project Alternatives also do not assume that Metropolitan would deliver water from its SWP Table A supply only. Rather, it has been assumed that Metropolitan may purchase SWP or other supplies. In short, ~~depending on approvals by the Department of Water Resources,~~* Metropolitan may deliver water to MWA from a variety of sources.

Another key aspect of banking and exchange operations is the timing of delivery to groundwater recharge. The Department of Water Resources (DWR) makes periodic estimates of total SWP Table A supply available in a given water year. These estimates are based on monitoring of precipitation, and particularly snow pack. Early season estimates (December and January) tend to be conservative and also may reflect short-term variations in annual precipitation. For example, in 1995 (DWR 1997), precipitation was about 90% of normal from October through December, and initial Table A allocations (following a dry 1994) were accordingly low. Substantial precipitation in January triggered an increase in Table A allocations; a subsequent dry February was cause for concern. Very high precipitation in March resolved supply concerns, DWR increased SWP allocations accordingly, and Metropolitan then made deliveries to banks in May and June. Uncertainty about supply early in the water year may therefore delay decisions to bank supplies until it is clear that there will be adequate supplies to meet demands and to make banking deliveries. Historically, Metropolitan's deliveries to banking have been minimal during September through February (DWR 2005). From 1993 through 2003, Metropolitan deliveries to banking from February through August account for almost 80% of total deliveries to water banking programs outside of Metropolitan's service area. Metropolitan's deliveries to groundwater banking projects and demand for return supplies would also vary based on year type and water supply associated with carryover storage from prior years. Although there is no certainty that Metropolitan will be able to deliver water to MWA for banking during this period, it is probable that deliveries will continue to be greatest during the spring and summer, after it is clear that conditions are appropriate for banking.

In contrast, returns of banked water, whether by direct return or by exchange, are generally made in dryer years and when demand is highest. In dryer years, available supplies are well below the capacity of SWP conveyance facilities, and deliveries can be made to meet demand in the high-use months, generally late spring to late fall.

* *The above phrase was deleted because DWR is reviewing policies related to such approvals and thus future Metropolitan delivery of supplies from other sources may or may not be subject to a formal DWR approval process.*

There is no reliable way to predict actual future precipitation and water supply availability, and thus analysis of potential water supply relies on evaluation of data from previous years. No single historic period is likely to be repeated, so one approach utilized by Metropolitan and its other water banking partners has been to select a mix of historic wet to dry years and use the historic SWP allocations for these years to determine whether Metropolitan would be delivering water to the groundwater bank, taking no action, or requesting returns of banked water. Metropolitan has previously used three subsets of the period 1986 to 1999 to reflect representative conditions. The period 1992 to 1999 represents a relatively wet period; the period 1986-1992 represents an extended drought; the period 1987-1996 represents a period of varied supply.

4.1.1 Traditional Water Banking

A traditional water banking operation would involve Metropolitan delivery of supplies to MWA for recharge/storage in years when Metropolitan's available supplies exceed demand, followed by MWA return of banked supplies over a multi-year period. Based on previous banking programs and calculations of losses associated with these programs, a loss factor of 10% would be used to adjust for losses of delivered water during conveyance and recharge. This loss factor is intended to be conservative, accounting for evaporation losses and losses due to percolation into groundwater during conveyance through seepage. For MWA, losses during conveyance will be low because MWA conveyance is in pipelines. In addition, groundwater seepage during recharge would not actually be a loss, because virtually all producers in MWA's service area utilize groundwater. Any recharge is therefore a net gain, whether it is at the recharge basin or occurs during transit.

Evaporation losses are a function of air temperature, soil temperature, and wind. These conditions would vary from month to month and so actual evaporation losses are difficult to predict. An estimate of actual losses associated with evaporation can be made using typical evaporation and evapotranspiration rates for various water uses in desert environments. This type of analysis provides a range of possible evaporation losses -- a worst and best case analysis. For this analysis, the best case may be represented by a typical high-water-use crop (Lahontan Regional Water Quality Control Board, 1990; alfalfa at 52 inches per year), a mid-range may be represented by the calculated evapotranspiration rate at the Victorville CIMIS site (CIMIS 2005; 66 inches per year), and the worst-case can be represented by the average annual evapotranspiration rate for playas at Edwards AFB (Lichvar et al 2002; 110 inches per year). Converted to average daily values, these annual evaporation rates are:

- Alfalfa: 0.14 inches/day
- Victorville CIMIS station 117: 0.18 inches/day
- Edwards AFB playas: 0.30 inches/day

These rates can then be compared to the average daily recharge rate at various Proposed Project locations and the ratio of loss to recharge calculated (Table 4-1). In this analysis, evaporation rates for inland locations such as Hodge, Lenwood, Daggett, Newberry Springs, and Morongo

Basin would likely fall within the medium to high range due to marginally higher temperatures and lower humidity in these locations.

Table 4-1. Range of probable evaporation rates at Proposed Project recharge sites.

SITE	RECHARGE	LOSS RATE AT LOW, MEDIUM AND HIGH AVERAGE DAILY EVAPORATION RATES		
		Low (0.14"/day)	Medium (0.18"/day)	High (0.30"/day)
Mojave River Mainstem	>24 inches/day	0.6%	0.75%	1.25%
Oro Grande Wash	6 inches/day	2.3%	3.0%	5%
Antelope Wash	6 inches/day	2.3%	3.0%	5%
Alto/Oeste	6 inches/day	2.3%	3.0%	5%
Hodge	6 inches/day	2.3%	3.0%	5%
Lenwood	6 inches/day	2.3%	3.0%	5%
Daggett	6 inches/day	2.3%	3.0%	5%
Newberry Springs	6 inches/day	2.3%	3.0%	5%
Morongo Basin	6 inches/day	2.3%	3.0%	5%

Total returns would be equal to not more than 90% of total deliveries, and thus the 10% loss factor would exceed maximum evapotranspiration rates under all conditions. If it is assumed that 50% of banked water is delivered to the Mainstem Mojave River aquifer where percolation rates exceed 2 feet per day, then the net loss associated with evapotranspiration would be 1.45% to 3.125%. A 10% loss factor therefore ensures that actual water banked will always exceed returns.

MWD calculates probable banking deliveries and returns using its Integrated Resources Planning Simulation models (IRP SIM Model, 2003). These models use a 77-year period of record to reflect available water supply and compare this to probable demand for MWD supplies. This comparison results in a prediction of (a) water availability for banking and (b) Metropolitan's need for banked water supplies. The model is then calibrated to reflect MWA's capacity to receive, recharge, and return banked supplies. Given this input, the IRP model then evaluates the probable total magnitude of the banking program. Model output is expressed as a range. Thus, for a given set of facilities and operational plans, the model will predict the minimum magnitude of a program and the maximum magnitude of the program. The IRP Model results (MWD 2005) are affected by two variables:

- MWA's capacity to take delivery of and recharge Metropolitan supplies for banking, and
- MWA's ability to return banked supplies when needed.

To take these factors into account, MWA and Metropolitan evaluated (a) three facility alternatives, each representing a different capacity for delivery and recharge of Metropolitan supplies; and (b) three possible return scenarios (Table 4-2). These scenarios were selected for evaluation because they represent the probable maximum range of traditional banking operations. The Minimum Facilities Alternative represents a project with minimum new delivery and recharge facilities and a range of return scenarios. The Small Projects Alternative represents a project with additional recharge capacity but no change in return capacity. The Large Projects Alternative represents a project with substantial added recharge capacity and an increased capacity to make returns of banked water via direct pumping of groundwater.

Table 4-2. Facility and Operational Scenarios evaluated for the Proposed Project

FACILITIES ALTERNATIVE	MWA RETURN SCENARIO	ANNUAL RETURN CAPACITY (AF)
Minimum Facilities Alternative	Return via pumped groundwater only	18,000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	40,000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	50,900
Small Projects Alternative	Return via pumped groundwater only	18,000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	40,000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	50,900
Large Projects Alternative	Return via pumped groundwater only	34,500
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	56,500
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	65,400

These scenarios were evaluated using Metropolitan's IRP model under the following assumptions:

- MWA Table A supply is nominally 75,800 acre-feet;
- Table A deliveries would be a percentage of 75,800 acre-feet, depending on hydrology and Department of Water Resources allocations;
- In year 2006, MWA Replacement Water and other obligations are 36,500 acre-feet;
- In year 2020, MWA Replacement Water and other obligations are 58,400 acre-feet;
- MWA Replacement Water and other obligations increase linearly from 2006 through 2020;
- A 25-year banking program, in which it is probable that Metropolitan would bank supplies early in the program and request returns later in the program; and
- Metropolitan would not begin to request returns from the bank until there was at least 75,000 acre-feet of supply in the bank.

To establish a range of possible yields from the banking program, the Metropolitan model is then run under two additional assumptions:

- Metropolitan would deliver supplies to all other banks first, or
- Metropolitan would give MWA priority and deliver supplies to it first.

This modeling analysis provides a very broad range of potential Proposed Project operations. Based on a statistical analysis of the 77-year period of hydrologic record, the model then predicts the probability that a given level of banking and return will occur. The results of Metropolitan's modeling are summarized on Table 4-3.

Table 4-3. Metropolitan modeling analysis of potential magnitude of a water banking program with MWA, for the period 2006 through 2025, by project alternative and operation scenario.

ALTERNATIVE	OPERATION SCENARIO	ESTIMATED TOTAL WATER BANKED IN ACRE-FEET		
		Low	Medium	High
Low Priority Scenario (Metropolitan delivers water to all other banks first)				
Minimum Facilities	Return via pumped groundwater only	0	18000	55000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	0	25000	75000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	0	28000	75000
Small Projects Alternative	Return via pumped groundwater only	0	18000	55000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	0	25000	75000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	0	28000	75000
Large Projects Alternative	Return via pumped groundwater only	0	35000	75000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	0	40000	90000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	0	45000	100000
High Priority Scenario (Metropolitan delivers water to MWA before delivering to other)				
Minimum Facilities	Return via pumped groundwater only	75000	110000	125000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	155000	185000	225000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	175000	240000	290000
Small Projects Alternative	Return via pumped groundwater only	80000	110000	125000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	155000	185000	225000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	185000	240000	290000
Large Projects Alternative	Return via pumped groundwater only	145000	205000	240000
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	220000	270000	335000
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	240000	320000	390000

Low, medium, and high estimates of potential banking project yield reflect statistical probabilities that, given precipitation and water supply typical of the 77 years from1922 through 1998 there would be a 75% chance of banking the "low" estimate, a 50% chance of banking the "medium" estimate, and a 25% chance of banking the "high" estimate. Thus the medium estimate represents a probable average yield from the banking program. There are several important trends in the modeling.

First, the priority that Metropolitan places on the bank has a significant impact on total amount of water banked. If Metropolitan makes deliveries to all other banks first, the magnitude of the banking project is quite low, regardless of the capacity of facilities. With a high priority placed on MWA's bank, the potential amount of water is substantially higher for all alternatives and operations scenarios. In practice, Metropolitan is likely to make deliveries on a more balanced basis, depending on conditions at the various banks it utilizes. However, MWA's Proposed Project varies from other banks used by Metropolitan in that it is not substantially constrained by recharge capacity, primarily because existing facilities can take substantial recharge and because there is very rapid recharge via the Mainstem Mojave River. Recharge rates in the Mojave River Mainstem are 5-10 times those of conventional water banks in Kern County. In addition, MWA has greater flexibility in delivery of its own supplies. Kern County's agricultural banking programs are constrained by delivery capacity during periods of high agricultural use. A reasonable estimate of project magnitude can be made assuming that MWA would be able to take delivery of Metropolitan supplies more frequently than other banks. If Metropolitan deliveries to the MWA bank are based on an equal priority given to each of the water banks Metropolitan uses, and adjusted upward by 30% to reflect MWA's ability to take supplies more rapidly and during more periods of the year, then probable bank magnitude for the three facilities alternatives (medium estimate) are summarized on Table 4-4.

Table 4-4. Probable MWA traditional banking program magnitude: medium estimate of banked water, 2006 to 2025, assuming equal priority delivery to Metropolitan water banks.

ALTERNATIVE	OPERATION SCENARIO	EST. WATER BANKED (af)
Minimum Facilities	Return via pumped groundwater only	**~~87,000*~~ 83,200**
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	**137,000**
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	**174,000**
Small Projects Alternative	Return via pumped groundwater only	**~~87,000*~~ 83,200**
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	**137,000**
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	**174,000**
Large Projects Alternative	Return via pumped groundwater only	**156,000**
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	**202,000**
	Return via pumped groundwater and exchange of MWA available SWP supplies minus 5,000 acre-feet	**237,000**

**The estimate of 87,000 acre-feet of banking was based on preliminary review of IRP Simulation Model runs and is modified slightly on the above tables based on subsequent conversations with MWD.*

A second trend, seen even more clearly on Table 4-4, is that the ability to make returns to Metropolitan is more important than increased recharge capacity. For example, there is no difference in the magnitude of the banking program for the Minimum Facilities Alternative and the Small Projects Alternative, even though there is more recharge capacity associated with the Small Projects Alternative. The importance of return capacity in determining total bank magnitude is further illustrated by the increase in magnitude for the Large Projects Alternative. A 92% increase in direct return capacity (return via pumped groundwater) from 18,000 acre-feet per year (Small Projects Alternative) to 34,500 acre-feet per year (Large Projects Alternative) results in an 86% increase in total project magnitude. Return capacity thus accounts for a majority of the additional benefits associated with the Large Projects Alternative.

4.1.2 Modified Banking Program (Banking plus Exchange)

Traditional water banking is based on the concept that water must be deposited in the water bank prior to returns, via either exchange or direct return. This rule is intended to protect local groundwater users by preventing pre-delivery of groundwater to a banking partner, and thereby reducing groundwater levels and causing overdraft and its associated problems such as land subsidence. This rule makes sense if (a) direct return is the means by which bank deposits are to be returned and (b) if exchange water is not adequate during a return year and local agencies would have to pump groundwater in lieu of receiving supplemental supplies. This rule effectively limits the water management options of the cooperating parties. Traditional water banking is also generally evaluated on a year-to-year basis, under the assumption that water would be banked in some year types and returned in other year types.

A supplemental exchange program may be added to the traditional water banking program without violating the prohibition on pre-delivery of groundwater to a banking partner. This approach would involve MWA delivery of a portion of its SWP supplies at any time during the banking program when Metropolitan had capacity to take these supplies. MWA would only deliver supplies in this way which it could otherwise not take due to recharge and/or cost considerations. In short, when MWA has SWP allocations in excess of its obligations, there may be opportunities to coordinate operations with Metropolitan on a month-to-month basis to optimize available supply for both parties.

A supplemental exchange program may be added to a banking program because (a) MWA does not now take all of its SWP supply and (b) Metropolitan has a multi-faceted approach to water management, with several key components (Metropolitan 2003):

- Use of reservoir storage to meet peak seasonal water demands when conveyance capacity may be limited; and
- Local agency use of in-basin groundwater supplies to meet peak seasonal demands, followed by Metropolitan replenishment of these groundwater supplies when conveyance capacity becomes available (generally from late fall through mid spring).

Metropolitan operates in this manner because peak demands constrain the ability to deliver available supplies. Thus, for example, the Final EIR for Diamond Valley Lake (Metropolitan 1990) provides use of about 100,000 acre-feet of stored water to meet summer and fall demands. In addition, Metropolitan and its member agencies anticipate a substantial increase in local groundwater use to meet peak season demands, with Metropolitan replenishment of these groundwater supplies increasing from 250,000 acre-feet per year in 2005 to 415,000 acre-feet per year in 2025 (Metropolitan 2003). Finally, Metropolitan operates a number of other water banking programs (primarily in Kern County). Even in normal-to-wet years, Metropolitan may have capacity in these programs but not have available SWP supply to utilize them.
Under a modified banking and exchange program, MWA could participate in Metropolitan's own in-basin and other storage replenishment programs on a month-to-month basis by delivering available SWP supplies to Metropolitan to either:

- Help Metropolitan meet peak demands and thus reduce the use of stored supplies, and/or
- Provide supplies to replenish reservoir storage and/or groundwater reserves.

MWA could make such deliveries without affecting groundwater levels in any year when it had SWP supply in excess of demand, even in years when Metropolitan might deliver supply to MWA. There are two reasons why Metropolitan would take deliveries during a year when it was also delivering water to MWA:

- In a wet year following a drought, Metropolitan may wish to optimize the availability of supply in order to replenish both its in-basin storage and its storage in water banks outside of its service area. For example, in the moderately wet 1993 water year, following a critically dry year (1992), Metropolitan would be able to utilize additional available supply to replenish all elements of its storage and banking programs. Metropolitan might therefore take early delivery of MWA SWP supplies and then return these supplies plus banking deliveries later in the year, when its in-basin capacity had been refilled.
- Within any water year, the availability of supply to Metropolitan depends on the timing of precipitation in the SWP watershed. In many years, moderately dry conditions may occur early or late. Thus, Metropolitan could request delivery of exchange water in a dry January-February, and return this supply and additional supply for banking to MWA following a wet March or April (such as occurred in 1995). As a result of such exchanges, MWA could pre-deliver supplies to Metropolitan for storage within Metropolitan's service area and take returns in the same or a subsequent year.

The extent that such pre-deliveries are feasible is not possible to predict precisely without a model that tracks supply and demand on a monthly or even a weekly basis. Metropolitan's IRP Model does not yet have this capability and thus projections of additional water exchanges under a modified banking program must be made based on a set of reasonable assumptions:

- Opportunities for within-calendar-year exchanges are greatest in the transition between wet-to-dry years and in dry-to-wet years.

- In transition years from wet to dry conditions, the surplus available in the wet year is optimized to restore groundwater storage; as a result, Metropolitan would wish to bank water in its service area before banking water in offsite banks. Under such conditions, MWA could deliver water to Metropolitan early and receive banked water later in the same year.
- In transition years from dry to wet, it may not be clear that a year will be wet until the spring. In these years, MWA could provide supplemental supply early in the water year and then this water would be returned when it became clear that wet conditions would result in high SWP allocations.
- Based on DWR records for 1901-2004, transition years occur about 40% of the time (DWR 2005a).

It is thus probable that supplemental exchanges between MWA and Metropolitan, in which MWA delivers surplus SWP supply to MWD and this was returned by Metropolitan at a later date, would occur in about 6 to 8 years of a 20-year banking and exchange program. A modified water banking and exchange program involving early MWA delivery of available SWP supplies to Metropolitan may have two effects on operations:

- Pre-deliveries to Metropolitan may be used to reduce MWA's obligations for direct return of groundwater water in dry years, thus reducing groundwater pumping in dry years, and/or
- MWA may operate the banking element of the program per the traditional banking concept and pre-deliveries to Metropolitan may be repaid to MWA at a later date.

It is likely that a modified banking and exchange program would involve a combination of these elements, and that the net result would be (a) reduction of the need for direct returns from banking and (b) a net increase in total groundwater stored in MWA over the term of the banking agreement.

An example of this type of operation would be a water year such as July 1994 to June 1995. After the dry water year from July 1993 to June 1994, conditions were also dry throughout the summer and fall of 1994. Nevertheless, even a repeat of the dry conditions of 1993-1994 would have allowed MWA to provide Metropolitan with 3500 acre feet of supply. The subsequent heavy rains of January-March would then have provided Metropolitan with the ability to return this supply and to put water into the MWA bank. This type of intra-annual exchange is feasible in almost all years, but is most likely in transition years. In dry-to-wet transitions, Metropolitan would take water early (when dry conditions still prevailed) and then return water late (after wet conditions had occurred). In wet-to-dry transitions, the reverse would occur.

For purposes of estimating benefits to Metropolitan and MWA, it has been assumed that these transition-year opportunities would result in supplemental deliveries to Metropolitan in about 40% of all years, or 8 years of a 20-year banking program. Given that these supplemental exchanges would probably not occur in years when Metropolitan was requesting returns of banked supplies (dry to below-normal years) or in a series of very wet years, MWA's average annual SWP allocation would be about 80% during these years, or about 60,500 acre-feet per year. During the first 20 years of the proposed banking program, MWA's average annual SWP demand would be about 48,000, leaving an average of about 12,000 acre-feet per year available for supplemental exchange. This would increase the total potential magnitude of the banking and exchange program by about 96,000 acre-feet; that is, MWA would provide Metropolitan with 96,000 acre-feet of its Table A supply which Metropolitan would return to MWA in wet to above-normal years. Table 4-5 summarizes the potential magnitude of the proposed combined banking and exchange program.

In addition, under such a modified program, to the extent that Metropolitan pre-delivers water, MWA may meet a substantial part of local demand with stored water and allow MWD to use MWA Table A. Such a program could affect timing of deliveries. Metropolitan may choose to deliver to MWA first and thus assure availability of MWA Table A water when allocations are higher. Metropolitan may then fall back on its range of traditional banking programs when conditions are dryer. Finally, the addition of a modified exchange program may affect Metropolitan's determination of whether it is more cost-effective to store supplemental water within MWA to maximize potential for return by exchange or through pump-back programs at other locations. Water quality of potential return water may also influence Metropolitan's decisions.

Table 4-5. Probable magnitude of a combined traditional banking program and on-going water exchange program: medium estimate of banked water, 2006 to 2025, assuming equal priority deliveries to all Metropolitan water banks.

ALTERNATIVE	OPERATION SCENARIO	ESTIMATED TOTAL WATER YIELD IN ACRE-FEET		
		Banking	Time-Shift Exchanges	Total
Minimum Facilities	Return via pumped groundwater only	**~~87,000*~~ 83,200**	**96,000**	**~~183,000*~~ 179,200**
	Return via pumped groundwater and exchange of up to 50 % of MWA SWP supplies	**137,000**	**96,000**	**233,000**
	Return via pumped groundwater & exchange of MWA SWP supplies minus 5,000 acre-feet	**174,000**	**96,000**	**270,000**
Small Projects Alternative	Return via pumped groundwater only	**~~87,000*~~ 83,200**	**96,000**	**~~183,000*~~ 179,200**
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	**137,000**	**96,000**	**233,000**
	Return via pumped groundwater and exchange of MWA SWP supplies minus 5,000 acre-feet	**174,000**	**96,000**	**270,000**
Large Projects Alternative	Return via pumped groundwater only	**156,000**	**96,000**	**252,000**
	Return via pumped groundwater and exchange of up to 50% of MWA SWP supplies	**202,000**	**96,000**	**298,000**
	Return via pumped groundwater and exchange of MWA SWP supplies minus 5,000 acre-feet	**237,000**	**96,000**	**333,000**

* *The estimate of 87,000 acre-feet of banking was based on preliminary review of IRP Simulation Model runs and is modified slightly on the above tables based on subsequent conversations with MWD.*

The estimates shown on Table 4-5 provide a reasonable basis for evaluating the benefits of a potential combined banking and exchange program. Estimates are based on probabilities of various weather conditions and SWP supply allocations. Actual operations will vary.

4.2 Facilities

The Proposed Project would involve construction of new facilities (Figure 4-1), with three basic increments of facilities formulated and evaluated for the Project EIR. In addition to using the existing recharge basins and pipelines and the Mainstem Mojave River for groundwater recharge, the Proposed Project would include construction of up to 880 acres of new recharge basins, up to 16-18 miles of new buried pipelines, new wells, and associated facilities such as monitoring wells and pumping stations. Recharge basins would be of essentially similar design, with large areas enclosed in levees and the internal area divided by levees (Figure 4-2) into 5-to-20 acre cells, connected by gates built into the levees.

4.3 Minimum Facilities Alternative

The Minimum Facilities Alternative is intended to optimize use of existing facilities, use of planned recharge facilities, and the use of the Mojave River Aquifer between Mojave Forks Dam and the Narrows to receive and distribute supplies from Metropolitan and MWA. The Minimum Facilities Alternative would utilize the existing capacity of the Mojave River Pipeline and the Morongo Basin Pipeline, including existing turnouts. These pipelines would not be modified. Direct return of banked supplies via groundwater pumping from a well field along the Mojave River would be feasible via a pipeline to the California Aqueduct.

4.3.1 Existing Facilities

4.3.1.1 Mojave River Pipeline and Recharge Facilities

The Mojave River Pipeline connects to the California Aqueduct about 5 miles south of Adelanto, runs due north for 10 miles, then turns east to the existing High Desert Power Plant turnout before turning north to run along the Mojave River to Hodge, Lenwood, Daggett and Newberry Springs, where there are existing recharge sites. The final segment of the pipeline, from Daggett to Newberry Springs is under construction and will be completed before implementation of the Proposed Project. Flow in the Mojave River Pipeline is by gravity. There are no facilities to pump return flows from downstream areas to the California Aqueduct. The Mojave River Pipeline has capacity at the California Aqueduct of 94 cfs (188 acre-feet per day). Capacities of recharge basins along the Mojave River Pipeline are (2004 Regional Water Management Plan):

- Hodge Recharge Basin: 9,000 acre-feet per year
- Lenwood Recharge Basin: 9,000 acre-feet per year
- Daggett Recharge Site: 16,800 acre-feet per year
- Newberry Springs Recharge Site: 6,000 acre-feet per year

Deliveries to the Hodge Facility may be increased because an oversized outlet valve was installed during construction. The nominal delivery rate documented in the 2004 PEIR is used. The Newberry Springs Recharge Site is part of the Mojave River Pipeline Project and is currently in construction. Groundwater is also recharged via the Rock Springs Turnout to the mainstem Mojave River. In addition, there are approximately 30 to 50 acres of new flood detention/recharge where Oro Grande Wash intersects with Green Tree Road. This facility, being constructed by Victor Valley Water District (VVWD), will be used by VVWD to receive SWP supplies provided by MWA. In addition, MWA may also have capacity for recharge and storage of supply at this site. Assuming use of this detention basin for 6 months of the year, capacity would be 3,600 acre-feet per year. Net existing recharge basin capacity for these 5 facilities and Rock Springs Turnout, would be at least 44,400 acre-feet.

Finally, MWA has demonstrated that releases of up to 500 cfs (1000 acre-feet per day) may be made from Silverwood Lake to the Mainstem Mojave River with flows contained within the low-flow channels of the West Fork of the Mojave River. In the 2003-2004 demonstration project, flows from Silverwood Lake were ramped up in 50 cfs increments. At 50 cfs, most flow percolated into the ground before reaching Mojave Forks Dam. Higher flows reached the Mainstem Mojave River, where sand berms had been pushed up to enhance spreading, retard flows, and increase the rate of percolation. For the Minimum Facilities Alternative, MWA would utilize the Mojave River Mainstem for recharge in a similar manner.

4.3.1.2 Morongo Basin Pipeline and Recharge Facilities

The existing Morongo Basin Pipeline connects to the California Aqueduct at Antelope Wash, runs northeast to Rock Springs Road where it crosses under the Mojave River, and then runs east and southeast for about 70 miles to its terminus at 3 recharge basins in the Yucca Valley. There is a 80 cfs turnout to the Mojave River Mainstem at Rock Springs. There are currently no facilities available to provide for pumping of return flows from the Morongo Basin back to the California Aqueduct; none are proposed in the Minimum Facilities Alternative. Capacities at various points along the pipeline (in cfs and acre-feet per day) are:

- California Aqueduct: 110 cfs (220 acre-feet/day)
- Rock Springs Outlet: 80 cfs (160 acre-feet per day)
- Past Rock Springs: 30 cfs (60 acre-feet/day)
- At Morongo Recharge Basins: 15 cfs (30 acre-feet/day)

These existing recharge facilities would not be altered under the Minimum Facilities Alternative.

4.3.2 New Facilities

4.3.2.1 Mainstem Mojave River

In the Mainstem Mojave River, MWA would annually construct sand berms across the riverbed to retard the downstream flow of water, spread out recharge areas, and concentrate recharge in the upstream reaches of the river to the extent feasible. These berms would be pushed up using a scraper or dozer, and would wash out rapidly during natural flows (as they did in MWA's 2003-2004 demonstration project). Water would be delivered to these areas via releases from Silverwood Lake and/or an unnamed wash that discharges to the Mainstem Mojave River about a mile downstream from Mojave Forks Dam (hereafter Unnamed Wash).

4.3.2.2 SWP Delivery via Unnamed Wash

From February 16 through September 15, deliveries to the Mainstem Mojave River via Silverwood Lake and the West Fork of the Mojave River would be constrained to the capacity of the Rock Springs outlet as the result of arroyo toad breeding in the West Fork of the Mojave River. This constraint could limit total recharge of the Mainstem Mojave River because California water supplies vary significantly on a month-to-month basis, even in nominally wet years.

To ensure that recharge capacity of the Mainstem Mojave River is not affected by the arroyo toad constraint, additional capacity for delivery to the Mainstem Mojave River would be developed by constructing a turnout from the California Aqueduct in Summit Valley that could be used alone or in combination with an existing turnout to make releases of up to 500 cfs down Unnamed Wash, which flows east from Summit Valley and joins the Mojave River about a mile downstream from Mojave Forks Dam. This currently undeveloped wash would convey flow to an intake structure and an undercrossing at Arrowhead Lake Road and then across 2500 feet of the Mojave River floodplain within low earthen levees located at approximately the boundary of the 100-year floodplain. Development is planned adjacent to this wash and the wash dedicated as open space. MWA is cooperating with the potential developer (Rancho Las Flores) regarding possible use of Unnamed Wash for recharge deliveries.

Facilities at Unnamed Wash would include a pipeline or canal/channel to convey water from the turnout through the proposed development to the head of the wash, several rock drop structures (artificial water falls) to reduce flow velocities and potential for erosion, a bridge undercrossing at Arrowhead Lake Road, an unpaved 8-foot access road or roads along the wash to allow for maintenance and monitoring, and a flat-car bridge (or bridges) across the wash to allow for maintenance vehicles to cross the wash. These facilities would follow the natural contours of the wash and minimize construction. General alignments have been coordinated with Rancho Las Flores. Continuing coordination will ensure that they are not in conflict with proposed Rancho Las Flores facilities to be developed in the wash as part of their development project.

The turnout at Unnamed Wash may also function to partially serve the Department of Water Resources (DWR) water management objectives for the California Aqueduct. A present, rapid shut down of deliveries to Silverwood Lake in emergencies may create conditions that would create a spill in the Summit Valley reach of the California Aqueduct. Such an uncontrolled spill may be somewhat ameliorated by releases from the turnout. Should DWR initiate planning for facilities to address this potential problem, MWA would cooperate with DWR in planning to minimize potential conflict in operations of the turnout and any facilities proposed by DWR.

4.3.2.3 Mojave River Well Field

The engineering analysis by Bookman-Edmonston (B-E 2004b) concluded that the Mojave River Aquifer had capacity of about 61,000 acre-feet with a dry zone of 20 feet in the upper level of soil to minimize potential for liquefaction effects. The 2003-2004 demonstration project confirmed the high recharge capacity of the Mainstem Mojave River. Even at releases of 350 cfs to 500 cfs, surface flows rapidly percolated into the aquifer and surface flows did not reach the Narrows. These flows move laterally into the aquifer adjacent to the riverbed

Recharge of the Mojave River (hereafter Instream Mojave River Recharge) requires (a) ability to deliver water in all months and (b) on-going extraction and use to balance recharge and extraction rates. The USGS (Stamos 2001) indicates that the Mojave River Aquifer and the Regional Aquifer are connected and that the Mojave River Aquifer recharges the Regional Aquifer at a rate of about 34,300 acre-feet per year (1931-1990 average). Water introduced into the Mojave River Aquifer above Rock Springs could thus be expected to flow laterally and downstream, and this water may be extracted for use by tapping into the adjacent Regional Aquifer. Recharge in this manner would raise water levels in the Mojave River Aquifer and extraction from the adjacent Regional Aquifer would result in a cone of depression that would further increase the difference in hydrostatic pressure, resulting in increased rates of flow from the Mojave River Aquifer to the adjacent Regional Aquifer. As a result, a majority of the water recharged via the Mojave River could be extracted and used in the Alto subarea.

The reach of primary recharge and extraction south of the Narrows is adjacent to Hesperia, Victorville, Apple Valley, and Adelanto, and urban water use in the Alto subarea in 2000 was 47,700 acre feet, resulting in a supply deficit of about 16,800 acre-feet. As the area grows, water use and supply deficits are anticipated to grow. Although annual Alto Basin agricultural water use is projected to decline from about 3,800 acre-feet (2000) to 1,300 acre-feet (2020), urban water use is projected to increase to 78,100 acre-feet per year by 2020, resulting in a supply deficit of 44,700 acre-feet (2004 Regional Water Management Plan).

The Mojave River Well Field and Well Field Delivery Pipelines would be constructed on both sides of the Mojave River south of Bear Valley Road, within about a mile of the river bank. Specific well locations would be evaluated based on detailed hydrogeologic investigations. It is probable that wells would be sited along public roads, primarily in residential and open space areas. Wells would be from 200 to 600 feet deep and would be protected from surface water influences with sheathing. Well sites would be selected based on the following criteria:

- Depth to groundwater,
- Potential for minimizing surface water influence,
- Proximity to public rights-of-way,
- Spacing between wells to optimize groundwater flow rates, and
- Ability to construct in a manner that would be compatible with existing development

4.3.2.4 Well Field Delivery Pipelines

The Mojave River Well Field would deliver raw water to existing pipelines and water treatment facilities serving Hesperia, Victorville, Apple Valley, and Adelanto, with main collector pipelines running north-south on either side of the river to connect the various wells. All connecting and delivery pipelines on the west would be constructed within existing public rights-of-way (roads and/or sidewalks). On the west, this connector pipeline would connect to a pumping station and then run east-to-west along Mesa Street, cross under Interstate 5 and continue until reaching the California Aqueduct. Pipeline peaking capacity would be up to 66 cfs. In years when there were no direct returns to Metropolitan, this capacity would be adequate to deliver 44,400 acre-feet of supply to local producers. If Metropolitan requested direct return of groundwater, the pipeline would have capacity to deliver 30,000 acre-feet to local producers and up to 18,000 acre-feet to the California Aqueduct. Several small pump stations would be required along the route. In addition, there would be four pipelines from this main arterial line to connect with existing City of Hesperia facilities and regional distribution hubs.

On the east side of the river, connector pipelines would run roughly along the alignment of Jess Ranch Parkway, a local road serving a development. Wells and pipelines would then generally follow the alignment of Apple Valley Road south, crossing undeveloped land. The eastern well field would be connected to existing local delivery pipelines near Jess Ranch Parkway.

New facilities needed for the Minimum Facilities Alternative are described on Tables 4-6 through 4-9. A typical view of the Mojave River Recharge during the 2003-2005 pilot project is shown on Figure 4-3. In addition, the Minimum Facilities Alternative would involve use of existing groundwater monitoring wells to monitor the movement of recharged water from north to south in the Mainstem Mojave River in the reach from Mojave Forks Dam to the well field south of the Narrows. Monitoring would be required to ensure that extraction of groundwater at the well field did not result in lowering of groundwater levels below what they would be without groundwater extraction.

Table 4-6. Facilities for the Minimum Facilities Alternative.

FACILITY	PURPOSE	DESCRIPTION
Instream Mojave River Recharge	Improve recharge in the mainstem river	An array of sand berms 2-3 feet in height would be constructed across the riverbed to spread flows out and reduce flow velocity to maximize recharge in the upper and middle reaches of the river.
Mojave River Well Field	Extract groundwater migrating downstream towards the Narrows	A field of up to 25 wells would be sited along both sides of the river and connected with a 36 to 54 inch pipeline. Probable west alignment is along Carob and Orchid street. East alignment is along Jess Ranch Parkway and local streets inland and south.
Mojave River Delivery Pipelines	Deliver groundwater to Hesperia, Victorville, Apple Valley, County areas, Adelanto, and the Mojave River Pipeline	On the west, a new 9-mile 36 to 54 inch pipeline would connect the new well field to existing raw water pipelines operated by subarea producers and link existing Alto basin wells and to the California Aqueduct. On the east, segments of new pipeline would be constructed to connect to existing Apple Valley Ranchos facilities at Jess Ranch Country Club, Jess Ranch Parkway, and the Town Center.
Recharge via Unnamed Wash	Ensure year-round delivery to the Mainstem Mojave River	An up to 500 cfs turnout from the California Aqueduct in Summit Valley with conveyance to the head of Unnamed Wash, which would be bridged at several locations to allow for passage of flows under roads/trails. Several drop structures constructed to reduce erosive flows. A bridge would be constructed at Arrowhead Lake Road and then flow would be between low levees across the floodplain.

Table 4-7. Probable pipeline alignments for the Well Field Delivery Pipelines

SEGMENT	APPROXIMATE LENGTH (miles)	ALIGNMENT
Potential Alignment of Connecting Pipelines: West		
WF1	0.25	Carob Street
WF2	2.0	Orchid Street from Carob to Lemon Street
WF3	1.25	Wilson Road
WF4	0.5	Wilson Road to Orchid Avenue via Talisman Street
WF5	0.75	Wilson Road to Orchid Avenue via Lemon Street
Potential Alignment of Pipelines to deliver water to Hesperia, Victorville, and/or Adelanto		
West1	2.0	Eucalyptus, from Orchid to Santa Fe
West2	2.0	Santa Fe (1 mile north to County service Facility 64; 1 mile south to Mesa)
West3	6.0	Mesa Street from Santa Fe to the California Aqueduct
West4	1.0	Mesa to VVWD reservoirs via Pinion Street
West5	1.0	Mesa to VVWD reservoirs via Amethyst Street
West6	0.5	Mesa to Hesperia Plant 14
Potential Alignment of Pipeline to deliver water to Apple Valley		
East 1	1.0	Along Jess Ranch Parkway south of Bear Valley Road
East 2	1.0	Along golf course boundary parallel to Apple Valley Road
East 3	NA	Short connecting pipelines from wells to existing Apple Valley Ranchos connections at Jess Ranch, Bear Valley, and Town Center

Table 4-8. Facilities design Parameters, Mainstem Mojave River, Minimum Facilities Alternative.

FACILITY	MATERIALS AND DIMENSIONS	CAPACITIES
In stream Mojave River Recharge	Sand berms: Height up to 6 feet Base width: 12 - 18 feet Total area length: 20,000 feet	Combined deliveries from Silverwood Lake, Unnamed Wash, and Rock Springs limited to about 48,800 af/year (44,400 extraction rate plus 10% loss factor).
SWP Delivery via Unnamed Wash	Turnout Capacity 500 cfs Intake capacity 500 cfs Flow velocity at intake 5 f/s Levee type earthen Width between levees 100 year floodplain Level width at crest 5 feet	Delivery capacity 1000af/day
Mojave River Well Field	Number of wells: up to 25 Type: Electric, vertical turbine Project life: 30 years Pumping rate: 3 cfs	Extraction rate, all wells: 150 af/day Annual extraction, 12 months operation: 44,400 af
Well Field Delivery Pipelines	Material: Reinforced concrete pipe Pipeline length 47,000 feet Lateral pipelines 6,800 feet Pipeline Diameter (maximum): 54 inches Pipeline Diameter (minimum): 16 inches Flow rate: 7 feet/second	Capacity (maximum): 66 cfs Direct return capacity from existing wells………………...10 cfs Direct return capacity: 18,000 af/y

Table 4-9. Potential annual recharge for the Minimum Facilities Alternative.

FACILITY	SUBAREA	RECHARGE CAPACITY IN ACRE-FEET
Existing recharge in Morongo Basin	Warren/Yucca Valley	3,475
Existing recharge at Lenwood	Centro	9,000
Existing recharge at Hodge	Centro	9,000
Existing recharge at Daggett	Baja	16,800
Existing recharge at Newberry Springs	Baja	6,000
Existing Green Tree Detention Basin	Alto	3,600
Instream Mojave River Recharge	Alto	44,400
TOTAL GROSS RECHARGE CAPACITY	ALL AREAS	92,275

4.3.3 Operations

4.3.3.1 Recharge and Water Management

The Minimum Facilities Alternative provides for use of facilities for Banking and MWA deliveries to meet demands. The capacity of existing and new facilities is therefore evaluated in terms of ability to meet both banking and on-going operational elements.

A practical limit on the annual recharge to the Mainstem Mojave River would be the extraction capacity of the downstream well field plus the 10% added to account for losses during recharge. With this assumption, and assuming that recharge would generally occur in the cooler months and percolation rates would be high, extraction of 90% of gross recharge would probably result in a slight increase in flow to the Narrows (a portion of the water assumed to be lost). From an operational perspective, net recharge capacity to accept water for banking purposes would be based on (a) subarea producers' ability to take and use banked supplies and (b) MWA's capacity to make returns. This would limit gross annual recharge deliveries to about 48,800 acre-feet in this element of the Minimum facilities Alternative.

Combined gross recharge capacity of combined releases from Silverwood Lake (5 months only), Unnamed Wash (12 months) and Releases from Rock Springs (12 months) would be substantially less than the sum of their total capacity because, following an initial discharge, the net annual discharge to the Mainstem Mojave River would be matched to deliveries from the well field, or about 44,400 acre-feet per year (48,800 acre-feet gross recharge less the 10% loss factor). Peak capacity in fall and winter would be over 1,000 cfs, which could probably not be sustained without surface flow reaching the Narrows. Nevertheless, in fall and winter months, MWA could take short-term high volume deliveries to the Mainstem Mojave River via all three delivery options.

Peak capacity in the period March through September would be in excess of 500 cfs (1000 acre-feet per day), via Unnamed Wash and the Rock Springs outlet. Again, this rate of delivery would be in excess of the sustainable rate, but would allow MWA to take delivery of banking supplies at a high rate when needed.

In the Morongo Basin, Centro, and Baja areas, there would be no effect of banking when compared to other forms of pre-delivery of supplemental supplies. All producers in these areas would continue to use their existing recharge and extraction facilities. Under the 2004 Regional Water Management Plan, MWA would increase recharge capacity at Morongo Basin (2004 PEIR). MWA would continue to deliver water adequate to meet on-going annual replacement obligations (hereafter "replacement water"). In the Morongo Basin, there are projected supply surpluses in the Johnson Valley throughout the period of banking operation. Deficits exist for the other three subareas in the Morongo Basin. Based on 2000 and 2020 average annual water balance data from the 2004 Regional Water Management Plan, Table 5-15, average annual deliveries to the Morongo Basin, Baja, and Centro areas would be:

Basin	2005	2010	2015	2020	2025
Morongo	1,000	1,100	1,600	1,900	1,900
Baja	22,700	11,900	5,900	6,100	6,100
Centro	0	200	1,300	2,700	2,700

These estimates of net deficits in these areas are based on continuation of the current decline in agricultural acreage within MWA's service area. Assuming a 20 to 30 year banking program and using average annual deficit, MWA could bank a substantial volume of water in these basins:

- Morongo: Average annual deficit: 1,450 acre feet
  Total banking capacity: 29,000 acre feet
- Baja: Average annual deficit: 11,400 acre feet
  Total banking capacity: 288,000 acre feet
- Centro: Average annual deficit: 1,350 acre feet
  Total banking capacity: 27,000 acre feet

This volume of banked water would allow MWA to meet all obligations to these subareas during the 20-year term of the banking agreement.

The Minimum Facilities Alternative would use the Mainstem Mojave River as a recharge and natural slow-sand filtration system, with recharge in the southern reaches of the river and recovery of recharged supplies at a well field located downstream of Rock Springs (Figure 4-1). Bookman-Edmonston (2004a) estimated recharge capacity for the Mojave River at upstream from the Narrows at about 61,000 acre-feet; this would ensure a maximum groundwater elevation of 20 feet. To maximize recharge capability of the river, MWA would operate this system on a "put-and-take" basis. MWA would recharge the river at a rate equal to the extraction rate at the downstream well field (less the loss factor). The Mojave River Well Field would be connected to the distribution systems of Alto subarea producers so that water extracted from the well field could be delivered to existing distribution and treatment facilities and used to meet on-going needs. Each of the up to 25 wells would be rated at 3 cfs each, but their actual capacity would be governed by daily variations in on-going demand. At peak operation the Mojave River Well Field could deliver about 54,750 acre-feet. To reflect downtime for maintenance and repair and less-than-peak deliveries during periods of low water use, the probable net extraction from the Mojave River Well Field is about 44,400 acre-feet per year. Based on these considerations, the net recharge capacity available for receiving banked supplies under the Minimum Facilities Alternative is shown on Table 4-10. Capacities on Table 4-10 are net recharge (90% of gross recharge to reflect the 10% loss factor).

Average annual capacity for delivery of supplies for banking (Table 4-10) could be in excess of 45,000 acre-feet per year in all years, except at the end of the proposed banking period (when Metropolitan may or may not be making deliveries). The Minimum Facilities Alternative would also provide MWA with up to 18,000 acre-feet per year of direct return capacity from the Mojave River Well Field and/or from local wells connected to the Mesa Street Pipeline.

Table 4-10. Average annual recharge capacity in acre-feet available for banking, Minimum Facilities Alternative, 2005-2020.

BASIN	RECHARGE CAPACITY	ANNUAL MWA REPLACEMENT DELIVERIES	ANNUAL BANKING RECHARGE CAPACITY
		2005	
Morongo	3,475 (pending-expansion)	-1,000	2,475
Centro	18,000	-0	18,000
Baja	22,800	-22,700	100
Alto	48,000	-22,900	25,100
TOTAL	92,275	-46,600	45,675
		2010	
Morongo	3,475	-1,100	2,375
Centro	18,000	-200	17,800
Baja	22,800	-11,900	10,900
Alto	48,000	-28,700	19,300
TOTAL	92,275	-41,900	50,375
		2015	
Morongo	3,475	-1,600	1,875
Centro	18,000	-1,300	16,700
Baja	22,800	-5,900	16,900
Alto	48,000	-35,700	12,300
TOTAL	92,275	-44,500	47,775
		2020	
Morongo	3,475	-1,900	1,575
Centro	18,000	-2,700	15,300
Baja	22,800	-6,100	16,700
Alto	48,000	-44,700	3,300
TOTAL	92,275	-55,400	36,875

4.3.3.2 Maintenance

Routine maintenance activities for the Minimum Facilities Alternative would include annual reconstruction of the sand berms in the Mainstem Mojave River, inspections and maintenance of wells, pipelines, and pumps; and inspection, monitoring, and maintenance of the conveyance along Unnamed Wash. Unnamed Wash will be maintained as a semi-natural channel and, except for the drop structures and maintenance access roads, would be managed to maintain existing desert wash-type habitats. Maintenance will be focused on vegetation control in the channel area to (a) minimize potential for channel migration, (b) repair drop structures if necessary, and (c) control growth of vegetation, such as tamarisk, that may develop as a result of more frequent wet conditions and result in reductions in channel capacity.

4.3.4 Construction

The Minimum Facilities Alternative involves construction of conventional temporary recharge berms in the Mojave River Mainstem, two well fields, and a system of distribution pipelines.

4.3.4.1 Instream Mojave River Recharge

Temporary sand berms would be constructed within the dry mainstem channel of the Mojave River. The configuration of these temporary berms may vary based on monitoring or recharge rates for different configurations. In all cases, construction will occur under dry conditions, that is when there is no natural flow in the channel. The berms will be constructed using in-channel sediment; no sediment will be discharged to or removed from the channel area. Berms may be up to 6 feet in height. Within an area 3-4 miles long, the total area affected would be 200-400 acres.

To construct these temporary berms, MWA would utilize track-driven bulldozers or scrapers, accessing the channel at sites currently used by the local flood control agency for its operations in the mainstem channel. These berms will be constructed to temporarily retard the flow of water delivered to these areas from the State Water Project so that this water may be percolated into the groundwater basin below the mainstem Mojave River. Temporary berm construction would not involve fill or draining of Waters of the United States. All construction would be limited to areas 100 feet away from native riparian vegetation along the channel.

It is anticipated that natural flows in the Mojave River will periodically breach and re-distribute the temporary berms within the floodplain. This may occur annually or there may be long periods when the berms will remain in place.

4.3.4.2 Mojave River Well Field

Along the Mojave River, up to 25 wells with a capacity of 3 cfs would be spaced about 1000 to 1700 feet apart and would be distributed on both sides of the river. Alternatively, more wells of lower individual capacity could be placed along the same alignment and spaced more closely. In all cases, wells would be sited along or near the rights-of way for the connecting pipeline (see Table 4-7, above). Well drilling would be accomplished using standard diesel drilling rigs and would involve temporary disturbance of an area about 50 feet by 50 feet (2500 square feet). Wells would be drilled to a depth of 200 to 600 feet. Each well would take approximately 20 to 30 working days to drill to this depth. During construction, the drilling site would be isolated from adjacent areas with sandbags to contain drill spoil and water. In urban and suburban areas, drill spoil would be hauled from the construction site daily. Several wells might be drilled at a given time.

4.3.4.3 Mojave River Delivery Pipelines

In all urban areas, distribution pipelines would be constructed within existing public rights-of-way (generally roads and bike paths). Trenching would be done with a backhoe to a depth equal to pipeline diameter plus 3-to-4 feet. Not more than one lane of traffic would be blocked during excavation, pipeline placement, and reconstruction. For purposes of estimating impacts associated with traffic and noise, it has been assumed that pipelines would be constructed at a rate of 100-200 feet per day, and thus total pipeline construction would take approximately 4 to 8 months, including time for equipment mobilization. More rapid rates of pipeline construction would result in shorter periods of traffic impact and shorter noise exposure times.

4.3.4.4 Unnamed Wash

Initially, a new gated turnout with a capacity of up to 500 cfs would be constructed along the east side of the California Aqueduct. Pending final alignment of Rancho Las Flores facilities, flow from this turnout would be allowed to pass down the wash. Some construction of an earthen channel may be required to direct flow. In the steeper sections of the wash, drop structures would be constructed with large rock and concrete. A bridge would be constructed at Arrowhead Lake Road to provide for unimpeded flow under the road and low earthen levees would be pushed up along the north and south edges of the channel to limit channel migration during recharge. When Rancho Las Flores completes its final designs for the Summit Valley element of its proposed development, MWA would coordinate with the developer and the City of Hesperia regarding the appropriate alignment of a channel or pipeline from the turnout through the developed areas in Summit Valley. By deferring construction of a pipeline or channel until later, land-use conflicts with Rancho Las Flores will be avoided.

4.4 Small Projects Alternative

The Small Projects Alternative was formulated to evaluate the potential to increase banking and exchange program yields at a minimum cost, while focusing on the Alto Basin, where the supply deficit and future demand is greatest. The Small Projects Alternative would also increase the ability of MWA to take peak short-term deliveries from Metropolitan (or of its own supplies to meet water demands) during periods when available supplies may exceed the capacity of the Minimum Facilities Alternative. This would be necessary if it is assumed that Metropolitan wished to deliver in excess of 48,000 acre-feet, which is the approximate practical limit of the Minimum Facilities Alternative in the Alto Basin (Table 4-11). Note also on Table 4-11 that MWA's ability to use the Mainstem Mojave River for recharge of banking supplies declines over time because MWA would also use this recharge area to make replacement water deliveries with its own SWP supply. The addition of recharge capacity to the Alto Regional Aquifer also adds storage that will not migrate rapidly downstream to the Narrows.

To accomplish this, the Small Project Alternative focuses on developing off-channel recharge capacity along the Mojave River and in the adjacent Regional Aquifer. The Small Projects Alternative consists of all facilities identified under the Minimum Facilities Alternative plus four additional recharge basins (Table 4-12; Figures 4-4 through 4-7). Recharge basins for the Small Project Alternative were sited to take advantage of potential cooperative management agreements with local government, primarily the City of Hesperia.

Table 4-11. Proposed additional facilities along the Mainstem Mojave River, Small Project Alternative.

FACILITY	PURPOSE	DESCRIPTION
Off-Channel Mojave River Recharge and Pipeline	Supplemental recharge during periods of high volume delivery of banked supplies	A new off-channel 100 acre recharge basin would be constructed on the Mojave River floodplain between the Morongo Basin Pipeline and Mojave Forks Dam, to take deliveries from the Morongo Basin Pipeline via a 42" buried pipeline. Two sites are considered: east and west of the Mojave River. Several new wells may be constructed at either site.
Oro Grande Wash Recharge	Recharge of the Alto Regional Aquifer	A new recharge basin of up to 80 gross acres, with 60 acres of effective recharge area, (north and/or south of the California Aqueduct) with delivery from the California Aqueduct. Several new wells may be constructed at the site.
Cedar Avenue Detention Basin	Recharge of the Alto Regional Aquifer	Cooperative use of a proposed flood detention basin for recharge. Gross area of about 60 acres, with net recharge area of 45 acres. A well and pipeline would be installed to provide for returns to the California Aqueduct. Several new wells may be constructed at the site.
Antelope Wash (Ranchero Road)	Recharge of the Alto Regional Aquifer	Cooperative use of a 65-acre flood detention basin for recharge. Gross area of 65 acres with a net area for recharge of 50 acres. Several new wells may be constructed at the site.

4.4.1 Recharge Basins

Recharge basins (Table 4-12) were sited and designed to (a) enhance recharge along the Mainstem Mojave River to accommodate high peak deliveries (b) enhance capability to store banked supplies in the long term with minimal potential for loss. In addition, MWA may construct several new wells at each site.

4.4.1.1 Off-Channel Mojave River Recharge

An off-stream recharge facility about 1.5-to-3 miles south of where the Morongo Basin Pipeline crosses under the Mojave River would be constructed at one of two potential sites along the Mojave River (Figure 4-3). This facility would be located off-channel, and would be used to add peaking capacity to the recharge when deliveries of banked and MWA supplies exceeded the capacity of the mainstem recharge facilities or when flow in the river precluded recharge to the Mainstem Mojave River.

<u>Site 1: West Side Facility</u>. This facility is a modification of a recharge project identified in the 2004 Regional Water Management Plan (Supply Enhancement Project 7, Table ES1, 2004 Regional Water Management Plan PEIR). A facility at this site would be supplied via a 42-inch pipeline constructed within the public right-of-way for Highway 173 (Arrowhead Lake Road).

Table 4-12. Facilities design parameters, Mainstem Mojave River, Small Projects Alternative.

FACILITY	MATERIALS AND DIMENSIONS	CAPACITIES
Off Channel Mojave River Recharge	Gross area: 100 acres Net area (80% of gross) 80 acres Berm height: 5 feet Berm crest width: 12 feet Berm slope: 2H on 1V Base width: 32 feet Berm spacing: 500 feet	Recharge Rate: 0.75 af/day Net recharge: 45 af/day Max annual recharge, 10 months operation: 13,500 af
Off-Channel Mojave River Recharge Pipeline	Material: Reinforced concrete pipe Length: up to 15,000 feet Diameter: 42 inches	Gross capacity: 74 cfs
Oro Grande Wash Recharge and Pipelines	Gross area: 80 acres Net area (80% of gross) 60 acres Berm height: 5 feet Berm crest width: 12 feet Berm slope: 2H on 1V Base width: 32 feet Berm spacing: 500 feet Distribution Pipelines 2,000 feet	Recharge Rate: 0.5 af/day Net recharge: 30 af/day Max annual recharge, 9 months operation: 8,000 af
Cedar Avenue Detention Basin and Pipelines	Gross area: 60 acres Net area (80% of gross) 45 acres Berm height: 5 feet Berm crest width: 12 feet Berm slope: 2H on 1V Base width: 32 feet Berm spacing: 500 feet Pipeline 3000 feet	Recharge Rate: 0.5 af/day Net recharge: 22.5 af/day Max annual recharge, 6 months operation: 4,000 af
Antelope Wash Detention Basin (Ranchero Road) and Pipelines	Gross area: 65 acres Net area (80% of gross) 27 acres Berm and flow through characteristics based on detention-basin design.	Recharge Rate: 0.5 af/day Net recharge: 13.5 af/day Max annual recharge, 9 months operation: 3,500 af

Site 2: East Side Facility. This facility would be located on disturbed grasslands on either side of an existing poultry facility about 1.5 miles south of the Morongo Basin Pipeline (south of the existing poultry farm buildings). A facility at this site would be supplied via a 42-inch pipeline within the public right-of-way of an unpaved road that runs about 200-300 feet from the Mainstem Mojave River channel.

Both potential facilities would be located downstream of sensitive habitats around Mojave Forks Dam, is located away from known significant cultural resource sites, has already been disturbed by prior use for water treatment, if not located in an area of potential high density housing, and is somewhat protected from erosive flood flows by an east-west trending hill immediately to the south that reduces potential for highly erosive flows.

Water for recharge at either facility would be delivered via an up to 42" reinforced concrete pipeline along the alignments. Both facilities could be gravity fed. Both recharge sites would be on benches above the river channel outside of the floodway maintained by San Bernardino County Flood Control. Pipeline alignments are described on Table 4-13.

Table 4-13. Pipeline alignments for Off-Channel Mojave River Recharge Pipeline.

SEGMENT	APPROXIMATE LENGTH (miles)	ALIGNMENT
East Alignment		
E1	1.5	River frontage unpaved road from Rock Springs Road to Recharge Site
West Alignment		
W1	1.1	Glendale Road from Rock Springs Road to Calpella Avenue
W2	1.1	Calpella Avenue from Glendale Road to Arrowhead Lake Road
W3	0.6	Arrowhead Lake Road from Calpella Road to Recharge Site

4.4.1.2 Oro Grande Wash Recharge and Pipelines

The Oro Grande Wash drainage flows north, parallel to Interstate 15 west of the City of Hesperia and then flows into the City of Victorville along the west side of I-15. The California Aqueduct crosses the wash about 4000 feet north of Main Street/Phelan Road. MWA has conducted pilot studies of the potential for this wash to serve as a recharge site. It is feasible to deliver water to sites with suitable soils both south and north of the California Aqueduct crossing, and both areas could provide recharge at an acceptable 0.5 feet per day. Recharge in these areas would contribute to the Regional Aquifer. A new turnout would be required to supply this site. Supply to the south side of the aqueduct could require pumping facilities if located sufficiently south of the California Aqueduct. New recharge basins would be located immediately upstream or downstream of the California Aqueduct.

4.4.1.3 Cedar Avenue Detention Basin Recharge and Pipelines

The City of Hesperia Master Plan identifies a 60-acre parcel west of the California Aqueduct near Cedar Avenue as a potential site for collection of runoff from a local wash that ponds along the west side of the California Aqueduct. The site would be used to contain these flows, which would be conveyed to it via a drainage channel along the aqueduct. Soils in the area are suitable for recharge at an acceptable rate of at least 0.5 feet per day. Recharge would be to the Regional Aquifer. The site is located upslope of City of Hesperia wells and would allow for recharge without a significant need for additional extraction facilities. A new turnout would be required from the California Aqueduct to supply this site.

4.4.1.4 Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines

The City of Hesperia Master Plan identifies a potential 65-acre detention basin along Antelope Wash adjacent to the Morongo Basin Pipeline. The detention basin would be constructed by raising Ranchero Road, which currently crosses the wash at grade. The 30-foot embankment/berm would be constructed to meet flood detention standards to allow the earthen berm to retain water during flooding (City of Hesperia 2003). Active recharge at this facility would require gating of the culverts/outlet of the road crossing/detention facility. Active recharge would be limited to the lower elevations of the wash. Assuming a recharge rate of 0.5 feet per day and an effective recharge area of 27 acres, the basin would have capability for annual recharge of 3,500 acre-feet. Recharge would be to the Regional Aquifer.

4.4.2 Operation

The four recharge basins added to the overall Proposed Project scope in the Small Projects Alternative, would increase project capacity to receive and recharge combined peak deliveries from Metropolitan and MWA during moderate to wet years (Table 4-14). These elements of the Small Project Alternative would be integrated with those of the Minimum Facilities Alternative in a number of ways.

First, the use of the Mojave River Aquifer is somewhat constrained by the need to extract banked supplies for use or risk the movement of stored supplies through the Narrows. These supplies may not be considered "lost" because they would eventually migrate downstream to downstream basins. But major producers to whom MWA must deliver replacement water would be unable to use these supplies during their slow migration downstream. This would limit subarea producers' ability to use banked water as replacement supplies from MWA.

Thus, once the Mojave River Aquifer is initially recharged, the effective recharge rate is equal to the rate of extraction from the well-field. Assuming that subarea producers agree to utilize the well field to the maximum extent feasible, extractions from the well field (and thus net recharge) are derived from a combination of MWA replacement water delivered via the Mainstem Mojave River and the well field and banked water.

Adding capacity to recharge the Regional Aquifer would therefore allow MWA and banking deliveries when the effective recharge of the Mojave River Aquifer between Mojave Forks Dam and the Narrows had been utilized.

The combination of Regional Aquifer recharge capacity and peaking capacity to the Mojave River Aquifer with an off-stream recharge basin (28,500 acre-feet of added annual recharge capacity) would also allow MWA to accommodate higher peak deliveries. This may be of particular importance in a modified banking and exchange program, where MWA may pre-deliver SWP supplies to Metropolitan, and Metropolitan may need to return these supplies and provide water to be banked in a single season. With new turnouts from the California Aqueduct providing for delivery from Unnamed Wash and use of deliveries from Silverwood Lake, total possible daily deliveries under the Small Projects Alternative would be 737.5 cfs, or 1475 acre-feet per day:

- Silverwood Lake: 500 cfs (1000 acre-feet/day)
- Mojave River Pipeline: 94 cfs (188 acre-feet per day)

- Off-Channel MR Recharge: 80 cfs (160 acre-feet per day)
- Morongo Basin Recharge: 30 cfs (60 acre-feet per day)
- Oro Grande Wash Turnout: 15 cfs (30 acre-feet per day)
- Cedar Avenue Turnout: 11.75 cfs (22.5 acre-feet per day)
- Antelope Wash Turnout: 6.75 cfs (13.5 acre-feet per day)

For short periods, then, the Small Projects Alternative would have capacity to recharge approximately 44,250 acre-feet in a single month.

The added recharge capacity provided by the Small Project Alternative would be available at all times during wet years. Thus, even when the Mojave River was flowing and recharge to the river itself was not feasible, the off-stream recharge provided by the 4 additional facilities of the Small Projects Alternative would be available, allowing for recharge of 56 cfs (112 acre-feet per day or 3360 acre-feet per month). Recharge of the Mojave River Aquifer via releases to the mainstem is clearly the most efficient means of rapid recharge, but when the need to accommodate a short-term pulse has passed, the availability of 33,600 acre-feet of annual (10 month) off-stream recharge capacity would increase overall banking capacity and reduce reliance on the limited total storage capacity of the Mojave River Aquifer and adjacent Regional Aquifer above the Narrows.

Assuming that recharge capacity is available for only 10 months of the year to allow for operation and maintenance and to exclude periods when precipitation inhibits artificial recharge, the addition of 28,500 acre-feet per year of recharge capacity would allow MWA to increase the rate of recharge by 2,850 acre-feet per month. This would enhance MWA's ability to combine banking deliveries with deliveries of its own SWP Table A and Article 21 supplies.

Table 4-14. Potential annual recharge for the Small Projects Alternative.

FACILITY	SUBAREA	ANNUAL RECHARGE CAPACITY IN ACRE-FEET
Minimum Facilities Alternative		
Existing recharge in Morongo Basin (pre-expansion)	Warren/Yucca Valley	3,475
Existing recharge at Lenwood	Centro	9,000
Existing recharge at Hodge	Centro	9,000[1]
Existing recharge at Daggett	Baja	16,800
Existing recharge at Newberry Springs	Baja	6,000
Existing recharge at Green Tree Detention Basin	Alto	3,600[2]
New recharge, Mojave River via Silverwood Lake, Unnamed Wash, and/or Rock Springs	Alto, Mojave River Aquifer and Regional Aquifer	44,400
SUBTOTAL		92,275
Small Projects Alternative		
Off-Channel Mojave River Recharge	Alto, Mojave River Aquifer	13,500
Oro Grande Wash Recharge	Alto, Regional Aquifer	8,000
Cedar Avenue Detention Basin	Alto, Regional Aquifer	4,000
Antelope Wash Recharge (Ranchero Road)	Alto, Regional Aquifer	3,500
SUBTOTAL		28,500
TOTAL		**120,775**

Notes:
1. Recharge at Hodge may be increased by about 80%; the nominal recharge from the 2004 PEIR and 2004 Regional Water Management Plan has been used.
2. The Green Tree detention basin would be shared by Victor Valley Water District and MWA: 3600 acre-feet of recharge is a conservative estimate of MWA's recharge at the site. Total recharge is likely to be higher.

4.4.3 Construction

The 100-acre Off-Channel Mojave River Recharge would be constructed on gently sloping ground adjacent to the Mojave River. Assuming berms would cover 25% of the gross area of the recharge basin, with average berm height of 5 feet, a crest width of 12 feet to allow for vehicle access, and berm side sloped of 2H on 1V, construction would involve the excavation of about 160,000 cubic yards, all of which would be utilized to construct the perimeter and interior berms. All soil for berm construction can be excavated from the 60-acres of active recharge area, with average excavation depth of slightly greater than 1 foot. Cells will be excavated and soil distributed to create an approximately flat cell invert for uniform recharge.

The pipeline to supply Off-Channel Mojave River Recharge would be constructed within existing public rights-of-way along public roads. Trenching would be done with a backhoe to a depth equivalent to pipeline diameter plus 4-5 feet. Not more than one lane of traffic would be blocked during excavation, pipeline placement, and reconstruction. For purposes of estimating impacts associated with traffic and noise, it has been assumed that pipelines would be constructed at a rate of 100-200 feet per day, and thus total pipeline construction would take approximately 4 to 8 months, including time for equipment mobilization. More rapid rates of pipeline construction would result in shorter periods of traffic impact and shorter noise exposure times.

Recharge basins at the two City of Hesperia flood detention basins and Oro Grande Wash would potentially be affected by infrequent flood flows and would be expected to be damaged. At the Cedar Avenue detention basin, an inlet structure could be constructed to reduce flow rates and levee wash out, but flow rates would nonetheless exceed those during banking operation and internal berms would have to be re-constructed at times.

4.5 Large Projects Alternative

The Large Projects Alternative (Table 4-15 and 4-16 and Figures 4-8 through 4-12) was formulated to evaluate the potential maximum practical recharge and direct return capacity for the proposed banking/exchange program combined with MWA's own use of facilities. It includes all of the facilities for the Minimum Facilities Alternative and the Small Projects Alternative, as well as expanded delivery, recharge, and direct return capacity. It would allow greater peak capacity for recharge and greater capacity for recharge in the Regional Aquifer.

For this alternative, the focus is again on the Alto and Oeste areas because of proximity to the California Aqueduct and the suitability of groundwater in these areas for potential direct return. Under this alternative, the siting of additional facilities for recharge was therefore focused on two Regional Aquifer areas immediately adjacent to the California Aqueduct that were evaluated during the initial screening process.

The Large Projects Alternative would add approximately 580 acres of active recharge capacity for the Regional Aquifer. It would add up to 25 wells for direct return of banked supplies to Metropolitan. These are maximum values for this alternative and the MWA Board may choose construct and operate smaller facilities, based on its deliberations related to cost versus benefit. The maximum extent of development has been assumed in this Project EIR to ensure appropriate level of impact analysis.

4.5.1 Recharge Basins and Associated Facilities

4.5.1.1 Oeste Recharge, Wells, and Pipelines

Recharge basins in the Oeste subarea would be located at two sites immediately adjacent to the California Aqueduct (Figure 4-9 and 4-10). At maximum size, these currently undeveloped sites would have a gross area of about 330 acres, with a recharge capacity of about 260 acres. With a projected recharge rate of about 0.5 acre-feet per acre, these sites could recharge about 130 acre-feet per day, 3900 acre-feet per month and about 35,000 acre-feet per 9-month operational period. In addition, at these sites, indigenous groundwater is of equal or better quality than average SWP supply, except for being marginally higher for arsenic and sulfate. Given that water recharged to these sites would be wet-year supply of better-than-SWP-average quality, the mix of SWP and indigenous groundwater would probably be of good quality and direct return from these sites could therefore be considered. Accordingly, at these sites, wells would be installed and connected to the California Aqueduct with pipelines. Pipelines would be constructed during construction of the recharge basins. Assuming each well could pump 2 cfs and that dry year returns to Metropolitan could be made over a period of 8 months with some allowance for down time, 15 Oeste area wells could provide for the direct return of about 11,000 acre-feet.

4.5.1.2 Alto Recharge, Wells, and Pipelines

Recharge basins in the Alto subarea would be located north and south of Duncan Road at White Road (Figure 4-8), immediately north and adjacent to the California Aqueduct. At this site, recharge basins of up to 150 gross acres (120 net acres of recharge) could be constructed. At maximum capacity and assuming a projected recharge rate of about 0.5 acre-feet per acre, this site could recharge about 60 acre-feet per day, 1800 acre-feet per month and about 16,900 acre-feet per 9-month operational period. In addition, at this site, indigenous groundwater is of equal or better quality than average SWP supply, except for being marginally higher for arsenic and fluoride. Given that water recharged to these sites would be wet-year supply of better-than-SWP-average quality, the mix of SWP and indigenous groundwater would probably be of good quality and direct return from these sites could therefore be considered. Accordingly, at these sites, wells would be installed and connected to the California Aqueduct with pipelines. Pipelines would be constructed during construction of the recharge basins. Assuming each well could pump 2 cfs and that dry year returns to Metropolitan could be made over a period of 8 months with some allowance for down time, 10 Alto area wells could provide for the direct return of about 5,500 acre-feet.

4.5.1.3 Antelope Wash Recharge and Pipelines

In addition to potential recharge basins associated with the proposed detention basin along Antelope Wash, additional recharge capacity is available immediately upstream and downstream of the California Aqueduct. At this site, it would be feasible to develop 100 acres of recharge at the locations shown on Figure 4-10. Assuming a net recharge area of 70 acres, Regional Aquifer recharge rate of about 0.5 acre-feet per acre per day, recharge at this site would be 35 acre-feet per day, or about 9500 acre-feet in a 9 month delivery period.

The draft EIR (Table 5-14) concluded that a 100-acre recharge basin located in Antelope Wash about 0.5 miles upstream and south of the existing Hesperia Airport (upstream recharge site) would affect 4 acres of disturbed habitat, 28 acres of desert scrub habitat, and 68 acres of Joshua Tree/juniper habitat. The draft EIR also noted that the upstream site remained connected to habitats in the San Bernardino Mountains and therefore "remains a viable part of a larger area of wildlife habitat." In addition, the draft EIR noted that Joshua Tree habitats are relatively rare in the area south of Hesperia/Victorville and that the City of Hesperia has a policy to protect Joshua Tree habitats.

Accordingly the draft EIR Section 5.4.7.2 proposed that if a recharge basin was sited at the upstream site in Antelope Wash, that MWA would either mitigate for loss of "locally-protected Joshua Tree habitat" at a ratio of 1:1 or "consider realignment of this basin to a site further downstream."

As discussed in the draft EIR, Section 5.13.1, based on preliminary geotechnical analyses, recharge conditions in Antelope Wash are in general likely to be quite good, both in terms of infiltration rates and in terms of low potential to encounter clay soils which could contain high concentrations of minerals that could leach into groundwater. Relocation of the proposed upstream recharge basin would thus be most beneficial if the relocation was in Antelope Wash. In addition, other potential sites for relocation of the upstream recharge basin had been eliminated from consideration as part of alternative screening processes detailed in Chapter 3 of the draft EIR. The focus of analysis for an alternative site was therefore on the reach of Antelope Wash downstream of the site evaluated in the draft EIR to the area immediately upstream and downstream of the Ranchero Road detention basin (Figure 4-12; combined Ranchero Road site).

This approximately 4000-foot reach of the wash is a broad and relatively flat section from1000 to 1500 feet wide, an area of about 140 acres. The stream gradient is about 50 feet per mile in this reach, and there is minimal cross-channel slope. Habitats in this downstream reach are dramatically different from those at the upstream recharge site. The level of disturbance is higher and the dense stands of Joshua Trees and junipers give way to disturbed desert scrub and desert wash scrub. The wash is particularly disturbed in the reach downstream of the unpaved road along an east-west alignment that approximately bisects the Hesperia Airport runway. In addition, the area downstream of Ranchero Road is routinely disturbed and is being disturbed by construction equipment as part of the Ranchero Road relocation and detention basin project. The area in the vicinity of the new detention basin is being disturbed by construction of the 30-foot-high embankment for the road relocation and detention basin. Once completed, the detention basin is designed to allow a depth at the road embankment of 22 feet, and the maximum flood pool will extend about 600 to 700 yards upstream. Approximately 55% to 65% of the total recharge area in the wash would be within the flood detention basin or immediately downstream. The combining of all Antelope Wash recharge at this site would involve following the natural contours of the wash rather than the 65-acre square parcel evaluated in the draft EIR. The result would be an approximately 135 to 140-acre site that would provide approximately equal net recharge area in the wash as would have been available at the two separate parcels examined in the draft EIR.

Development adjacent to this reach of the wash is moderately more intensive to that along the upper wash site and similar to that at the Ranchero Road site -- there is housing and some commercial development along the rim of the wash. There is no development in the wash itself. There are no paved road crossings of the wash in this reach.

The expansion of recharge at the Ranchero Road site in lieu of developing the upstream recharge site could:

- Reduce proposed project pre-mitigation impacts substantially;
- Marginally reduce total impact area in Antelope Wash; and
- Reduce proposed project mitigation requirements and mitigation costs.

This alternative siting would not substantially affect recharge, construction methods, or construction schedule.

In the FEIR, MWA has therefore evaluated the potential effects of the Antelope Wash recharge basins described in the draft EIR and the potential effects of this proposed mitigation measure.

Table 4-15. Proposed new facilities, Large Projects Alternative

FACILITY	PURPOSE	DESCRIPTION
Oeste Recharge and Pipelines	Recharge of the Regional Aquifer	Up to 330 total acres of recharge basins with a net recharge area of 260 acres; up to 15 extraction wells; new turnout from California Aqueduct.
Alto Recharge and Pipelines	Recharge of the Regional Aquifer	Up to 150 total acres of recharge basins with a net recharge area of 120 acres; up to 10 extraction wells; new turnout from the California Aqueduct
Antelope Wash Recharge and Pipelines	Recharge of the Regional Aquifer	Up to 100 total acres of recharge basins with a net recharge area of 70 acres; new turnout from the California Aqueduct. Several new wells may be constructed at the site. or Expansion of recharge upstream and downstream of the new Ranchero Road embankment. Wells and a pipeline to the California Aqueduct may be constructed at the site.

Table 4-16. Design specifications/capacities, new facilities, Large Projects Alternative

FACILITY	MATERIALS AND DIMENSIONS	CAPACITIES
Oeste and Alto Recharge and Pipelines	Gross area: 480 acres Net area (80% of gross) 380 acres Berm height: 5 feet Berm crest width: 12 feet Berm slope: 2H on 1V Base width: 32 feet Berm spacing: 500 feet Pipeline 25000 feet	Recharge Rate: 0.5 af/day Net recharge: 190af/day Max annual recharge, 10 months operation: 51,000 af
Wells at Oeste and Alto recharge basins	Number of wells: up to 25 Type: Electric, vertical turbine Project life: 30 years Pumping rate: 2 cfs	Capacity: up to 50 cfs Direct return capacity: 16,200 af/yr
Antelope Wash Recharge and Pipelines	Gross area: up to 80 acres Net area (80% of gross) up to 65 acres Berms: Temporary	Recharge Rate: 0.5 af/day Net recharge: 40 af/day Max annual recharge, 8 months operation: 9,500 af

4.5.4.2 Operations

Large Project Alternative facilities would be sized and operated to optimize MWA ability to take deliveries of supplies for banking and deliveries of its own SWP Table A and Article 21 supplies during periods when delivery rates were high (Table 4-17). Thus, the Oeste, Alto, and Antelope Wash recharge basins would be utilized when recharge capacity via the Mainstem Mojave River (Alto subarea) had been used to its practical maximum, or when other factors affected the ability to deliver water to the mainstem (such as mainstem natural flow during a wet year). Assuming that recharge capacity is available for only 10 months of the year to allow for operation and maintenance and to exclude periods when precipitation inhibits artificial recharge, the addition of 61,400 acre-feet per year of recharge capacity would allow MWA to increase the rate of recharge by 6,140 acre-feet per month. This would enhance MWA's ability to combine banking deliveries with deliveries of its own SWP Table A and Article 21 supplies.

Supplies banked in these facilities would recharge the Regional Aquifer, which has a low rate of lateral movement. As a result, banked supplies would mound in the vicinity of the recharge basins, mix with indigenous groundwater, and be available for direct return to Metropolitan via the California Aqueduct if returns could not be made via exchange. The Large Project Alternative would thus significantly increase MWA's capability to receive and return banked water. Note that the nominal recharge capacities of these new recharge areas are quite high.

4.5.3 Construction

Oeste and Alto recharge basins would be constructed on virtually flat land. Construction of these permanent recharge basins would involve excavations to a depth of 1 to 5 feet to provide soil for construction of exterior and interior berms. Typical levee designs for recharge basins are shown on Figure 4-2. An inlet structure in the highest elevation cell will provide for discharges from supply pipelines. Gates will be constructed to allow flow between cells.

Wells at the Oeste and Alto recharge basins would be constructed at and north of the basins, drilled to a depth of from 250 to 800 feet, and separated by about 1500 feet. Construction would be limited to an area of about 0.1 acres (each). Following construction, they would be enclosed in chain link or other protective fencing/walls. They would be connected to a pipeline running to the California Aqueduct that would discharge at a rate of up to 60 cfs.

The Antelope Wash recharge basin would potentially be affected by infrequent flood flows and would be expected to be damaged. High flows in washes could potentially wash out berms completely. Accordingly, the recharge basins developed under the Large Projects Alternative would be constructed as low berms across the washes which could be washed out during flood events and reconstructed rapidly following a flood.

Table 4-17. Recharge and direct return capacity, Large Projects Alternative

FACILITY	SUBAREA	GROSS ANNUAL RECHARGE & DIRECT RETURN CAPACITY IN ACRE-FEET	
		Recharge	**Direct Return**
Minimum Facilities Alternative			
Existing recharge in Morongo Basin (1750 acres)	Warren/Yucca Valley	3,475	0
Existing recharge at Lenwood	Centro	9,000	0
Existing recharge at Hodge	Centro	9,000[1]	0
Existing recharge at Daggett	Baja	16,800	0
Existing recharge at Newberry Springs	Baja	6,000	0
Existing Green Tree Detention Basin	Alto	3,600[2]	
New recharge, Mojave River via Silverwood Lake, Unnamed Wash, and/or Rock Springs	Alto, Mojave River Aquifer and Regional Aquifer	44,400	18,000
SUBTOTAL		**92,275**	**18,000**
Small Projects Alternative			
Off-Channel Mojave River Recharge	Alto, Mojave River Aquifer	13,500	0
Oro Grande Wash Recharge	Alto, Regional Aquifer	8,000	0
Cedar Avenue Detention Basin	Alto, Regional Aquifer	4,000	0
Antelope Wash (Ranchero Road)	Alto, Regional Aquifer	3,500	0
SUBTOTAL		**120,775**	**18,000**
Large Projects Alternative			
Oeste Recharge, Wells and Pipelines	Alto Regional Aquifer	35,000	11,000
Alto Recharge, Wells, and Pipelines	Alto Regional Aquifer	16,900	5,500
Antelope Wash Recharge and Pipelines	Alto Regional Aquifer	9,500	0
SUBTOTAL		61,400	16,500
TOTAL		**182,175**	**34,500**

Notes:
1. Recharge at Hodge may be increased by about 80%; the nominal recharge from the 2004 PEIR and 2004 Regional Water Management Plan has been used.
2. The Green Tree detention basin would be shared by Victor Valley Water District and MWA: 3600 acre-feet of recharge is a conservative estimate of MWA's recharge at the site. Total recharge is likely to be higher.

4.6 Construction Schedule

A detailed construction schedule would depend on the alternative selected and on whether there was simultaneous construction of various project elements. Because construction schedules affect impacts associated with air quality, traffic, noise, and other potential elements of the proposed project, several representative construction scenarios are presented here, based on the following assumptions:

- Recharge basins would be constructed in 40-acre increments requiring 30 working days or 45 total days, and any given recharge basin would be constructed continuously until completed to avoid costs and delays associated with repeated mobilization;
- Wells would be drilled one at a time, requiring about 15 working days or 20 total days each;
- Once pipeline construction was initiated, pipelines would be constructed continuously at a rate of 100 - 200 feet per working day (1.4 calendar days); in recharge/pipeline elements of the project, pipelines and recharge basins would be constructed simultaneously.

Pipeline construction rates will vary considerably depending on conditions. The pipeline proposed from Rock Springs Road to off-channel recharge basins may be constructed at a substantially higher rate because there will be few right-of-way, traffic and utility constraints. Pipeline construction under Interstate 15, however, would be substantially slower. In short, the exact construction schedule will vary, depending on the location of each facility. A rate of 100 feet per day has been used to estimate pipeline construction because a majority of construction will occur in urban areas, in public rights-of-way, with traffic controls, re-paving requirements, and utilities to be maintained during construction. Given these considerations, the estimated time to completion for various elements of the Proposed Project alternatives are shown on Table 4-18. The estimated on Table 4-18 show that critical path for construction will be a function of:

- Rate of construction for pipelines. If, on average, pipelines may be constructed at a rate of 200 feet per day, then total time for construction of this feature may be reduced significantly.
- Phasing. If recharge basins are phased (constructed sequentially in increments of 40 acres and require 45 calendar days for each increment) then the Large Projects Alternative would take 900 calendar days to construct. All other elements of the Proposed Project may be constructed within this 900-day period, but this would require simultaneous construction of various facilities.

Table 4-18. Estimated mobilization-to-completion time for major elements of the three alternatives. Minor appurtenant facilities are assumed constructed in parallel. Mobilization and demobilization are assumed to take 5 working days each and have been added to each "Time to construct."

FACILITY		CONST. UNIT	# OF UNITS	CONST. TIME (Calendar days)	TIME TO CONSTRUCT	
					Calendar Days	Working Days
Minimum Facilities Alternative						
Instream Mojave River Recharge		Day	15	15 days	15	10
Mojave River Well Field		Well	25	20 days	500	350
Well Field Delivery Pipelines		100 feet	581	1.4 day	820	580
Unnamed Wash	Turnout	Day	50	50 day	50	35
	Conveyance	100 feet	25	1.4 days	40	28
	Bridges	Bridge	3	60 days	180	126
	Levees	200 feet	25	1.4	40	28
Small Projects Alternative						
Off-Channel Mojave River Recharge		40 acres	2.5	45 days	120	85
MR Off-Channel Recharge Pipeline		100 feet	200	1.4 day	290	205
Oro Grande Wash Recharge		40 acres	2	45 days	100	70
Oro Grande Wash Pipeline		100 feet	76	1.4 days	110	77
Cedar Avenue Detention Basin		40 acres	1.5	45 days	80	56
Cedar Avenue Pipeline		100 feet	30	1.4 days	42	30
Antelope Wash Recharge (Ranchero Road)		40 acres	Major construction by City of Hesperia			
Large Projects Alternative						
Oeste Recharge Basin		40 acres	8.5	45 days	400	280
Oeste Pipelines		100 feet	250	1.4 day	365	256
Alto Recharge Basin		40 acres	3.5	45 days	170	120
Alto Basin Pipelines		100 feet	50	1.4 day	80	56
Antelope Wash Recharge		40 acres	2.5	45 days	120	85

4.7 Measures for Avoidance and Minimization of Environmental Impacts incorporated into the Project Description

MWA is committed to minimizing the environmental impacts of the Proposed Project and includes the following avoidance and minimization measures as elements of all Proposed Project Alternatives.

4.7.1 Facility Site Selection

To the extent feasible, facilities have been sited to minimize distance from the California Aqueduct and MWA's existing facilities linking service areas to the California Aqueduct. This siting near existing facilities was intended to reduce costs and the need for an extensive network of new conveyance facilities, with their associated costs and environmental impacts.

Siting has also been focused on reducing the potential for effects to the arroyo toad, desert tortoise, Mohave ground squirrel, and cultural resources; thus the Minimum Facilities Alternative, which serves as a baseline for all alternatives: (a) utilizes existing facilities to the extent feasible; (b) optimizes use of the Mojave River Mainstem; (c) avoids known arroyo toad habitats near Mojave Forks Dam; (d) concentrates construction in the urbanizing areas of Hesperia, Victorville, Apple Valley, and Adelanto where wildlife habitat is already highly disturbed; and (e) avoids known significant cultural resource sites along the Mojave River.

4.7.2 Operation Schedule

Operation of the Proposed Project incorporates conditions for the release of water from Silverwood Lake to the West Fork of the Mojave River only during periods when the arroyo toad is estivating and only at rates which the 2003-2004 demonstration project showed to be fully contained within the main channel of the river.

4.7.3 Best Management Practices when Constructing in the Public Right-of-Way

When constructing in an urban setting to construct pipelines and recharge basins, MWA would comply with applicable city encroachment permit policies. These may vary, and therefore typical policies in the Manual on Uniform Traffic Control Devices, California Supplement, Part 6 (Caltrans 2003). These policies specify work schedules and work practices intended to minimize construction impacts on traffic, local businesses, local residents, storm water runoff, and utilities and public services.

4.7.4 Aesthetic Treatment

Where facilities such as wells would be visible, MWA would contain them in structures designed to be compatible with adjacent construction and in consultation with nearby residents. Pipelines will be buried.

4.7.5 Air Quality

MWA would adopt best management practices per the Mojave Desert Air Quality Management District/Antelope Valley Air Quality Management District (AVAQMD/MDAQMD 2004), and incorporated by reference herein.

4.7.6 Noise

The siting of the Proposed Project contributes to avoidance of noise impacts to adjacent business and residents. Only pipelines and wells associated with the Minimum Facilities Alternative would be constructed in public roads adjacent to existing development.
For areas adjacent to residential development MWA would comply with the following construction protocols:

- Permanent above-ground facilities (wells and treatment plant) would be contained within structures that would ensure that adjacent ambient noise levels are below the levels established for facilities in commercial and manufacturing areas.
- Except when more stringent standards apply to construction in the roadway, construction work would be limited to the hours from 7 AM to 7 PM, with no construction on weekends.
- Construction noise would be monitored on site by the construction contractor and portable noise attenuation barriers would be erected between construction and housing if construction noise measured at the exterior of adjacent housing exceeded 65 dBL.

4.7.7 Construction Crew Training, On-Site Biological Monitoring, and Isolation of the Construction Area

To prevent adverse impacts associated with wildlife incidental use of the construction area, MWA would implement the following avoidance and minimization measures:

- Construction and maintenance personnel would participate in a USFWS/CDFG-approved environmental awareness program. Under the program, workers shall be informed about the potential presence of special-status species and that unlawful take of these species is a violation of FESA and CESA. Prior to construction activities, a qualified biologist would instruct construction personnel about the identification and the life history of the various special status species which may inhabit the Proposed Project area. Color photographs would be provided for maintenance on site. Proof of instruction shall be provided to USFWS and CDFG.
- Prior to initiation of construction activities, a qualified biologist would survey the area to confirm that no special-status species are present. If special-status species are present, they would be allowed to move away from construction activities.

4.7.8 Water Quality

MWA would implement best management practices to avoid construction runoff during construction activities, including:

- Daily pre-construction inspection of all construction equipment to ensure that oil and/or gas/diesel fuel are not leaking from equipment;
- Secondary containment for fueling and chemical storage areas shall be provided during construction and Proposed Project operation;
- Secondary containment for equipment wash water shall be provided to ensure that wash water is not allowed to run off the site;
- Silt traps and/or basins would be provided to prevent runoff from the construction site;
- In areas where runoff from construction could adversely affect the Mojave River (such as in the well field and pipeline construction areas of the Minimum Facilities Alternative), materials stockpiles would be covered to prevent runoff;
- Loose soils would be protected from potentially erosive runoff;
- If construction equipment is used within the river channel, equipment will be inspected routinely for fuel, lubricant, and other fluid leaks. Any leaks will be repaired. If necessary, the equipment would be fitted with secondary containment materials at potential oil/fuel leakage sites.

MWA would comply with the terms and conditions of the State's General Stormwater Permit program for construction activities. Issues related to runoff from construction sites will be addressed by preparation and implementation of a Storm Water Pollution Prevention Plan based on the guidance in CalTrans' *Storm Water Pollution Prevention Plan and Water Pollution Control Plan Preparation Manual*, March 2003.

4.7.9 Cultural Resources Management

In general, siting and construction scheduling have reduced the potential for construction of the Proposed Project to impact cultural resources in many areas. There is potential for construction to encounter buried cultural resources within existing roads during pipeline construction and at recharge basins. In these areas, MWA would address potential impacts to buried cultural resources through:

- Construction Personnel Training. Prior to initiation of construction, all construction personnel shall be trained regarding (a) the recognition of possible buried cultural remains and (b) procedures to be followed if archeological materials are discovered. Training would provide that construction in the area of a discovery shall be halted immediately and a qualified archeologist notified.
- Construction Monitoring and resource recovery. In areas near known cultural resource sites, construction monitoring shall be undertaken by a qualified archeologist familiar with the types of historic and prehistoric resources that could be found within the

Proposed Project area. Monitored locations shall include all areas designated as having a high probability of finding subsurface cultural resources. If cultural resources are discovered during excavations, then the monitor would initiate consultation with the State Historic Preservation Office and develop and implement an appropriate resource recovery program.

- Compliance with DHS requirements for the treatment of buried human remains. If human remains are found during construction, MWA would immediately halt construction and implement the notification and treatment protocols required by DHS.

4.7.10 Assurances that Impact Minimization Measures will be implemented

MWA will ensure implementation of impact minimization measures in several ways. First, costs associated with these measures will be a mandatory line item in project budget requests to Metropolitan and to MWA's Board of Directors. Second, as appropriate, MWA will incorporate the above measures, and other specific mitigation measures described in Chapter 5, into construction contracts. Third, MWA will assign a staff mitigation manager to monitor compliance and make appropriate and timely reports to all regulatory and permitting agencies.

Finally, MWA's long-term agreement for the Proposed Project banking and exchange with Metropolitan will identify impact minimization costs as a line item to be cost-shared by MWA and Metropolitan consistent with the cost-sharing provisions of the agreement.

4.8 Project Energy Use and Measures to Reduce Energy Use

4.8.1 Construction Energy Use

Facility construction necessarily utilizes diesel fuel, gasoline, and electrical energy. The vast majority of energy use associated with construction is used by heavy diesel-powered equipment. Estimates of fuel consumption from diesel fueled construction equipment vary, depending on the type of construction and the load factors for each piece of equipment. Approximations of daily fuel consumption during construction can be made by estimating equipment use and using average hourly fuel consumption for each piece of equipment. Total energy use can then be estimated based on probable duration of each element of construction. This approach is shown on Table 4-19.

As Table 4-19 indicates, fuel consumption for project construction will be approximately 920,000 gallons. This assumes that the City of Hesperia would do the initial construction of the Antelope Wash (Ranchero Road) site. Total energy use would not be affected by changes in schedule or rate of construction; acceleration of the schedule would require more equipment and/or higher load factors (hours of use per day).

Table 4-19. Estimated daily/ total diesel fuel consumption for Proposed Project facilities.

EQUIPMENT (# USED)	HOURS/DAY	GALS/ HOUR	GALS/DAY	DAYS OF USE	TOTAL
Mojave River Recharge (Berm Construction)					
Scraper (2)	8	15	240	15	3600
Total 20 years (3600 x 20)					72000
Contingency 25%					18000
TOTAL					**90,000**
Mojave River Well Field (up to 25)					
Scraper (1)	2	15	30	15	450
Loader (1)	2	3	6	15	90
Water Truck (1_	1	5	5	15	75
Dump truck (1)	1	8	8	15	120
Small compactor (1)1	1	0.25	0.25	15	4
Small dozer (1)	1	10	10	15	150
Large drilling rig (1)	8	12	96	15	1440
Subtotal					2329
Contingency 25%					583
Total one well					2911
TOTAL 25 wells					**72,775**
Well Field Delivery Pipelines (approximately 11 miles)					
Backhoe (1)	8	2	16	580	9290
Hydro. Excavator (1)	8	3	24	580	13920
Dump truck (1)	4	8	32	580	18560
Water truck (1)	4	5	20	580	11600
Crane (1)	8	5	40	580	23200
Small compactor (1)	2	0.25	0.50	580	290
Small dozer (1)	1	10	10	580	5800
Subtotal					82660
Contingency 25%					20665
TOTAL					**103325**
Unnamed Wash					
Scraper (2)	8	15	120	110 (average)	13200
Loader (1)	2	3	6	110	660
Water Truck (1)	4	5	20	110	2200
Dump truck (1)	4	8	32	110	3520
Compactor (1)	4	1	4	110	440
Subtotal					20020
Contingency 25%					5005
TOTAL					**25025**
Off Channel Mojave River Recharge (100 acres)					
Scraper (2)	8	15	240	85	20400
Loader (1)	8	3	24	85	2040
Water Truck (2)	8	5	80	85	6800
Excavator (1)	8	10	80	85	6800
Medium Dozer (1)	8	10	80	85	6800
Subtotal					42840
Contingency 25%					10710
TOTAL					**53550**

EQUIPMENT (# USED)	HOURS/DAY	GALS/ HOUR	GALS/DAY	DAYS OF USE	TOTAL
Mojave River Off-Channel Recharge Pipeline					
Backhoe (1)	8	2	16	205	3260
Hydro. Excavator (1)	8	3	24	205	4920
Dump truck (1)	4	8	32	205	6540
Water truck (1)	4	5	20	205	4100
Crane (1)	8	5	40	205	8200
Small compactor (1)	2	0.25	0.5	205	103
Small dozer (1)	1	10	10	205	2050
Subtotal					29173
Contingency 25%					7293
TOTAL					**36466**
Oro Grande Wash Recharge (80 acres)					
Scraper (2)	8	15	240	70	16800
Loader (1)	8	3	24	70	1680
Water Truck (2)	8	5	80	70	5600
Excavator (1)	8	10	80	70	5600
Medium Dozer (1)	8	10	80	70	5600
Subtotal					35280
Contingency 25%					8820
TOTAL					**44100**
Oro Grande Wash Pipeline					
Backhoe (1)	8	2	16	77	1232
Hydro. Excavator (1)	8	3	24	77	1848
Dump truck (1)	4	8	32	77	2464
Water truck (1)	4	5	20	77	1540
Crane (1)	8	5	40	77	3080
Small compactor (1)	2	0.25	0.5	77	38
Small dozer (1)	1	10	10	77	770
Subtotal					10972
Contingency 25%					2743
TOTAL					**13715**
Cedar Avenue Detention Basin (60 acres)					
Scraper (2)	8	15	240	56	13440
Loader (1)	8	3	24	56	1344
Water Truck (2)	8	5	80	56	4480
Excavator (1)	8	10	80	56	4480
Medium Dozer (1)	8	10	80	56	4480
Subtotal					28224
Contingency 25%					7056
TOTAL					**35280**
Oeste Recharge Basins (330 acres)					
Scraper (2)	8	15	240	280	67200
Loader (1)	8	3	24	280	6720
Water Truck (2)	8	5	80	280	22400
Excavator (1)	8	10	80	280	22400
Medium Dozer (1)	8	10	80	280	22400
Subtotal					141120
Contingency 25%					35280
TOTAL					**176400**

EQUIPMENT (# USED)	HOURS/DAY	GALS/ HOUR	GALS/DAY	DAYS OF USE	TOTAL
Oeste Pipelines					
Backhoe (1)	8	2	16	256	4096
Hydro. Excavator (1)	8	3	24	256	6144
Dump truck (1)	4	8	32	256	8192
Water truck (1)	4	5	20	256	5120
Crane (1)	8	5	40	256	10240
Small compactor (1)	2	0.25	0.5	256	127
Small dozer (1)	1	10	10	256	2560
Subtotal					36479
Contingency 25%					9119
TOTAL					**45599**
Alto Recharge Basins (150 acres)					
Scraper (2)	8	15	240	120	28800
Loader (1)	8	3	24	120	2880
Water Truck (2)	8	5	80	120	9600
Excavator (1)	8	10	80	120	9600
Medium Dozer (1)	8	10	80	120	9600
Subtotal					60480
Contingency 25%					15120
TOTAL					**75,600**
Alto Basin Pipelines					
Backhoe (1)	8	2	16	56	896
Hydro. Excavator (1)	8	3	24	56	1344
Dump truck (1)	4	8	32	56	1792
Water truck (1)	4	5	20	56	1120
Crane (1)	8	5	40	56	2240
Small compactor (1)	2	0.25	0.5	56	27
Small dozer (1)	1	10	10	56	560
Subtotal					7979
Contingency 25%					1995
TOTAL					**9974**
Antelope Wash Recharge (100 Acres)					
Scraper (2)	8	15	240	85	20400
Loader (1)	8	3	24	85	2040
Water Truck (2)	8	5	80	85	6800
Excavator (1)	8	10	80	85	6800
Medium Dozer (1)	8	10	80	85	6800
Subtotal					42840
Contingency 25%					10710
TOTAL					**53550**
Oeste and Alto Wells (25)					
Scraper (1)	2	15	30	15	450
Loader (1)	2	3	6	15	90
Water Truck (1)	1	5	5	15	75
Dump truck (1)	1	8	8	15	120
Small compactor (1)	1	0.25	0.25	15	4
Small dozer (1)	1	10	10	15	150
Large drilling rig (1)	8	12	96	15	1440

Subtotal					2329
Contingency 25%					583
Total one well					2911
TOTAL 25 wells					**72,775**
Hauling of Construction Equipment					
Tractor Haul Rig 1	8	5	40	100	**4000**
Crew driving to construction sites. 10,000 trips at 20 miles each way = 40,000 miles at 15 mpg					**2666**
TOTAL ESTIMATED CONSTRUCTION FUEL CONSUMPTION					**914,800**

4.8.2 Operations Energy Use

Operations energy use is difficult to estimate because the volume of deliveries and extractions is not fixed. Energy used to import supplies for banking and exchange programs will, over the long-term be equivalent to that of the No Project Alternative, because long-term water deliveries will be the same as for the project. The Proposed Project simply pre-delivers this water for storage to allow for reliable use over an extended period of time. Operations energy use for extraction and delivery of supplies from groundwater will be affected by the Mojave River Well Field, which will allow for extraction at lower depths than may currently be feasible with wells in the Regional Aquifer. Water migrating from the river channel to the boundary of the Floodplain and Regional Aquifer will raise water levels and reduce energy costs for extraction as extraction is shifted from existing deep wells to these shallower wells.

4.9 Summary and Comparison of Proposed Project Alternatives

The three Proposed Projects structural alternatives, evaluated within the context of a traditional water banking program and a modified banking and exchange program represent the practical range of alternatives for accomplishing the goals and objectives of the Proposed Project. They vary in a number of ways:

- Capacity to receive deliveries of supplies for banking;
- Capacity to store supplies from banking;
- Capacity to return supplies by exchange and by direct return;
- Total land area directly affected by construction and operation;

They have a number of elements in common. Because they would involve use of existing facilities in areas that are too remote to provide for direct return to the extent that banked supplies delivered to these areas could be returned via exchange, they optimize use of these remote facilities to the extent feasible. This approach is also taken in regard to use of the Mojave River Aquifer in the Alto subarea, where the primary constraint on banking is the ability of local agencies to utilize banked water in order to make returns of banking water via exchange. Thus the Proposed Project first optimizes the practical use of existing facilities throughout MWA's service area. A summary comparison of the three alternatives is shown on Table 4-20.

Table 4-20. Summary comparison of alternatives.

PROJECT ELEMENT	ALTERNATIVES		
	Minimum Facilities Alternative	**Small Projects Alternative**	**Large Projects Alternative**
Capacities			
Annual recharge capacity: in acre-feet	**92,275**	**120,775**	**182,175**
Acres of new recharge	**300**	**605**	**1,185**
Instream	**300**	**300**	**300**
Off-stream	**0**	**305**	**885**
Total Acres of New Construction	**68**	**343**	**923**
Permanent Land Use Change	**8**	**305**	**768**
Maximum instantaneous recharge rate (cfs)	**646**	**737**	**1,014**
Capacity for direct return (af/year)	**18,000**	**18,000**	**34,500**
Number of new wells	**up to 25**	**up to 25**	**up to 50**
Estimated Banking Project Yield (See also Table 4-5, above.)			
Traditional water banking	**174,000**	**174,000**	**237,000**
Modified banking/exchange	**96,000**	**96,000**	**96,000**
TOTAL	**270,000**	**270,000**	**333,000**

*Includes 200+ acres of temporary berms in the Mainstem Mojave River

4.10 Required Approvals

The proposed projects would require permits and/or approvals from the following agencies:

- Local jurisdiction plan approvals and encroachment permits, local well construction permits
- California Department of Transportation encroachment permits for construction in state rights-of-way
- U.S. Army Corps of Engineers Section 404 permit for actions within jurisdictional waters, including the West Fork and Mainstem Mojave River, Antelope Wash, Oro Grande Wash, and Unnamed Wash
- U.S. Fish and Wildlife Service Endangered Species Act Section 10(a) permit or Section 7 consultation permit for actions affecting federally listed threatened and/or endangered species
- California Department of Fish and Game, Section 2081 permit for incidental take of threatened and/or endangered species
- California Department of Fish and Game, Section 1600 streambed alteration permit for effects to rivers and washes
- Lahontan and Colorado River Regional Water Quality Control Board Clean Water Act Section 401 certifications

- California General Stormwater Permit from Lahontan and Colorado River Regional Water Quality Control Boards
- California Department of Water Resources potential approval of new turnout(s) from the California Aqueduct and change in point of delivery agreements
- Superior Court, State of California, County of Riverside, approval of any plan provisions for direct return of banked groundwater via pumping of groundwater and delivery to the California Aqueduct;
- Metropolitan Water District of Southern California, approval of its participation in the cooperative banking and exchange program

* *Following discussions during the public comment period, Metropolitan was added as a CEQA Responsible Agency because it may take action to participate in the proposed project.*

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 5: ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION

5.1 Environmental Setting: General

5.1.1 Setting

The 4,900 square mile MWA service area lies inland of the coastal Los Angeles/Riverside/San Bernardino Basin and is separated from this basin by the San Gabriel and San Bernardino mountains, which reach elevations of over 10,000 feet (MWA 2004b). The primary transportation linkage to the more urbanized areas of the coastal basin is Interstate 15/State Highway 395 via the Cajon Pass. Other road links to the more urbanized coastal basin include Highway 18/14 via Palmdale, Highway 18 via Big Bear Lake and Lake Arrowhead, and Highway 62 from the Morongo Basin to Riverside County via Interstate 10. Most development in the MWA service area is (a) along the Interstate 15/State Highway 395 corridor and (b) concentrated in the Hesperia, Victorville, Apple Valley, and Adelanto areas. The other major population center is Barstow at the intersection of Interstate 15, Interstate 40, and State Highway 58. In 2000, about 74% of the population of the MWA service area was located in the Alto Basin, within 20 to 40 miles of the Los Angeles Basin (via Interstate 15/State Highway 395). Another 10% of the total population in MWA's service area was located in the Centro Basin, concentrated at Barstow. The Yucca Valley in the Morongo Basin has the only other major population zone, with a year 2000 population of about 17,000. From 1990 to 2000, growth was greatest in the Alto and Oeste basins, which lie closest to the I-15/State Highway 395 corridor. As available land has been developed in the coastal basin areas and housing costs have risen to record highs, the pace of development has increased in all inland areas of southern California. In Victorville, for example, 390 new houses were constructed in 2000, 637 in 2001, 986 in 2002, and 2,103 in 2003. Outside of the urban centers, the MWA service area is sparsely populated and development is generally distributed along major roads which offer utility connections.

In response to a comment from Department of Water Resources (Appendix A), MWA notes that the MWA service area incorporates much of the south-central Mojave Desert, an area of low precipitation and long periods of high temperature and low humidity. The basin consists of a series of valleys formed as a result of uplift, volcanic activity, and seismic activity along the San Andreas Fault and related earthquakes. These valleys tend to be hydrologically and hydrogeologically isolated. Most of the water available to people and wildlife is derived from runoff from the mountains to the west and south, and the various basins are crossed by desert washes that lead to dry lake beds. Runoff percolates rapidly into groundwater when it reaches the valley floor and runoff reaching dry lakes accumulates and then dries out rapidly. Surface water quality tends to deteriorate with distance from the mountains. Along the Mojave River, water flows under the channel and is forced to the surface at several sites where seismic activity has created blocks to sub-surface flow.

Wildlife in the Mojave Basin show various typical adaptations to an environment characterized by seasonally extreme hot and dry conditions and periodically more severe and extended drought. For plants, these adaptations include deep roots, waxy/oily leaves, creation of plant/soil "crusts" that reduce erosion of the very thin topsoils, and loss of leaves during drought conditions. Animal adaptations include burrowing, estivation or hibernation during dry periods, special physiological adaptations to drought, and/or the ability to recolonize marginal habitat where localized extinctions may occur during extreme droughts. These adaptations make desert ecosystems relatively sensitive to human disturbance, particularly disturbance that affects soil integrity and fragments habitat.

Climate in the high desert is typical of California's inland deserts. Winters are cool (average daily temperatures of 45 F to 66 F) but seldom freezing, and there is minimal precipitation; about 75% of average annual precipitation at Victorville falls in December-March. The extended warm season (May through October) is hot and dry (average daily high temperatures from 80 F to 98 F). Extreme daily high temperatures may exceed 110. Precipitation generally declines with distance from the mountain ranges.

The majority of the MWA service area is high desert, consisting of valleys and closed basins, with a general trend towards declining elevations from west to east, and south to north. Elevation at Victorville, for example, is 2715 feet. Elevation at Afton Canyon is about 1550 feet. With the exception of some drainage from the Morongo Basin to the Colorado River, rivers drain north and east to dry lake beds. Except in extraordinary years, rivers and streams are dry most of the year and surface water is available only at springs and where localized geology causes upwelling or groundwater moving downstream in the Alluvial Aquifer.

From a socio-economic perspective, the MWA service area has historically been relatively isolated from the more densely populated coastal basins to the south and west. This is reflected in key socio-economic indicators. In Victorville, for example, median household income, median house value, median education level, and median age are all below California state averages (City-data.com 2005). The economies of the region are influenced by large military installations, such as George Air Force Base (north of Victorville), Edwards Air Force Base (partially within MWA service area on the west), the US Marine Corps Logistics Base ant Nebo and Yermo, and the Fort Irwin National Training Center (north of Barstow). Interstate 15/State Highway 395 provide for area residents to commute to jobs in Riverside, San Bernardino, and Los Angeles counties. Key demographic, economic, and social development trends in the MWA service area include (MWA 2004a):

- A net 1990-2000 population decline of 7,000 in the Morongo Basin;
- A net 1990-2000 population decline of 3,700 in the Baja Basin;
- Declining agricultural water consumptive use;
- Increasing urban water consumptive use; and
- Increasing concentration of population in and around the existing urban centers.

Combined with the increased housing construction in the Alto and Oeste basins, these trends suggest a shift towards an urban/industrial/commercial economy becoming more closely linked to the economies of the coastal basin. Changes in demographics and in regional development are reflected in the regional effort to address water supply and water quality issues. Since 2003, water conservation and water supply are being addressed in a coordinated manner via the Alliance for Water Awareness and Conservation, which includes water districts, cities, and other local government agencies along with the US Bureau of Reclamation and University of California Cooperative Extension.

The Proposed Project takes place in the context of a number of water management programs in the MWA service area. In addition to MWA's completion of projects initiated following the 1994 Regional Water Management Plan, there are three pending projects within the City of Hesperia and the City of Victorville that are features of the Proposed Project. The first project is VVWD's recharge project south of the Green Tree golf course. When surveys were being conducted for this EIR, this project was observed to be in early stages of clearing the land for construction. It has therefore been assumed to be an existing project. MWA and VVWD are in on-going discussions regarding the cooperative use of this facility and 3,600 acre-feet of capacity per year has been assumed for analysis purposes.

Second, the City of Hesperia has identified sites for and is investigating and obtaining funding for two flood detention basins -- at Cedar Avenue and at the Ranchero Road crossing of Antelope Wash (City of Hesperia 2003). It has been assumed that these projects will go forward. At Cedar Avenue, however, construction activity for recharge facilities may alter the configuration of the basin and involve substantially greater surface disturbance and earth moving than the detention basin alone. At the Antelope Wash-Ranchero Road detention basin, the City proposes to raise the road (currently on grade) on a berm. It has been assumed that construction and on-going maintenance to clean out debris following flooding would result in this site being cleared routinely. In addition, recharge at this site may require only minimal construction of berms and other facilities (which will be inundated periodically and subject to erosion from flood flows). For this reason, construction-related effects of recharge at this site have been assumed to accrue to the City's Project.

5.1.2 Scope of Impact Assessment

The 2004 PEIR evaluated the potential for the Proposed Project to affect Agriculture and Mineral Resources and found that there was no mechanism by which the broad suite of projects evaluated could affect these resources. No aspect of the Proposed Project has features which would change this general conclusion of the 2004 PEIR. There is no active agriculture or mining at any of the proposed facility sites. Consistent with this prior finding, this Project EIR does not specifically address Agriculture or Mineral Resources.

5.2 Aesthetics

5.2.1 Environmental Setting

As discussed in the 2004 PEIR, the MWA service area has significant scenic resources. With generally cloudless conditions, the various isolated valleys and plains provide long-range views of the surrounding desert mountains, with generally dry washes, streams, and rivers visible at various times. The Mojave River itself is a scenic resource, particularly in the areas with riparian vegetation lining the channel. The open desert generally consists of creosote bush scrub and western Mojave Desert saltbush scrub, mixed with occasional Joshua trees that may occur as dense woodland. The overall character of the MWA service area is that of an expansive open desert horizon, sparsely populated.

Within the urban centers of MWA's service area, towns are a mix of old historic areas surrounded by new urban commercial and residential development. There are no designated scenic highways or vista points, but there are roads that could be eligible for such designation. San Bernardino County uses the following criteria for determination of scenic value for a landscape feature or scenic vista:

- Provides a vista of undisturbed natural areas;
- Includes a unique or unusual feature which comprises an important or dominant portion of the viewshed; and/or
- Offers a distant vista which provides relief from less attractive views of nearby features (such as views of mountain backdrops from urban areas).

The Town of Apple Valley and County of San Bernardino have developed aesthetic guidelines for the protection of native plants (Town of Apple Valley 2000; County of San Bernardino 1989) County of San Bernardino guidelines have been adopted and cross-referenced in the City of Hesperia Municipal Code. These guidelines are focused on maintaining the natural plant heritage of the desert and contain provisions protecting native trees and riparian vegetation. Protection is specifically provided for Joshua Trees and several types of native cactus.

5.2.2 Facilities Impacts

5.2.2.1 Mechanisms for Effect

Only above-ground construction could adversely affect aesthetics. The facilities of all alternatives involve different levels of above ground construction at recharge basins, wells, and (potentially) connections to existing power lines. These facilities may affect a viewshed in several ways:

- By blocking view of a distant landscape feature due to walls or raised berms at recharge basins and well sites;

- By changing the character of an existing setting (wells and recharge basins) by altering vegetative cover in rivers or washes which are a part of the viewshed of residents living along the crest of the wash;
- By having a demonstrable negative effect on local views (well containment structures within a residential area or impacts to Joshua Tree/juniper habitat);
- By raising levee berms to 3-5 feet above ground level adjacent to existing development and thereby altering the local view.

5.2.2.2 Facility Impacts: Minimum Facilities Alternative

The Minimum Facilities Alternative would involve above-ground construction along the Mojave River north and south of Highway 18 (wells), construction of several small bridges and drop structures in Unnamed Wash, and could involve raising low levees on either side of the Unnamed Wash as it flows from Arrowhead Lake Road to the Mainstem channel. All other features of this alternative involve use of existing facilities, buried facilities such as pipelines, connections to existing wells, and the use of the Mainstem Mojave River for recharge, involving intermittent short term construction of sand berms in the riverbed. New-construction elements of the Minimum Facilities Alternative that would be visible to the public are:

- Mojave River Well Field;
- Intermittent use of construction equipment in the Mojave River for berm construction and maintenance; and
- Bridges, drop structures, and levees at Unnamed Wash.

Mojave River Well Field: The well field proposed for the Minimum Facilities Alternative would involve drilling of up to 25 new wells on vacant lands and road easements adjacent to commercial and residential development along the Mojave River. The existing context of this area is characterized by:

- A gentle slope leading down to the Mojave River on both sides of the floodplain, and
- Mixed residential and commercial development.

Wells would be sited to minimize visibility from residential property. A typical enclosed well occupies about 100 square feet of space, and would be enclosed in a 10 X 10 X 8 structure that would be designed and/or landscaped to blend with existing commercial and residential development. Such enclosed wells are found in numerous areas of the urban landscape of the Alto subarea. These small enclosures would be visible from roads and some residences. They would be sited to be consistent with existing local policies, guidelines, and regulations.

Instream Mojave River Recharge: Prior to recharge releases from Silverwood Lake (Cedar Springs Dam) or Rock Springs (via the Morongo Basin Pipeline), MWA would use earth moving equipment to push up low temporary berms to enhance spreading of water across the riverbed and slow down surface flow to enhance percolation. Existing conditions in this reach of the river are:

- The riverbed is dry in most months, and
- There is intermittent construction activity for flood control purposes in the riverbed, including movement of construction materials.

Short-term construction activities will not affect views for an extended period of time and use of the Mainstem Mojave River for recharge will provide a more frequent water view to adjacent landowners.

Unnamed Wash

Unnamed Wash has been designated as open space in the Rancho Las Flores Environmental Impact report, with development along the margins of the wash, particularly in the upstream watershed of the wash in the Summit Valley area. Construction of Proposed Project facilities would not alter use for open space, and would be consistent with open space recreational aesthetics. A bridge across the wash would function as a trails link and erosion-control drop structures would be designed to blend in with the surroundings. The use of the wash for recharge would involve periods of sustained inundation, and could result in an incised channel. The roadway at Arrowhead Lake Road would be raised several feet to accommodate flow under the road, and would therefore provide marginally better views of the Mojave River and adjacent hills and mountains. Low levees to contain wash flows across the floodplain would be vegetated and would blend in with the disturbed grasslands and scrub vegetation of the floodplain.

5.2.2.3 Facility Impacts: Small Projects Alternative

The Small Projects Alternative would add four above-ground recharge facilities to those of the Minimum Facilities Alternative:

- Off-Channel Mojave River Recharge: 100 acres on the west side of the Mojave River about 3 to 4 miles south of the Morongo Basin pipeline;
- Oro Grande Wash Recharge: Approximately 80 acres of new recharge at Oro Grande Wash at two sites north and south of the California Aqueduct;
- Cedar Avenue Detention Basin Recharge: Approximately 60 acres of recharge at a flood water detention basin; and
- Antelope Wash Detention Basin (Ranchero Road) Recharge: Approximately 65 gross acres of recharge at a flood detention basin.

Off-Channel Mojave River Recharge: At either of the two sites being considered (East and West) the 100-acre recharge basin would be located in undeveloped areas that have previously been disturbed: for disposal of treated water (West) and for farming (East). Both sites are at the base of a slope along the river floodplain.

The West Site is disturbed, has remnants of old levees, and is in the immediate viewshed of 3 houses. The effects of a new recharge basin at this site would be to raise a low levee along the downslope side of Highway 173 for about 0.5 miles. Given the slope of the ground, this levee would be from 2-3 feet and would probably not affect views of the Mojave River itself or of surrounding hills. The recharge basins would be distantly visible from parts of Highway 173 from Mojave Forks Dam and from the crest of the hill immediately south of the recharge basin. The East Site would be located near a poultry ranch facility in an area served only by local roads. It would be in an area where flood control involves the construction of low berms along the river and where there is only sparse adjacent housing. Low berms needed along the upslope end of the recharge facility would not affect the viewshed of adjacent houses. Neither the east or west site has locally-protected riparian or Joshua Tree habitats.

<u>Oro Grande Wash Recharge Basin(s):</u> These recharge facilities would be constructed within the wash, below grade. Existing aesthetic conditions at the potential south project site are characterized by:

- There is residential and commercial development along portions of the wash in the proposed reach, with about 30 housing units along the rim of the wash in a development just south of the California Aqueduct and east of Oro Grande Wash and about 15 residential units about 0.25 miles north of the California Aqueduct, again along the east rim of the wash;
- The wash has been disturbed by off-road vehicle and other use such as trash dumping;
- There is a road crossing (Highway 395) from which it is possible to view the wash;
- The wash is not visible from Interstate 15.

Work at this site could be viewed from Highway 395 and from some commercial development to the east of the wash. All work would be below grade and would not affect views of surrounding landscape, mountains, or the valley below.

Existing aesthetic conditions at the potential north project site are characterized by:

- To the east, the site has been graded for housing;
- The site itself has been graded for storm water detention;
- To the west, there is some mixed creosote scrub.
- To the north, there is an existing golf course across a major road.

Site aesthetics have essentially already been lost due to grading for storm water detention, and recharge would be undertaken within this area. There is a small area of Joshua Tree habitat along the south of the potential recharge site, already disturbed and near development. No new aesthetic effects are anticipated.

<u>Cedar Avenue Detention Basin Recharge:</u> This element of the Small Projects Alternative would not be visible from the north and east, as the existing California Aqueduct would block this view. There is sparse existing development (about 5 houses) along the south and west boundaries of the potential detention basin/recharge facility, where the views would again be of the levees of the California Aqueduct. No locally-protected vegetation types are found on site.

At this site, the recharge facility will function as a dual purpose facility -- providing flood control and recharge. The facility will have low berms (3-5 feet high) to contain flood flows from local drainage that tend to collect against the California Aqueduct and threaten homes to the west and south of the aqueduct.

Regardless of who constructs these berms, they would not alter existing views from adjacent development, which are of a similar facility -- the California Aqueduct. This facility would have no affect on view of significant scenic resources, views of which are already affected by the nearby levee of the California Aqueduct. Planting along outer berm where levees are adjacent to existing development would reduce localized impacts to a level of less than significant.

<u>Antelope Wash Detention Basins (Ranchero Road) Recharge</u>: At this site, existing conditions include:

- Scattered existing housing and commercial development along the rim of the wash, with a total of about 30 residential units along the rim of the wash;
- Guard rails along the existing road to the north of the proposed recharge and detention basins, which block view of the wash from cars traveling on the south side of the road; and
- A moderate level of existing landscape disturbance due to human use of the wash.

At the site, Ranchero Road is currently an on-grade crossing of the wash. A flood detention basin is proposed by the City of Hesperia at this site, involving an embankment to raise the road and detain flood flows to reduce downstream peak floods. The flood detention basins would involve complete removal of vegetation and there would be periodic inundation of the site. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas.

The detention basin (and any recharge berms constructed within it) would be visible from some portions of the road to the north and from a few adjacent residential buildings. In this site, recharge will be consistent with the flood management function of the site, and vegetation will be periodically cleared by MWA and/or flood control authorities. Operation of the basin for recharge will not alter the visual character of the site, which will be maintained for flood control purposes as well, including routine removal of shrub vegetation to ensure basin outlet works are not clogged by vegetation during flooding.

5.2.2.4 Facility Impacts: Large Projects Alternative

The Large Projects Alternative would add three large detention basins to the Small Projects Alternative, with up to 580 acres of recharge at three sites. All of these features would be visible from some vantage points. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas.

Oeste Recharge Basin: Existing conditions at the two potential sites for these basins are characterized by:

- No existing development along the boundary of the recharge basins on the west side of the Oeste site;
- Four existing homes along the boundary of the recharge basins on the east side of the Oeste Site; and
- Sparse development in the general area.

Recharge basins at this site would involve construction of levees about 3 to 5 feet in height and these levees would be closer to nearby residences than the levees of the existing California Aqueduct. They would therefore somewhat alter the current view. They would not affect views of the surrounding mountains or interrupt vistas in any direction.

Alto Recharge Basin: Existing conditions at this site on the north side of the California Aqueduct include:

- Views of the sites are substantially blocked from the south by the existing California Aqueduct;
- The view from the north is of the bare ground and the north levee of the California Aqueduct;
- There is residential development (8 houses) along portions of the proposed perimeter levees at both sites;
- There is mixed disturbed desert scrub and Joshua Tree habitat; and
- There is a road crossing the California Aqueduct immediately west of the proposed site.

Recharge basins at this site would create a view of 3 to 5 foot earthen levees. This view would be consistent with the existing view, but the levees would be closer to adjacent residences. The new levees would not be high enough to affect views of the surrounding mountains or interrupt vistas in any direction.

Antelope Wash Recharge Basins: The additional recharge basins would be located in sparsely developed canyons north and south of the California Aqueduct. The potential sites are characterized by:

- There is existing housing (total 40-50 houses) along the northern rim of Antelope Wash in this reach and in a small new development on the southern rim, and this housing has an unobstructed view of the mountains to the south and east;
- Immediately below this housing, there is a road at the base of the bluffs on the north side of the wash;
- The wash is currently a semi-disturbed desert wash with extensive stands of native vegetation, including sensitive Joshua Tree/California Juniper/Desert Scrub communities.

Recharge basins in this portion of Antelope Wash would be visible from the housing lining the bluffs and from the road. The viewer would look down on the new basins, but the facilities would not otherwise alter views of surrounding vistas.

The Ranchero Road area is characterized by scattered housing and commercial development, including Hesperia Airport. If this upstream Antelope Wash recharge site were to be replaced by an expanded Ranchero Road recharge area as described in Chapter 4, page 4-31, impacts to the high aesthetic values of the upstream recharge site would be avoided. Expansion of the recharge basins to include areas from the airport to downstream of the Ranchero Road detention basin would therefore have lower aesthetic impacts than those associated with the upper recharge basin. Given the moderate to high level of existing development, including the airport complex, no significant aesthetic impacts would be anticipated by construction and operation of recharge basins in this reach.

5.2.3 Operational Impacts

5.2.3.1 Mechanisms for Effect

Operations will not alter the view of recharge facilities except (a) to the extent that the internal structures of the recharge basins might be visible. Given that off-stream recharge basins have been sited on relatively flat land, the internal portions of the recharge basins will not be readily visible except at:

- Oro Grande Wash (view from Highway 395 and local road crossing and from some adjacent development along the rim of the wash);
- Antelope Wash (view from road crossings and residential development on the rim of the wash);
- Mojave River Off-Channel Recharge (view from Highway 173 coming out of the mountains); and
- Instream Mojave River Recharge.

At all of these sites there would be intermittent water views during recharge. The view within the basins when not filled would be of open, sandy soils separated by earthen berms. For the Mainstem Mojave River, on-going operations will frequently alter the view of the Mainstem Mojave River, which will be wetted with greater frequency. During recharge, the dry-sandy appearance of the river between Mojave Forks Dam/Unnamed Wash and Rock Springs will be changed to the appearance of a flowing river.

5.2.3.2 Operational Effects

Operational effects on aesthetics, both beneficial and adverse, will increase with the magnitude of the Proposed Project and the volumes of delivery associated with banking, exchange, and MWA operations. As the magnitude of deliveries increases, the wetted area of recharge areas will increase and the frequency of flow in washes and the Mainstem Mojave River will increase.

These effects will be most pronounced in the Unnamed Wash and the Mainstem Mojave River. Although it is not feasible to precisely determine the schedule for delivery of water related to banking, time-shift exchanges, and MWA deliveries, the Proposed Project clearly contemplates delivery to recharge in wet years and return of banked water via exchange in dry years. In normal-to-wet years, the Unnamed Wash and the Mainstem Mojave River will be wetted for longer periods of time than they would be otherwise. In dry years, MWA may take delivery of only a small portion of its SWP supply, and its own deliveries to recharge will be minimal. This will not likely affect dry-year flows in unnamed wash and the Mainstem Mojave River because, even without making returns to Metropolitan, the available SWP supply can be accommodated using only existing facilities. Thus, the net effect of the Proposed Project in the aesthetics of the Unnamed Wash and the Mainstem Mojave River will be to increase the frequency of a water view for residents, primarily in normal-to-wet years. At sites where the interior of recharge basins is visible, the same pattern of wetted and non-wetted conditions would occur.

5.2.4 Significance of Impacts, Mitigation and Significance of Impacts after Mitigation

Per the 2004 PEIR, the facilities associated with the various alternatives would have significant aesthetic effects if they (phrases in parentheses refer to column titles headings on Table 5-1):

1. Blocked scenic views (block view);
2. Altered the appearance of designated scenic resources (alter resources);
3. Created significant contrasts with the scale, form, line, color, and/or overall visual character of the existing landscape setting (contrast with existing view);
4. Were inconsistent with applicable local guidelines or regulations (inconsistent w/local);
5. Conflicted with adopted visual resource policies (local policy conflict);
6. Had a substantial, demonstrable negative effect (negative effect);
7. Substantially reduced the vividness, intactness, or unity of high quality views (affect high-quality view);
8. (Substantially changed the quality of scenic corridors or views from scenic highways (change view from scenic highways).

The potential significance of alternative facilities is summarized in regard to these issues on Table 5-1. The rationale for the analysis summarized on Table 5-1 is then discussed below, along with proposed mitigation and significance after implementation of mitigation measures.

5.2.4.1 Instream Mojave River Recharge

On the Mojave River, recharge operations will intermittently enhance views of the river for all residents with a view by providing a desirable water view. The anticipated 2-weeks of construction activity necessary to raise low berms for recharge in the river bed is consistent with on-going flood control channel maintenance activities and will not create a significant adverse aesthetic effect. Given the width of the floodplain and the low sand berms, the berms will be only barely visible to most residents and from most roads. No significant effect is anticipated. No mitigation is required.

5.2.4.2 Mojave River Well Field

Although wells would be enclosed in small structures and sited to minimize impacts to residential areas, well structures along the Mojave River have the potential to alter local views in the immediate vicinity of the wells. To mitigate for this potential impact, MWA would enclose wells in structures designed to be consistent with structures in the immediate vicinity and/or would plant screening vegetation. With this mitigation, impacts would be reduced to a level of less-than-significant.

Table 5-1. Significance of aesthetic impacts associated with potential project alternatives, compared to the 8 criteria for significance. NSI = no significant impact; PSI = Potential significant impact prior to mitigation. Potential effects are shown in bold type.

FACILITY	POTENTIAL SIGNIFICANT IMPACTS, BY SIGNIFICANCE CRITERIA							
	Block view	Alter resources	Contrast with existing views	Inconsistent with local regulations	Local policy conflict	Negative effect	Affect High quality view	Change view--scenic road
Instream Mojave River Recharge	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
SWP Delivery via Unnamed Wash	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Mojave River Well Field	NSI	NSI	**PSI**	NSI	NSI	**PSI**	NSI	NSI
Off-Channel Mojave River Recharge: West	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Off-Channel Mojave River recharge: East	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Oro Grande Wash Recharge	NSI	NSI	**PSI**	NSI	NSI	**PSI**	NSI	NSI
Cedar Avenue Detention Basin Recharge	NSI	NSI	NSI	NSI	NSI	**PSI**	NSI	NSI
Antelope Wash Detention Basin Recharge	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Oeste Recharge and Wells	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Alto Recharge and Wells	NSI	NSI	NSI	NSI	NSI	**PSI**	NSI	NSI
Antelope Wash Recharge	NSI	**PSI**	**PSI**	NSI	NSI	**PSI**	NSI	**PSI**
Antelope Wash Downstream Relocation	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NIS

5.2.4.3 SWP Delivery via Unnamed Wash

Views of scenic resources will not be significantly affected by the small bridges and drop structures (artificial waterfalls) in the upper reaches of the wash (west of Arrowhead Lake Road). In this area, the wash will be enhanced aesthetically by flowing water and by incidental growth of sparse riparian vegetation. Downstream of Arrowhead Lake Road, the levees will be low and rapidly colonized by the non-native grasses in this area, blending into the surrounding landscape. This general area has remnant areas with raised levees and the bridge and levees would not be inconsistent with the existing visual character of the site. No significant impacts are anticipated and no mitigation is required.

5.2.4.4 Oro Grande Wash Recharge

Oro Grande Wash near the California Aqueduct has been disturbed by ongoing off-road vehicle use, existing road berms and the aqueduct, and other activities. Construction of recharge basins will nonetheless somewhat alter the viewshed from adjacent housing. When dry, the recharge basins will present a view of a sandy, unvegetated basin, in contrast to the currently sparse scrub. When wet, the basins would provide a pleasing water view. The removal of one or two Joshua Trees would not conflict with local protection for these aesthetically valuable plants because County and local code allows for such removal by public utilities. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Given the disturbed nature of the wash, recharge basins are not an aesthetically inconsistent use of this area and impacts will be less-than-significant.

5.2.4.5 Cedar Avenue Detention Basin Recharge

At the Cedar Avenue site, the existing view from adjacent housing is across disturbed scrub vegetation to the levees of the California Aqueduct; new facilities at these sites would not change the character of the viewshed but would bring levees closer to adjacent housing. These effects would be in addition to those of the flood control facility to be constructed by the City of Hesperia. To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Given the existing view of levees and disturbed scrub vegetation, this mitigation would enhance the appearance of the recharge basins and reduce impacts to a level of less-than-significance.

5.2.4.6 Antelope Wash Detention Basin (Ranchero Road) Recharge

Prior to use as a recharge facility, Antelope Wash at Ranchero Road will be altered by the proposed City of Hesperia detention basin and on-going vegetation maintenance associated with this flood management function. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Given prior construction and operation of the detention basin, the addition of gating to the detention basin outlet and creation of a series of low berms to spread flows will, in the context of the proposed flood control project, have a less-than-significant impact on aesthetics at this site.

5.2.4.7 Off-Channel Mojave River Recharge

For recharge south of the Morongo Basin Pipeline, recharge facilities at either site have little potential for significant impact. The sites slope gently downstream from the road, and therefore the upslope berm may be relatively low. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Both sites are isolated from significant areas of residential development and they would have no substantial effect on the views of those using Highway 173 or the local roads on the east side of the river. No significant impacts are anticipated and no mitigation is required.

5.2.4.8 Oeste Recharge and Wells

Recharge facilities at the Oeste sites would be immediately adjacent to the California Aqueduct in an area with little residential development. Only one existing residence would be within 200 feet of a facility outer berm, and the existing view from this residence is of the California Aqueduct. The facilities would be visible from local roads, but low berms along the road would not affect views of surrounding mountains or other scenic resources. Wells would be enclosed in small structures and sited to minimize impacts to residential areas, and designed to be consistent with structures in the immediate vicinity. MWA would also plant drought tolerant native screening vegetation along the outside of the perimeter levee maintenance road and where wells are sited. With this mitigation, impacts are anticipated to be less than significant.

5.2.4.9 Alto Recharge and Wells

The Alto recharge basins would be located adjacent to the California Aqueduct, which is a prominent feature of the existing viewshed. The recharge facilities would be visible to a few residents. To mitigate these potential effects, where levee for recharge basins would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners. Wells would be enclosed in small structures, sited to minimize impacts to residential areas, and designed to be consistent with structures in the immediate vicinity. These mitigations would enhance the appearance of the recharge basins and wells and reduce impacts to a level of less-that-significance.

5.2.4.10 Antelope Wash Recharge

Antelope wash is a significant natural feature in the viewshed of about 60 residents and is visible from the road that runs along the base of the cliffs and north of the wash. Construction of recharge basins at this site would adversely affect this view, removing a significant stand of mature native vegetation. Although Antelope Wash is not designated as a scenic resource, it has substantial visual integrity as a natural landscape (despite some disturbance) and consists of a mix of desert scrub and Joshua Tree/Juniper desert scrub. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Construction and operation of recharge facilities at this site would have a significant effect on aesthetics, at least at a local level. MWA would contour the outer berms of recharge facilities and plant native shrubs along the outer margins of the perimeter levee maintenance roads to minimize effects; at this site, perimeter screening may include transplanting or planting of Joshua Trees and junipers. This would reduce aesthetic impacts for drivers on the road along the north bank of the wash.

The conversion of a large area of mature natural vegetation to unvegetated recharge would have adverse aesthetic impacts when dry, but could be considered of scenic value as a water view during recharge operations. With these mitigations, and considering the high aesthetic value of any water view in the desert, it is probable that the aesthetic effects of recharge at this site would be considered less-than-significant under CEQA. MWA may also consider moving the proposed Antelope Wash Recharge Basin downstream to a site with less scenic integrity. There are several sites downstream where there are higher levels of disturbance and less mature vegetation communities. These sites were not formally surveyed for the Proposed Project because of access constraints, but MWA may conduct future studies of these sites as alternatives to the Antelope Wash site identified in this Project EIR. If they are determined to have lower levels of impact for the full range of CEQA impact categories, they will be considered as potential alternatives to recharge at the site documented in this EIR.

The alternative of relocating this recharge to the area downstream from the Hesperia Airport as described in Chapter 4, page 4-31 would avoid these adverse impacts and reduce aesthetic effects of this increment of recharge capacity to less-than-significant.

5.2.5 Unavoidable Significant Impacts after Mitigation

With the proposed mitigation actions, and considering the current disturbed nature of the local viewsheds in many locations proposed for facility development, the potentially significant adverse impacts of facility development under all alternatives would be reduced to a level of less than significance.

5.2.6 Effects of the No Project Alternative

As described in Section 3.4.2, the No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan, and would involve development of recharge and conveyance capacity without banking capacity. Ultimately, MWA would develop additional facilities that would allow it to meet its obligations to import, recharge, store, and equitably distribute up to 75,800 acre-feet of SWP supply in a year. The No Project Alternative would therefore have the effect of (a) reducing the rate at which aesthetic impacts would occur and (b) re-siting of some facilities so that aesthetic effects were transferred from one site to another.

Aesthetic effects associated with Minimum Facilities Alternative and Small Project Alternative facilities will probably occur as described above because these facilities will probably be developed, albeit over a longer period of time. Potential re-siting of recharge for Off-Channel Mojave River Recharge, Oeste Recharge, and Alto Recharge would transfer any aesthetic effects associated with these elements to other sites. Reductions in the lengths of buried pipelines associated with the No Project Alternative would not affect aesthetic impacts. Given that such re-siting would occur as a result of prior development of these sites, re-siting would occur in the context of development in these areas and aesthetic effects would probably be similar.

5.3 Air Quality

5.3.1 Environmental Setting

The environmental setting is described in detail in the 2004 PEIR. The Mojave Desert Air Basin is affected by locally-generated and regionally-generated pollution, but conditions for the formation of inversion layers and ozone formation are different than conditions in the South Coast Air Basin to the south and west. Frequent and often extreme winds also provide for better mixing and dispersal of pollutants. Nevertheless, from 1999-2003, the Mojave Desert Air Basin was in a state of nonattainment relative to ozone about 80-90 days per year and respirable particulate matter (PM10) about 18-32 days per year. Ozone is primarily a problem in the summer, when (a) pollution is transported into the basin from the west and (b) prevailing winds may decline in velocity at night, promoting concentration of pollutants. Existing Mojave Desert Air Quality Management District (MDAQMD) plans and policies for the management of air quality in the Mojave Desert Air Basin have been formulated to meet both Federal and California Air Resources Board requirements. Current plans are:

- Draft MDAQMD 2004 Ozone Attainment Plan
- Federal Particulate Matter (PM10) Attainment Plan

These plans provide specific guidance and permitting requirements for stationary sources and facilities such as those proposed under all three alternatives would generally not be regulated by MDAQMD. Construction activities would be subject to MDAQMD rules:

- Rule 401: Visible emissions
- Rule 402: Nuisance
- Rule 403: Fugitive Dust
- Rule 1103 Paving
- Rule 1111 Architectural coatings

Any project that disturbs greater than 100 acres is required to prepare a Dust Control Plan. In addition, MDAQMD has established significance standards for emissions from project construction activities, including emissions from construction vehicles (Table 5-2).

Table 5-2. MDAQMD Significance Thresholds for construction and operation emissions (MWA 2004b).

POLLUTANT	SIGNIFICANCE THRESHOLDS	
	Annual (tons/yr)	Daily (lbs/day)
Carbon monoxide (CO)	100	548
Oxides of Nitrogen (NOx)	25	137
Volatile Organic Compounds (VOCs) Reactive Organic Gases (ROG's)	25	137
Oxides of Sulfur (SOx)	25	137
Particulate Matter (PM10)	15	82

5.3.2 Facilities Impacts

5.3.2.1 Mechanisms for Effect

Construction and operation/maintenance have the potential to emit all of the pollutants shown on Table 5-2, via the following mechanisms:

- Vehicle emissions during construction
- Vehicle emissions during long-term maintenance and operation
- Removal of vegetation, resulting in increased wind-erosion and PM10 mobilization

5.3.2.2 2004 PEIR analysis

At recharge sites, there is also potential for operations to cause a reduction in PM10 emissions when basins are being recharged. The wetted area of the basins would not be exposed to winds and wind-generated erosion, resulting in some reductions in ambient PM10 levels. The 2004 PEIR estimated the potential daily effects of a typical recharge basin construction project, pipeline construction project, and injection well construction project (Table 5-3), based on typical construction scenarios and evaluation of emissions associated with typical construction equipment.

Table 5-3. 2004 PEIR estimated daily unit construction emissions for a typical recharge basin, well, and pipeline project, MWA service area. (PM10 emissions are restricted to brake wear, tire wear, and entrained road dust from on-road vehicle travel. Estimates do not include fugitive dust during construction.**)**

PROJECT TYPE	PROJECT SIZE	MDAQMD STANDARD/ESTIMATED EMISSIONS[1]			
		CO	NOx	VOCs/ROGs	PM10
Recharge Basin	20 acres	548/133	137/110	137/15	82/19
Well	1 well	548/93	137/68	137/13	82/12
Pipeline/canal	1 construction crew	548/106	137/78	137/12	82/18

The 2004 PEIR noted that the estimates on Table 5-3 were to be used as a general guideline and that "prior to approval, emissions estimates would determine significance of individual projects." The 2004 PEIR notes that the air quality impacts of facility operations would not likely exceed either daily or yearly MDAQMD thresholds for significance. The 2004 PEIR estimates were based on calculations of emissions from a standard set of construction equipment, assuming continuous operation over an 8-hour day. They were also based on outdated equipment specifications, not on new 1999 EPA regulations that went into effect in 2004 (EPA 2004). In addition, they do not reflect the May 11, 2004 Final Rule for diesel engines, which includes a set of new engine standards to be implemented in a series of phases or tiers, the first of which will take effect in 2007.

5.3.2.3 Methods for Calculating Project-Specific Emissions

Estimates of Emissions from Construction Equipment

There are a number of methods for estimating emissions from construction equipment. The 2004 PEIR methodology was based on continuous operation of equipment and was inconsistent with EPA's models for estimating emissions. Use of the EPA models and probable load factors yields a better estimate, but there are studies indicating that the EPA modeling may over or underestimate actual emissions by about $\pm$ 5% (Environment Canada 2004). In addition, emissions of SOx are sensitive to the sulfur content of diesel fuel, and use of highway diesel compared to the diesel typically used for construction results in an estimated 85% reduction in SOx emissions (Genesis Engineering 2003). As a result of these uncertainties, a number of entities have tried to characterize and model *actual emissions* from typical construction equipment in use.

For example, the Sacramento Air Quality Management District (SMAQMD 2004) has developed a set of final CEQA guidelines which specify construction equipment emissions rates to be used in CEQA analyses, and these have been adopted by several other AQMDs in California (Eldorado County APCD 2001). The SMAQMD emission rates are based on field data for typical road construction. Road grading and excavation are similar to the type of grading, excavation, and general earth moving which would be undertaken for the Proposed Project. Although road building requires a wider range of construction equipment than the Proposed Project, the same basic grading, excavating, filling, hauling, and drilling equipment is used. The SMAQMD estimates of emissions from each type of standard construction equipment are thus a reasonable basis for estimating emissions from construction of recharge basins, canals, pipelines, and even wells. Other entities have conducted extensive tests of actual construction fleets (such as Genesis Engineering 2003) to develop typical exhaust/crankcase emissions factors for typical construction equipment.

These different approaches yield different results. For example, the SMAQMD CEQA guidelines specify an hourly ROG of 0.65 pounds/day for a typical backhoe/loader. For a 102 horsepower diesel backhoe loader, the Genesis Engineering study of City of Seattle construction equipment developed an estimate of 0.777 grams/horsepower-hour ROG for exhaust emissions and a total 0.793 grams/horsepower hour (including crankcase emissions), or 1.43 pounds/day. This estimate was based on continuous operation of equipment for a full 8-hour day. Given that typical equipment in operation for an 8 hour day is under full load approximately 50% of the time, the Genesis Engineering (2003) estimate would be adjusted to about 0.71 pounds per day. This would be about 8% more than the SMAQMD estimate, reflecting the variation in estimates identified by Environment Canada (2004).

From this comparison, it is clear that estimates of diesel emissions are therefore not a precise science; a key variable in calculations is the daily use patterns for the various pieces of machinery used. But the SMAQMD and Genesis Engineering data are within 10% of each other, suggesting that the SMAQMD estimates are probably an appropriate basis for estimating construction equipment emissions for individual pieces of typical construction equipment, if a contingency is applied to address potential error and to deal with emissions from the many small engines used on a construction sites such as gas generators, small hand tools such as compactors, and so forth. Given the variation in emissions estimates for different types of equipment, the analysis approach adopted in this EIR has been to utilize the SMAQMD CEQA guidelines and adjust them upwards by 25% to provide for a conservative estimate.

For well and pipeline construction, the daily emissions rates in the SMAQMD CEQA guidelines for drilling rigs were adjusted upward by a factor of 2 to reflect the higher horsepower of production well-drilling rigs and reduced for most other equipment to reflect the reduced hours of operation for scrapers, dozers, dump trucks, loaders, and other earth moving equipment that may be used, but used infrequently, during well drilling and pipeline construction.

The SMAQMD guidelines do not include SOx, which is not considered a major problem associated with construction equipment and is highly dependent on fuel composition. For these calculations, the field estimates of SOx emissions developed by Genesis Engineering (2003) for the City of Seattle were used, and, consistent with analysis by Genesis Engineering (2003) were adjusted downward by a conservative 80% to reflect use of lower sulfur highway diesel to minimize sulfur emissions. Highway diesel is fully compatible with construction equipment and adds approximately $0.025 per gallon to the cost of construction (Genesis Engineering 2003).

Finally, PM10 emissions from construction equipment are probably the least significant component of construction-related particulate generation. Fugitive dust generation would be a significant issue for recharge basins, but not for pipelines, wells, and levees, where the average area exposed to active construction would be small, less than a maximum of 10,000 square feet (levees at Unnamed Wash). For all elements of the proposed project, fugitive dust emissions will be controlled in a manner consistent with MDAQMD rules.

<u>Analysis Methodology</u>. For analysis of Alternatives air quality impacts, a "unit" approach was taken. That is a minimum unit of construction was established and daily emissions were calculated for this unit. Units were:

- For recharge basins: a 40-acre recharge basin constructed over a period of 30-40 days;

- For wells: a single production well constructed over a period of 20-30 days;
- For pipelines: 100 feet of pipeline per day, involving one construction crew in a continuous operation;
- For levees: 100 feet of levee per day, involving a single construction crew in a continuous operation;
- For work in the Mojave Mainstem: a single diesel (D-7) operating for 10 working days.

These unit values could then be used to evaluate the potential emissions from the various alternatives by determining the number of units of each type of construction which would be on-going at any time and summing the unit emissions from each unit.

5.3.2.4 Daily Unit Emissions Estimates

The unit emissions estimates from these calculations are shown on Tables 5-4 through 5-8. The construction emissions calculations on Tables 5-4 through 5-8 do not include hauling of construction equipment to the site, which are shown separately and are based on use of a 300 horsepower flat bed hauler. Hauling equipment to the construction and from the worksite would involve round trips of about 50 miles by up to 8 hauling rigs. Each round trip would take approximately 1 hour (on average). Assuming a hauling rig of 300 hp, this would generate emissions approximately equal to those generated by a 300 hp water truck operated 8 hours:

Table 5-4. Daily Emissions Calculation: Typical 40-acre recharge basin to be constructed in 30 working days. Based on SMAQMD CEQA Guidelines and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel.

EQUIPMENT	**#**	**DAILY USE**	**ESTIMATED EMISSIONS (pounds/day)**				
			ROG	**CO**	**NOx**	**SOx**	**PM10**
Scraper	2	100%	7.28	59.24	45.84	0.21	1.42
Loader	1	100%	0.65	3.65	6.66	0.07	0.34
Water truck	2	180%	6.48	55.12	37.60	0.50	1.04
Excavator	1	100%	1.84	15.64	10.67	0.06	0.29
Medium dozer	1	100%	0.65	4.64	4.98	0.06	0.19
Subtotal			16.9	138.29	105.75	0.9	3.28
With 25% Contingency			21.13	172.86	132.19	1.13	4.1
Fugitive Dust, based on 10 acres of exposed surface at 26.4 lbs/day							**264**
TOTAL			**21.13**	**172.86**	**132.19**	**1.13**	**268.1**
Hauling	4	25%	3.60	30.62	20.89	0.27	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-5. Daily Emissions Calculation: Typical levee construction in floodplain of Unnamed Wash at 400 feet per day. Based on SMAQMD CEQA Guidelines and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	CO	NOx	SOx	PM10
Scraper	2	100%	7.28	59.24	45.84	0.21	1.42
Loader	1	20%	0.13	0.73	1.33	0.02	0.07
Water truck	1	50%	1.80	15.31	10.45	0.14	0.29
Medium dozer	1	50%	0.33	2.32	2.49	0.03	0.1
Roller/Compactor	1	50%	0.92	6.56	6.05	0.14	0.26
Subtotal			10.46	84.16	66.16	0.54	2.14
With 25% contingency			13.08	105.2	82.7	0.68	2.68
Fugitive Dust, based on 10 acres of exposed surface at 26.4 lbs/day							**264**
TOTAL			**13.08**	**105.2**	**82.7**	**0.68**	**266.68**
Hauling	4	25%	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-6. Daily Peak Emissions Calculation: Well construction. Based on SMAQMD CEQA Guidelines, construction equipment emission rates for 2006 and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	CO	NOx	SOx	PM10
Scraper	1	20%	0.73	5.9	4.58	0.04	0.14
Loader	1	25%	0.17	1.16	1.25	0.02	0.04
Water truck	1	10%	0.36	3.06	2.09	0.03	0.06
Dump truck, 10cy	1	10%	0.36	3.06	2.09	0.03	0.06
Small Compactor	1	10%	0.18	1.31	1.41	0.03	0.06
Small Dozer	1	10%	0.18	1.31	1.41	0.03	0.06
Large drilling rig	1	100%	4.42	37.50	30.44	1.00	0.70
Subtotal			6.4	53.30	43.27	1.18	1.12
With 25% contingency			8.0	66.6	54.09	1.48	1.4
Fugitive Dust, based on 0.1 acres of exposed surface at .264 lbs/day							0.264
TOTAL			**8.0**	**66.6**	**54.09**	**1.48**	**1.66**
Hauling	4	25%	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-7. Daily Emissions Calculation: Pipeline construction. Based on SMAQMD CEQA Guidelines and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel. Paving ROG generation of about 0.06 pounds per day is included in the contingency for ROG.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	**CO**	**NOx**	**SOx**	**PM10**
Backhoe/loader	1	100	0.65	3.65	6.66	0.07	0.34
Hydraulic excavator	1	100	1.84	15.64	10.67	0.06	0.29
Dump truck, 10cy	1	50	1.80	15.31	10.45	0.12	0.29
On/off-site water truck	1	50	1.80	15.31	10.45	0.12	0.29
Pipe layer/crane	1	100	1.44	12.27	8.37	0.30	0.23
Small Compactor	1	25	0.46	3.28	3.53	0.08	0.13
Small Dozer	1	50	0.33	1.85	3.33	0.04	0.17
Subtotal			8.32	67.31	53.46	0.79	1.74
With 25% contingency			10.40	84.31	66.82	0.99	2.18
Fugitive Dust, based on 0.2 acres of exposed surface at .528 lbs/day							0.528
TOTAL			**10.40**	**84.31**	**66.82**	**0.99**	**2.72**
Hauling	4	0.25	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-8. Daily Emissions Calculation. Berm construction in the Mojave River Mainstem. Not including tractor hauling of equipment to/from site.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	**CO**	**NOx**	**SOx**	**PM10**
Large Dozer (D-7 or 8)	1	100%	1.45	10.35	11.12	0.2	0.43
With 25% contingency			1.81	12.9	13.9	0.25	0.54
Fugitive Dust, based on 10 acres of disturbed surface at 26.4 lbs/day							**264**
TOTAL			**1.81**	**12.9**	**13.9**	**0.25**	**264.54**
Hauling	4	25%	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Based on these calculations, the unit emissions for recharge basins, canals, wells, pipelines, and work in the Mojave River are shown on Table 5-9.

Table 5-9. Estimated daily unit emissions associated with construction activities, including a 25% contingency.

FACILITY	DAILY EMISSIONS ESTIMATE (POUNDS PER DAY)				
	ROG	**CO**	**NOx**	**SOx**	**PM10**
Construction Equipment Emissions					
40-acre Recharge Basin	21.13	172.86	132.19	1.13	268.1
Levee (Unnamed Wash)	13.08	105.20	82.7	0.68	266.68
One Production Well	8.0	66.6	54.09	1.48	1.66
Pipeline Construction	10.40	84.31	66.82	0.99	2.72
Instream Mojave River Recharge Berms	1.81	12.9	13.9	0.25	264.54
Total (1 unit of each type/day)	**54.42**	**441.87**	**349.7**	**4.53**	**803.7**
MDAQMD CEQA Significance Threshold	137	548	137	137	82
Simultaneous Construction will exceed CEQA Significance Thresholds?	NO	NO	YES	NO	YES

Using these daily unit estimates of equipment emissions and fugitive dust emissions, it is possible to estimate the approximate magnitude of construction-related emissions for each alternative. These unit estimates for each type of construction are a baseline for impact analysis. Increasing the number of increments constructed in a day, such as increasing the rate of pipeline construction from 100 feet per day to 300 feet per day, would incrementally increase equipment load factors and would thus increase daily emissions for all constituents except fugitive dust.

5.3.3 Alternative Emissions Estimates

The potential air quality impacts associated with construction of proposed facilities for all alternatives are shown on Table 5-10.

Table 5-10. Estimated incremental construction-related daily emissions for all Proposed Project facilities, by alternative. Assumes that recharge basins would be constructed in increments of 40 acres and the acreage of soil exposed to active construction at recharge basins will remain 10 af/day. Basin cells will be completed and watered.

FACILITY AND TYPE	UNITS	ESTIMATED DAILY EMISSIONS (pounds per day)				
		ROG	CO	NOx	SOx	PM10
Minimum Facilities Alternative						
Instream Mojave River Recharge	NA	1.81	12.9	13.9	0.25	264.54
Mojave River Well Field	1	8.0	66.6	54.09	1.48	1.4
Mojave River Well Field Delivery Pipelines	1	10.40	84.31	66.82	0.99	2.18
Levee (Unnamed Wash)	1	13.08	105.20	82.7	0.68	266.68
TOTAL, ALL Facilities		**28.21**	**230.41**	**188.9**	**4.2**	**534.8**
Small Projects Alternative						
Off-Channel Mojave River Recharge	2.5	21.13	172.86	132.19	1.13	268.1
Off-Channel Mojave River Recharge Pipeline	1	10.40	84.31	66.82	0.99	266.18
Oro Grande Wash Recharge	2.0	21.13	172.86	132.19	1.13	268.1
Oro Grande Wash Pipelines	1	10.40	84.31	66.82	0.99	2.18
Cedar Avenue Detention Basin Recharge	1.5	21.13	172.86	132.19	1.13	268.1
Cedar Avenue Detention Basin Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
Antelope Wash Detention Basin Recharge (Ranchero Road)	1.55	21.13	172.86	132.19	1.13	268..1
Antelope Wash Detention Basin Recharge (Ranchero Road) Pipeline	1	10.40	84.31	66.82	0.99	2.18
Subtotal, Small Projects Alt. Facilities		**126.12**	**1028.68**	**796.04**	**8.48**	**1345.1**
Large Project Alternative						
Oeste Recharge	8.25	21.13	172.86	132.19	1.13	268.1
Oeste Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
Alto Recharge	3.75	21.13	172.86	132.19	1.13	268.1
Alto Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
Antelope Wash Recharge Basins	2.5	21.13	172.86	132.19	1.13	268.1
Antelope Wash Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
SWP Delivery via Unnamed Wash (Canal)	1	21.13	172.86	132.19	1.13	268.1
Oeste and Alto Wells	1	8.0	66.6	54.09	1.48	1.4
Total, Large Projects Facilities		**123.72**	**1010.97**	**783.31**	**8.97**	**1080.34**
MDAQMD CEQA Thresholds		137	**548**	**137**	137	**82**

5.3.4 Summary Analysis

In addition to the impacts shown on Table 5-10, MWA may also construct wells near Off-Channel Mojave River Recharge, Oro Grande Wash, Cedar Avenue Detention Basin, Antelope Wash at Ranchero Road, and Antelope Wash south of the Hesperia Airport. Construction schedule has not been determined.

From Table 5-10, simultaneous construction of a number of facilities will clearly cause daily and annual MDAQMD thresholds of significance to be exceeded for all but SO_x emissions. From the construction schedule in Chapter 4, it is likely that multiple wells and multiple recharge basins would be constructed at any given time. The magnitude of daily alternative impacts on air quality would thus depend on the construction schedule. Exact construction scheduling cannot be accomplished until final design specifications have been developed, but the effects of construction schedule on emission rates can be evaluated based on overall construction time and overlap of construction activities (Table 4-18).

For the Minimum Facilities Alternative, pipeline, well construction, and construction at Unnamed Wash involve extended construction periods; all three components are important to initiation of routine delivery of banked and MWA replacement water supplies to the Mojave River Aquifer and the adjacent Regional Aquifer. In addition, construction of the well field connecting and delivery pipelines may require simultaneous construction of several portions of the pipelines at once (east and west side of the river). Otherwise, benefits of the well field would be available to only a portion of MWA's Alto subarea producers. This would also limit the delivery of banked water, since deliveries to the Mojave River are to be balanced with extractions from the Mojave River and Regional aquifers adjacent to the river. Thus, it is not feasible to avoid significant air quality impacts associated with construction of the Minimum Facilities Alternative, except via the implementation of emissions controls mitigation. The added recharge capacity (and associated production wells) for the Small Projects Alternative and the Large Projects Alternative may be phased. The daily pre-mitigation emissions for construction of recharge basins and associated wells and pipeline are shown on Table 5-11.

Table 5-11. Incremental effects of phasing construction to provide for 1 unit of recharge, well, and pipeline construction per day.

FACILITY	DAILY EMISSIONS ESTIMATE (POUNDS PER DAY)				
	ROG	**CO**	**NOx**	**SOx**	**PM10**
40-acre Recharge Basin	21.13	172.86	132.19	1.13	268.1
One Production Well	8.0	66.6	54.09	1.48	1.66
Pipeline Construction	10.40	84.31	66.82	0.99	2.72
Total (1 unit of each type/day)	**39.53**	**323.77**	**253.1**	**3.6**	**272.48**
MDAQMD CEQA Significance Threshold	137	548	137	137	82
Simultaneous Construction will exceed CEQA Significance Thresholds?	NO	NO	**YES**	NO	**YES**

Recharge basin construction in increments of 40 acres, at 45 days per unit would result in an extended period of construction (See also Table 4-18):

- Off-channel Mojave River recharge: 120 days
- Oro Grande Wash Recharge: 100 days
- Cedar Avenue Detention Basin Recharge: 80 days
- Antelope Wash Recharge (Ranchero Road): NA (City Construction)
- Oeste Recharge: 400 days
- Alto Recharge: 170 days
- Antelope Wash recharge: 120 days

An incremental construction schedule for all Small Projects Alternative and Large Project Alternatives would significantly reduce emissions from construction, but pre-mitigation impacts would still remain significant for NO_x and PM10.

Because project air quality impacts are proportional to the construction area, relocation of recharge from the upstream recharge site to an expanded Ranchero Road site as described in Chapter 4, page 4-31 could result in marginal reductions in construction and operational impacts associated with recharge basin repair and maintenance, because there may be substantial overlap of these operations with flood control maintenance.

5.3.5 Operational Impacts

Non-periodic maintenance of facilities is exempt from the provisions of the Fugitive Dust Rule (Rule 403.2 (D)(1)(g) Exemptions). Regardless of the exemption, the potential for facility operations is addressed below.

The operation and maintenance of recharge basins and associated facilities with potential for substantial air quality emissions will primarily involve (a) intermittent 15-day periods of berm grading in the Mainstem Mojave River and (b) maintenance of recharge basins, including inspection and intermittent removal of fines which may accumulate on the top of recharge basins. Fine-grained sediments from water delivered to recharge basins accumulate in a layer of sands and clays mixed with organic matter, forming a thin crust on the recharge basin that must be periodically removed prior to use of the basin. Removal of fines may be necessary annually or on a longer schedule, depending on build up of fines in the basins.

Maintenance generally involves the use of scraper, loader, and small dump truck. Material removed generally has high organic content and may be used by landscape contractors for fill and/or as a component of commercial mulch. Scraped material may be stockpiled outside of the recharge basin, in which case the stockpile will be compacted and watered to minimize wind erosion. Alternately, material removed from recharge basins during routine maintenance may be sold as fill or for use in producing commercial potting soil/mulch. Given this type of activity, estimated impacts of operations on air quality are:

- Grading of low sand berms in the Mainstem Mojave River will not generate emissions in excess of MDAQMD significance thresholds (Table 5-11).
- Removal of fines that accumulated in recharge cells may be accomplished following watering to reduce potential for PM10 emissions, and will be done on a cell-by-cell basis. Given cell size of 10 to 20 acres, daily emissions will be well below the levels of activities associated with recharge basin construction and will thus be below MDAQMD thresholds of significance. Maintenance will vary in timing. In Kern County's recharge basins, removal of fine sediments is undertaken in some basins while others are in operation. Given a similar management approach, it is likely that maintenance will be phased and no more than about 20 acres will be affected at any given time, resulting in emissions below significance thresholds.

All wells and pumps associated with the proposed facilities would be electric powered and would not generate emissions. In addition, water banking raises groundwater levels and reduces pumping energy requirements. Given that a vast majority of the water that MWA will return to Metropolitan will be via exchange of SWP supplies, the Proposed Project would result in groundwater levels higher than under the baseline condition and thus reduce the energy required to extract groundwater at all sites where water is banked. Given that most water used in the MWA service area is groundwater, the Proposed Project would result in net energy savings to the MWA service area. There would thus be no indirect energy effects on local power generation facilities and no indirect increase in emissions associated with the operation of the banking project.

Energy developed to deliver exchange supplies to Metropolitan operations will also not be affected. Metropolitan's Integrated Resources Plan (Metropolitan 2005) provides for the purchase of supplies from north of the Delta as a feature of long-term water supply reliability programs. The energy to transport such supplies to Metropolitan's service area is the same as the energy needed to convey exchange supplies provided by MWA, and may be less because of MWA's ability as a SWP Contractor to schedule deliveries more flexibly than would be feasible via a purchase. Thus, energy required for the exchange component of operations will not be greater than that for the baseline condition and no indirect increase in power consumption and related emissions from power plants will occur.

There would also be no long-term significant impacts to air quality associated with wells and pipelines, which will not have exposed soil surfaces. Daily management activities, including routine inspection and operation of facilities will involve use of vehicles, but these highway vehicles will not generate emissions in excess of the MDAQMD CEQA thresholds.

Operation of recharge basins has some potential to reduce wind-borne dust from the recharge sites. When wetted, these sites will not produce dust that would otherwise be mobilized by wind blowing over dry soil. In addition, experience in Kern County, which experiences periods of high winds and dust storms, suggests that wind-borne dust may be trapped by internal levees much as snow is trapped along fence lines and other points of lower wind velocity. The potential benefit of the Proposed Project on long-term generation of wind-borne dust is not quantifiable, but benefits may be expected. The routine use of the Mainstem Mojave River for recharge may also reduce local dust generation in this reach of the river. The beneficial effects of recharge on wind-borne dust increase with the magnitude of the proposed program, particularly for off-channel recharge basins, which will be used more frequently as program deliveries increase. Operations will therefore not have significant air quality impacts and no mitigation is required.

5.3.6 Mitigation and Significance of Impacts after Mitigation

5.3.6.1 Significance Thresholds

The Proposed Project would be considered to have a significant air quality impact if it:

- Conflicted with or obstructed implementation of the applicable air quality plan;
- Violated any air quality standard or contributed to an existing or projected air quality violation;
- Resulted in a cumulatively considerable net increase of any nonattainment pollutant;
- Exposed sensitive receptors to substantial pollutant concentrations; or
- Created objectionable odors affecting a substantial number of people.

The Mojave Desert Air Quality Management District (MDAQMD) and Antelope Valley Air Quality Management District (AVAQMD) have jointly published recommendations that establish specific daily and annual thresholds levels, above which impacts are considered significant.

Based on the above analysis and as summarized below, construction of the Proposed Project Facilities would generate emissions that would exceed the MDAQMD and AVAQMD thresholds of significance.

5.3.6.2 PM10 and Fugitive Dust

For all alternatives, MWA will implement all of the fugitive dust control measures required by Rule 403 (Fugitive Dust):

- Use periodic watering for short-term stabilization of Disturbed Surface Area (maintaining moist disturbed surfaces);
- Take action sufficient to prevent project-related trackout onto paved surfaces;
- Cover loaded haul vehicles while operating on Publicly Maintained paved surfaces;
- Stabilize graded site surfaces upon completion of grading;
- Cleanup project-related Trackout or spills on Publicly Maintained paved surfaces within 24-hours; and
- Reduce non-essential Earth-Moving Activity under High Wind conditions

The South Coast AQMD provides some guidance related to the effectiveness of these mitigation actions, noting that keeping exposed soil continuously moist reduces fugitive dust from exposed surfaces by 75%, watering haul roads reduces fugitive dust by 3%, and covering haul/dump trucks results in an additional 2% reduction. Implementation of these measures would reduce PM10/fugitive dust emissions from construction of the Minimum Facilities Alternative from 534.8 pounds per day to 106.96 pounds per day.

Implementation of these measures for construction of the additional recharge basins provided for in the Small Projects Alternative and Large Projects Alternative would reduce 40-acre-unit PM10/fugitive dust emissions from 272.4 pounds per day to 54.48 pounds per day. If recharge basin construction is phased in 40-acre increments, then, implementation of these measures would reduce daily PM10/fugitive dust emissions to a level of less than significant. Simultaneous construction of any two 40-acre units would, however, result in significant daily PM10/fugitive dust emissions.

5.3.6.3 NOx

NOx emissions from diesel-powered equipment are a persistent concern, even in Europe where diesel fuel of very high quality is available. MWA's requirement that highway diesel fuel be used in construction will have only a fractional influence on NOx production. No practical phasing of construction elements, including incremental construction of recharge basins, effectively reduces construction-related NOx emissions to levels of less than significant. Even assuming sequential construction of the facilities provide for in these alternatives, the simultaneous construction of recharge basins and the wells/pipelines associated with each recharge-basin facility would result in daily NOx emissions in excess of MDAQMD thresholds of significance.

5.3.6.4 ROG, CO, and SOx

Construction of the Minimum Facilities Alternative involving simultaneous construction of up to 5 wells and 2 segments of pipeline would not result in impacts in excess of MDAQMD thresholds of significance for ROG, CO, or SOx, but construction involving higher levels of activity would cause significant impacts related to these constituents. Similarly, simultaneous construction of 2 units of recharge would not cause impacts in excess of MDAQMD thresholds of significance for ROG, CO, or SOx, but construction involving higher levels of activity would cause significant impacts related to these constituents.

5.3.6.5 Comparative Significance of Construction-Related Air Quality Impacts

Although all construction scenarios would involve air quality impacts in excess of MDAQMD thresholds of significance, the relative magnitude of the potential emissions in the context of overall diesel emissions within MWA's service area can be understood by comparing construction emissions from construction of all Large Projects Alternative facilities simultaneously to emissions from diesel truck traffic within MWA's service area. The most meaningful comparison for diesel is NOx and PM10.

For 2004, Caltrans annual average daily truck traffic for the major roads in the MDAQMD service area (Caltrans 2005) are:

- Interstate 15 at Victorville: 13,013
- Highway 395 at Palmdale road: 2,699

- Highway 18 at Highway 395: 649
- Highway 58: 6512

Assuming that some of this traffic on these interconnecting roads involves the same vehicles, a conservative estimate of daily truck traffic on these major roads in the MDAQMD area is about 15,000 truck trips per day. On these roads, with sparse development, these trips would generally be long haul trips. Assuming an average trip length of 100 miles and an average speed of 65 mph, average trip length would be 1.5 hours. If California standards for diesel emissions are assumed to be met by all trucks, then a 1.5 hour trip by a truck with a 300-horsepower diesel would generate:

NOx:	300 x 5.0 g/hp-hr/454 x 1.5	=	4.95 pounds of NOx
PM10:	300 x 0.1 g/hp-hr/454 x 1.5	=	0.1 pounds of PM 10

Using these approximate values, 15,000 truck trips per day would generate:

NOx:	4.95 pounds/day x 15,000	=	67,500 pounds per day
PM10:	0.1 pounds/day x 15,000	=	1,500 pounds per day

These estimated values for diesel emissions are conservative in two ways. First, they assume all trucks operating on the major roads comply with California diesel emissions standards. Second, they do not account for PM10 emissions from traffic as a result of tire wear, and road dust. These conservative values are compared to the values for project-related NOx and PM10 emissions, with project-related PM10 emissions adjusted to reflect the effects of mitigation, on Table 5-12.

Table 5-12. NOx and PM10 emissions from simultaneous construction of all potential project facilities compared to estimated emissions from commercial truck traffic on major roads in the MWA service area. (PM10 emissions from construction adjusted to reflect mitigation).

POLLUTANT	EMISSIONS IN POUNDS/DAY		PROJECT EMISSIONS AS A % OF TRUCK EMISSIONS
	Large Project Alternative	Truck Traffic	
NOx	1,979	67,500	3%
PM10 (vehicle)	54	1,500	4%
PM10 (Fugitive dust)	580	Not estimated	Not estimated

The comparison on Table 5-12 suggests that maximum probable emissions from simultaneous construction of all of the proposed project's Large Projects Alternative would be from 3-4% of total emissions from long-haul truck traffic in the MWA service area and a substantially smaller fraction of total emissions from all sources.

Even within this broader context, simultaneous construction of multiple recharge and other facilities under the Minimum Facilities Alternative, the Small Projects Alternative and/or the

Large Projects Alternative would result in emissions in excess of both daily and annual MDAQMD CEQA thresholds of significance for NOx, CO, ROG, and PM10. Feasible mitigation such as use of highway diesel fuels and use of additional pollution equipment to trap exhaust particulates or NOx would be implemented as part of the project, but would not likely reduce emissions to a level of less-than-significant. MWA would evaluate potential for phasing of construction to reduce emissions, but phasing:

- May not be feasible given the need to utilize recharge facilities early in the proposed banking/exchange project, and
- May extend the duration of other categories of impact such as noise and traffic.

In summary, even with all feasible mitigation, it is likely that construction of facilities for the Proposed Project will result in emissions which exceed daily and annual MDAQMD thresholds of significance. Long-term operations activities will not result in emissions that exceed daily or annual MDAQMD thresholds of significance.

The long-term operation and maintenance of facilities would not involve activities that would result in current air quality impacts in excess of MDAQMD and AVAQMD significance thresholds. Some reductions in wind-borne dust may be anticipated as a result of operations of recharge basins.

5.3.7 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan, and would involve development of recharge and conveyance capacity without banking capacity. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year plus available supplies under Article 21 of the SWP contract. The effect of the No Project Alternative on air quality impacts would be to defer implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

By delaying construction of some facilities, the No Project Alternative would reduce net annual emissions and allow for a greater scheduling flexibility. Individual facilities may be constructed over a longer period of time, thus reducing daily vehicle emissions and fugitive dust from construction. In addition, lack of a pipeline connection from the Mojave River Well Field to the California Aqueduct would reduce net construction activity and fugitive dust emissions. Nonetheless, given the unit impacts of construction on NOx and PM10 emissions, it is likely that there would be periodic violations of daily MDAQMD thresholds of significance for these constituents. The No Project Alternative would reduce annual emissions related to construction, but would continue to periodically have significant daily emissions related to construction. Given long-term implementation of EPA diesel emissions programs, the delay associated with the No Project Alternative would also mean that vehicles with lower average emissions would be utilized in construction, therefore further reducing daily emissions.

5.4 Biological Resources

5.4.1 Environmental Setting

5.4.1.1 General

The MWA service area is entirely to the north of the ridgeline of the San Bernardino Mountains, which separate the Mojave Basin from the coastal basin that includes Los Angeles, Orange, western Riverside, and western San Bernardino counties. The mountains form an ecological divide, dramatically reducing coastal influence in the MWA service area. Precipitation in the MWA service area is about 30 to 40 percent of that in the coastal basin, and the flora and fauna of the MWA service area reflect this low-moisture, high-temperature environment. Although there are times when general winter storms affect the entire MWA service area, significant precipitation is often intermittent and precipitation may be distributed in a patchy manner.

Native plants have a number of drought-tolerant characteristics, such as waxy leaves; early season; and rapid growth, flowering, and germination. Animals are also physiologically and behaviorally adapted to a hot, low-moisture environment and use burrowing, hibernation, and nocturnal behavior to minimize exposure to desert conditions. In such an environment, activities which affect water availability may be considered inherently important. Thus, rivers, washes, adjacent riparian areas, lakes, and springs are relatively rare and important ecological features.

A vast majority of the vegetation in the MWA service area falls into three categories: desert scrub, alkali desert scrub, and Joshua Tree "forest." Desert scrub is associated with stabilized sand-dune accumulations. The desert scrub community consists of low growing perennial plants with a few taller shrubs such as creosote bush and a suite of forbs and grasses (Table 5-13). Desert scrub occurs in virtually all upland areas from sea level to 4000 feet. Alkali desert scrub distribution is more limited, and it is usually associated with dry lake beds and floodplains. Its plant communities are adapted to saline soils (Table 5-13). Joshua Tree forest is a mixed woodland community occurring between areas of desert scrub and higher elevation pinyon-juniper woodlands. As a transitional community between lowlands and mountains, the Joshua Tree forest may occur in and along desert washes and along the lower slopes of the foothills of the northern San Bernardino Mountains.

Within the matrix of desert scrub, alkali desert scrub, and Joshua Tree forest, there are a number of plant and animal communities of limited distribution. Along the Mainstem Mojave River, there are reaches of desert riparian vegetation (Table 5-13) where there is high groundwater and/or surface flow. Two of these areas, from the Narrows to near Helendale and downstream from Yermo, are designated by CDFG as riparian protection zones; they represent the majority of desert riparian vegetation communities in the MWA service area.

Desert wash communities (Table 5-13) occur in the ephemeral, generally dry washes that drain to the Mojave River from local uplands. These washes may contain a variety of vegetative communities, which are generally more robust and diverse than the desert scrub communities that generally surround them. Periodic flow enhanced large shrub growth and results in a variability in the plant community from the low-flow channel to the edges of the canyons.

The foothills of the San Bernardino Mountains are dominated by three other plant communities: mixed chaparral, chamise-redshank chaparral, and pinyon-juniper woodland (Table 5-13). These shrub communities are distributed in patches along the northern slopes of the San Bernardino Mountains from the valley floor to elevations of up to 8,000 feet. Their distribution is affected by slope, aspects, and soils. All three communities are affected by recurring fire. Their dominant plants are characterized by high oil content and waxy leaves. Many have seeds which must be exposed to heat and/or smoke before they germinate. These communities are therefore characterized by infrequent cycles of often intense fire, followed by sprouting of seeds and sprouting of new growth from the root crown of the burned plant. A period of rapid growth follows until dead and decaying branches reach a critical mass and a new fire cycle occurs. Fire cycles may range from 15 to over 50 years.

5.4.1.2 Issues and Conservation Planning

The West Mojave Basin has experienced significant growth over the past 30 years, with associated habitat loss and disturbance. This has occurred primarily in the urbanizing Victor Valley, Yucca Valley, Barstow areas, and at Fort Irwin north of Barstow. Development in these areas, off-road vehicle use, and development along road corridors has affected the status of a number of desert species, most notably the desert tortoise, the Mohave ground squirrel, and a suite of riparian-dependent birds. In addition, there are numerous desert plants with a distribution limited to certain soil and hydrologic conditions. A number of these species have been listed as threatened or endangered under the federal and/or California endangered species acts.

Table 5-13. Major plant communities of the MWA service area that may be affected by Proposed Project alternatives.

COMMON PLANTS	COMMON ANIMALS	POTENTIAL T&E AND PROTECTED SPECIES IN PROJECT AREA HABITATS
	Desert Scrub (creosote bush scrub)	
Creosote bush Catclaw Desert agave Coastal bladderpod White brittlebush Burrobush White bursage Barrell cactus Hedgehog cactus Branched pencil Teddybear cholla Palmer's coldenia Wiggin's croton Desert globemallow Jojoba Littleleaf ocotillo Beavertail pricklypear Rabbitbush Desert sand verbena Desert senna Squaw waterweed Anderson's wolfberry Mojave yucca Evening primrose Galleta Galletagrass Spanish needles	Couch's spadefoot toad Desert tortoise Desert iguana Common kingsnake Black-throated sparrow Pocket mice (various) Kangaroo rats (various) Antelope squirrel Kit fox Coyote Bobcat Desert cottontail rabbit Black-tailed jackrabbit California horned lark Raven Le Conte's thrasher Prairie falcon Coast horned lizard	**Listed or protected** Desert tortoise (FT/CT) Mohave ground squirrel (ST/FSC) **Other Special Status Species** Western burrowing owl (FSC/CSC) Prairie falcon (CSC) Le Conte's thrasher (CSC) Ferruginous hawk (CSC) Coast horned lizard (CSC) Barstow wooly sunflower (CNPS 1B) Booth's evening primrose (CNPS 2) Desert cymopterus (CNPS 1B) Mohave monkeyflower (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B) Small-flowered androstephium (CNPS 2) Clokey's cryptantha (CNPS 1B) Creamy blazing star (CNPS 1B) Crucifiction thorn (CNPS 2)
	Joshua Tree Forest	
Joshua trees California juniper Singleleaf pinyon California buckwheat Longspine horsebrush Desert thorn Cactus Mojave yucca	Pocket mice (various) Kangaroo rats (various) Kit fox Coyote Bobcat Desert cottontail rabbit Antelope squirrel Black-tailed jackrabbit California horned lark Le Conte's thrasher Raven Prairie falcon Coast horned lizard Desert night lizard Ladder-backed woodpecker Cactus wren Scott's oriole	**Listed or protected** Desert tortoise (FT/ST) Mohave ground squirrel ST/FSC) **Other Special Status Species** Western burrowing owl (FSC/CSC) Desert cymopterus (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B)
	Desert Riparian	
Cottonwood Willow Tamarisk Velvet ash Mesquite	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit	**Listed or protected** Desert tortoise (FT/ST) Yellow-billed cuckoo (FE/CE) SW willow flycatcher (FE/CE) Mohave ground squirrel (ST/FSC)

	Black-tailed jackrabbit California horned lark Le Conte's thrasher Prairie falcon Coast horned lizard Cooper's hawk Yellow-breasted chat Brown-crested flycatcher Summer tanager Raven Gambel's quail Mourning dove Chuckwalla	Mojave River vole (FSC/CSC) Arroyo toad (FE/CSC) California red-legged frog (FT/CSC) Mojave tarplant (CE) **Other Special Status Species** Cooper's hawk (CSC) Yellow Warbler (CSC) Long-eared owl (CSC) Western burrowing owl (FSC/CSC) Prairie falcon (CSC) Yellow-breasted chat (CSC) Brown-crested flycatcher (CSC) Summer tanager (CSC) Southwestern pond turtle (FSC/CSC) San Diego horned lizard (CSC) Mohave monkeyflower (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B)
Desert Wash		
Active wash area Catclaw Allscale Saltbush Desert willow Mesquite Desert almond Cheesebush Skunkbush Blackstem Pigmy cedar **Adjacent uplands** Creosote bush Catclaw Desert agave White brittlebush Burrobush White bursage Barrell cactus Hedgehog cactus Branched pencil Teddybear cholla Litteleaf ocotillo Beavertail pricklypear Rabbitbush Mojave yucca Evening primrose	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit Antelope squirrel Black-tailed jackrabbit California horned lark Le Conte's thrasher Raven Coast horned lizard Desert night lizard Ladder-backed woodpecker Cactus wren	**Listed or protected** Desert tortoise (FT/CT) Mohave ground squirrel (ST/FSC) **Other Special Status Species** Western burrowing owl (FSC/CSC) Prairie falcon (CSC) Le Conte's thrasher (CSC) California horned lark (CSC) San Diego horned lizard (CSC) Barstow wooly sunflower (CNPS 1B) Booth's evening primrose (CNPS 2) Desert cymopterus (CNPS 1B) Mohave monkeyflower (CNPS 1B) Plummer's mariposa lily (CNPS 1B) Robinson's monardella (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B) Small-flowered androstephium (CNPS 2) Southern skullcap (CNPS 1B)
Mixed Chaparral		
Chamise Birchleaf mountain mahogany Silk-tassel Toyon Yerba-santa California buckeye Poison oak Sumac California buckthorn Hollyleaf cherry Montana chaparral pea California fremontia	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit Black-tailed jackrabbit California horned lark Le Conte's thrasher Prairie falcon Coast horned lizard Red tail hawk Mountain kingsnake	**Listed or protected** Desert tortoise (FT/CT) Western burrowing owl (FSC/CSC) **Other Special Status Species** San Diego horned lizard (CSC) Short-joint beaver-tail cactus (CNPS 1B) Grey vireo (CSC)

<table>
<tr><td></td><td>Ringtail cat
Badger
Mule deer
Mountain lion</td><td></td></tr>
<tr><td colspan="3">Chamise-redshank Chaparral</td></tr>
<tr><td>Chamise
Redshank
Toyon
Ceanothus
Sugar sumac</td><td>Pocket mice (various)
Kangaroo rats (various)
Coyote
Bobcat
Desert cottontail rabbit
Black-tailed jackrabbit
California horned lark
Le Conte's thrasher
Prairie falcon
Coast horned lizard
Red tail hawk
Mountain kingsnake
Ringtail cat
Mule deer
Mountain lion
Badger</td><td>Listed or protected
Desert tortoise (FT/ST)
Western burrowing owl (FSC/CSC)

Other Special Status Species
Short-joint beaver-tail cactus (CNPS 1B)
Grey vireo (CSC)</td></tr>
<tr><td colspan="3">Pinyon-juniper Woodland</td></tr>
<tr><td>Pinyon
Juniper
White fir
Blackbrush
Common snakeweed
Narrowleaf golden bush
Parry's nolina
Curlleaf mountain mahogany
Antelope bitterbush
Parry's rabbitbrush
Mojave yucca
Ponderosa pine</td><td>Pinyon mouse
Bushy-tailed woodrat
Pinyon jay
Plain titmouse
Bushtit</td><td>Listed or protected
Desert tortoise (FT/ST)
Western burrowing owl (FSC/CSC)

Other Special Status Species
Baja navarretia (CNPS 1B)
Short-joint beaver-tail cactus (CNPS 1B)
Prairie falcon (CSC)</td></tr>
</table>

Legend:

FE = Listed as endangered under the federal Endangered Species Act
FT = Listed as threatened under the federal Endangered Species Act
FSC = Listed as a species of concern by USFWS
CE = Listed as endangered under the California Endangered Species Act
FT = Listed as threatened under the California Endangered Species Act
CFP = Listed as fully protected under California Fish and Game Code
CSC = Listed as a species of concern by CDFG
CNPS = California Native Plant Society. CNPS produces lists of species, each list reflecting a CNPS Judgment related to the potential of species rarity and potential for extinction. Though unofficial and having no legal standing, designations as CNPS 1B or CNPS 2 indicate that a species is rare and potentially threatened.

In response, regional land management agencies and regulatory agencies have developed a comprehensive multi-species habitat conservation plan (West Mojave Plan) that is intended to guide development and conservation planning in all of the western Mojave Basin, including MWA's service area. The final Environmental Impact Statement/Environmental Impact Report for the West Mojave Plan was issued in the spring of 2005 (BLM 2005). The West Mojave Plan identifies areas of conservation priority and areas where development may occur with lower potential impacts; mitigation ratios for impacts to natural habitats are varied depending on the relative sensitivity of the habitats within zones. Although the West Mojave Plan is not yet in implementation and changes may be made, it summarizes nearly a decade of study, analysis, and planning and represents the general consensus of a large number of local and regional experts regarding the relative sensitivity and importance of various habitats and geographic areas for a wide range of species.

Except for Unnamed Wash, Oeste Recharge, Alto Recharge, and Antelope Wash Recharge south of the California Aqueduct, all of the potential facilities for the Proposed Project are located in or near development or agricultural lands, are currently disturbed habitats, and are outside of the boundaries of existing and/or proposed conservation areas. In addition, all of the new facilities are in West Mojave Plan proposed "No Survey Zones" for desert tortoise, reflecting several decades of surveys in these areas which have found no sign, or minimal sign, of desert tortoise. In the proposed No Survey Zones, the West Mojave Plan provides for impact analysis and multi-species mitigation based on habitat type, condition, and suitability. New facilities for the Proposed Project would be constructed in two zones:

- An urban zone south of State Highway 18 and east of State Highway 395, where conditions are highly disturbed and thus proposed mitigation ratios are 0.5 acres of mitigation for each 1 acre of habitat impact; and
- A semi-rural zone south of State Highway 18 and west of State Highway 395, where proposed mitigation ratios are 1.0 acres of mitigation for each acre of habitat impact.

If implemented and adopted by local governments, the West Mojave Plan explicitly provides for much higher mitigation ratios in other areas to provide (a) an incentive for development in the Proposed Project area and (b) a disincentive for development in more sensitive areas. In addition, review of available data on sightings of threatened and endangered species in the Proposed Project area (West Mojave Plan and CNDDB 2004) indicates that there have been few recent sightings of desert tortoise or Mohave ground squirrel in the Proposed Project area. This suggests that listed species are unlikely to be found in the Proposed Project area.

5.4.2 Facilities Impacts: Mechanisms for Effect

5.4.2.1 General

Construction of project facilities in areas of wildlife habitat will involve removal of habitats within the construction right-of-way. For both recharge areas and pipelines these impacts would have permanent effects on wildlife habitat, which would not be expected to recover within the construction right of way due to (a) routine inspection and monitoring along the rights-of-way, aesthetic treatment, and/or (c) potential long-term management. Construction would permanently alter soil structure as well, with a loss of soil integrity and alteration of soil hydrogeology. Any special-status plant species in the construction right-of-way would be permanently removed.

Loss of habitat may be accompanied by potential direct injury to threatened and endangered animal species, due to crushing of burrows. The primarily daytime burrowing/nocturnal foraging behavior of virtually all terrestrial desert species would limit potential for animals to be active during the daylight hours, and thus it is likely that any injury or death would occur to animals in their burrows. All burrowing species at a construction site would be affected.

During construction in or adjacent to wildlife habitat , there would also be general noise and visual disturbance during daylight hours, but the daytime burrowing/nighttime foraging pattern of desert animals would tend to ameliorate this type of effect. In the area immediately adjacent to the construction right-of-way, ground vibration and noise may drive some burrowing animals from their burrows resulting in exposure to predation and stress associated with activity during the heat of the day.

At the Unnamed Wash, routine and sustained releases of water in many year types and over periods when flow would otherwise not occur would alter the habitats of the wash. At release rates of 100 to 500 cfs, there is potential for the wash to erode, creating an incised channel, with loss of scrub habitats. Channel maintenance would control potential invasion of this area by exotic phreatophytes such as tamarisk. During recharge operations, the canal at the downstream end of the wash would potentially inhibit wildlife movement along the western side of the river. There would also be maintenance access roads along the wash to provide for crews to inspect and maintain drop structures. These access roads would likely also be used as trails.

Finally, recharge of groundwater in the vicinity of the Mojave River has potential to raise groundwater levels along the river banks to within 20 to 40 feet of the surface, which may encourage the growth of deep-rooted phreatophyte vegetation, including invasive species such as tamarisk.

5.4.2.2 Range of Threatened, Endangered, and other Special-Status Species

Direct effects associated with habitat loss are applicable to special-status species if (a) the habitat at the site is suitable for the species and (b) the habitat occurs within the known range of the species. The potential for listed threatened and/or endangered species to occur at various sites under consideration for Proposed Project facilities is described below, based on field surveys and habitat characterizations and on data about the known distribution of the species, based on species accounts prepared by regional species experts for the West Mojave Plan (BLM 2005).

<u>Desert tortoise (FT/CT)</u>. The West Mojave Plan evaluates the current distribution of the desert tortoise and concludes that the neither individuals nor substantial signs of the species have been

found in recent years south of State Highway 18 (West Mojave Plan Map 3-6). This does not mean that the species has been declared extirpated south of State Highway 18; it may be interpreted to mean that the likelihood of finding desert tortoise would decrease with distance south of this major east-west arterial road. This reflects (a) the habitat-fragmentation effects of roads and (b) the on-going urban and suburban development that is occurring along and south of State Highway 18. Pending a final decision related to the proposed West Mojave Plan "no survey zone" for desert tortoise, pre-construction surveys would be conducted for this species.

Mohave ground squirrel (FSC/ST). Mohave ground squirrels aestivate in burrows during periods of low moisture and high temperatures (as long as March through November). Part of their life history strategy is to defer reproduction in years of low food supply, and as a result local populations may be extirpated during periods of extended drought. The Mohave ground squirrel is known to travel long distances and to recolonize areas where local populations have been extirpated. The species is also sensitive to development, and roads/developed areas may block recolonization. The Mohave ground squirrel's range extends south of State Highway 18 and could include virtually all habitats with (a) appropriate desert scrub characteristics, (b) soil appropriate for burrowing and not likely to be inundated during the summer, and (c) connectivity to other populations. Features that would affect connectivity in the Proposed Project area where new facilities may be constructed include the California Aqueduct, State Highways 18 and 395, and the urban development of Hesperia, Adelanto, Victorville, and Apple Valley. The species is thus less likely to occur in an urban matrix, south and west of the junction of Interstate 15 and State Highway 395. This is reflected in mapping of historic and recent sightings in the California Natural Diversity Database (CNDDB 2005). Pre-construction surveys would be conducted for this species except in the Mainstem Mojave River and adjacent loose sandy soils where burrowing is not feasible.

Mojave tarplant (CE). The Mojave tarplant occupies habitats typical of *Hemizonia* species -- clay, silty, or gravelly soils that are seasonally saturated (CDFG 2000). Both CDFG (2000) and LePre (2004) note that the species has not been found in San Bernardino County since 1933. LePre (2004) indicates that the species has been extirpated from the county. Extirpated plants have, however, been known to re-appear in areas where they have been declared extirpated, and pre-construction surveys would be conducted where soil conditions for the plant might be appropriate. Nevertheless, this species is not likely to occur in the area in general and less likely to occur in (a) urban areas, (b) in dry upland areas, and (c) in disturbed habitats.

Arroyo toad (FE/CSC). The arroyo toad requires shallow slow-moving stream and riparian habitats that are disturbed naturally by flooding (USFWS 2005). The arroyo toad is found in the east and west forks of the Mojave River and at Mojave Forks Dam where the two forks converge. Mainstem Mojave River habitat is not suitable from about 0.75 miles downstream of Mojave Forks Dam to the Narrows, because this area is not routinely flooded and high percolation rates cause the river to go dry during periods when the arroyo toad would require ponds for egg and tadpole rearing. None of the other potential sites for new facilities has suitable ponded habitat for the toad.

California red legged frog (FT/CSC). The California red-legged frog requires permanent pond-type conditions, none of which occur within Proposed Project new facility areas. As noted in the 2004 PEIR, it has been observed in ponds near Silverwood Lake.

Yellow-billed cuckoo (FE/CE). This riparian species may occur in the vicinity of Mojave Forks Dam and in patches of riparian habitat upstream (USFWS 2005). It may occur in riparian habitats downstream of the Narrows. There is no suitable desert riparian habitat at other Proposed Project facility sites.

Southwestern willow flycatcher (FE/CE). This riparian species may occur in dense willow thickets or tamarisk in the vicinity of Mojave Forks Dam and in patches of riparian habitat upstream. It may occur in riparian habitats downstream of the Narrows. There is no suitable desert riparian habitat at Proposed Project facility sites.

5.4.2.3 Range of other Special Status Species

Western burrowing owl (FSC/CSC). Western burrowing owl was once a common inhabitant of grasslands and pasture lands, living in burrows adjacent to roads and levees, and along the banks of washes (CDFG 2005). Burrowing owls are less likely to occur (a) in urban areas, (b) in areas with dense soils and/or sandy soils where burrows may not be maintained, and (c) in areas with limited rodent populations.

Mojave river vole (FSC/CSC). This species occurs in weedy herbaceous growth in wet areas along the Mojave River and adjacent irrigated pasture, burrowing in soft, but not sandy soils. It may occur immediately downstream from Mojave Forks Dam, but is not likely to be found in the Proposed Project reach of the Mainstem Mojave River and/or at other sites considered for facilities due to lack of routinely wet conditions and weedy herbaceous vegetation in the Mainstem Channel upstream of the Narrows and along the dry portions of the floodplain which may be used for facility construction. The species may be found adjacent to off-channel recreational lakes, but these are outside of the Proposed Project area.

Prairie falcon (CSC). This species forages across most of the MWA service area, nesting in cliff habitats. No nesting habitat occurs at any of the Proposed Project facility sites.

Le Conte's thrasher (FSC/CSC). Le Conte's thrasher utilizes a wide range of desert scrub and desert wash habitats, nesting in dense spiny cactus 2-8 feet above ground. The species is thus likely to occur where there is adequately developed cactus habitat. It may forage over any of the proposed sites.

Ferruginous hawk (CSC). The ferruginous hawk is a winter resident, nesting in tall trees and artificial nest sites such as power poles. This species is expected to forage across a wide range of desert habitats. There is no nesting habitat at the various facility sites, but the species may forage over them.

Cooper's hawk (CSC). The Cooper's hawk nests in riparian forest habitats along the Mojave River. Only the riparian habitat immediately downstream of Mojave Forks Dam would be suitable for Cooper's hawk nesting; all other facility sites are devoid of significant riparian habitats. The species may forage over a wide range of desert habitats and may thus forage at all facility sites.

California horned lark (CSC). California horned lark is a ground-breeding bird broadly distributed in open desert habitats. It may occur in all but heavily disturbed (graded, barren soil) areas where facilities are proposed. This species was documented on most of the Proposed Project facility sites during spring 2005 surveys.

Long-eared owl (CSC). The long-eared owl nests in wooded areas and forages in adjacent open areas. It is distributed throughout such habitats in the MWA service area, and would be expected to nest in riparian forest habitats upstream and downstream of Mojave Forks Dam. Nesting habitat is not available at other facility sites, but the species may forage over all facility sites.

Yellow Warbler (CSC). In the MWA service area, the yellow warbler is a riparian species known only at one location, 5 miles southwest of Hesperia near Mojave Forks Dam. It is unlikely to occur at other potential facility sites.

Yellow-breasted chat (CSC). The yellow-breasted chat is a riparian thicket species that may occur in the riparian habitats immediately downstream of Mojave Forks Dam, but there is no habitat for the species at other potential facility sites.

Brown-crested flycatcher (CSC). The brown-crested flycatcher is a riparian thicket species that may occur in the riparian habitats immediately downstream of Mojave Forks Dam, but there is no nesting habitat for the species at other potential facility sites. It may forage above other potential facility sites that are near river habitats.

Summer tanager (CSC). Summer tanagers are riparian thicket birds that may occur in the riparian habitats immediately downstream of Mojave Forks Dam, but there is no nesting habitat for the species at other potential facility sites. It may forage above other potential facility sites that are near river habitats.

Grey vireo (CSC). This chaparral species may occur in the hills to the south of Hesperia, including unnamed wash. The species is unlikely to occur outside of dry chaparral and sage scrub habitats and not probable at other potential facility sites.

Southwestern pond turtle (FSC/CSC). This species is known to inhabit ponds, rivers, canals, lakes, and marshes. It prefers low-velocity habitat and inhabits the riparian areas from Mojave Forks Dam to Silverwood Lake. It is amphibious, and this may explain its adaptation to a wide range of aquatic environments; it has the ability to move to land during periods of floods. In the reach below Silverwood Lake, its survival reflects its behavioral adaptation to highly variable hydrology. It is not likely to be found at other potential facility sites.

San Diego horned lizard/coast horned lizard (CSC). These related species are found in a variety of desert habitats and may be anticipated to inhabit all potential facility sites where soils have not been compacted and burrowing is therefore feasible.

Mojave fringe-toed lizard. Written comments on the draft EIR from the California Department of Fish and Game suggested that MWA include the Mojave fringe-toed lizard in its analysis. MWA initially reviewed distribution data for the Mojave fringe-toed lizard, which shows known distribution well to the north and east of proposed project areas. In addition, according to the California R015 California Wildlife Habitat Relationships System (California Department of Fish and Game California Interagency Wildlife Task Group): "The Mojave fringe-toed lizard occurs in desert regions of Inyo, San Bernardino, Los Angeles, and Riverside [Counties]. It is restricted to fine, loose, wind-blown deposits in sand dunes, dry lakebeds, riverbanks, desert washes, sparse alkali scrub and desert shrub habitats."

CDFG also included the Lucerne Valley in its list of potential project locations. Although a potential project site in this area was evaluated during initial screening of alternatives, the proposed project does not include any new facilities or activities in this area. There are areas near the Lucerne valley where Mojave fringe-toed lizards have been found. There would also be potential habitat for the species in this area, where there is suitable fine, loose, windblown sand. However, the elimination of the Lucerne Valley as a potential project facility/activity site early in the analysis means that the sites actually being considered for project construction and operation are a considerable distance outside of the known range for this species.

In addition, MWA has explicitly avoided siting recharge basins in areas with the fine, wind-blown sands required for the species to escape high daytime temperatures. Sandy habitats in the Mojave River channel that will be affected by in-channel recharge are coarse and subject to surface flow, as well as being upstream of the historic distribution of the Mojave fringe-toed lizard, which was primarily between Helendale and Camp Cady (West Mojave Plan Working Group, 1999). No dune-type habitats will be affected by the project. The creosote scrub habitats that may be affected by the project have been chosen to avoid fine sandy areas such as the wash at Sheep Creek, because these areas may also be associated with subsurface layers of fines and clays, which are not suitable for groundwater recharge.

In short, there is no reasonable potential for the proposed project to affect Mojave fringe-toed lizards because (a) none of the proposed sites are within the known range of the species and (b) groundwater recharge is optimized where there are coarse sands and sandy loams, and the selection of such sites probably eliminates potential for the Mojave fringe-toed lizard. Nevertheless, as provided in the EIR, we will survey for special-status species prior to construction. If Mojave fringe-toed lizards are found during such surveys, MWA will notify CDFG and initiate consultation regarding appropriate avoidance and mitigation.

In addition, there are a number of habitat- special status plant associations (See Table 5-13). The special status plants associated with each habitat on Table 5-13 are assumed to be present at sites with each habitat type, even if they were not observed during surveys. Desert plants often have long seed dormancies and germination patterns that reflect variable desert hydrology. The seed bank may therefore exist even if the species does not germinate in a given year.

5.4.3 Impact Analysis Methods

The purpose of impacts analysis is to provide decision makers with a sound basis for ranking and selection of alternatives. For biological resources, this may be accomplished on a habitat and habitat quality basis, by evaluating the probability of various special-status species to utilize each site, based on factors such as habitat type, habitat condition, isolation from adjacent occupied habitats due to roads or development, and whether known populations occur at or near the site. Based on these factors, and on habitat surveys and mapping conducted in spring 2005 (Cadre Environmental 2005), the relative site sensitivity can be evaluated, generally, and for threatened and endangered species.

Habitat surveys and mapping were not conducted in urban areas, such as along the probable alignments of wells and pipelines for the Mojave River Well Field (Minimum Facilities Alternative). These facilities would generally be constructed in or adjacent to public roads and other rights of way through the City of Hesperia and the Town of Apple Valley and no habitat impacts would be anticipated in these developed areas. There is some potential for well and pipeline construction on the slopes leading down to the Mojave River. Although this area is disturbed by adjacent development and by incidental local use, disturbed habitats typical of desert scrub would potentially be affected. Well sites are not known with precision at this time, and therefore impacts are assumed to approximately 1-2 acres of desert scrub (10 well pads and short segments of connecting pipeline). Work in the Mainstem Mojave River to push up berms to enhance recharge (Minimum Facilities Alternative) would not affect wildlife habitat because construction management protocols prohibit work within 100 feet of native vegetation. Finally, in the Unnamed Wash area, recent data from surveys conducted for the Rancho Las Flores Environmental Impact Report were used (in preparation).

5.4.4 Facility Impacts: Specific Mechanisms for Effect

Construction of recharge basins, wells, and pipelines, bridges, levees, and drop structures would result in permanent loss of all native habitats within the footprint of these facilities. During grading for these facilities, burrowing animals could be injured or killed. These areas would remain devoid of habitat.

Construction of recharge basins in washes (Antelope Wash and Oro Grande Wash) and along the floodplain of the Mainstem Mojave River could affect wildlife movement to and from the San Bernardino Mountains and the Mainstem Mojave River. This effect on wildlife movement would not necessarily occur in Unnamed Wash, because (a) the wash would remain in open space, (b) incidental growth of riparian vegetation along the centerline of the wash could enhance habitat diversity and quality in the wash and enhance wildlife movement, and (c) structures constructed in the wash would have minimal effects on wildlife movement. Construction of other recharge basins would not affect wildlife movement because all of these recharge basins would be located adjacent to the California Aqueduct, which currently inhibits north-south wildlife movement and wildlife movement may be feasible via the raised levee system of the recharge basins; wildlife are commonly observed to utilize levee systems in water banks as part of their movement corridors.

Buried pipelines and other small facilities such as well housings will be operated with little effect on wildlife. Recharge basins and canals would introduce water to areas that currently have limited and highly seasonal water supply. Recharge basins could be expected to attract wildlife and alter the adjacent wildlife communities. Species attracted to recharge facilities (when in use) would include ravens, plovers, stilts, and avocets. Ravens are a predator of desert tortoise and they may forage in a wide band of habitat around sources of water and food (William Wagner, Wagner Environmental, personnel communication). The introduction of surface water sources into areas where such sources are scarce may increase raven use of the area and indirectly affect desert tortoise. Ravens do not require large bodies of water to utilize an area, and raven use of an area may not increase proportionally to the surface area of water. It should be noted that all proposed facilities are adjacent to the California Aqueduct, in urban areas where food and surface water are plentiful, and/or adjacent to the Mainstem Mojave River. Some ravens may be attracted to Proposed Project facilities, but a substantial increase in raven populations is not likely because there is already plentiful water available at or near all sites. In addition, there are food sources at or near all of the proposed facility sites. In short, there are not at present significant constraints to raven occupation and use of habitats at Proposed Project sites.

Although recharge will occur on a 24-hour basis, routine operation such as maintenance of facilities will cause noise and visual disturbance, but will generally be limited to daylight hours, when most desert animals are in burrows. Noise and visual disturbance are not likely to cause effects on the adjacent burrowing animal population.

5.4.5 Facility Impacts

Table 5-14 summarizes the potential for construction and operation effects on biological resources, both direct and indirect, which are summarized by alternative below.

5.4.5.1 Minimum Facilities Alternative

The Minimum Facilities Alternative includes operations of existing recharge basins, and the recharge basin being constructed at Green Tree Road; at these sites, there will be an increase in the frequency and duration of recharge basin use, resulting in extended periods of surface water availability. Impacts of Proposed Project are summarized below.

Operation of Existing Facilities. Use of existing facilities would have no direct effects on habitats or special-status species. Also, banking would not substantially increase the frequency at which existing recharge facilities in the Baja, Centro, and Morongo Basins would be used, because banking supplies delivered to these areas, combined with other supplies delivered to meet MWA replacement water obligations, would not exceed MWA's total replacement water obligations for these areas or other deliveries. This limitation on use of banked water in these subareas would be necessitated by the inability to make direct returns to Metropolitan from these areas (unlike the Alto subarea where direct returns may be feasible). There would thus be no significant change in deliveries of supplies to these groundwater basins, and no substantial increase in the availability of water, which may attract ravens and other potential desert tortoise predators. No change in predation rates on desert tortoise would therefore be expected.

Mojave River Recharge. Recharge to the Mainstem Mojave River would involve releases from Silverwood Lake and/or the California Aqueduct via Unnamed Wash and Rock Springs. In the 2003-2005 pilot project, releases from Silverwood Lake were restricted to September 15 through February 15, and were found to be fully contained within the active channel below the reservoir. In response to a comment from Department of Water Resources (see Appendix A), MWA notes that based on data to date, 2003 deliveries to MWA were 24,874 acre-feet and in 2005 were approximately 20,000 acre-feet. No erosion or scour of adjacent habitats was observed. Recharge via Unnamed Wash would cause some changes in habitats in this drainage, as outlined below.

Use of the Mainstem Mojave River channel for recharge will have no direct effects on habitat because construction in the riverbed will be restricted to areas 100 feet away from native habitats. Construction equipment will enter the river at locations currently used for access. All in-river work will be conducted during daylight hours and in periods of no natural flow in the river. Soil conditions in the river are unsuitable for burrowing animals and infrequent flows also make the riverbed itself unsuitable for burrowing. When there is natural flow, this flow tends to be highly erosive in the Hesperia/Victorville reach, as was demonstrated during the 2003-2004 pilot project, when moderate precipitation resulted in flows that washed out the berms constructed as part of the pilot project.

This aspect of the Minimum Facilities Alternative would have no affect on habitats and low potential for direct effects on listed Federal Species. There are no recent records of desert tortoise in the area, the Mohave ground squirrel would not be found in the mainstem river, and there are no suitable habitats for the Mojave tarplant. It is probable that wildlife utilize the river bed for north-south movement, but this would not be affected significantly because the berms to be constructed will not block movement. East-west movement may be affected in the reach where there is surface flow (approximately to Rock Springs), but (a) wildlife may utilize the raised berms, (b) water depths will be low in the downstream reaches and will not be a barrier to larger animals, (c) surface flow is not anticipated north of this area unless Rock Springs Outlet is in use, and (d) inflow rates will be monitored and managed to reduce the potential for surface flow in the vicinity of the well field. East-west wildlife movement will thus not be blocked for any extended period of time.

Given that this recharge area may be in use for many months during the year, and over a period of years, there is a possibility that ravens will utilize the area for water. This should not have a significant effect on raven populations and indirectly on desert tortoise because there is already plentiful surface water supply at various recreational lakes and ponds, including artificial fish-rearing facilities, outside of the Proposed Project area along the Mainstem Mojave River, and there is surface flow in the Narrows as well. The availability of surface water in this southern reach, where signs of desert tortoise are rare, should not therefore cause an increase in raven predation.

Given that extractions at the well field are limited to 90% of deliveries to recharge (as described), a portion of the water recharged will (a) migrate laterally to the regional aquifer and marginally raise groundwater elevations and (b) migrate downstream to the Narrows, where increases in surface flow may incidentally help sustain riparian vegetation.

Finally, recharge may under some conditions raise groundwater levels to from 20 to 40 feet below the surface. Phreatophyte vegetation may colonize these areas. Both MWA and flood control officials have programs for removal of exotic phreatophyte species such as tamarisk, and would take action to do so if they are found. These on-going, existing programs would reduce the potential for phreatophytes to colonize the river reach between Mojave Forks Dam to the Narrows.

Mojave River Well Field and Pipelines. The well field and pipelines will be constructed in an urban and disturbed area. No significant wildlife habitats will be permanently affected; several wells may be constructed on the vegetated slope above the river channel, but this area is highly disturbed and wells may be sited to avoid any pockets of viable habitat. There is a low potential for Mohave ground squirrels in the undeveloped areas along this reach of the Mainstem Mojave River. Well footprints will be small. Pipelines will be underground in public rights-of-way. Wells will be adjacent to these rights of way. Buried facilities will not affect wildlife movement. The wells and pipelines will be self-contained and will not provide water for ravens. Special status species that could be affected by construction include:

- Barstow wooly sunflower (CNPS List 1B): low potential
- Booth's evening-primrose (CNPS List 2): potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkeyflower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential
- Mojave river vole (FSC/CSC) limited potential

SWP Delivery via Unnamed Wash. Unnamed Wash is good quality desert scrub habitat with some elements of desert wash. The watershed is quite small, flows are infrequent and of short duration, and thus significant desert wash habitats do not now exist. In response to a comment from County of San Bernardino (Appendix A), MWA also notes that, based on the field surveys of existing habitat conditions, there is no evidence of existing overbank flooding at a level that creates conditions for an wide area of desert wash habitat. Wash habitat is intermittent and confined to a small area about 15-30 feet wide. The adjacent habitat is desert scrub, a community that does not depend on periodic overbank flows for plant propagation. In addition, as noted above, more sustained flows from recharge operations would likely raise groundwater levels adjacent to the channel. This would be more likely to marginally promote some expansion of wash, rather than restricting it. The site is south of the known range of the Mohave ground squirrel and the desert tortoise. Habitat surveys suggest that the habitat would support special-status species, including:

- Barstow wooly sunflower (CNPS List 1B): low potential
- Booth's evening-primrose (CNPS List 2): potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkeyflower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): observed on site
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The wash drains to the Mojave River, a jurisdictional Water of the United States, and will therefore be subject to jurisdiction of the U.S. Army Corps of Engineers, CDFG, and the Lahontan RWQCB. No jurisdictional wetland habitats currently occur in the wash, which is only intermittently wet.

Approximately 6 to 8 acres of desert wash and desert scrub habitats will be permanently affected by construction of the proposed turnout, canal/or pipeline, drop structures to control erosion, unpaved access and maintenance roads, and small bridges. There will also be a short term loss of non-native grasslands associated with construction of the bridge under Arrowhead Lake Road and the low levees downstream of this road. It is anticipated that long-term operation of the turnout will increase the frequency of flow down the wash and increase the area affected by flow, and that an incised channel may form as a result of more frequent inundation. Deliveries of SWP supplies would occur for extended periods of time, providing surface water and raised groundwater levels adjacent to the centerline of the wash. The result will probably be creation of a permanent sandy-rock bottomed channel with adjacent desert wash shrub habitats. Routine maintenance will be minimal, but the channel will be maintained to exclude vegetation, such as tamarisk, that may result in restrictions in channel flow. The channel and the open space to be conserved by Rancho Las Flores will provide a movement linkage between the Mainstem Mojave River and remaining habitat in the wash and upstream of the wash. The loss of 6 to 8 acres of desert wash habitat resulting from drop structures and maintenance roads would be considered a significant impact.

Impact Summary

As noted on Table 5-14, the Minimum Facilities Alternative would affect about 6-8 acres of desert wash habitat in Unnamed Wash, but would otherwise not affect wildlife habitats.

Potential for impact to special-status species is low. There is a low potential for wells and pipelines to affect Mohave ground squirrel. Burrowing owls and other special-status species may use the slopes leading to the Mojave River, and impacts to 1-2 acres of wildlife habitat may occur in this portion of the Well Field and Pipeline area.

5.4.5.2 Small Projects Alternative

The focus of the Small Projects Alternative is to increase recharge capacity in the Alto subarea. Four recharge basins may be constructed under this alternative, all located in or adjacent to water courses.

<u>Off-channel Mojave River Recharge and Pipeline.</u> A number of sites were evaluated for this potential 100 acre-facility. Sites in the first mile downstream of Mojave Forks Dam were determined to have significant riparian habitats and suitable habitat for the arroyo toad (FE/CSC), Yellow-billed cuckoo (FE/CE), and Southwestern willow flycatcher (FE/CE), as well as a suite of other special-status (unlisted) plant and animal species. There is an established arroyo toad population upstream of the dam and thus there is a likelihood of arroyo toad use of suitable downstream habitats. For this reason and because of known cultural resource sites, upstream (southern) locations for an off-channel recharge basin were eliminated from consideration. Impacts associated with this site are therefore not shown on Table 5-14.

The potential East Site for this facility consists of disturbed grasslands and desert scrub located south of an existing poultry operation. It is off channel and not subject to routine flooding. Thus, even if Mohave tarplant was not extirpated from this portion of its historic range, there is little potential for it to be found in this habitat. Also, it is south of the known distribution of Mohave ground squirrel, although there is some potential for the species to colonize this area from populations to the north. The pipeline needed to bring water to this site would be constructed in the alignment of an existing unpaved road, with no native habitat. Some potential for impacts to burrowing owls along the road exists. Given the level of habitat disturbance, the site may support:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The site is within the floodplain of the Mojave River, but is outside of the Mainstem channel. It has no features that would indicate Corps of Engineers jurisdiction.

If the East Site were chosen for this facility, it would place berms in the path of wildlife moving along the river and the base of the hills. Simultaneous operation of the recharge basin and recharge to the Mainstem Mojave River would thus reduce the width of area available for wildlife movement. However, the site would not be lighted, it is immediately south of an old poultry operation and some scattered housing, and wildlife are known to utilize recharge basins for movement and foraging. In addition, wildlife movement on the opposite bank of the Mainstem Mojave River would not be affected if this site were chosen. Finally, wildlife movement north is limited by the constraints of the Narrows and by commercial and residential development. The most important movement corridor for wildlife is along the river upstream of the proposed recharge site and then along the hills to the east. The proposed recharge facility, east site, would not significantly affect this movement and would preserve about 100 acres of open space in a portion of this movement corridor that may alternatively be developed to a higher density than at present. No significant effect on nocturnal movement is anticipated. Intermittent use of this site for recharge would result in greater availability of surface water, but the site is a considerable distance from known desert tortoise habitat and ravens attracted to the site have alternative water supplies in closer proximity to desert tortoise habitats. The potential for significant increases in raven predation on desert tortoise as a result of operations is therefore low.

Construction of the pipeline from Rock Springs to this site would occur in sandy soils along an unpaved road alignment near the edge of the mainstem channel. This would potentially affect burrowing animals along the road alignment for the pipeline. But the soils are quite sandy, and there is only a low potential that burrowing owls or Mohave ground squirrels would be found in the vicinity of the road.

The West Site consists of a disturbed non-native grassland adjacent to a recreational lake and treated wastewater discharge ponds. The pipeline from Rock Springs to this site would be constructed within the right-of-way of Arrowhead Lake Road, which is the disturbed eastern shoulder of the road. The heavy growth of non-native grasses, lack of desert scrub plants, and historic levels of disturbance make it unlikely to support special-status plant species, although it may still provide habitat for western burrowing owl and Mohave ground squirrel. It is likely foraging habitat for Le Conte's thrasher, prairie falcon, and Cooper's hawk.

If the West Site were chosen for this facility, it would place berms in the path of wildlife moving along the river and the base of the hills. As for the East Site, simultaneous operation of the recharge basin and recharge to the Mainstem Mojave River would thus reduce the width of area available for wildlife movement. However, the site would not be lighted, it is immediately south of a recreation lake and near scattered housing, and wildlife are known to utilize recharge basins for movement and foraging. In addition, wildlife movement on the opposite bank of the Mainstem Mojave River would not be affected if this site were chosen. Finally, wildlife movement north is limited by the constraints of the Narrows and by commercial and residential development. The most important movement corridor for wildlife is along the river upstream of the proposed recharge site and then along the hills to the west. The proposed recharge facility, west site, would not significantly affect this movement and would preserve about 100 acres of open space in a portion of this movement corridor that may alternatively be developed to a higher density than at present. No significant effect on nocturnal movement is anticipated. Intermittent use of this site for recharge would result in greater availability of surface water, but the site is a considerable distance from known desert tortoise habitat and ravens attracted to the site have alternative water supplies in closer proximity to desert tortoise habitats. The potential for significant increases in raven predation on desert tortoise as a result of operations is therefore low.

Impacts associated with pipeline construction to the West Site would be temporary. Given that there is only one CNDDB record of Mohave grounds squirrel in the Proposed Project area, and that the range of the Mohave ground squirrel extends only slightly south of Highway 18, the potential for Mohave ground squirrel to be found in this area is minimal.

<u>Oro Grande Wash Recharge Basins</u>. The potential recharge basins and internal pipelines at Oro Grande Wash would be constructed at a site bounded by the California Aqueduct, State Highway 395, Phelan Road, and Interstate 15. A majority of construction would occur in desert scrub habitats in the lower portions of the wash; more sensitive Joshua Tree/California Juniper scrub occurs upslope of the probable basin locations, but could be affected by construction. Pipelines to deliver water to these basins would be constructed within the wash or in/adjacent to public roads.

If recharge basins were constructed in Oro Grande Wash, there is a small potential for direct effects on Mohave ground squirrel (ST/FSC) and effects on nine special status plant species and four special status animal species:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Plummer's mariposa lily (CNPS List 1B): low potential
- Robinson's monardella (CNPS List 1B): low potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Southern skullcap (CNPS List 1B): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The site's distance from known desert tortoise habitat and isolation by three major highways makes desert tortoise presence highly unlikely and project potential for effects on desert tortoise should be considered only marginally higher than none. The site is not near known desert tortoise habitat and the availability of surface water during recharge operations, while it may attract ravens, is not likely to result in increased predation on known desert tortoise habitat which is 10 miles away.

Although the natural portion of Oro Grande Wash terminates at the Green Tree Golf Course and downstream wildlife communities are limited, the was probably at one time a wildlife movement corridors under Interstate 15. Wildlife movement is now constrained to the culverts under the California Aqueduct and any wildlife movement along this wash would be adapted to human habitation, such as coyotes, and raccoons. These species may utilize culverts, but it is not likely that the wash is used by large numbers of animals for movement.

Construction of facilities in Oro Grande Wash would therefore have a limited potential to affect local populations of Mohave ground squirrel (if local extirpations have not already occurred) and other special-status species, but the functional isolation of the site by roads, aqueducts, and encroaching development in the Interstate 15 corridor would suggest that these effects would not be important to the long-term preservation of the affected species. This is reflected in the low mitigation ratio assigned to this area in the West Mojave Plan.

Cedar Avenue Detention Basin. The site for the Cedar Avenue Detention basin is highly disturbed, including areas that show evidence of previous grading and recreational vehicle use. The site is isolated on the north by the California Aqueduct, although there is a flowage structure that allows flood flows to pass over the Aqueduct. Isolation of the site suggests that there is little potential for Mohave ground squirrel or desert tortoise. Although disturbed, the site has a low potential to support some special-status species:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- California horned lark (CSC): observed on site
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The site is isolated from known desert tortoise habitat by State Highway 18, State Highway 395, Interstate 15, and the California Aqueduct. Direct effects on desert tortoise are highly unlikely. The site is not a wildlife movement corridor; there is development around it and the California Aqueduct is a barrier to wildlife movement, with the possible exception of human-adapted species such as coyotes, which may cross the Aqueduct via the flowage structure. This isolation, particularly the California Aqueduct, would probably exclude Mohave ground squirrel from the site.

Antelope Wash Recharge (Ranchero Road). This site is unsuitable for recharge until the dip crossing at Ranchero Road has been replaced with a detention basin. This work, performed in advance of the development of recharge basins in the detention basin, would result in complete removal of any wildlife habitat at the site and thus the potential construction of recharge basins would have no direct effects on wildlife or their habitat. Construction of recharge basins within this proposed City of Hesperia Detention basin would therefore have no significant impacts on wildlife.

In the long-term, wildlife movement would be restricted by use of the site as a flood detention basin, the flood gates under Ranchero Road, and on-going development around the wash. Operations may increase the availability of water and attract ravens, but the site is far from known desert tortoise populations and there is available water in many locations near the site.

Summary of Impacts. If all facilities of the Small Projects Alternative were constructed, and the East site chosen for Off-Channel Mojave River Recharge, habitat effects would include loss of:

- 53 acres of disturbed habitats
- 157 acres of desert scrub in various condition from disturbed to moderate quality
- 30 acres of Joshua Tree habitat

Effects related to these habitats would include low potential to potential impacts on up to 14 special-status (unlisted) species, and very low potential impacts to desert tortoise and Mohave ground squirrel.

If all facilities of the Small Projects Alternative were constructed, and the West site was chose for Off-Channel Mojave River Recharge, habitat effects would include the loss of:

- 113 acres of disturbed habitats
- 97 acres of desert scrub in various condition from disturbed to moderate quality
- 30 acres of Joshua Tree habitat

Effects related to these habitats would include low potential to potential impacts on up to 14 special-status (unlisted) species, and very low potential impacts to desert tortoise and Mohave ground squirrel.

5.4.5.3 Large Projects Alternative

The Large Projects Alternative includes 3 potential recharge basins to expand on or substitute for the capacity of the other alternatives. The potential recharge sites are further away from existing development that those for the other alternatives, reflecting MWA's alternative formulation strategy of siting recharge to minimize impacts and costs before addressing larger and more remote sites.

Oeste Recharge, Pipelines, and Wells. The potential recharge site in the Oeste subarea would be constructed about 15 miles east of State Highway 395 and immediately south of State Highway 18. This is the most remote site under consideration. Surveys indicate that the various parcels being considered (and adjacent areas) are a monotypic Creosote Bush Scrub form of desert scrub that may support a typical desert scrub wildlife community. The site is within several miles of known desert tortoise habitat and thus there is a moderate to high potential for an isolated individual tortoise to be found, even though signs of desert tortoise south of State Highway 18 are rare. The habitat is in the range of the Mohave ground squirrel and it is moderately to highly likely that the species would be found on site. The potential for desert tortoise and Mohave ground squirrel to be found in this portion of the Mojave Basin is reflected in the 1:1 mitigation ratio assigned to this portion of the Victor Valley in the West Mojave Plan. In addition to these two listed species, the site may support:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The construction of recharge basins would remove about 300 to 350 acres of habitat for these species, which would be considered a significant impact.

The sites at Oeste are isolated from development, but are also between the California Aqueduct and State Highway 18, thus being partially isolated from adjacent wildlife communities. There are several local washes that pass under Highway 18 and over the California Aqueduct, and several local roads pass over the Aqueduct as well. There is therefore some likelihood that wildlife movement occurs at the two sites. If this is the case, the presence of recharge basins may affect wildlife movement, but this effect would probably not be significant. Wildlife are known to use recharge basin levees for movement and the presence of water may enhance conditions for movement as well.

Given that Oeste recharge basins would be within 5 miles of known desert tortoise habitat north of State Highway 18, their operation may attract ravens which would forage within known desert tortoise habitat. This could result in increased predation on desert tortoise in the southern portion of their existing range. This would be considered a significant and adverse effect on desert tortoise, affecting populations within the area designated for conservation of the species.

Alto Recharge, Pipelines, and Wells. The potential recharge sites in the Alto area (at the junction of the California Aqueduct and the Mojave River Pipeline) are bounded on the south by

the California Aqueduct in an area parcelized for rural-residential development and would be expected to develop during the period when the Proposed Project would be developed and operated. There is existing development to the east and an east-west road crossing of the California Aqueduct to provide for access to the urban areas to the east.
The easternmost recharge site in this area is a monotypic Mojavean creosote bush scrub, while the western site is Mojavean creosote bush scrub with fingers of Joshua tree/Mojavean creosote bush scrub. Being 4 miles south of State Highway 18, the sites probably do not support desert tortoise, but there is moderate to high potential for Mohave ground squirrel and a suite of special-status species:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The construction of recharge basins would remove about 150 acres of habitat for these species, which would be considered a significant impact.

The sites at Alto are isolated from development except on the east, but there are expanses of similar habitat between these sites and State Highway 18. There are several local washes that pass under Highway 18 and over the California Aqueduct, and several local roads pass over the Aqueduct as well. It is therefore likely that the sites are part of a large wildlife community and that there is unconstrained movement of wildlife within the area. If this is the case, the presence of recharge basins may affect wildlife movement, but this effect would probably not be significant. Wildlife are known to use recharge basin levees for movement and the presence of water may enhance conditions for movement as well.

Given that Alto recharge basins would be within 7 miles of known desert tortoise habitat north of State Highway 18, their operation may attract ravens which would forage within known desert tortoise habitat. This could result in increased predation on desert tortoise in the southern portion of their existing range. This would be considered a significant and adverse effect on desert tortoise, affecting populations within the area designated for conservation of the species.

<u>Antelope Wash Recharge and Pipelines</u>. Recharge basins at this site would be located in designated open space south and east of the Hesperia Airport, adjacent to a range of hills that separate the wash from the Mainstem Mojave River. The potential recharge site is dominated by Joshua Tree/California Juniper/Desert Scrub, with an expanse of Joshua Trees across the upper portions of the wash. Although the wash is well outside of the known range of the desert

tortoise, and on the edge of Mohave ground squirrel range (and subject to flooding and thus not good burrowing habitat), it may supports a suite of other special-status species, including:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Robinson's monardella (CNPS List 1B): low potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Southern skullcap (CNPS List 1B): low potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

In the urbanizing portion of the Victor Valley, large stands of Joshua Tree habitat have become increasingly rare, and loss of up to 80 acres of this habitat type, with its sensitive species, would be considered a significant impact. In addition, the California Aqueduct goes into pipeline in the vicinity of the wash and there is thus connectivity between the wash and the adjacent hills. Recharge basin construction and operation could affect wildlife movement between the mountains and lower portions of the wash. The significance of this wildlife movement is probably not great because the downstream portions of the wash flow through heavily developed areas, but it could be considered significant, depending on the extent to which the recharge basins filled the lower portions of the wash. Wildlife are known to use recharge basin levees for movement, and thus the current level of wildlife movement in the wash could be reduced, but connectivity would probably not be severed. Operations may increase the availability of water and attract ravens, but the site is far from known desert tortoise populations and there is available water in many locations near the site. No indirect impacts to desert tortoise are anticipated.

As discussed in the draft EIR Section 5.4, habitat quality and potential wildlife use of the upstream recharge site is substantially better than that downstream of the dirt road that would be the southern boundary of the alternative expanded Ranchero Road recharge basins (Chapter 4, page 4-31). The potential for special status species to utilize the downstream site would also be lower, in part because construction of the Ranchero Road detention basin will result in disturbance of a substantial portion of the habitats at this site. In addition, shifting this recharge capacity downstream would eliminate impacts to 68 acres of moderate to high quality Joshua Tree/juniper habitat, replacing it with impacts to disturbed desert scrub habitat (in the portion of the site upstream of the area which will be flooded when the detention basin is in use). The remaining area would be routinely disturbed by maintenance of the detention basin, including post-flood sediment and debris removal.

Summary of Impacts. If all facilities proposed for the Large Projects Alternative were constructed and operated, this would result in the following habitat loss:

- 23 acres of disturbed habitat,
- 498 acres of desert scrub habitat, and
- 68 acres of Joshua Tree habitat (no impacts to this habitat type if recharge is relocated to downstream site)

Of this habitat, all but 100 acres in Antelope Wash would have a low-to-moderate potential for Mohave ground squirrel, and a low potential for desert tortoise impacts. Although the Alto and Oeste areas would have a higher potential for use by desert tortoise and Mohave ground squirrel, this potential remains low-to-moderate because surveys conducted over the past 20 years have seldom found these species south of Highway 18. The higher potential sensitivity of these sites compared to those further to the south and east reflects the West Mojave Plan's mitigation ratios, which are 0.5 to 1 for all other Proposed Project sites but 1 to 1 for the Alto and Oeste recharge sites.

Relocation of the upstream Antelope Wash recharge to the downstream location would substantially reduce potential impacts to special-status species.

5.4.6 Operational Impacts

5.4.6.1 Mechanism for Effects

Operations of the Proposed Project facilities (Table 5-14) may affect biological resources in several ways:

- Flow in the Mainstem Mojave River and Unnamed Wash may inhibit wildlife movement across these areas
- Although extractions from the Mojave River Well Field will be matched to net recharge rates, additional flow in the Mainstem River may result in increases in surface flow in the narrows and the Transition Zone because extractions of 90% of recharge will mean that at least 5% of recharge from banking will not be extracted for use and may flow downstream.
- Recharge operations will result in increased availability of water in some areas, attracting wildlife.

5.4.6.2 Operational Effects: Minimum Facilities Alternative

A majority of the potential operational effects of the Proposed Project occur as a result of the Minimum Facilities Alternative, which provides for extended periods of flow on the Unnamed Wash and the Mainstem Mojave River. Movement of small animals of all species would probably be inhibited when there was flow. The availability of water would also attract other species, and the wildlife community could be expected to change as a result. These effects would not likely increase proportionally to the magnitude of the project because (a) the necessary recharge/extraction balancing for the Mainstem Mojave River effectively defines the maximum recharge and (b) additional recharge facilities would be used to address needs to increase banking project and long-term MWA increases in deliveries to recharge.

Table 5-14. Summary of Project Effects on Special Status Species and Habitats. Potential for effects on threatened and endangered species reflect relative effects among the alternatives. In general, this potential is low. (Disturbed refers to area of bare ground due to roads, off-road vehicle tracks, and previous grading or construction). Listed species effect: 0 = none, 1 = low, 2 = moderate, 3 = high. Recharge includes associated wells and pipelines.

FACILITY	CONSTRUCTION EFFECTS												OPERATIONS EFFECTS		
	Habitats affected (acres)				FSC/CSC		Potential T&E species affected								
	Disturbed	Desert scrub	Joshua tree/juniper	Desert wash	Animals	Plants	Desert Tortoise	Mohave Ground Squirrel	Mojave tarplant	Yellow-billed cuckoo	SW willow flycatcher	Arroyo toad	Wildlife Movement Affected (Relative Level of Effect	Wildlife Attraction to Water and Indirect Effects	Enhanced Predation by Ravens (Relative Level of Effect)
Minimum Facilities Alternative															
Mojave River Recharge Berms	0	0	0	0	0	0	0	0	0	0	0	0	Low	Low	Low
Mojave River Well Field & Pipelines	0	1-2	0	0	5	6	0-1	1	0	0	0	0	Low	None	Low
SWP Delivery via Unnamed Wash	1	6-8	0	<2	4	8	0-1	1	0	0	0	0	Low	Low	Low
Use of Existing Recharge	0	0	0	0	0	0	0	0	0	0	0	0	Low	Low	Low
Small Projects Alternative															
Off-Channel Mojave River Recharge: East	40	60	0	0	4	6	0-1	0-1	0	0	0	0	Mod	Low	Low
Off-Channel Mojave River Recharge: West	100	0	0	0	4	6	0-1	0-1	0	0	0	0	Low	Low	Low
Oro Grande Wash Recharge	13	37	30	0	5	9	0-1	0-1	0	0	0	0	Low	Low	Mod
Cedar Avenue Detention Basin	0	60	0	0	4	6	0-1	0-1	0	0	0	0	Low	Low	Low
Antelope Wash Detention Basin Recharge	Not applicable. Initial construction of the detention basin by City of Hesperia would remove all habitats.														
Large Project Alternative															
Oeste Recharge, pipelines, and wells	9	330	0	0	4	6	1	1-2	0	0	0	0	Low	Mod	Low
Alto Recharge, pipelines, and wells	10	140	0	0	5	6	1	1-2	0	0	0	0	Low	Mod	Low
Antelope Wash Recharge and wells	4	28	68	0	4	9	0-1	0-1	0	0	0	0	Mod	Mod	Low
Downstream Antelope Wash site	60	40	0	0	4	9	0-1	0-1	0	0	0	0	Low	Low	Low

Wildlife movement in Unnamed Wash will eventually be constrained by the planned development of this area, which includes housing on either side of the wash and drainage and water treatment facilities. Even considering this, the Proposed Project would introduce a new constraint on wildlife. Wildlife movement across the Mainstem would continue to be feasible north of Rock Springs and during many periods when Mainstem Mojave River recharge is suspended. The recharge rates for the river are quite high, and thus input of the maximum recharge of about 48,000 acre-feet per year may be accomplished rapidly (with extensive surface flow) or at lower rates (with less extensive downstream migration of surface flow). At a maximum recharge rate of 500 cfs (1,000 acre-feet per day), the maximum period of surface flow in the river would be about 50 days per year. At this rate, surface flow might extend to near the Narrows. At a lower rate of 100 cfs (200 acre-feet per day), surface flow would probably not extend more than several miles downstream of Mojave Forks Dam because recharge is sustainable for several months at about 100-300 cfs (200 to 600 acre-feet per day, even during flood periods; see Water Resources: Hydrology in Section 5-14). At this rate, much of the river would be dry, and the wetted area would be wet for about 120 days. In short, wildlife movement across the river and across Unnamed Wash will be at worst affected totally for only about 50 days per year and at best affected in a limited reach about 120 days per year. In addition, when Unnamed Wash is in operation, it is unlikely that there would be need to make deliveries via Silverwood Lake and thus east-west movement along the northern slope of the San Bernardino Mountains would be unaffected.

Wildlife may be attracted to the new water source (when it is available) but there is already significant open water in the vicinity of the Mainstem Mojave River due to development of off-channel recreation lakes and other facilities. Any wildlife attraction effects have probably already occurred and the addition of flow in the mainstem may have little effect on wildlife communities in this urbanizing reach of the river, given the intermittent nature of this new flow regime.

5.4.6.3 Small Projects Alternative

With the exception of Off-Channel Mojave River Recharge, new facilities would have minimal potential to affect wildlife movement. Facilities at Oro Grande Wash, Antelope Wash at Ranchero Road, and Cedar Avenue Detention Basin are currently isolated by major roads and/or development. Significant wildlife movement at these sites is not anticipated. Off-Channel Mojave River Recharge at either east or west site would affect movement to some extent, but wildlife are known to utilize recharge areas for movement.

As recharge magnitude increases at these facilities, the frequency and duration of wetting will be increased and wildlife will be temporarily attracted to the water source. Given the isolation of the sites at Oro Grande Wash, Cedar Avenue, and Antelope Wash at Ranchero Road from adjacent wildlife habitat, this attraction effect will be minimal.

5.4.6.4 Large Projects Alternative

Operation of recharge basins at Oeste, Alto, and Antelope Wash would not substantially affect wildlife movement because these facilities would (a) be readily used by wildlife and (b) be utilized intermittently. Wildlife movement at Oeste and Alto is already affected by Highway 18 to the north and the California Aqueduct to the south. Thus, while wildlife movement is feasible in these areas, there are more significant constraints already in place. At Antelope Wash, wildlife movement could be significantly constrained due to the alteration of habitat conditions in the wash. Relocation of the upstream Antelope Wash recharge to a downstream location would reduce wildlife movement impacts.

The introduction of water to these facilities, which would be expected to increase as banking and exchange project magnitude increases, would likely attract wildlife and, given the relatively undeveloped nature of habitat in these areas, could alter wildlife communities. There is some development in these areas and thus some water availability. The California Aqueduct runs nearby. But open, unfenced areas of water could attract wildlife. The potential for wildlife attraction increases with the magnitude of the banking and exchange program because a larger program increases the frequency and duration of recharge.

5.4.7 Significance, Mitigation, and Significance of Impacts after Mitigation

5.4.7.1 Significance Thresholds

Under CEQA, thresholds for significance of biological resources are based on Section 15065 and Appendix G of the CEQA *Guidelines*, as well as professional judgment. Impacts to biological resources would be considered significant if the Proposed Project activities:

- Have a substantial adverse impact, either directly or through habitat modifications, on an species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by California Department of Fish and Game or US Fish and Wildlife Service;
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service;
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance;
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat

conservation plan;

- Substantially reduce the habitat of a fish and wildlife species;
- Cause a fish or wildlife population to drop below self-sustaining levels;
- Threaten to eliminate a plant or animal community; or
- Reduce the number or restrict the range of an endangered, rare, or threatened species.

5.4.7.2 Significance

Based on the above analysis of the potential for the Proposed Project to affect fish, wildlife, and their habitats, potentially significant effects of Proposed Project facility construction and operation could involve:

- Direct and indirect impacts on several threatened and/or endangered species,
- Direct impact on wildlife habitats
- Direct effects on wildlife movement
- Indirect effect on wildlife community structure by attracting wildlife to water

Based on preliminary field surveys (and the data and analysis that has formed the scientific basis for the West Mojave Plan), the probability of direct take of individual desert tortoise or Mohave ground squirrel is very low. The proposed project facilities are outside of the known current range of the desert tortoise, although it is possible that isolated individuals may still survive south of Highway 18. The projects with appropriate Mohave ground squirrel habitat are within the historic range of the species, but sightings south of Highway 18 have been rare and most of the proposed facilities are in urbanizing areas of highly fragmented habitat with limited access for either desert tortoise or Mohave ground squirrel. Federal and State listed threatened or endangered plants are unlikely to be found at the project sites, but sites will be again surveyed for these plants prior to construction.

Several of the proposed project sites have also been heavily disturbed by prior use. The recharge basin sites at Cedar Avenue, Antelope Wash (Ranchero Road), and both east and west sites for Off-Channel Mojave River Recharge lack substantial integrity as wildlife habitat. Soils have been disturbed and conditions for native plants are compromised. Specifically:

- At the Cedar Avenue site, a majority of the habitat has been identified as disturbed Mojavean Desert Scrub and there is evidence of off-road vehicle use. The site is isolated on the north and east by the California Aqueduct, and by ranchettes along its other boundaries. No CDFG sensitive habitats occur on site. In addition, the site is subject to flooding when runoff in excess of the capacity of existing drainage systems collects at the base of the California Aqueduct; this alters basic hydrologic and soil conditions in the area. Finally, the site has been designated for a flood detention basin by the City of Hesperia.
- At the Antelope Wash, Ranchero Road site, there is development (including an airport) to the west and residential development to the east. The City of Hesperia plans a flood

detention basin at this site, and MWA would integrate its recharge facilities into the City's recharge basin.

- At the west site for Off-Channel Mojave River Recharge, past land use as a site for disposal of waste has resulted in a site characterized in initial biological surveys as non-native grassland. The site has been divided into leveed basins separated by low berms, and has been maintained and flooded routinely. Soil structure and chemistry have been altered and the site is monotypic grassland, with virtually no shrub habitats.
- At the east site for Off-Channel Mojave River recharge, past use for agriculture has resulted in a virtually shrub-less habitat, with areas of disturbed Mojavean Desert Scrub mixed with areas of almost bare earth.

These four sites were selected in part because of their (a) isolation, (b) low habitat value, and (c) past history of disturbance. Although there is a low potential for finding patches of some special-status plant species at these sites, their wildlife communities are probably dominated by animals well-adapted to human environments. Finally, the proposed recharge basins will function at least as well for human-adapted wildlife as the habitats presently available. There will be shrub habitat along portions of the perimeter maintenance roads, grasses and forbs along levees, and available water. When not in use, recharge basins will be disturbed non-native grasslands. Wildlife will be able to utilize these sites for movement. At these four sites, construction and operation of recharge facilities would therefore not result in a loss of significant wildlife habitat. Recharge basins at these sites will not inhibit wildlife movement and no significant indirect impacts are anticipated.

The Oro Grande Wash has different site characteristics from the above four sites, but was also selected in part because of low potential for significant impacts to wildlife. South of California Aqueduct, the site is completely isolated from adjacent wildlife habitats by the aqueduct, State Highway 395, Phelan Road, and Interstate 15. Wildlife must cross these barriers or pass through culverts under raised road beds or the aqueduct. In addition, there is development on the east and west sides of the site which introduces human disturbance, and the site has evidence of extensive off-road vehicle use. The southern portion of the site is thus more likely to be a sink for wildlife and probably does not contribute to adjacent wildlife communities. The northern portion of Oro Grande Wash is also heavily disturbed. It is located in a quarter section of undeveloped land that is isolated to the south by the California Aqueduct, to the east by development and Interstate 15, and to the north by Bear Valley Road (State Highway 18) and new medium to high density development. There is extensive ranchette (low-density) development extending several miles to the west of the site. The Oro Grande Wash sites for recharge are therefore functionally islands of disturbed habitat within an urban/suburban matrix. At the Oro Grande Wash sites, the proposed recharge basins will probably function at least as well for human-adapted wildlife as the habitats presently available. There will be shrub habitat along portions of the perimeter maintenance roads, grasses and forbs along levees, and available water. When not in use, recharge basins will be disturbed non-native grasslands. Wildlife will be able to utilize these sites for movement. At Oro Grande Wash, construction and operation of recharge facilities would therefore not result in a net loss of significant wildlife habitat.

Recharge basins at these sites will not inhibit wildlife movement and no significant indirect impacts are anticipated.

Indirect impacts associated with Mojave River Recharge include some constraints on wildlife movement across the river during active recharge operations. East-west movement across the Mainstem Mojave River channel has not been studied, but probably occurs. It will be affected by recharge, but at worst the channel would be completely wetted for only a short period of time. Given Metropolitan's historic pattern of deliveries to groundwater banks, recharge is most likely to occur in the spring and summer (See Section 5.13, below). After February 15, recharge in this period would not be made from Silverwood Lake and east-west wildlife movement along the north slope of the mountains would be unaffected throughout the spring, summer and early fall. In addition, recharge operations will not generally involve wetting of the Mojave River channel past Rock Springs for an extended period of time and wildlife movement would be possible in the reach between the Narrows and Rock Springs Road much of the time. This area is within the urban reach of the River, and no significant wildlife movement is anticipated as a result. The effects of recharge operations on the Mainstem Mojave River are thus less than significant.

MWA also considered the potential for water at all recharge basins to attract wildlife, with subsequent changes in wildlife communities and potential minor increases in ravens and raven-related predation on desert tortoise. There is, however, substantial water and food available at present throughout the Proposed Project Area. Proposed new facilities would be constructed within the urban matrix or within a matrix of hundreds of small ranchettes to the east of Hesperia. Thus, food and water probably do not at present constrain raven populations in this portion of MWA's service area. Even in the vicinity of the Oeste and Alto recharge basins, there is substantial available water in the California Aqueduct, there is nearby intermittent development along Highway 18, and there are approximately 1,500 housing units within 5 miles of the Oeste and Alto recharge basin sites. Thus, the introduction of water to these areas would probably not significantly increase populations of ravens in this area. No significant indirect effects on desert tortoise are thus anticipated.

In addition, avian species foraging would not be adversely affected by recharge basin construction. Recharge basins are a complex habitat and would support small mammals and lizards, which are common prey for a variety of birds. In addition, the intermittent recharge at these sites would marginally increase populations of some insects which will provide forage for bats and insectivorous birds.

Potential for impacts to special status species is thus likely to be limited to habitat loss associated with project features at Unnamed Wash, Antelope Wash (airport site), and at the Alto and Oeste Recharge basins.

The potential Alto Recharge basin site was selected in part because of its proximity to the California Aqueduct and its functional isolation from significant areas of wildlife habitat. The smaller eastern site consists of 10-acre or smaller parcels adjacent to a low-density development of about 40 houses. To the south, the site is isolated by the California Aqueduct. To the west, there is a graded site for maintenance of the California Aqueduct. This already parcelized 38-acre recharge site may be developed for low-density housing (its current zoning status). The larger (112 acres) site to the west includes 12 acres of land with water project facilities and the remaining 100 acres consists of Mojavean Creosote Bush Scrub with fingers of Joshua Tree/Mojavean Creosote Bush Scrub that have developed where drains across the California Aqueduct have altered drainage patterns. There is evidence of disturbance, but the general habitat quality is good.

The potential Oeste Recharge basin sites (east and west) were selected in part because they generally avoid the Sheep Creek Wash, although there is some drainage across the western parcels where drains across the California Aqueduct have been constructed. The eastern site consists of disturbed Mojavean Creosote Bush Scrub bounded on the south by the California Aqueduct and on the north by Highway 18 and ranchette development across Highway 18. There is patchy development mixed with wildlife habitat to the east of the site. The western site is located between the California Aqueduct and Highway 18 and part of the southern boundary is formed by a raised-bed railroad line.

The Oeste and Alto Recharge sites have moderate quality habitat and some potential for special-status plant species. Potential for Mohave ground squirrel and desert tortoise is low, as reflected in the West Mojave Plan's preliminary designation of these areas no survey zones. Habitat value is low, however, due to the isolation of the sites in a triangle formed by the California Aqueduct, Highway 18, and the railroad. These features limit wildlife movement and Highway 18 carries significant car and truck traffic. Major roads are often sinks for animals and connectivity between the proposed recharge sites at Alto and Oeste and viable communities to the north of Highway 18 is probably minimal. The sites may support special-status plants. Although their isolation from viable wildlife habitats to the north makes these sites of low value in the long term (as reflected in the West Mojave Plan which encourages development south of Highway 18 by providing for low mitigation ratios south of the highway and high mitigation ratios north of the highway), the development of these sites for recharge would be considered significant under CEQA because (a) Joshua Tree habitat at the Alto site is protected by local ordinance and (b) the sites may support special-status plants.

Recharge basins at Antelope Wash south of the California Aqueduct would impact a generally high quality mixed juniper and Joshua Tree habitat. Although upstream portions of the wash are not high quality habitat, there is no current development between the California Aqueduct and the San Bernardino Mountains. The site is connected to habitats in the San Bernardino Mountains and therefore remains a viable part of a larger area of wildlife habitat. Removal of this habitat would be considered significant under CEQA. This impact would be avoided by relocation of the site downstream as described in Chapter 4, page 4-31.

Unnamed Wash is a relatively undisturbed habitat, portions of which are designated to remain as open space in the Rancho Las Flores development. Impacts to the Desert Wash habitat as a result of construction and maintenance of an outlet channel from the California Aqueduct, rock drop structures, a bridge crossing, and maintenance roads/trails along the wash would be considered significant under CEQA.

No wetland habitats will be affected. Movement effects will be minimal. The Proposed Project is not in conflict with existing community or regional planning.

In summary, habitats at Cedar Avenue, Oro Grande Wash, Antelope Wash (Ranchero Road), Off-channel Mojave River Recharge (east and west), and Oeste Recharge are isolated and/or highly disturbed and impacts at these sites would be less-than-significant unless special-status plant species were identified at these sites. Similarly, only impacts to the Joshua Tree habitats at Alto recharge would be considered potentially significant (because this habitat is protected by local ordinance). The site is otherwise isolated from viable wildlife habitat. Impacts to habitats at Unnamed Wash and Antelope Wash south of the California Aqueduct would be considered significant under CEQA.

5.4.7.2 Proposed Mitigation

Given the elimination of the biologically-most-sensitive potential Off-Channel Mojave River Recharge site (near Mojave Forks Dam), and the focus on full use of existing recharge and recharge associated with dual-purpose projects (flood control) in the Minimum Facilities and Small Projects Alternatives, the Proposed Project facilities represent a continuum of the least damaging practicable alternatives for a given level of recharge and extraction.

As specified in the 2004 PEIR and in Section 5.4.2.2 above, prior to site disturbance, MWA would conduct protocol surveys for potential special-status species at facility sites and would report results to the CDFG and USFWS. In the highly unlikely event that individuals of threatened or endangered species are found at sites before construction, MWA would implement standard impact avoidance and minimization measures prior to initiating construction. For Mohave ground squirrel and desert tortoise, these may include trapping and removal of the species per CDFG and USFWS procedures. If special status plants were found on site, MWA would either avoid impact to these plants or mitigate for their impacts at a ratio of 1 acres of mitigation for each acre of special-status plant habitat identified. Mitigation may be accomplished by purchase of lands with appropriate plant species or by transfer of funds to CDFG for use in their acquisition programs. In either case, MWA would provide for management via a one-time management endowment. The Proposed Project involves sites under the jurisdiction of the Corps of Engineers, and impact minimization and mitigation could be addressed administratively through the resulting Section 7 consultation if federally-listed species are documented on the sites.

Unless special-status plants are identified at the sites, no mitigation is proposed for facility development at:

- Oro Grande Wash
- Cedar Avenue Detention Basin

- Off-Channel Mojave River Recharge
- Antelope Wash (Ranchero Road)
- Oeste Recharge

At the Alto Recharge sites, MWA would mitigate for loss of about 15 acres of Joshua Tree habitat and any special-status plant habitat identified during focused pre-construction surveys at a ratio of 1:1.

Impacts to Desert Wash habitat in Unnamed Wash would be mitigated consistent with the terms of the pending Rancho Las Flores Habitat Conservation Plan or at a 1:1 ratio if this plan has not been approved by the time construction is initiated.

Impacts to locally-protected Joshua Tree habitat at the Antelope Wash south of the California Aqueduct may be mitigated at a 1:1 ratio. As noted in discussion of project aesthetic impacts, prior to approval of the 100-acre-Antelope Wash recharge basin south of Hesperia Airport, MWA may also consider realignment of this basin to a site further downstream where existing conditions may be more heavily disturbed. This alternative recharge site, described in Chapter 4, would substantially reduce impacts and would not require 1:1 mitigation for impacts to Joshua Tree habitats.

In addition to habitat mitigation, MWA would adopt reasonable measures to avoid and minimize effects to special-status species, including those incorporated into the Proposed Project description and outlined in Chapter 4.

In their comments on the DEIR, California Department of Fish and Game noted that there was no explicit mitigation proposed for potential project impacts to burrowing owls and recommended a mitigation protocol for unavoidable impacts to this species (see Appendix A for the specific protocol recommended).

MWA is aware of the protection for burrowing owls as provided in Fish and Game Code section 3503.5. ("It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto.")

MWA will conduct pre-construction surveys for burrowing owls to determine if there are occupied habitats for the species. If burrowing owls are found in the potential area of effect, MWA would consult with Ms. Rebecca Jones, CDFG Environmental Scientist (as directed by CDFG in their comments). In consultation with Ms. Jones, MWA may then choose to take action to avoid impacts to burrowing owls (such as constructing outside of the nesting season and/or establishing a buffer zone between construction activity and any active nest). Recharge basins have not proved incompatible with burrowing owls (there is occupied burrowing owl habitat adjacent to recharge areas at Kern Water Bank, for example). If, in consultation with Ms. Jones, MWA finds that the impacts of its facilities would be inconsistent with the protections provided under Fish and Game Code Section 3503.5, MWA would consider feasible avoidance, minimization, and mitigation, including the recommended protocol described in Appendix A, and would implement the appropriate actions.

5.4.7.3 Significance after Mitigation

Given the low probability of any impact to threatened or endangered species associated with the Proposed Project sites and the habitat mitigation proposed, the proposed mitigation would reduce the direct biological resources impacts of all facilities to a level of less-than-significant.

5.4.8 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site some of them because of development that would constrain siting options for MWA.

Under the No Project Alternative, the facilities of the Minimum Facilities Alternative and the Small Project Alternative would likely be constructed and operated as described in the Project EIR. The potential delay in implementation would, however, result in a smaller potential for take of threatened and endangered species because these species populations would have been reduced within this portion of their range due to on-going urban development south of Highway 18. For the three facilities which might have to be re-sited due to delay in implementation (Off-channel recharge, Alto recharge, and Oeste Recharge) re-siting would potentially involve movement of the Alto and Oeste facilities further north of the California Aqueduct. This would marginally increase the potential for impacts to Mohave ground squirrel and desert tortoise. Potential re-siting of Off-Channel Mojave River Recharge would most likely reflect development pressure from the north, and thus involve re-siting of the facility to the south, where potential project impacts on riparian habitat, arroyo toad, and on wildlife movement would be greater.

5.5 Cultural Resources

5.5.1 Environmental Setting

During the late Pleistocene, the deserts contained woodlands; basins were joined by rivers; and herds of horses, camels, and mammoths roamed the fertile basins. As the glaciers retreated between 12,100 B.P. and 10,100 B.P., both vegetation and animals began to move to higher elevations. Due to fluctuations in the lake levels in the southern portions of the Mojave Desert, the floral and faunal composition of the Project area did not become established until after 4300 B.P., during the late Holocene. Based on research from pollen records and pack rat middens, it is believed that the low-elevation woodlands of the Mojave Desert were replaced by desert vegetation between 12,000 and 8,000 years ago (AEW 2005, citing Earle et al. 1997; Mehringer 1967; Van Devender and Spaulding 1979).

Vegetation in the Project area is currently composed of Mojave Desert scrub from the saltbush scrub (halophytic and arid phases), creosote bush scrub, Joshua tree and juniper woodland, and wash wetland or mesquite communities (AEW 2005, citing Earle et al. 1997; Sawyer 1994; Vasek and Barbour 1977). Numerous plant species in these communities were utilized as foods and medicines, or provided materials for making bows, arrows, baskets, cordage, digging sticks, houses, or fuel for Native American groups. The Project area also provides habitat for a variety of animals, including birds, insects, reptiles, rodents, pronghorn and bighorn sheep, coyote, and fox, which may have been hunted by Native American groups as well (AEW 2005, citing Earle et al. 1997).

5.5.1.1 Prehistoric Setting

The prehistoric cultural chronology for the general Project area has been divided into seven cultural periods: Fluted Point Period, Lake Mojave Period, Pinto Period, Gypsum Period, Saratoga Springs Period, Late Period, and Contact/Ethnographic Period. For purposes of evaluating the cultural resources identified during the archaeological survey of the Project area, only the Gypsum Period, Saratoga Springs Period, Late Period, and Contact/Ethnographic Period are reviewed below.

<u>Gypsum Period (4000–1500 B.P.):</u> Several Gypsum Period sites have been identified in the general Project area. This period is characterized by a trend toward increasingly effective moisture, which began in the late middle Holocene and culminated in a pronounced pluvial episode between ca. 3700 and 3500 B.P. At that time, a number of basins in the Mojave and Owens river drainages supported perennial lakes (AEW 2005, citing Enzel et al. 1992). In general, the projectile points of this cultural period are fairly large (dart point size), but also include more refined notched (Elko), concave base (Humboldt), and small stemmed (Gypsum) forms. In addition to diagnostic projectile points, Gypsum Period sites include leaf-shaped points, rectangular-based knives, flake scrapers, T-shaped drills, and occasionally, large scraper planes, choppers, and hammerstones (AEW 2005, citing Warren 1984:416). Manos and milling stones are common; the mortar and pestle also were introduced during this period. Other artifacts include shaft smoothers, incised slate and sandstone tablets and pendants, bone awls, *Olivella* shell beads, and *Haliotis* beads and ornaments. A wide range of perishable items dating to this period was recovered from Newberry Cave, located along the Mojave River near the southern end of the Troy Lake Basin, including atlatl hooks, dart shafts and foreshafts, sandals and S-twist cordage, tortoise-shell bowls, and split-twig animal figurines. The presence of both *Haliotis* and *Olivella* shell beads and ornaments and split-twig animal figurines indicates that the California desert occupants were in contact with populations from the southern California coast, as well as the southern Great Basin (e.g., Arizona, Utah, and Nevada).

Technologically, the artifact assemblage of this period is similar to that of the preceding Pinto Period; new tools also were added either as innovations or as “borrowed” cultural items. Included are the mortar and pestle, used for processing hard seeds (e.g., mesquite pods [*Prosopis glandulosa]*) and acorns, pine nuts, yuccas, and agaves, as well as the bow and arrow, as evidenced by the presence of Rose Spring projectile points late in this period. Ritual activities became important, as evidenced by split-twig figurines (likely originating from northern Arizona) and petroglyphs depicting hunting scenes. Finally, increased contact with neighboring groups likely provided the desert occupants important storable foodstuffs during less productive seasons or years, in exchange for valuable lithic materials such as obsidian, chalcedonies, and cherts. The increased carrying capacity and intensification of resources suggests higher populations in the desert with a greater ability to adapt to arid conditions (AEW 2005, citing Warren 1984:420). Large villages or village complexes also appear in the archaeological record during the Gypsum Period, reflecting a transition from seasonal migration (i.e., seasonal round) to year-round sedentary occupation of the Western Mojave Desert (AEW 2005, citing Sutton 1988).

Saratoga Springs Period (1500–800 B.P.): The Saratoga Springs Period saw essentially a continuation of the Gypsum Period subsistence adaptation throughout much of the California deserts. Unlike the preceding period, however, the Saratoga Springs Period is marked by strong regional cultural developments, especially in the southern California desert regions, which were heavily influenced by the Hakataya (Patayan) culture of the lower Colorado River area (Warren 1984:421–422). Specifically, turquoise mining and long distance trade networks appear to have attracted both the Anasazi and Hakataya peoples into the California deserts from the east and southeast, respectively, as evidenced by the introduction of Buff and Brown Ware pottery and Cottonwood and Desert Side-notched projectile points. The initial date for the first Hakataya influence on the southern Mojave Desert remains unknown; however, it does appear that by about 1000 to 1100 B.P. the Mojave Sink was heavily influenced, if not occupied by, lower Colorado River peoples. Trade with the California coastal populations also appears to have been important in the Western Mojave Desert region and helped to stimulate the development of large complex villages containing deep middens and cemeteries that have been dated from 2200 to 300 B.P., as well as large quantities of shell beads and steatite items from the coast.

Brown and Buff Ware pottery, first appearing on the lower Colorado River at about 1200 B.P. started to diffuse across the California deserts by about 1100 B.P. (AEW 2005, citing Moratto 1984:425). Associated with the diffusion of this pottery were Desert Side-notched and Cottonwood Triangular projectile points dating to about 800 to 850 B.P., suggesting a continued spread of Hakataya influences. Trade along the Mojave River also expanded resulting in middlemen between coastal and Colorado River populations. The Hakataya influence in coastal and inland southern California regions appears to have diminished during the late Protohistoric Period when the extensive trade networks along the Mojave River and in Antelope Valley appear to have broken down and the large village sites were abandoned (AEW 2005, citing Warren 1984:427). Evidence presented by Jones and others (1999) points to the apparent concordance between the reduction in use of the interior desert and the Medieval Climatic Anomaly. This period, lasting from approximately 1100 to 650 B.P., was typified by increased aridity here as elsewhere in the southwest (AEW 2005, citing Stine 1994; Warren 1984:427). This dry period may have led to the withdrawal of southwestern Native populations, such as the Anasazi, from marginal desert areas. Warren (cited in AEW 2005) also suggests that the apparent disruption in trade networks may have been caused by the movement of Chemehuevi populations southward across the trade routes during late Protohistoric times.

<u>Late Period (800–300 B.P.):</u> The Late Period reflects an adaptive modification of the cultural developments that were established during the Saratoga Springs Period. With the waning of the Medieval Climatic Anomaly, desert settlement is believed to have expanded. Bettinger and Baumhoff (cityed in AEW 2005) propose an expansion of Numic-speakers around 800 B.P., possibly precipitated by this climatic crisis, while Moratto (cited in AEW 2005) has suggested an earlier beginning date for this expansion (1000–900 B.P.), perhaps associated with prolonged drought. However, it is not currently known what effect Numic expansion had on the immediate Project area as Numic-speakers appear to have moved into the area during an earlier period.

Socioeconomic and sociopolitical organization continued to increase in complexity during this period, and by this time the "desert village" model of settlement appears to have become generalized in at least some areas of the western Mojave Desert. This model is based on population-driven sedentism and geographical limitation of gathering and hunting territories as accompanied by ever more intensive exploitation of a larger array of less attractive and less cost-efficient food resources (AEW 2005, citing Earle et al. 1997).

With the return of wetter conditions around 500 B.P., there is some evidence of population increase in southern California and archaeological evidence indicates that the Late Period populations utilized a greater variety of subsistence resources. This included the exploitation of both small and large mammals, and in some areas, fish. The continuation of milling technologies reflect a persistence of seed collecting, and the frequency of special purpose sites increases proportionally with a growing awareness of resource availability and potential (AEW 2005, citing McIntyre 1990).

<u>Contact/Ethnographic Period (300 B.P.–present)</u>: At the time of the first historic contact the western Mojave Desert was occupied primarily by the Serrano, a Shoshonean ethnographic group whose language is classified in the Takic subfamily of the Uto-Aztecan linguistic family (AEW 2005, citing Moratto 1984:534). This group developed socioeconomic and sociopolitical systems that set them apart from other Uto-Aztecan groups in the Mojave Desert and linked them to coastal Takic-speaking groups, the Gabrielino and Luiseño (AEW 2005, citing Warren 1984:344). In the southern Mojave, sites are characterized by Desert Side-notched and Cottonwood triangular points and lower Colorado Buff and Tizon Brown ceramic wares.

The Serrano were hunters and gatherers who utilized both large and small game, as well as numerous plant resources. Large game such as deer, mountain sheep, and pronghorn were hunted with bow and arrows, and smaller animals such as rabbits and various rodents were taken with throwing sticks, nets, and arrows. Acorns, pinyon nuts, and mesquite beans were among the staple foods supplemented by seeds from plants such as chia and ricegrass, and roots and tubers, and greens (AEW 2005, citing Bean and Smith 1978).

The Serrano and neighboring language groups were socially organized on the basis of independent but interacting village communities. Each of these villages consisted of one or more patrilineal clans that belonged to one of two exogamous moieties and maintained complex ceremonial relationships with neighboring communities (AEW 2005, citing Gifford 1918; Strong 1929). The Serrano clan that occupied the Mojave Forks region was known as the *Kaiwiem*, and was affiliated with the coyote moiety. Within the larger Kaiwiem territory there were several subregions, one of which encompassed the Mojave Forks area and were known as *Wa'peat*, which took its name from the Serrano word for juniper, which is the dominant species in the region from Summit Valley to Hesperia. The main village of *Wa'peat* was called *Guapiabit* by the early Spanish explorers; this village was located at the west end of Summit Valley at the Las Flores Ranch. *Guapiabit* was visited in 1776 by Spanish missionary Francisco Garces, in 1806 by Father Jose Maria Zalvidea, and in 1819 by the Lieutenant Gabriel Moraga expedition at which time it appeared that the village had been abandoned (AEW 2005, citing Altschul et al. 1989:16–18).

The actual Mojave River Forks area, and quite possibly CA-RIV-176, or the Deep Creek Site identified in the Mojave River Dam Area parcels, was called *Maka'taveat* by the Serrano, which was a landmark on the Mojave Trail at its junction with a trail from the Mojave River up to Bear Valley. The next major village to the north was *Atongaibit*, or the Hendrick Ranch Site (CA-SBR-48), located about 3 kilometers north of the Deep Creek Site. It has also been postulated that the village of *Atongaibit* may have included all the archaeological sites along the Mojave River between the Deep Creek Site on the south and the Hendrick Ranch Site on the north. Many Serrano villages were dispersed linearly along rivers and were composed of small isolated pockets of habitation, and as these were occupied seasonally during the winter months, the exact location of residential structures could change yearly with archaeological deposits accumulating over a large area with only a small portion ever occupied at one time (AEW 2005, citing Altschul et al. 1989:18).

5.5.1.2 Historical Setting

For the most part, the western Mojave Desert has a somewhat abbreviated history as it was a frontier to be crossed rather than settled. As discussed above, the earliest non-Native people to enter the general Project region were the Spanish explorers. In 1776, Francisco Garces, a priest associated with a Spanish mission in Tucson, traveled with several Indian guides along the Old Mojave Indian Trail and approached the Mojave River area in the vicinity of present-day Hesperia in March of that year. During subsequent years, several other Spanish explorers traversed the Project area.

In 1821, Mexico declared its independence, and as the colonial administration disintegrated, American explorers and entrepreneurs began exploring the California desert, the first of which was Jedediah Strong Smith, who first crossed the Colorado River into California in 1826. Like Garces, Smith and his group of approximately 30 trappers were led by several Indian guides along the Old Mojave Indian Trail, over the Cajon Pass, to the Mission San Gabriel. As early as 1828, Indian horse thieves, including some from the Mojaves, the Chemehueves, and the Utes, as well as white men and runaway mission Indians, began raiding the large coastal missions and Mexican ranchos stealing hundreds of fine horses. Summit Valley, just east of the Cajon Pass, likely became a rendezvous point for the horse thieves prior to crossing the Mojave Desert

(AEW 2005, citing de Barros 1990:2-51)). The largest and best organized of these raiding parties was led by the legendary *Walkara*, a Ute Indian known as the "Hawk of the Mountains," and Thomas "Peg-leg" Smith; over a 20-year period it is reported that they had gathered more than 5,000 prized horses from the greater San Bernardino Valley and ran them across the Cajon Pass, following the Mojave River and the Old Mojave Indian Trail to the Colorado River and points to the east and south (http://www.wemweb.com/traveler/towns/16victor/16vhist/history.html).

Few changes occurred in Alta California until the Missions were fully secularized in 1836. By the 1830s, trappers and traders with commercial interests were traveling regularly from Santa Fe, New Mexico, to Los Angeles, following the Old Mojave Indian Trail. For several years, the "fork on the road" at the Mojave River lower narrows led eastward to Santa Fe; this was known as the "Spanish Trail." After the Mormons colonized Utah, Salt Lake City gradually supplanted Santa Fe as a destination of commerce, and this route became known as the Salt Lake-Santa Fe Trail (AEW 2005, citing Sturm 1993:16).

After gold was discovered on the western slope of the Sierra Nevada Mountains in 1849, many immigrants followed the Spanish Trail in search of riches in California. California became a state of the United States in 1850. The San Bernardino Baseline and Meridian was established in 1853 and mapping of the desert lands began in earnest, followed by settlers seeking land to homestead (AEW 2005, citing Sturm 1993:17). Also in the early 1850s, a graded road had been built up the southern face of the San Bernardino Mountains, making it possible to freight wagon loads of supplies and lumber to and from the sawmills in the mountains that provided lumber for residences and commercial businesses in the San Bernardino Valley.

By the 1860s, there were numerous mining claims along the San Bernardino Mountain periphery, including a gold claim at Big Bear Lake, staked by William Holcomb of San Bernardino. The boom that followed saw the creation of the town of Belleview in the mountains and the building of additional roads from the Victor Valley side of the Cajon Pass to points southward (http://www.wemweb.com/traveler/towns/16victor/16vhist/history.html). The 1870s and 1880s witnessed expanded mining in the desert region as well. The Oro Grande Mining District, which included Hesperia, Victor, and Oro Grande, was a rich region for minerals, including gold, silver, gem stones, marble, and limestone (AEW 2005, citing Sturm 1993:17). Miners needed supplies, which increased demand for roads and services. In 1854, a wagon road was built from San Bernardino to Salt Lake; however, the road was poorly constructed, particularly over the Cajon Pass. In 1861, an early settler named John Brown, a San Bernardino pioneer, and two associates built a toll road, known as Browns Toll Road, across the west Cajon Pass, which shortened the trip and eliminated some of the steeper segments of the climb (AEW 2005 citing de Barros 1990:2-52). Later in 1883 the California Southern Railroad, later known as the Atchison Topeka & Santa Fe Railroad (AT&SF), was built over the Cajon Pass; the railroad reached the Atlantic & Pacific Railroad (later known as the Union Pacific Railroad) junction in Barstow/Dagget in 1885. In 1923, the former Browns Toll Road became paved for the first time, and in 1933 the Brown Toll Road became part of the state highway system.

Although ranching began as early as 1863 at Rancho Las Flores in Summit Valley of the Cajon Pass, historical settlement of the western Mojave was initially based on mining. However, in the later part of the nineteenth century, Victor Valley was slowly being settled by ranchers and farmers, and the railroad companies began to engage in the real estate business, with the Southern Pacific Railroad promoting the township of Hesperia. Following in the tracks of the railroads, land developers such as Appleton Land & Water Company and Ursela M. Poates promoted real estate in the 1890s and 1900s due to the area's agricultural potential for orchards of apples, pears, and grapes (www.wemweb.com/traveler/towns/16victor/16vhist/history.html). In 1915, the state legislature and the federal government authorized the Victor Valley Water Project, largest of its era in the nation, and the AT&SF Railroad began to lay double trackage to serve the anticipated needs of the growing Victor Valley. In 1916, the Arrowhead Reservoir & Power Company was formed; however, by 1917, many of Victor Valley's homesteaders, ranchers, dam builders, and cow-hands left the Valley for World War I. It was not until after World War II that the Victor Valley witnessed another expansion of settlement.

5.5.2 Facilities Impacts

Prior to archaeological surveys of the seven accessible Proposed Project locations, a literature and records search was conducted by personnel from the San Bernardino County Archaeological Information Center, housed at the San Bernardino County Museum in Redlands, in May 2005. Results of this search are described below by the proposed Project locations.

Intensive archaeological surveys of the seven proposed Project locations were performed by four Applied Earth Works archaeologists from May 10 to May 23, 2005. Survey transect spacing ranged from 10 to 15 meters. All landforms likely to contain or exhibit prehistoric or historically sensitive cultural resources were inspected carefully to insure that all visible, potentially significant or important cultural resources were discovered and documented. Additionally, surveyors also investigated any unusual landforms, contours, soil changes, distinctive vegetation patterns, features (e.g., road cuts, ditches, stream cuts), and other potential cultural site markers. Surveyors were particularly attentive when transecting through Project areas where previously recorded cultural resources had been identified as being located on, or directly adjacent to, the proposed parcels of interest. All potentially significant cultural resources identified were documented on State of California Department of Parks Recreation Primary Record Forms (DPR 523). Site locations were plotted on the appropriate 1:24,000 scale USGS topographic map using GPS, as well as the Project's aerial maps.

Surveys were not conducted along potential pipeline alignments, because pipelines would be constructed within existing public rights-of-way and these rights of way were either disturbed or paved. Surveys of well sites in urban areas were not conducted for the same reason. No evaluation was made of the Mainstem Mojave River because (a) the river is subject to infrequent but significant scouring flows, sediment transport, and subsequent sediment deposition and (b) grading activity to push up low sand berms in the channel would not extend below the level of recent scour/deposition and thus no significant cultural resources would be encountered.

Results of cultural resource surveys have been transmitted to the Native American Heritage Commission which has also been contacted regarding siting of sacred sites. The Commission responded on September 9, 2005 noting that there are no known sacred sites in the immediate project area and enclosing a list of appropriate Native American individuals/organizations who may have knowledge of cultural resources in the project area.

5.5.2.1 Mechanisms for Effect

To the extent that construction activities involve sub-surface excavations, project construction activities would have potential to disturb buried prehistoric and historic cultural resources.

5.5.2.2 Survey Results

The results of cultural resources literature search and field surveys are shown on Table 5-15. In addition to survey of the sites shown on Table 5-15, surveys were conducted at a site immediately downstream and to the east of Mojave Forks Dam. The literature search for this area revealed a listed prehistoric site covering a large portion of the potential recharge basin area. For this and other reasons, recharge in the immediate vicinity of Mojave Forks Dam will not be pursued.

In addition to the literature survey and field surveys performed for this project, extensive investigations of cultural resources have been undertaken as part of the proposed Rancho Las Flores development, which would eventually extend into the Unnamed Wash which is a feature of the Minimum Facilities Alternative. These investigations (Rancho Las Flores 2004) identified a number of historic and pre-historic sites along the West Fork of the Mojave River and several sites in the Mesas surrounding this river valley. A majority of known resources have been found along the West Fork of the Mojave River and at its confluence with Deep Creek. These are all south of the proposed sites along the Mojave River. No sites were identified in the vicinity of Unnamed Wash.

Table 5-15. Results of literature search and cultural resources survey. NA = Not applicable because site was paved or highly disturbed.

SITE	SURVEY RESULTS AND EVALUATION		
	Literature Search	**Field Survey**	**Potential for Buried Cultural Resources**
Minimum Facilities Alternative			
Instream Mojave River Recharge	NA: Active riverbed	NA: Active riverbed	None
Mojave River Well Field and Pipeline	NA: Urban, paved or highly disturbed	NA: Urban, paved or highly disturbed	Moderate to High
SWP Delivery via Unnamed Wash (Canal)	No prior surveys	Surveyed for Rancho Las Flores project.	Moderate
Small Projects Alternative			
Off-Channel Mojave River Recharge: East Site	No records of significant sites	Remnants of historic farmhouse located 2300 feet east of Mojave River channel.	Moderate
Off-Channel Mojave River Recharge: West Site	No records of significant sites	No surface resources found. Land disturbed by agriculture and other activities	Moderate
Off-Channel Mojave River Recharge Pipeline	No records of significant resources	NA: To be constructed in paved or unpaved public rights of way, which are highly disturbed.	Moderate
Oro Grande Wash and Pipeline (both sites)	No records of significant resources	No cultural resources identified.	Low, disturbed
Cedar Ave. Detention Basin and Pipelines	Two historic refuse scatters	No cultural resources identified	Low
Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines	No prior surveys	No cultural resources identified	Low
Large Projects Alternative			
Oeste Recharge, Wells, and Pipelines	No prior survey	No cultural resources identified	Low
Alto Recharge, Wells, and Pipelines	Historic unpaved road	No present evidence of historic roads, no other resources identified	Low
Antelope Wash Recharge	No prior surveys	No present evidence of cultural resources	Low

5.5.2.3 Site Sensitivity Analysis

Given the scarcity of water resources in the desert, the highest probability for buried cultural resources probably occurs adjacent to springs and drainages, particularly the Mainstem Mojave River, which would serve as the logical locus for larger prehistoric and historic settlements. The Mojave River and various tributary washes themselves are unlikely to contain such resources because of periodic erosion and deposition associated with infrequent but heavy precipitation. No new facilities are proposed outside of the Oeste and Alto areas, and these areas are north of the steep San Bernardino Mountains. High energy flows from the mountains have eroded washes to a depth of 30 to 50 feet in many places. Upper portions of these washes may have slopes of 25 to 50 feet per mile. Similarly the Mainstem Mojave River consists of a broad, sandy riverbed, generally dry and devoid of vegetation. The sands that make up the riverbed are rapidly eroded and transported downstream during even moderate flows, as was evidenced by the rapid destruction of sand berms constructed for the 2003-2004 Banking Demonstration Project. Flows in excess of 500 cfs resulted in washout of the sand berms. Flood flows such as those experienced in 2005 would be expected to erode, transport, and re-distribute river bed sediments throughout the potential project reach of the river.

Although there was probably pre-historic and historic use of all of the areas where new facilities may be sited, permanent or semi-permanent prehistoric and historic sites were generally located along the rivers and washes and the highest probability of encountering buried resources at potential new facility sites is along the banks of the Mojave River, outside of the area which would be subject to highly erosive flows. Soil composition is probably a good indicator of the potential for buried resources, because unconsolidated sands in the floodplain have probably been subject to erosion and deposition, and intact buried resources are not likely to be found. Such soils are most suitable for groundwater recharge, and excavation depths of 3-5 feet will probably not extend below the zone of recent flood-related disturbance. Thus the most sensitive potential sites for buried resources are probably associated with well fields and pipelines along the Mojave River and in the upslope urbanized areas.

Cultural resource literature review identified no known cultural resource sites in the Antelope Wash area, either at the upstream or downstream site at Ranchero Road, and none would be expected in an area subject to substantial flooding and scour. The potential for buried cultural resources to be found during construction would be no higher at the downstream site than at the upstream site. There would therefore be no change in projected impacts to cultural resources associated with relocation of the upstream Antelope Wash recharge site to a downstream site. With the mitigation provided for in the draft EIR, the expansion of recharge at Ranchero Road in lieu of development of recharge at the upstream site would reduce impacts to a level of less-than-significant.

5.5.3 Operational Impacts

Following construction of new facilities, there is no mechanism by which routine operations and maintenance would affect cultural resources.

5.5.4 Mitigation and Significance of Impacts after Mitigation

Under CEQA, impacts to cultural resources would be considered significant if the Proposed Project activities:

- Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5;
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5;

- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature;
- Disturb any human remains, including those interred outside of formal cemeteries?

The 2004 Regional Water Management Plan specifies mitigation for cultural resources impacts that is consistent with the CEQA *Guidelines* for reducing such impacts to a level of less than significance:

- Implementing agencies shall avoid impacts if feasible on identified cultural resources including prehistoric and historic archeological sites, locations of importance to Native Americans, human remains, and historic buildings and structures. Methods of avoidance may include, but not be limited to, project re-route or re-design, project cancellation, or identification of protection measures such as capping or fencing.
- Implementing agencies shall retain archeological monitors during construction for ground-disturbing activities that have the potential to impact significant archeological remains as determined by a qualified archeologist.

Based on this policy and the results of literature search and field surveys, MWA would implement the monitoring provision above for all facilities located adjacent to the Mainstem Mojave River, including:

- The Mojave River Well Field
- The Well Field Delivery Pipelines
- Off-Channel Mojave River Recharge (east or west site) and the supply pipeline to this site

If the eastern site is selected for Off-Channel Mojave River Recharge, MWA would also design the recharge to avoid the recently identified historic farmhouse site and/or provide for a suitable archeological testing and recovery program consistent with State of California and Federal policy.

Because previously unrecorded and/or unanticipated archaeological deposits, features, and Native American burials may be encountered during implementation of the Project, the Project Archaeologist would prepare a *Construction Phase Monitoring and Cultural Resources Treatment Plan* prior to Project construction. The purpose of this *Plan* would be to clearly outline and expedite the process by which the Mojave Water Agency will resolve any significant impacts upon newly discovered, historically significant cultural resources, including consultation with the State Historic Preservation Officer (SHPO), thereby eliminating untimely and costly delays in construction. Specifically, the *Plan* would outline the process by which cultural resource discovery notifications are made and treatment plans are implemented, describe the cultural resource classes anticipated during Project construction, describe the treatment options for each cultural resource class, and detail procedures for implementing treatment. In addition, the *Plan* would summarize the Native American involvement in the Project (including a sample Native American Burial Agreement), outline the procedures for curation of materials recovered during site treatment (including a proposed Archaeological Curation Agreement with a facility that meets California curation standards), and address report requirements. This *Plan* would be submitted to the SHPO for review and comment prior to Project construction.

Implementation of these measures will reduce the potential for cultural resources impacts to a level of less-than-significant.

5.5.5 Summary Comparison of Alternative Impacts

As mitigated, none of the alternative facilities would affect a known prehistoric or historic cultural site. The highest probability of finding buried cultural resources is associated with (a) the Minimum Facilities Alternative well field and associated distribution pipelines and (b) the Small Projects Alternative off-stream recharge basin and associated distribution pipeline on either the east or west banks of the Mainstem Mojave River. Implementation of Cultural Resources Management elements of the Proposed Project will result in no significant impacts to such resources.

5.5.6 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The highest probabilities for finding significant buried cultural resources are associated with excavations for the Minimum Facilities Alternative and the Small Projects Alternative. The No Project Alternative would likely involve construction of these facilities over the long-term, resulting in similar levels of effects and similar levels of mitigation. The shorter pipeline from the Mojave River Well Field to local producer facilities would marginally reduce the potential for finding buried cultural sites. The No Project Alternative would probably not, therefore, result in a significant reduction in cultural resources impacts when compared to the various facilities alternatives.

5.6 Geology and Soils

5.6.1 Environmental Setting

The 2004 PEIR described 21 soil associations within MWA's service area, and provides a map of these associations. Based on this mapping, the various facilities to be utilized in the proposed water banking/exchange program are:

- **Recharge basins at Yucca Valley, Newberry Springs**: Rockland (rocky sandy alluvium)

- **Recharge basins at Daggett, Hodge, and Lenwood:** Arizo-Daggett (gravelly sand)
- **Recharge basins, wells, and pipelines in Oeste and Alto**: Greenfield-Ramona (gravelly sand and sand)
- **Mainstem Mojave River and adjacent floodplain**: Riverwash (sandy alluvium)
- **Well fields and pipelines in Hesperia, Victorville, Apple Valley, and Adelanto**: Adelanto Mojave, Mojave-Adelanto variants; Greenfield Ramona, Hanford-Greenfield, Ramona (sandy loams):

In general, these are loosely consolidated, porous soils and sites for recharge basins and well fields have been selected based on these characteristics. No surface fines or clays are found in the proposed recharge areas. There may be some lenses of clays in the areas designated for distribution pipelines. The sandy loam soil associations (Adelanto Mojave, Mojave-Adelanto variants; Greenfield Ramona, Hanford-Greenfield, Ramona soils) have potential for high erosion due to windy conditions. None of these soils are designated as expansive, although pipelines in sandy loam areas may cross intrusions of expansive soils.

As the 2004 PEIR notes, a majority of the facilities being contemplated for the Proposed Project lie in areas crossed by a series of earthquake faults which trend northwesterly direction: the Helendale Fault (northeast of Apple Valley), the Lenwood Fault (southwest of Barstow) and the Calico Fault (near Newberry Springs). South of Yucca Valley, the Morongo Valley Fault runs at a 90-degree angle to these northwesterly trending faults. The Mojave Segment of the San Andreas Fault is to the southwest of the MWA service area. MWA's service area is seismically active, with local faults capable of generating earthquakes of 4.8 to 7.6 maximum magnitude (Richter magnitude) or up to VIII on the Modified Mercalli Intensity Scale. The highest potential for seismic-related damage to structures is in the southern portion of MWA's service area, and is associated with the San Andreas Fault. All new facilities for the Proposed Project would be located in this zone.

Seismic-induced groundshaking and associated liquefaction of soils may occur in some locations where facilities may be sited, including in the City of Hesperia (areas with high groundwater), along the Mainstem Mojave River between Mojave Forks Dam and the Narrows, and at Barstow. Potential for liquefaction increases as groundwater elevations rise. Partially as a result of significant overdrafting of groundwater basins, groundwater in the Regional Aquifer is generally quite deep. Based on groundwater elevation data from California Department of Water Resources (MWA 2004b; USGS 2002), in the Oeste and Alto areas, groundwater is generally 300 ro-400 feet or more below ground surface. USGS has estimated that groundwater levels in the Alto Regional Aquifer have declined between 50 and 75 feet since mid-1940, by 100 feet in the Centro area, and almost 100 feet in the Baja area.

In the Mojave River Aquifer, groundwater levels fluctuate in response to river flow. For example, upstream of the Narrows, DWR shows groundwater levels fluctuating from about 10 to 50 feet below ground surface. Near the Narrows, groundwater is forced to the surface and well levels are at or near ground-surface elevation. To the south, near potential off-stream recharge basins on the Mainstem Mojave River, groundwater elevations range from 40 to 90 feet below ground surface. There are similar river-influenced fluctuations in groundwater levels near Lenwood, Daggett, and Newberry Springs. Well levels are generally 30 to 80 feet below ground surface near the river, while wells located away from the river in the Regional Aquifer are lower and there has been a decline over the years. The 2004 PEIR summarizes the data from regional wells and notes that areas with groundwater less than 50 feet below ground surface occur from Mojave Forks Dam downstream to about Rock Springs, in the Lenwood - Hodge reach of the river, and near Newberry Springs. Relatively high groundwater levels also occur near the existing recharge basins southwest of Yucca Valley.

5.6.2 Facilities Impacts

5.6.2.1 Mechanisms for Effect

The Proposed Project has no potential for creating landslide or affecting expansive soils. Siting of facilities precludes these effects because none of the proposed facilities is sited in a landslide area or on expansive soils, with the exception of pipelines which will be buried and will not contribute to phenomena associated with expansion and contraction of soils due to cycles of wet and dry conditions. The Proposed Project Alternative also has no significant potential to create subsidence, because (a) there will be a net increase in recharge as a result of the Proposed Project, (b) recharge will always occur prior to extraction, (c) soil conditions in the Mainstem Mojave River and Mojave River Floodplain Aquifer are not likely to result in subsidence, and (d) groundwater levels in the Regional Aquifer where soil conditions create a potential for subsidence will occur in areas where groundwater levels are at least 200-300 feet below the surface and surface subsidence associated with historic overdraft has already occurred. Recharge and conveyance of groundwater may thus affect geology in several ways:

- Recharge may raise groundwater levels to near the surface, resulting in an increased risk of liquefaction during seismic-induced ground shaking;
- Recharge and groundwater extraction may result in short term declines in water levels;
- Water stored in recharge facilities and pipelines may be released if facilities are damaged by seismic ground shaking;
- Exposed soils may erode during high winds;
- Soils may erode in Unnamed Wash until the channel reaches equilibrium; and
- Soils may erode during construction.

Liquefaction Effects: Liquefaction effects are difficult to estimate precisely because they depend on the interaction of soil type, soil age, soil saturation level, depth to groundwater, earthquake source, earthquake path, and specific site processes (Silva et al 2003). Nevertheless, basic approaches to evaluating liquefaction susceptibility are well established, and reasonable judgments about relative impacts can be made based on soils characteristics and depth of groundwater. For example, Knudsen et al (2000) evaluated liquefaction potential on a qualitative scale (Very High to Very Low) for soil types versus depth to groundwater in the San Francisco Bay area. In general, they note that potential liquefaction effects are low to very low when depth to groundwater is greater than 30 feet, and consistently very low for depths to groundwater of greater than 50 feet. Key findings related to soil/depth relationships were:

- For recent stream channel deposits, liquefaction potential isVery High at < 10 feet, High for depths of 10 to 30 feet, and Moderate for depths of 30 to 50 feet;
- For alluvial fan deposits, liquefaction potential is Moderate at < 10 feet, Moderate for depths of 10 to 30 feet, and Low for depths of 30 to 50 feet; and
- For alluvial terrace deposits, liquefaction potential is High for depths from 0 to 30 feet and Moderate to Low for depths of 30 to 50 feet.

This is consistent with findings from numerous other studies where depth to groundwater/soil relationships have been studied (for example Davral et al 2001). Based on these studies, it is reasonable to conclude that liquefaction potential is a concern when depth to groundwater is about 30 feet. At 50 feet, potential liquefaction effects are very low, even for unconsolidated sandy soils. The potential for liquefaction to adversely affect human safety is related to liquefaction potential and the proximity of development to areas of high groundwater.

Liquefaction is a localized phenomenon, a function of saturated soils in the immediate vicinity. Groundwater recharged mounds below the recharge zone, with maximum elevation of groundwater immediately below the recharge basin. Groundwater sinks as it spreads, and in porous soils such as those used for recharge has a relatively high rate of horizontal and vertical movement. Potential for liquefaction effects from recharge therefore decrease with distance from the recharge site and may also be affected by localized pumping, which creates a cone of depression at the well site.

<u>Short-term declines in groundwater levels during extraction:</u> The 1996 adjudication prohibits pumping of natural production out of the basin and thus the net effect of banking on the Regional and Mojave River aquifers is that there will always be more groundwater in storage than is pumped for local use or for making return deliveries to Metropolitan. The Proposed Project could result in recharge of one portion of the aquifers and pumping from another portion. In the short term, this has potential to lower local well levels.

<u>Impacts related to damage to facilities:</u> Recharge in the Mainstem Mojave River will have no potential for impact associated with failure as a result of seismic shaking because the riverbed is the low point of the basin and any water contained in the temporary sand berms of the riverbed will simply run downstream.

At other existing and new recharge basins, basin size is small and/or facilities are relatively isolated from adjacent development. Recharge basins also consist of a series of small cells (to minimize wave action due to wind) and damage. In addition, recharge basins are constructed by removing about 1.5 feet of soil to use in levee construction. A recharge basin 5 feet deep thus generally has levees extending only 3.5 feet above ground level. Finally, in the event of a levee failure, it is not likely that there would be a catastrophic failure of the entire levee. Rather a break in the levee would occur, adjacent soil would fall into the break, and the break would expand; as the basin drained, the rate of drainage would decline. Failure of internal cells would have similar effects.

Release from a damaged 20-acre recharge basin, filled to a depth of 3.5 feet (1.5 feet below pre-construction grade, would be about 40 acre-feet. For recharge basins in local washes, a release would be accommodated by the wash itself, and no damage to adjacent properties would occur. Given that recharge basins other than those in washes are sited on relatively flat ground, the effect of such a release would be to create sheet flow no deeper than about 2 feet immediately next to the levee, with depths declining rapidly as the water spread out along streets. Velocities would be low.

Water release associated with damage from pipelines is limited by automatic shut off valve installed to limit releases during seismic events. These valves shut down flow from the source and result in isolation of various segments of pipelines. Leakage is thus minimal, even if a segment of pipeline fails; a 1-mile segment of 54" pipeline contains approximately 2 acre feet of water, and even a catastrophic failure would result in release of only a portion of this supply. There would be localized erosion and flooding associated with such releases. The effect of the banking project on existing pipelines is to extend the period of their use and increase the potential for the pipeline to be in use during a seismic event.

Soil erosion from high winds: Soil erosion is a potential problem, but experience in Kern County during periods of high wind and dust storms suggests that recharge basins and irrigation canals collect, rather than distribute sediments. At Arvin-Edison Water Storage District, high winds often trap wind-borne sediment, filling recharge basins and requiring periodic cleanout. The effect of recharge basins on wind-driven erosion may therefore be to ameliorate problems associated with wind-driven dust. In addition, none of the existing or proposed facilities is located on a soil series likely to be subject to high erosion from winds.

Erosion during construction: Wind and precipitation may cause soil erosion during construction. Erosion from winds is an Air Quality concern and is addressed in the discussion of Air Quality impacts. Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.2.2 Potential Effects: Minimum Facilities Alternative

Liquefaction: The Minimum facilities Alternative could involve annual recharge of about 48,000 acre-feet with on-going extraction at the Mojave River Well Field of about 44,000 acre feet in the Mojave River Aquifer between Mojave Forks Dam and the Narrows. Project feasibility-level technical analyses (Bookman-Edmonston 2004a) indicate that about 61,000 acre-feet of storage could be accommodated without raising groundwater levels at mid-channel to 20 feet below surface elevation, an elevation limitation incorporated into the project to avoid increasing liquefaction risk. Once the initial fill is provided, groundwater levels in this reach of the Mainstem Mojave River would then be managed by matching annual input of groundwater in the southern portion of the reach to groundwater extraction and use in the northern portions of the reach. This is an essential feature of the banking and exchange program and will contribute to stabilization of groundwater adjacent to the Mainstem Mojave River at levels below those likely to cause liquefaction. The analysis leading to this conclusion is described below.

In 2001 the US Geological Survey (USGS 2001) modeled changes in groundwater levels throughout the Mojave River Basin based on recharge of 1,300,000 acre-feet of SWP supply over a 20-year period. Their modeling suggests that without recharge, groundwater levels would continue to decline in virtually all areas. With this magnitude of recharge, groundwater levels would rise in the vicinity of (hypothetical) recharge sites in the Oeste, Alto, Centro, and Baja subareas, rising as much as 50-200 feet in the active recharge area and to a lesser but still substantial extent as much as 10 miles away from recharge sites. The magnitude of net recharge used in their model (1.3 million acre-feet) greatly exceeds the magnitude of the Proposed Project, but the general trend towards mounding of water below recharge sites and a slow horizontal migration of this water would be expected regardless of the magnitude of the project. The USGS analysis confirms that groundwater levels will rise in the vicinity of recharge basins.

Existing depth to groundwater is greater than about 300 feet throughout the Regional Aquifer areas that would be affected by the Minimum Facilities Alternative. Because groundwater recharge will be distributed throughout the MWA service area, the magnitude of recharge at any site will be minimized and it is not likely that groundwater levels will rise above 50 feet below ground surface at any Regional Aquifer site. Groundwater levels at recharge basins in Hodge, Lenwood, and Daggett are adjacent to the Mojave River and depth to groundwater varies from about 30 to 80 feet. There is a potential for increased groundwater recharge associated with banking to raise water levels and increase the potential for liquefaction, but predicted seismic shaking in this area is low (0.2-0.3g) and the area adjacent to the recharge basins is sparsely populated and agricultural. At Newberry Springs, groundwater levels have been declining and recharge would not likely raise groundwater levels to within 50 feet of the ground surface. At Yucca Valley, increased recharge may raise groundwater levels to less than 50 feet, and the area is predicted to experience 0.5 to 0.6g shaking, but the area is sparsely developed and the risk of adverse effect is low. At all of these sites, Bookman-Edmonston (2004a) projected a substantial capacity for recharge, well in excess of that contemplated in the Proposed Project, with maximum groundwater depth of 20 feet or more at the recharge site. Groundwater levels adjacent to the site would be lower. The proposed project is therefore not likely to substantially increase liquefaction potential at these sites.

Bookman-Edmonston (2004a) modeled potential groundwater levels in the Mainstem Mojave River at approximately Rock Springs in response to a 5-year hypothetical input of about 156,000 acre-feet per year with subsequent pumping at a rate of 134,740 acre-feet per year. This analysis suggests that groundwater levels would rise by about 40 feet at this site over a 5-year recharge/pumping program.

Based on these and other considerations, Bookman-Edmonston (2004b) concluded that the Mojave River Mainstem could store a maximum of 61,000 acre-feet, assuming a dry zone of 20 feet within the upper portion of the aquifer in mid-channel, to reduce the risk of liquefaction and water use by phreatophytes. Groundwater would mound under the active recharge area, with groundwater levels declining as water spread towards the river's banks. At river edge, then, groundwater levels would be lower than at mid-channel. On the west, development in the area begins on land about 20 feet above the mid-river channel itself. In the middle of the proposed well field, for example, the river channel elevation is about 2880 and all adjacent development is above elevation 2900. Thus, on the west of the channel, virtually all development would occur in areas where groundwater levels would be at least 40 feet or more below the surface. Groundwater levels along the slope leading down to the river would be deeper. On the east banks of the river, the floodplain is flatter, but is raised by about 10 to 15 feet above the river channel. In this area, maintaining water levels about 20 feet below the mid-channel surface would mean that groundwater below developed areas would be at or below 30 to 40.

Under the Proposed project, recharge would probably not result in storage of 61,000 acre-feet, but would involve on-going recharge and extraction at a marginally lower level. The potential effects of recharge-extraction on groundwater levels can be illustrated with a typical operation scenario, based on Metropolitan and MWA efforts to optimize recharge during periods when water quality is highest. If deliveries are assumed to be up to 48,800 acre-feet within a 4 month period (March through June; a delivery rate of about 153 cfs or about 30% of the proposed maximum delivery rate) and extraction rates are assumed to be constant at a rate of 3700 acre feet per month, then monthly increase in storage during deliveries would be:

Delivery:	12,200 acre-feet
Extraction	-3,700
Net:	8,500

Over a typical 4-month delivery period, storage in the Floodplain Aquifer would rise by 34,000 acre-feet, or 27,000 acre-feet less than the storage level at which groundwater levels would be 20 feet below the mid-channel surface. The Mojave River Well Field would create cones of depression at the junction of the Floodplain Aquifer and the Regional Aquifer from Rock Springs Road to Bear Valley Road and it is assumed that the well field would extract 85 to 90% of recharge, with the remaining water welling up as it approached the Narrows and becoming surface flow. Given an estimate that storage of 61,000 acre-feet would raise groundwater levels to within 20 feet of the riverbed, the lower net increase in storage occurring within the 4 months of the recharge-extraction cycle would result in lower groundwater levels than predicted for a 61,000 acre-foot level of storage. Under the probable project operations scenario, storage except losses to the Narrows would be extracted by the well field within the 4-mile reach south of Bear Valley Road. If wells are sited on either side of the river and about 1250 feet from the river channel at this reach, then the area affected by mounding of recharged water is about 3500 feet wide or about a total of 1700 acres, representing capacity of about 27,000 acre-feet. Assuming even distribution of the unused capacity, the probable groundwater depths would be about 45 feet below ground surface at the channel edge and to 55 to 65 feet below the nearest adjacent development. Following the initial 4-month pulse of recharge, water levels would continue to decline as a result of on-going extraction, not rising again until there was natural flow or a new recharge pulse. In short, because the Proposed Project would maintain mid-channel groundwater levels at or below 20 feet, and proposed coordinated operation of recharge and extraction from the river is likely, liquefaction effects associated with recharge of the Mainstem Mojave River are unlikely.

Based on these considerations, the potential for the Minimum Facilities Alternative to increase the risk of adverse effects related to liquefaction is:

- Yucca Valley: Very Low (minimal increase in groundwater level, low risk of damage);
- Newberry Springs: Very Low (low starting groundwater levels, little potential to raise levels to above 50 feet;
- Lenwood, Hodge, and Daggett: Very Low (moderate potential to raise groundwater levels to above 50 feet, but there is minimal development adjacent to recharge and groundwater levels will decline outside of the recharge basin);
- Mojave River Mainstem: Very Low (potential to raise groundwater levels to within 40 to 50 feet from ground surface in the floodplain aquifer immediately adjacent to the river).

<u>Short-term declines in groundwater levels during extraction:</u> For the Minimum Facilities Alternative, groundwater extraction will be balanced . No adverse impact is anticipated.

<u>Impacts related to damage to facilities:</u> For the Minimum Facilities Alternative, new facilities at Newberry Springs will be in an agricultural matrix and a low seismic hazard area, with only a few residences within 0.25 miles of the facility. Levee failure is unlikely and water leaking from a failed levee would be carried away from the site on local roads and spread rapidly across the flat plain, and percolate into the ground. Potential for adverse impact is low.

<u>Soil erosion from high winds:</u> As noted above, recharge basins have been found to trap blowing sediments. No impact from soil erosion is anticipated.

<u>Soil erosion in Unnamed Wash</u>. Although the Proposed Project in Unnamed Wash would include construction of several drop structures to reduce potential erosion in areas where such erosion may be high, it is probable that routine flow of up to 500 cfs will result in an incised channel in this wash. There would be short term sediment mobilization as this channel formed and this sediment would recruit to the Mainstem Mojave River. Erosion control with drop structures would limit sediment recruitment by limiting flow velocities in steep sections of the wash. It is not possible to precisely estimate the channel configuration, but the existing wash is subject to periodic high flows and flows following the natural contour of the wash. Exposed soils would be a mix of sands, gravels, and cobbles typical of soils in desert wash environments. Mobilization of fines would be minimal.

<u>Erosion during construction:</u> Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.2.3 Small Projects Alternative

Liquefaction: The Small Projects Alternative adds off-stream recharge capacity along the Mojave River and at three sites in the Regional Aquifer. Off-Channel Mojave River Recharge may contribute to groundwater flow in the Mojave River Floodplain Aquifer, but total recharge of this aquifer will be managed to control groundwater levels. Use of this recharge basin would not, therefore, affect the proposed management of groundwater levels in the Mainstem Mojave River. Recharge sites in the Regional Aquifer will contribute to raising groundwater levels, but groundwater will remain substantially below 100-400 feet. No liquefaction effects are anticipated.

Short-term declines in groundwater levels during extraction:

The recharge of the Regional Aquifer in the Hesperia Area may allow for some direct return of water from existing City of Hesperia wells, in lieu of supply from wells along the California Aqueduct. To the extent that this is feasible, the Small Projects Alternative would reduce potential for localized declines in well levels.

Impacts related to damage to facilities:

Damage to all of the recharge facilities proposed for the Small Projects Alternative except the facility at Cedar Avenue would result in discharge to an existing wash or directly into the Mojave River. Drainage from potential recharge would therefore be contained in existing watercourses. At Cedar Avenue, the recharge basin would be designed primarily for flood control purposes and only incidentally for recharge. This facility would be designed to withstand anticipated seismic forces during a flood condition. Failure during recharge, when only a fraction of its capacity may be in use, is therefore highly unlikely. No adverse impact is anticipated.

Soil erosion from high winds: As noted above, recharge basins have been found to trap blowing sediments. No impact from soil erosion is anticipated.

Erosion during construction: Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.2.4 Large Projects Alternative

Liquefaction: The Large Projects Alternative would add up to 580 acres of Regional Aquifer recharge capacity to the Proposed Project, in areas with existing groundwater levels 400 to 600 feet below ground surface. Recharge is not expected to increase groundwater levels to a point at which liquefaction becomes an issue. No impacts are anticipated. The use of the unnamed wash to deliver water to the Mojave River would not affect the basic water in/water out balance described for the Minimum Facilities Alternative and thus the Large Projects Alternative would not change potential for liquefaction on the Mainstem Mojave River.

Short-term declines in groundwater levels during extraction: The Large Projects Alternative would substantially increase storage and extraction capacity in the vicinity of the California Aqueduct. Direct pump back from these facilities would occur after recharge, with wells sited downslope from the recharge sites to intercept the mound of water moving towards them. Some short-term reductions in groundwater levels may occur where the wells intercept groundwater, but these levels would recover as the mounded groundwater migrated into the resulting cones of depression. No impacts are anticipated.

Impacts related to damage to facilities: Large Project Facilities north of the California Aqueduct would be sited in areas with sparse development. Given their potential size and capacity, failure of the levees during a seismic event, while not anticipated, would result in some erosive flow in the immediate vicinity of the levee break and sheet flow across the broad, flat valley. Water escaping from damaged recharge basins in the Antelope Wash would be fully contained in this broad wash and much of any release would percolate into the ground before reaching the proposed City of Hesperia flood detention basin at Ranchero Road. No impacts are anticipated.

Soil erosion from high winds: As noted above, recharge basins have been found to trap blowing sediments. No impact from soil erosion is anticipated.

Erosion during construction: Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.3 General Operational Effects

Groundwater levels at all recharge sites will initially rise as a result of the Proposed Project because MWA would return at least a portion of banked supplies via exchange and all banking deliveries will result in at least a 5% increase in net supply. Rises in groundwater levels will generally be greater as the magnitude of the project increases. In addition, if expanded facilities allow MWA to import more water from, for example, SWP Article 21 supplies, then pre-delivery of this water will raise water levels. The exception to this generality is the Instream Mojave River Recharge element of the Minimum Facilities Alternative which will have a maximum recharge and this recharge will be balanced by extractions.

It is not possible to predict the rise in groundwater because banking and exchange supplies will be variable and will be distributed to up to 13 recharge areas. MWA will generally try to match banking deliveries and pre-deliveries of its own supplies to the imported water needs of various subareas, pre-delivering water that may be utilized in lieu of SWP deliveries in dry years. Groundwater will mound beneath groundwater basins and be extracted on a routine basis by subarea producers. The effects of recharge are thus likely to be small and limited to the vicinity of the recharge site.

Although well fields will be located near recharge areas, there may be short term imbalances in recharge and extraction at specific sites. Underground movement of water, while generally understood due to the general flow from the mountains north and towards the Mojave River, may vary in rate, and thus there may be irregularities in groundwater depth across a general gradient. Groundwater levels in individual wells may vary and some local lowering of groundwater levels is possible.

No erosion is anticipated due to releases from Silverwood Lake, as the pilot project showed that flows of 500 cfs are contained within the existing channel and do not result in velocities adequate to remove in-channel vegetation. Erosion will occur in Unnamed Wash as more frequent and longer duration flows are released from the California Aqueduct. This erosion will be concentrated in the early period of operation as the streambed reaches equilibrium. Thereafter, flows of 500 cfs will be contained in the channel and there will be sediment recruitment and transport typical of a reasonable stable stream.

Potential for liquefaction is limited to the Mainstem Mojave River, where routine recharge/extraction of about 48,000/44,000 acre-feet (respectively) will mean that groundwater levels will below the 20-foot level determined by Bookman-Edmonston (2003a) to result from recharge of about 61,000 acre-feet. Increasing the magnitude of the program through exchanges or increases in other facilities will not affect this potential.

5.6.4 Mitigation and Significance of Impacts after Mitigation

5.6.4.1 Under CEQA, the Proposed Project would be considered to have significant effects related to geology and soils if activities were to:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: a) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42; b) Strong seismic ground shaking; c) Seismic-related ground failure, including liquefaction; or d) Landslides;
- Substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; or
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

As noted in the above analysis, the Proposed Project has limited mechanisms for potential to cause significant effects. Any potential Proposed Project effects are limited to (a) liquefaction, (b) short-term declines in groundwater, (c) impacts related to damage of facilities, (d) soil erosion from high winds, (e) erosion in Unnamed Wash, and erosion during construction. Mitigation for these effects and significance of effects with mitigation implemented is discussed, by mechanism for effect, below.

5.6.4.2 Liquefaction

There is a low potential for operation of the Mainstem Mojave River recharge to increase risks associated with liquefaction in the floodplain immediately adjacent to the river. To reduce this risk, MWA will monitor existing well levels and establish an additional system of shallow monitoring wells to track changes in groundwater levels as the mound of recharged water moves downstream to the extraction well field. These wells will allow real-time management of recharge rates to minimize the potential for groundwater levels under developed areas to rise to within 30 feet of the surface. Similar monitoring will occur at Lenwood and Hodge to ensure that recharge at these sites does not result in high groundwater levels. With this mitigation measure, the potential for the project to increase risks associated with liquefaction is less-than-significant.

5.6.3.3 Short-term declines in groundwater levels during extraction

Proposed Project facilities will be operated and monitored to ensure that groundwater levels are not adversely affected by the project. For the banking element of the Proposed Project, banked water will always be in excess of returns to Metropolitan. The exchange element of the Proposed Project involves exchanges of SWP supplies that are not recharged and will have no effect on groundwater levels. There may be localized effects on groundwater levels during extraction of supplies for direct return of groundwater to Metropolitan and/or as a result of local subarea producers pumping differentially from one well or another. Water mounded at recharge sites may also not move towards the intercepting well field at a uniform rate, and extractions may create localized declines in groundwater levels as a result. This may cause water levels for adjacent wells to decline. If MWA determines that its operations have adversely affected groundwater levels in an adjacent well, it will either (a) compensate the owner of the well for increased energy costs associated with pumping or (b) reduce extractions so that groundwater levels recover to baseline conditions.

5.6.4.4 Impacts related to damage to facilities

Although the potential for impacts related to damage from facility failure during a seismic event is low, there is some potential for erosive flows affecting properties immediately adjacent to MWA recharge basins. It is not feasible to predict where seismic-related damage might occur. MWA will maintain a stockpile of rock at each recharge facility where levee damage might result in minor flooding of adjacent property to ensure that any levee damage can be rapidly patched to reduce potential for erosive flows.

5.6.4.5 Soil erosion from high winds

No effects related to wind-driven soil erosion are anticipated and no mitigation is proposed.

5.6.4.6 Erosion in Unnamed Wash

Drop structures will be constructed as part of the Proposed Project to reduce excess erosion and sediment transport. Levees will be placed along the edge of the 100-year floodplain to contain releases.

5.6.4.7 Erosion during construction

To mitigate for the potential for soil erosion from construction sites, MWA has incorporated best management practices for water quality (see Section 4.5.8) into the Proposed Project. Implementation of this mitigation protocol would reduce potential for erosion associated with construction to a level of less-than-significant.

No significant impacts associated with geological conditions and geologic hazards are anticipated in Antelope Wash at either the upstream recharge site or the Ranchero Road recharge site. Normal flows would be routed through the recharge basins and would not be captured for natural recharge. Expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to geology and soils.

5.6.5 Summary Comparison of Alternative Impacts

There is potential for soil erosion from both wind and runoff of precipitation associated with all elements of construction; this potential increases with the total area affected by construction. Potential for liquefaction effects associated with rising groundwater levels is low and limited to the use of the Mainstem Mojave River; few structures are located on the alluvial soils immediately adjacent to the river channel due to flooding concerns and thus the number of structures potentially subject to liquefaction is small. There will be soil erosion and sediment recruitment to the Mainstem Mojave River associated with use of Unnamed Wash to convey SWP supplies to the river. This erosion will be a function of channel building during the initial use of the wash and should reach a dynamic equilibrium following several years of channel use. Erosion will be minimized with rock drop structures where the channel is steep. With proposed mitigations, the construction and operation of the potential facilities for the Proposed Project would not have significant effects related to geology and soils.

5.6.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The No Project Alternative would initially result in lower levels of recharge into all recharge areas because banking deliveries would not be added to the deliveries required of MWA to meet replacement water obligations. Groundwater levels would therefore remain more stable, neither rising as a result of banking nor declining as a result of direct return of banked water via pumping and delivery to the California Aqueduct. It is likely that in the short-term the No Project Alternative would result in generally lower groundwater levels in the Mojave River Aquifer and adjacent Regional Aquifer in the Alto subarea than under the various facilities alternatives. The small potential for liquefaction effects associated with mounding of water under recharge areas as a result of banking would not occur.

5.7 Hazards and Hazardous Materials

5.7.1 Environmental Setting

The 2004 PEIR identifies 9 known Superfund Contamination Sites in the MWA service area, all of them located in urban areas, mostly associated with military activity, mining, and cement manufacturing. In addition, the 2004 PEIR identifies sites of leaking fuel tanks, hazardous waste generators, and landfills that may affect groundwater. Again, these sites are associated with urban areas. None is in the vicinity of (or upslope of) proposed recharge and extraction facilities of the various Proposed Project Alternatives. Wastewater treatment plants (percolation ponds for local treatment plants) are located along the Mojave River. A July 2003 Regional Water Quality Control Board (LRWQMB 2001) list of impaired water bodies does not include surface water resources in the MWA service area.

5.7.2 Facilities and Operations Impacts

5.7.2.1 Mechanisms for Effect

The 2004 PEIR identifies several mechanisms by which the Proposed Project alternative facilities or operations could affect hazards and hazardous materials:

- Project construction could encounter soils during excavation that have been subject to contamination, including petroleum hydrocarbons, poly-chlorinated biphenols, pesticides, nitrates, and metals;
- Some project elements, such as pumping facilities, could involve storage and handling of hazardous materials, which could enter the environment during accidents. In addition, fuels storage and handling during construction could result in spills of fuels, and other hydrocarbon products. Construction-related hazardous materials handling and potential for adverse impacts increases with the acreage and duration of construction.; and
- Construction of many facilities, particularly pipelines and urban well fields, will occur within public road rights-of-way. As noted in the discussion of traffic, construction could

affect the movement of vehicles, including vehicles providing police, fire, and emergency service.

These effects increase as the magnitude of the banking and exchange program increases.

5.7.2.2 Minimum Facilities Alternative

The Minimum Facilities involves construction and operation of up to 25 wells along the Mojave River and would involve releases of SWP supplies from Silverwood Lake, the California Aqueduct down Unnamed Wash, and from the Morongo Basin Pipeline at the Rock Springs Outlet. The U.S. Environmental Protection Agency (USEPA 2004) has finalized a Groundwater Protection Rule which will require monitoring and management of groundwater extraction facilities. If facilities are found to have deficiencies (that is, high viral or bacterial counts), then corrective action is required. Local agencies have requested that MWA supply raw water to their facilities, where they will monitor water quality and treat water at their existing facilities. Thus, the Proposed Project does not specifically involve construction or operation of treatment facilities.

During construction of the Minimum Facilities Alternative pipelines, there is a possibility of excavation in areas with contaminated soils, particularly during construction along public rights-of-way in urban areas.

During construction of all facilities, there is potential for fuel and lubricant leaks and spills from construction equipment.

During construction in the public right-of-way, could result in minor traffic delays that could affect implementation of an emergency response plan or emergency evacuation plan,

5.7.2.3 Small Projects Alternative

The Small Projects Alternative adds recharge capacity to the Minimum Facilities Alternative, including additional pipelines to connect recharge areas to the California Aqueduct and existing MWA pipelines. Two of the recharge areas would be City of Hesperia flood detention basins; no hazardous materials occur at these sites. Two other detention basins are located in active washes. In these washes, which are subject to infrequent high flood flows, there is no residential or commercial development and no probable source of contamination. There is a potential for contaminated soils along the Mojave River where a pipeline would be constructed between the Morongo Basin Pipeline and a recharge basin to the south. Contaminated soil associated with an historic poultry operation may be encountered on the east side of the river. Contaminated soils associated with water treatment plant discharges to percolation ponds may be found on the west side of the river.

During construction of facilities, there is thus some potential for excavation of soils contaminated by past commercial and industrial activity. During construction of all facilities, there is potential for fuel and lubricant leaks and spills from construction equipment.

5.7.2.4 Large Projects Alternative

The Large Projects Alternative would add significant recharge capacity to the Proposed Project at three sites and provide for groundwater extraction by up to 25 wells. Development adjacent to these facility sites is sparse and there is minimal potential for these previously undeveloped lands to be contaminated. At Antelope Wash, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to hazards and hazardous materials.

5.7.3 Mitigation and Significance of Impacts after Mitigation

5.7.3.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant effects if activities:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials;
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;
- Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school;
- The project was located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment;
- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area;
- For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area;
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan;
- Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

The project does not involve routine transport of hazardous materials, will not involve storage of hazardous materials that may accidentally be released, does not involve emissions of toxic materials, will not affect airport operations, and will not cause conditions that could increase risks associated with wildland fires. The Proposed Project, by bringing water sources into new areas may enhance wildland fire fighting. Based on the above analysis, the Proposed Project's potential for significant impacts associated with hazards and hazardous materials is limited to: (a) construction-related excavations, (b) potential fuel and lubricant spills during construction, and (c) temporary interference with emergency response during construction.

5.7.3.2 Construction-Related Excavations

Review of the 2004 PEIR maps related to potential for hazardous materials sites indicated that there are no known hazardous materials sites in the Proposed Project area. Minor areas of soil contamination may be found during construction. Consistent with the 2004 PEIR, prior to construction all sites will be evaluated to identify past uses that may have resulted in soil contamination. If the site assessment identifies a potential for contaminated soils, MWA would conduct further analysis to confirm this finding and would either (a) redesign the area to avoid impacts or (b) remediate the contamination to meet Regional Water Quality Control Board standards. During construction of pipelines in areas that cannot be assessed prior to construction, MWA would provide for monitoring of excavated soils and construction contracts will specify monitoring procedures and proper procedures for reporting and responding to potentially contaminated soils. Excavated materials containing hazardous waste will be handled, transported, and disposed of in accordance with applicable regulations. With these mitigations, the potential for adverse impacts associated with excavation of facilities in areas with contaminated soils will be less-than-significant.

5.7.3.3 Potential Fuel and Lubricant Spills during Construction

The Proposed Project includes protocols for management of fuels and lubricants during construction. With these mitigations, the potential for adverse impacts associated with fuels and lubricant handling during construction will be less-than-significant.

5.7.3.4 Effects to Emergency Response Plans or Evacuation Plans

Project traffic management, including selection of a Well Field Pipeline alignment that minimizes potential for traffic delays, will reduce the potential for the project to affect emergency response plans or evacuation plans to a level of less than significant.

5.7.4 Summary Comparison of Alternative Impacts

All aspects of the Proposed Project that involve excavation have some potential for encountering contaminated soils and for construction-related fuel and lubricant spills. Construction in the public right-of-way may affect emergency response/evacuation in some areas. This potential increases marginally as the scope of construction increases. With proposed mitigation, all of the alternative facilities, individually or in combination, would have less-than-significant impacts.

5.7.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.
The No Project Alternative would delay construction of some facilities and the Mojave River Well Field and other pipelines would be reduced in total length. The result would be a small reduction in risk associated with excavation in areas where soils could be contaminated and where fuel and lubricant spills associated with construction could occur.

5.8. Land Use

5.8.1 Environmental Setting

The MWA service area is located in the western portion of San Bernardino County in the Desert Region. The southwestern portions of this region (Victor Valley subregion) have experienced annual population growth of 6% to 9% and concentrated along the I-15 corridor (California Department of Finance 2004). Lower growth rates have occurred in and around the City of Barstow (0.2% in 2003); this has been attributed to a shortage of potable water. Growth in the Morongo Basin has been greater in the town of Yucca Valley and adjacent Twenty-Nine Palms than in the Morongo Basin portions of the MWA service area. Since 1975, the pattern of growth has been a concentration of development and population within existing cities and towns, with some urban sprawl outside of city/town limits. As evidenced by recent reductions in water use for agriculture, agriculture is declining as development occurs. Since 1995, water use for agriculture in MWA's service area has declined from 54,400 acre-feet to 28,600 acre-feet in 2001 (MWA 2004a), indicating reductions in agricultural acreage. The Proposed Project will take place within the context of the County of San Bernardino General Plan, Victor Valley Subregional Planning Area and Barstow Subregional Planning Area; the general plans for the Cities of Victorville, Barstow, Adelanto, and Hesperia and Town of Apple Valley; the U.S. Bureau of Land Management California Desert Conservation Area Plan and the pending West Mojave Plan; and the California Department of Conservation's programs for the conservation of farmland.

5.8.2 Facilities Impacts

5.8.2.1 Mechanisms for Effect

The Proposed Project Facilities could have a potentially significant effect on land use if they:

- Conflicted with applicable city and county land use designations,
- Were located on important farmland or Williamson Act lands, and/or

- Were located on lands designated by Bureau of Land Management for other uses, particularly for sensitive species conservation under the BLM West Mojave Plan.

5.8.2.2 Minimum Facilities Alternative

Potential for Minimum Facilities Alternative land use impact is shown on Table 5-16 and discussed below.

Table 5-16. Potential land use impacts of Facilities for the Minimum Facilities Alternative

FACILITY	POTENTIAL EFFECTS ON LAND USE		
	Conflict with Land Use Designation?	**Agricultural Land Converted?**	**Conflict with BLM West Mojave Plan?**
Mojave River Berms	NO	NO	NO
Mojave River Well Field and Pipeline	NO	NO	NO
SWP Delivery via Unnamed Wash	NO	NO	NO

The construction of temporary sand berms in the mainstem Mojave River would have no impact on land use. The dry river bed is within the floodplain of the Mojave River. This reach of the Mainstem Mojave River, dry in almost all years, is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development).

The Mojave River well field and associated pipeline would be urban infrastructure, generally constructed in public rights of way. Wells would be constructed within commercial and residential areas, with a post construction footprint of approximately 15 x 15 feet each, resulting in conversion of about 5,000 square feet of land (0.11 acres) from commercial/residential to infrastructure. The General Plan for the City of Hesperia provides for integration of utilities and residential/commercial land uses, so the well-field will not have substantial impacts on existing or proposed land uses. No agricultural lands are located in the vicinity of the well field/pipelines. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development).

Use of the Unnamed Wash to deliver water from the California Aqueduct to the Mojave River would not directly affect land use, and on-going coordination between MWA, the City of Hesperia, and Rancho Las Flores, will ensure that conflicts with this planned development are minimized. Based on preliminary drawings prepared by Rancho Las Flores for their pending Environmental Impact Report, the drainage to be used would flow between a Town Center unit and adjacent housing and the lower drainage would be predominantly open space and an off-channel water treatment plant. At the downstream end of the wash, flow would be collected in an earthen intake structure and conveyed beneath Highway 173 (Arrowhead Lake Road) to flow between low levees across lands designated for development. Proposed levees would approximately follow the contour of the 100-year flood plain. Development within the 100-year floodplain is constrained by Federal Emergency Management Administration regulations and thus the use of the floodplain for water conveyance would not conflict with any local development plans. The development of an incised channel across the floodplain would probably reduce potential for sheet flow across the floodplain and would also provide an aesthetic resource for adjacent development. There would be no significant conflict with potential development use. The affected area is not agricultural nor identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the arroyo toad (which requires ponded water for eggs and larvae development).

5.8.2.3 Small Projects Alternative

Potential for Small Projects Alternative land use impact is shown on Table 5-17 and discussed below.

Table 5-17. Potential land use impacts of facilities for the Minimum Facilities Alternative and Small Projects Alternative

FACILITY	POTENTIAL EFFECTS ON LAND USE		
	Conflict w/Land Use Designation?	**Ag. Land Conversion?**	**Conflict w/ West Mojave Plan?**
Minimum Facilities Alternative			
Instream Mojave River Recharge	NO	NO	NO
Mojave River Well Field and Pipeline	NO	NO	NO
SWP Delivery via Unnamed Wash	NO	NO	NO
Small Projects Alternative			
Off-Channel Mojave River Recharge (East Site)	YES	NO	NO
Off-Channel Mojave River Recharge (West Site)	YES	NO	NO
Off-Channel Mojave River Recharge Pipelines	NO	NO	NO
Oro Grande Wash Recharge and Pipelines	NO	NO	NO
Cedar Avenue Detention Basin Recharge and Pipelines	NO	NO	NO
Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines	NO	NO	NO

Off-stream recharge along the Mojave River at the potential east recharge site would be located on lands designated for a combination of agricultural and low-density residential uses. Approximately 100 total acres would be converted from these potential uses. Based on review of maps from the California Digital Conservation Atlas, it appears that about 60% of the site has been mapped as agricultural, the remainder is low-density residential. The Department of Conservation considers conversion of 100 acres of farmland to other uses to be an effect requiring an EIR to be prepared, but the CEQA significance of conversion is based on analysis of effects within the regional context. The east recharge site has been characterized during biological surveys as disturbed ruderal and disturbed Mojavean desert scrub. The actual use of the land is therefore no longer agricultural and its conversion to other uses would not, in fact, result in a loss of active agriculture in the MWA service area. There is no residential development on the site. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development).

The west site for this recharge would be located on land designated for open space. The site has been used for wastewater treatment in the past and use for recharge would thus not significantly alter land use. No recreational or new public uses are currently planned for the site. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development). The Proposed Project use would not conflict with past use or the primary open space value of the site, which is primarily preservation of scenic views from Arrowhead Lake Road. None of the other elements of the Small Projects Alternative would have land use effects for the following reasons:

- The pipeline between the Morongo Basin Pipeline and the recharge basin to the south would be constructed in existing public rights of way;
- The two recharge basins in existing wash areas are in flood-prone areas where no agriculture or development is designated;
- The recharge area at the proposed Cedar Avenue detention basin would make incidental use of a designated flood detention basin;
- None of the facilities is located in a conservation area under the West Mojave Plan.

5.8.2.4 Large Projects Alternative

The Large Projects Alternative adds recharge and extraction-well capacity to the Small Projects Alternative. Effects on land use are summarized on Table 5-18 and discussed below.

Recharge, wells, and pipelines at both the Oeste and Alto recharge areas would be constructed in areas designated for low density residential of the Victor Valley Subregional Planning Area, with conversion of 480 acres to public uses. There is currently sparse development in this area, which covers approximately 200 square miles west of Interstate 15. The Oeste and Alto recharge basins, in combination, would therefore affect about 0.005 percent of the developable land designated for low to medium density residential (and commercial) within the western portion of the Victor Valley Subregional Planning area. No designated farmland exists in this area, although some grazing occurs on undeveloped lands. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development). For Antelope Wash, the upstream recharge site and the Ranchero Road recharge site are located in public rights of way, and development is limited due to the potential for flooding in the wash. With implementation of best management practices for noise and other factors that could affect adjacent development, no land use impacts would occur. Expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to land use.

Table 5-18. Potential land use impacts of facilities for all Project Alternatives

FACILITY	POTENTIAL EFFECTS ON LAND USE		
	Conflict w/Land Use Designation?	**Ag. Land Conversion?**	**Conflict w/West Mojave Plan?**
Minimum Facilities Alternative			
Instream Mojave River Recharge	NO	NO	NO
Mojave River Well Field and Pipeline	NO	NO	NO
SWP Delivery via Unnamed Wash	NO	NO	NO
Small Projects Alternative			
Off-Channel Mojave River Recharge (East)	YES	NO	NO
Off-Channel Mojave River Recharge (West)	YES	NO	NO
Off-Channel Mojave River Recharge Pipelines	NO	NO	NO
Oro Grande Wash Recharge and Pipelines	NO	NO	NO
Cedar Avenue Detention Basin Recharge and Pipelines	NO	NO	NO
Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines	NO	NO	NO
Large Projects Alternative			
Oeste Recharge and wells	YES (330 acres)	NO	NO
Alto Recharge and wells	YES (150 acres)	NO	NO
Antelope Wash Recharge	NO	NO	NO

5.8.3 Operational Impacts

5.8.3.1 Mechanisms for Effect

The operation and maintenance of recharge and associated facilities may have potential indirect effects on adjacent land use if they are perceived as incompatible with existing or proposed uses. Factors such as noise, visible fencing, and other aesthetic issues may affect the perceived incompatibility of such facilities. It is difficult to quantify these effects because there are both positive and negative aspects to each. Noise associated with intermittent operation and maintenance may be offset by reduced noise that would be associated with the development that would otherwise occur on the facility site. Visible fencing and levees may affect views at ground level, but this may be offset by the absence of housing or commercial development (which would have even greater effects on view). The net indirect effect of recharge basins and associated facilities on land use is thus not clear.

In areas where there are extensive recharge and conveyance facilities associated with water banking, such as Kern County, these facilities do not appear to be incompatible with development, and there is residential and commercial development along canals and along the exterior levees of recharge basins.

5.8.3.2 Operations Effects: All Alternatives

Except for underground pipelines, all of the proposed facilities may indirectly affect perceived compatibility with adjacent development. Experience with similar facilities in Kern County suggests that neither residential nor commercial development is significantly constrained, and that there are benefits as well as adverse effects associated with living adjacent to recharge facilities. No significant operational effects are therefore anticipated.

5.8.3.3 Operational effects related to project magnitude

Project magnitude affects the number and size of recharge facilities, but once such facilities have been constructed, the magnitude, frequency, and duration of recharge would not change land use impacts.

5.8.4 Mitigation and Significance of Impacts after Mitigation

5.8.4.1 Significance Thresholds

Under CEQA, the Proposed Project could be considered to have significant land use impacts if it:

- Physically divided an established community;
- Conflicted with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; or
- Conflicted with any applicable habitat conservation plan or natural community conservation plan.

5.8.1.2 Mitigation and Significance after Mitigation

MWA has avoided conflicts between regional land use planning efforts (a) through siting of recharge basins and other facilities in areas that do not conflict with significant existing development and do not conflict with regional conservation planning, (b) by providing for multiple uses of planned flood detention facilities, and (c) by maximizing use of the recharge capacity of existing facilities and the Mainstem Mojave River as the basis for the Minimum Facilities Alternative, which is a baseline for the other Proposed Project alternatives. In addition, to further reduce potential land use impacts, MWA would:

- Continue to coordinate with Rancho Las Flores to ensure compatibility of the Unnamed Wash feature of the Minimum Facilities Alternative with the proposed development;
- Coordinate with city and town officials to develop methods to ensure long-term compatibility of recharge and associated facilities with development; and

- Design of facilities to minimize adverse indirect effects on noise, and other factors that may affect perceived incompatibility of such facilities with residential and commercial development.

None of the facilities requiring construction, nor their operation, is in conflict with regional conservation efforts, particularly the West Mojave Plan; none is sited in an area designated for conservation under that plan or has been designated as critical habitat for other species. None of the facilities affects active agricultural lands. The siting of recharge, along with mitigation to reduce conflicts of the proposed facilities with future development, would reduce land use impacts from all aspects of the Proposed Project to a level of less-than-significant.

5.8.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

To the extent that changes in land use occur in the vicinity of Proposed Project facilities (off-channel Mojave River recharge and recharge basins at Alto and Oeste), there is a greater potential for land use conflicts under the No Project Alternative, and re-siting in the context of future development would likely be complicated by changes in land use. The No Project Alternative therefore would not reduce impacts when compared to the Proposed Project.

5.9. Noise

5.9.1 Environmental Setting

Environmental noise for mobile sources such as construction equipment is regulated by state and federal agencies, which establish noise standards and technology for such equipment. Noise from stationary sources is generally regulated by local agencies. Noise from both sources is a potential CEQA issue for the Proposed Project. There are various methods for describing noise:

- A-weighted decibels (dBA): A direct measure of sound energy intensity, adjusted for the variation in frequency response of the human ear;
- Maximum noise level (L_{max}): The highest noise level measured in a given period;
- Energy-equivalent noise level (L_{min}): The average noise level over a given period;
- Day-Night noise level (DNL): A weighted noise level for a 24-hour period; and
- Community noise equivalent level (CNEL): Equal to DNL except that a 5 dBA adjustment is added to the night noise level.

Noise energy levels (dBA) decrease with distance from the source. For "line" sources such as traffic, noise levels decrease by 3 to 4.5 dBA for every doubling of the reference distance from the source. For stationary sources, noise reduction is 6.0 to 7.5 dBA for every doubling of the reference distance from the source. Thus, for example, if traffic noise is measured at 65 dBA at 50 feet, it will be reduced to 62 to 60.5 dBA at 100 feet. Noise levels are also affected by topography, structures, wind direction, and humidity. Noise regulations in the MWA service area vary by community (Table 5-19).

There have been a number of studies of construction noise levels. The 2004 PEIR cites EPA data from 1971, noting that typical construction activities generate noise of from 78 to 89 (L_{min}) at 50 feet. The National Park Service notes that typical noise levels from construction equipment range from 74 dBA to 89 dBA at 50 feet (NPS 2000).

A majority of these studies have been based on tests in the 1970's and 1980's, and there have been improvements in construction equipment noise management since then. A conservative estimate of potential for construction to exceed noise standards can be made using the 1971 EPA estimates, and projecting these estimated noise levels at 50, 100, 200, 400, and 800 feet:

- 50 feet: 78 dBA to 89 dBA
- 100 feet: 72 dBA to 83 dBA
- 200 feet: 66 dBA to 77 dBA
- 400 feet: 60 dBA to 71 dBA
- 800 feet 54 dBA to 65 dBA

Comparing estimated construction noise to the community noise standards on Table 5-19, construction noise will exceed all standards for nighttime even at 800 feet from the construction site, and will exceed most of the daytime standards for daytime at 800 feet as well.

Ambient noise levels along highway and major arterial corridors generally exceed community standards. The 2004 PEIR cites the Caltrans March 1980 Noise Manual in noting that noise levels in excess of 80 dBA are common in a noisy urban environment and that heavy traffic generates about 64 dBA at 300 feet (or about 75-80 dBA at 50 feet). Daytime construction noise in an urban commercial area will thus not be significantly greater than the ambient noise level.

Table 5-19. Noise regulations in portions of the MWA service area which may be affected by construction and operation of the Proposed Project (from local jurisdiction ordinances)

NOISE STANDARD	JURISDICTION				
	Adelanto	Apple Valley (may not exceed for more than 30 minutes in any hour)	Hesperia (may not exceed for more than 30 minutes in any hour)	Victorville (may not exceed for more than 30 minutes in any hour)	San Bernardino County
CNEL Residential Daytime	65	45	60	65	Construction equipment exempt from noise standards during daylight hours.
CNEL Residential Nighttime		40	55	55	
CNEL Multi-family Daytime		50			
CNEL Multi-family Nighttime		45			
CNEL Commercial Daytime	75	60-65	65 anytime	70 anytime	
CNEL Commercial Nighttime		55-60	65 anytime	70 anytime	
CNEL Light/heavy industrial		70/75 anytime	70 anytime	75 anytime	
CNEL Schools (exterior)					
CNEL Schools (interior)	60				
CNEL Libraries (max)	65				
CNEL Libraries (average)	40				
CNEL Hospital, nursing home (max)	55				
CNEL Hospital, nursing home (average)	45				
CNEL recreational areas (not quiet)	70				

5.9.2 Facilities Impacts

5.9.2.1 Mechanisms for Effect

Construction equipment will generate almost continuous noise levels of from 78 dBA to 89 dBA at 50 feet from the construction site, with lower noise levels at greater distances. The potential for each alternative to cause adverse noise impacts is summarized on Table 5-20 and discussed below.

Table 5-20. Summary of Potential Noise Impacts, All Alternatives.

FACILITY	DISTANCE TO NEAREST RECEPTOR (FEET)	ESTIMATED NOISE LEVEL AT RECEPTOR (dBL)	APPROXIMATE RESIDENCES AND BUSINESSES AFFECTED
Minimum Facilities Alternative			
Instream Mojave River Recharge	200	64-70	50 residences
Mojave River Well Field	50	78-89	100 residences
Well Field Delivery Pipelines	50	78-89	650+ residences and 100+ businesses
SWP Delivery Via Unnamed Wash	400	60-71	<10
Small Projects Alternative			
Off-channel Mojave River Recharge	400-600	54-71	<15 residences
Oro Grande Wash Recharge (both sites)	200	66-77	60+
Cedar Avenue Detention Basin Recharge	200	66-89	<40
Antelope Wash Detention Basin (Ranchero Road) Recharge	200	66-77	<30
Large Projects Alternative			
Alto Recharge and Pipelines	200	66-77	<10
Oeste Recharge and Pipeline	400	60-71	<5
Antelope Wash Recharge	2000	45-55	<60
	400	60-71	Airport

5.9.2.2 Minimum Facilities Alternative

The Minimum Facilities Alternative would involve construction of temporary sand berms in the Mainstem Mojave River for a period of several weeks in each year. This construction will be upstream of Rock Springs, and in areas where the Mojave River channel is from about 600 to 1000 feet to 2000 feet wide. Adjacent land use is sparse, with only about 50 residences within 100 feet of the river channel. Berm construction will be focused on the mid-channel area, and thus construction equipment will be moving back and forth across the river, in general more than 200 feet from adjacent development. Caterpillar D-7 or D-8 dozers will be used, which have peak noise levels of 82 dBA at 50 feet (US Department of Transportation, Federal Highway Administration). This construction will generate noise levels of 70 dBA when it is closest to adjacent development and on average about 64 dBA, equivalent to heavy traffic.

Construction of the Mojave River Well Field and Well Field Delivery Pipelines on the west side of the River will be in residential and commercial areas along Orchid Street and Eucalyptus Street from the Mojave River to Santa Fe with secondary pipelines extending from Orchid Street to wells along the river. The pipeline would then run along Santa Fe to Mesa Street, and follow the Mesa Street alignment to the California Aqueduct. On the east side of the river, the well field and pipelines will be located about 200-800 feet from the river channel, and then connect to several existing pipelines via short stubs off the pipeline connecting the various wells to one another. In most of these areas, construction will be within 50 feet of residential and or commercial development. This construction will generate noise levels typical for construction, approximately 78 to 89 dBA. Well Field Delivery Pipelines will affect all residences and businesses along a short portion of Eucalyptus Street (from Orchid to Santa Fe for about 2 miles) and then Mesa Street for the remaining 7-8 miles. There would be connecting pipelines along several side streets to existing local reservoir facilities. Based on site survey and review of recent (2004) aerial photographs, these roads have varying levels of development:

- From Orchid Street west to Santa Fe, Eucalyptus Street is residentially and commercially developed on both sides through about 2 miles of Hesperia. About 75 percent of the development in this zone is residential. Residential development is mixed with vacant lots and small commercial. With mixed development, some vacant lots, and frontage of about 100 feet per lot, construction of the Well Field Delivery Pipelines through this portion of Hesperia would affect about 100 residences, and about 20 businesses would be affected.
- For the final 7-8 miles of the pipeline down Santa Fe and then west along Mesa Street, there is residential development only to the north of Mesa Street, and only along about 50% of the road length is developed. Santa Fe Street has a railroad track along the west side of the street. Connecting pipelines to existing reservoir facilities would pass along north-south residential streets. Making the same assumptions as above, pipeline construction in this portion of the route would affect up to 100-200 residences and 20-30 businesses.
- Assuming construction of pipelines to connect various wells along Orchid Street, development is generally on the west of the street, where there are about 20 residences. On the east side of the street, there are about 10 residences.
- For the pipeline to serve Apple Valley, there is relatively sparse existing development in the first three miles, and road construction would affect approximately 50-60 residences and 10 businesses.

The inlet and small levees associated with SWP delivery via Unnamed Wash, would be constructed along the middle of the wash, within about 400 feet of 6 existing homes. Noise levels at these homes would be 60 dBA to 71dBA.

5.9.2.3 Small Projects Alternative

The Off-Channel Mojave River Recharge basins for the Small Projects Alternative would be constructed in areas with few residents. Regardless of whether an eastern site or a western site is selected, the nearest residence would be 400 to 600 feet from the construction site. Noise levels at these receptors would be 60 dBA to 71 dBA. Along the east pipeline (Deep Creek Road) construction would be approximately 800 feet from the nearest residence, resulting in noise levels at this receptor of 54 to 65 dBA. Along the west pipeline (Arrowhead Lake Road and Calpella Avenue) there is residential development along the bluffs overlooking the river about 30 feet above the river channel and about 1000 feet from the pipeline alignment and several residences along the river and about 200 feet from the pipeline alignments. Noise levels from construction would be above City of Hesperia thresholds only for the residences along the river channel.

At Oro Grande Wash, construction would occur below grade and within 200 feet of residential development where there is housing along the east bluffs of the wash south of the California Aqueduct. In this area, construction would generally be about 200 feet away from the development, generating noise levels of 66 dBA to 77 dBA. Additional construction would involve pushing up berms in the detention basin with a grader. Noise levels would be 66 dBA to 77 dBA at adjacent residences.

At the Cedar Avenue Detention Basin Recharge, the levees of the California Aqueduct would block noise to the north and east. On the south and west, there are several residences within 200 feet of the probable outer levee of the facility, and noise levels at these residences would be from 66dBA to 77 dBA. There is construction underway to the southwest, but this development adjoins the potential detention basin site at a corner. Noise levels at the corner would be in the 78 dBA to 89 dBA range, but would attenuate rapidly both west and south of this point of contact between the two projects.

At the Antelope Wash Detention Basin (Ranchero Road), construction of recharge facilities would not be undertaken until after the City of Hesperia had constructed the embankment for raising the road 30 feet above current grade. All construction following that would be within approximately 200 feet of existing housing on the bluffs above the wash. These receptors would be exposed to noise in the 66 dBA to 77 dBA range.

5.9.2.4 Large Projects Alternative

The two large recharge basins for the Large Projects Alternative are located in sparsely developed areas. At the Alto Recharge Basin site, there is scattered development adjacent to the smaller element of this recharge basin, with several houses within 200 feet of the outer levee. Noise levels would be approximately 66 dBA to 77 dBA for these receptors. At Oeste Recharge Basins, there are two residences about 400 feet from the east boundary of the potential recharge basin, where noise levels would be 60 dBA to 71 dBA.

The recharge basin in the Antelope Wash would be located to the east and south of the Hesperia Airport, and would be about 2000 feet from existing residences along the bluffs overlooking the wash. At this distance, noise from construction would be 45 dBA to 55 dBA. Airport users would be affected by construction noise, with noise at about 400 feet from some facilities estimated at 60 dBA to 71 dBA.

For all facilities of all alternatives, construction noise would be a temporary effect. For pipelines, the construction site will move at a rate of about 100 feet per working day and noise will thus affect a given residence or business along the pipeline route as construction moves past the site. At 100 feet per day, residents and businesses within 50 feet of the pipeline alignment would experience noise levels of 78-89 dBA for only one day, when construction was immediately in front of the residence or business. Noise levels in the range of 66 to 83 dBA would be experienced for about 4 days as construction moved to within 250 feet and moved away from the site by 250 feet. Similarly, noise levels from about 58 dBA to 70 dBA would be experienced for 4 additional days when construction was between 450 and 250 feet away from the residence or business. The remainder of the time, noise levels would be typical of ambient noise along a moderately busy street, from 54 to 65 dBA. For Antelope Wash, construction noise for recharge basin construction could be marginally higher at the expanded Ranchero Road site than at the upstream site. Relocation of the upstream recharge to the area downstream as described in Chapter 4, page 4-31 could marginally increase short-term noise impacts of the proposed project. MWA proposes best management practices that reduce these temporary noise impacts to a level of less-than significant. Given implementation of these best management practices, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to noise effects.

Noise associated with recharge basin construction would be more constant. Noise associated with well drilling would be experienced for about 15-20 working days.

5.9.3 Operational Impacts

5.9.3.1 Mechanisms for Effect

During operations, stationary facilities such as wells, pumps, and potential chloramination facilities would generate relatively constant noise. As noted in the Project Description, these facilities would be fully enclosed in locked buildings. These buildings would be designed to ensure that noise levels outside the buildings did not exceed 40 dBA at the site, or about 36 dBA at 50 feet. This is equivalent to the interior of a library. These facilities would therefore have no mechanism by which they could routinely generate adverse noise impacts.

Operation and maintenance of recharge facilities will involve periodic use of heavy equipment to remove fine sediments from the recharge basin cells and maintain and repair levees. A majority of this work would be undertaken within the outer levees, which would block and deflect noise. Routine levee inspection and maintenance traffic would have potential to cause short-term daytime noise effects for adjacent residents and businesses. Maintenance involving vegetation control (mowing and weed-whacking) would create short-term temporary disturbance.

5.9.3.2 Minimum Facilities Alternative

There are no facilities associated with the Minimum Facilities Alternative that would involve routine operation and maintenance involving construction. No operational noise impacts are anticipated.

5.9.3.3 Small Projects Alternative

There would be routine operational noise from maintenance and repair of all of the recharge basins for the Small Projects Alternative. Operations would affect receptors identified in the above analysis.

5.9.3.4 Large Projects Alternative

There would be routine operational noise from maintenance and repair of all of the recharge basins for the Large Projects Alternative. Operations would affect receptors identified in the above analysis.

5.9.3.5 Project magnitude and noise effects

The magnitude of deliveries will have no significant effect on project noise effects. Recharge activities do not generate significant noise. There is potential for some noise associated with releases to Unnamed Wash, but adjacent to development these releases will either flow down a constructed channel or be carried in a pipeline to the head of the wash, which will be in open space and several hundred yards from adjacent housing and commercial development. Noise effects from running water in Unnamed Wash will be insignificant.

5.9.4 Mitigation and Significance of Impacts after Mitigation

5.9.4.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant noise impacts if it resulted in:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels;
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels;
- For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

Based on the above analysis, potentially significant noise impacts associated with the Proposed Project are limited to construction-related activities. Mitigation measures and significance of these effects is discussed below.

5.9.4.2 Mitigation and Significance after Mitigation

To minimize noise impacts, MWA will restrict construction to daylight time periods consistent with local ordinances, which may also require time restrictions along major arterial roads to minimize traffic impacts during rush hours. Construction along roads in developed areas may therefore be practically limited to the period from 8:30 am to 4:30 pm.

For work within 400 feet of housing, MWA will require construction contractors to utilize available noise management technology (muffling) and to maintain noise suppression equipment on construction machinery to ensure that noise emissions are minimized at the source. Equipment not in use for more than 5 minutes will be turned off.

If pile driving equipment is necessary, pile holes will be pre-drilled if feasible and vibratory pile driving equipment will be used whenever possible.

MWA will require construction contractors to locate fixed construction equipment such as generators as far as possible from noise-sensitive receptors.

During construction of wells, pipelines, and associated facilities such as pump stations and chloramination facilities in areas where construction is within 400 feet of a residence or business, construction noise will be periodically monitored on site and at the residence or business. If noise levels are found to exceed those mandated by local ordinance, MWA will, to the extent feasible and in consultation with the resident or business, install temporary noise barriers along the boundary of the construction site to further reduce noise impacts. Barriers may be installed along the boundary of the construction zone or on private property, depending on conditions and the permission of the landowner/resident.

In addition, in areas where there are residences within 400 feet of construction, once construction areas for fixed location construction such as well drilling pads have been cleared and construction can commence, MWA will install temporary noise barriers around the construction site, to the extent feasible, to block noise transmission.

At recharge basin sites where there is adjacent development, MWA will initially construct outer levees along the boundary with adjacent development. This will allow construction of inner levees and basins behind a mound of earth, which will reduce noise levels for adjacent residents and businesses.

MWA will notify residents and noise-sensitive receptors in the affected areas several weeks in advance of operations that would generate noise in excess of local standards. Information distributed will describe the operations and duration of the project.
All stationary equipment will be designed, constructed, and operated to comply with all local noise ordinances.

The majority of potential noise impacts are associated with well-field and pipeline features of the Minimum Facilities Alternative, because these facilities will be constructed in an urban area. Other features of the various alternative facilities would have less potential to affect large numbers of people and to create exterior noise levels at residences, businesses, or public facilities that exceed local standards. Implementation of these noise management mitigations will reduce noise impacts of the project to less-than-significant.

5.9.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

In the short-term, the No Project Alternative could reduce the number of people affected by construction noise. However, if there is substantial development around sites where facilities would eventually be sited, then delay in construction could increase the number of people exposed to construction noise. At the same time, better noise management equipment may be anticipated for construction equipment. Since the effects of construction noise on future development are not predictable, and there are both potential benefits and impacts associated with deferring some construction, the No Project Alternative's effects on noise must be considered neutral when compared to the various facilities alternatives.

5.10 Public Services and Utilities

5.10.1 Environmental Setting

Routine public services are provided by a range of entities within MWA's service area (Table 5-21). As the table indicates, there are a number of joint powers authorities providing regional utility services. Water is supplied by local agencies, which rely on groundwater and on MWA supplies for replacement of pumped groundwater. MWA's conveyance facilities are linked to groundwater recharge areas that provide supply that may be tapped by local producers. There are no municipal hazardous waste facilities. MWA's service area is traversed by major interstate power and natural gas lines, which deliver electric power from eastern generation facilities and natural gas from major producers in the southwest. Emergency services are provided through police and fire departments, supplemented by private company ambulance services.

5.10.2 Facilities Impacts

5.10.2.1 Mechanisms for Effect

The Proposed Project construction and operation will not affect the level of public services required within MWA's service area. No changes in police, fire, or public emergency services will be caused by the construction or operation of facilities. Construction may generate some solid waste, particularly associated with drilling of wells and construction of pipelines. Pipeline alignments may cross through areas with buried soils contaminated by hazardous waste, and this hazardous waste would need to be contained and then disposed of at an appropriate facility. Recharge basins and canals do not tend to generate waste material because soil for their construction is excavated at the site and used in levee construction.

Construction of facilities may also involve excavation in areas with existing buried electric utility lines and pipelines (gas, petroleum, drinking water, sewage). There is some potential for excavations to adversely affect these facilities, causing temporary interruptions in service and the release of materials in pipelines.

5.10.2.2 Minimum Facilities Alternative

The Minimum Facilities Alternative will involve work in an urban setting, particularly the construction of wells and pipelines associated with the Mojave River Well Field element of the alternative. During planning, several alignments for the East-West delivery pipelines were explored, including Sycamore Road and Eucalyptus Road. At the suggestion of the City of Hesperia, Mesa Street was selected because of low levels of development, low traffic volumes, and the ability to route limited traffic around construction easily via local roads. This alignment will reduce the potential for interruptions of public services along major arterial roads through urban areas. Low levels of traffic along this route will mean that public service vehicles may pass readily along the route, even with one lane blocked by construction for about 200 linear feet per day. There is a low potential for interruption of major utilities and for excavation of hazardous wastes along these largely residential alignments.

Well construction, use of the Mojave River Mainstem, use of existing facilities, and construction of bridges, undercrossings, drop structures, and levees associated with use of Unnamed Wash will all involve work outside of the public right of way, except for construction under Arrowhead Lake Road. All can be accomplished without interrupting movement of public service vehicles.

Given the Mesa Street alignment for the Well Field Delivery Pipeline, the Minimum Facilities Alternative has a low potential to result in interruptions of essential public services. The Proposed Project also does not generate a need for additional public services.

Table 5-21. Public service providers in MWA's service area (MWA 2004b).

TYPE OF SERVICE	PROVIDER	JURISDICTION/AREA
POLICE	County of San Bernardino	Unincorporated areas, City of Hesperia, City of Victorville, Town of Yucca Valley, Apple Valley, Adelanto
	California Highway Patrol	State and Interstate highways
	City of Barstow	City of Barstow
FIRE	San Bernardino County Fire Department	Unincorporated areas
	California Department of Forestry and Fire Prevention	Wildland fires, City of Hesperia, Town of Yucca Valley,
	Victorville Fire Department	City of Victorville
	Hesperia Fire Protection District	City of Hesperia
	Regional Fire Protection Authority Apple Valley Fire Prevention District	Hesperia, Barstow, Victorville, Apple Valley, Lucerne Valley, Wrightwood, Adelanto, and Hinkley
	Barstow Fire Protection District	Barstow, Lenwood, Grandview, North Barstow, Barstow Heights
WASTEWATER TREATMENT	Victor Valley Wastewater Reclamation Authority	Victorville, County Sanitation Agencies 42 and 64, Apple Valley, Hesperia
	City of Barstow	City of Barstow
	Town of Yucca Valley	(None --all septic)
WATER	Mojave Water Agency	Entire Service Area
	Southern California Water Company	Barstow, Lucerne Valley, Apple Valley
	City of Hesperia Water Department	City of Hesperia
	Victor Valley Water District	City of Victorville
	City of Adelanto	City of Adelanto
	Baldy Mesa Water District	Unincorporated areas west of Hesperia
	Apple Valley Ranchos Water Company	Apple Valley
	High Desert Water District	Warren Valley, Town of Yucca Valley and unincorporated areas
	Joshua Basin Water District	Unincorporated areas
	County of San Bernardino	County Service Areas
	Numerous smaller water service districts such as Marina Ranchos, Thunderbird, and Apple Valley Foothill	Specific service areas
SOLID WASTE	Barstow Sanitary Landfill	Barstow and unincorporated areas
	Lenwood/Hinkley Landfill	Barstow and unincorporated areas
	City of Hesperia	City of Hesperia
	Mojave Desert Solid Waste Joint Powers Authority	City of Victorville
	Hi-Desert Disposal	Town of Yucca Valley and unincorporated areas

5.10.2.3 Small Projects Alternative

The facilities proposed for the Small Projects Alternative would be constructed outside of public roads. There would be no project effects to the delivery of public services. The Proposed Project also does not generate a need for additional public services.

5.10.2.4 Large Projects Alternative

The proposed facilities for the Large Projects Alternative are located in isolated areas and will involve construction outside of roads and highways. There would be no project effects to the delivery of public services at these sites. The Proposed Project also does not generate a need for additional public services. Expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to public services and utilities.

5.10.3 Operational Impacts

5.10.3.1 Mechanisms for Effect

Otherwise, the operation of recharge and conveyance facilities is not likely to affect the need for or delivery of public services, except when there is a need for pipeline or well maintenance or repair. The magnitude of water deliveries, or the type of banking program selected for implementation, will have no effect on public services as all releases will be contained in the facilities described.

The projects operations involve releases of large amounts of water into the Mojave River from Silverwood Lake and from the California Aqueduct. Releases from Silverwood Lake will remain within the river channel, as demonstrated by the 2003-2004 demonstration project, but may enhance flows past several local recreational areas from September 15 through February 15. Flows in the Mojave River will be monitored and managed to match extractions to inflow, but it is also probable that flows into the Narrows will increase marginally. The 10% loss factor applied to returns from banking will probably result in some recharged water passing through the Narrows. This additional flow, perhaps several thousand acre-feet per year will enhance the existing wildlife and recreation potential of this reach of the river. No new park or recreation facilities will be needed, but some enhancement of aquatic activities may be anticipated.

5.10.4 Mitigation and Significance of Impacts after Mitigation

5.10.4.1 Thresholds of Significance

Under CEQA, the Proposed Project would be considered to have significant impacts to public services if it:

- Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

Police protection
Schools
Parks
Other public facilities

Based on the analysis above, there is no mechanism by which the Proposed Project could have long-term effects on public services. Potential impacts are associated with potential traffic delays that could temporarily delay delivery of public services in areas where construction will occur with the public right-of-way. Mitigation for these effects, and significance after mitigation are discussed below.

5.10.4.2 Mitigation and Significance after Mitigation

The potential for significant public service effects for the Proposed Project facilities is limited to the Minimum Facilities Alternative, Well Field Delivery Pipeline, which may occupy one lane of local service roads through the City of Hesperia. All other construction will be in locations where impacts to the delivery of needed public services will not be affected by construction or long-term operation.

For the Well Field Delivery Pipeline system, MWA would implement traffic controls (as noted in the discussions of traffic and noise impacts). In addition, MWA would coordinate with providers of public services prior to initiating construction to ensure that police, fire, and emergency service providers were aware of the location of any construction activities in the public right of way. During construction in roads, this coordination would occur daily to precisely define the areas where traffic delays might occur. A majority of the potential public service impacts of the Proposed Project would be associated with one facility -- the Mojave River Well Field Delivery Pipelines. Other facilities would not have impacts on the delivery of public services. Implementation of traffic controls and coordination with providers of public services will reduce potential public service impacts of all alternative facilities to a level of less-than-significant.

5.10.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The No Project Alternative would reduce the intensity of construction and allow for construction of the Mojave River Well Field and Delivery Pipelines over a longer period of time (with a shorter pipeline), but it is likely that they would be constructed at some time in the future, given the high level of interest in this water management option. Development in the future could accommodate a construction schedule involving only one segment of pipeline at a time, reducing the potential for traffic-related delays of public services. At the same time, development along potential well-field and delivery-pipeline alignments may intensify if there is a substantive delay in facility development. Delay may therefore mean greater traffic congestion along the proposed pipeline alignments. The No Project Alternative therefore has potential to somewhat ameliorate potential traffic-related problems associated with construction of the pipelines, but might also result in greater problems associated with construction after additional development has occurred.

5.11 Recreation

5.11.1 Environmental Setting

A substantial portion of the MWA service area is in public ownership, with multi-use on Bureau of Land Management lands and recreational uses on Joshua Tree National Park. The Bureau of Land Management has 4 designated areas of intensive use (including off road vehicle use), 6 major wilderness areas, and large areas of general recreation access. Along the Mojave River, there are water-based recreation areas: Mojave Forks Regional Park, Mojave Narrows Regional Park, Hesperia Lake Park, and a number of smaller private recreational lakes. A number of golf courses are located in or near urban areas. Regional parks are supplemented by local-community parks and recreation facilities such as swimming pools, tennis courts, and areas for field sports.

5.11.2 Facilities and Operations Impacts

5.11.2.1 Mechanisms for Effect

The Proposed Project facilities do not create a demand for new or expanded recreation. No new recreation facilities would be required.

Only the west site for the Off-Channel Mojave River Recharge would sited near existing recreation facilities (a recreational lake). A corner of the recharge basin would be about 250 to 300 feet from the south end of the recreation lake, and would not affect access to or use of the lake. Recharge basin construction and operation would have no effects on recreation. Pipeline and well construction in the vicinity of urban parks may create short-term disturbance and reduce access to park facilities for a brief period of time. Operation of wells and buried facilities would not affect recreation. Facilities have been sited in a manner that avoids the conversion of recreation lands to other purposes. Wells and delivery pipelines for the Mojave River Well Field element of the Minimum Facilities Alternative will be sited to minimize potential construction and operation effects on recreation on the east side of the river (trout ponds and the Jess Ranch Country Club.

The operation of recharge involving delivery of water from Silverwood Lake via the West Fork of the Mojave River (September 15 through February 15) could affect recreation at private and public recreation facilities along the West Fork of the Mojave River. Additional late-summer and winter flow may adversely affect some activities by increasing flow rates and depth and enhance others via the same mechanism. Casual swimming and fishing may be affected due to higher flows.

At Unnamed Wash, releases from the California Aqueduct will generally enhance the recreation potential of this wash, which has been designated as open space in the Rancho Las Flores planning documents. Recreation use of this open space may be designed around the wash, and bridges and drop structures may create opportunities for people to enjoy a desert wash habitat.

Neither development of recharge facilities at the upstream recharge site or the Ranchero Road recharge site would have effects on recreation. Thus, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to recreation.

5.11.3 Mitigation and Significance of Impacts after Mitigation

5.11.3.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant impacts to recreation if it:

- Would increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated; or
- Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?

No aspect of the Proposed Project would have these potential effects. However, MWA recognizes that its activities may affect recreational activities in the West Fork of the Mojave River during construction and operation. The magnitude of deliveries under various operations scenarios may affect the duration of recreation effects. MWA therefore addresses mitigation of these potential effects on recreation below.

5.11.3.2 Mitigation and Significance after Mitigation

As was done during the 2003-2004 demonstration project, MWA will notify recreation providers along the West Fork of the Mojave River when deliveries from Silverwood Lake will be made and will ramp such deliveries up in 50-cfs increments to avoid sudden increases in downstream. A similar program will be developed for deliveries made via Unnamed Wash. MWA will coordinate siting of the potential Mojave River Well Field and associated facilities with local governments and the owners of private local facilities to minimize the effects of wells and pipelines on recreational activities along the river in this area (Bear Valley Road to Rock Springs). With these mitigations, the effects of the Proposed Project facilities and operations on recreation would be less-than-significant.

5.11.4 Summary Comparison of Alternative Impacts

None of the facilities proposed for the various alternatives would increase demand for recreation or otherwise require changes to existing or planned recreation development. There may be minor impacts to recreation facilities on the east side of the Mojave River in the vicinity of the Jess Ranch County Club and local trout ponds.

5.11.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The No Project Alternative would probably not avoid impacts to recreation in the vicinity of the Mojave River Well Field, which would probably be constructed at some level at a future date. If recreation were expanded in this area prior to construction of these facilities, a not unlikely event considering the rapid projected growth on both sides of the river which will increase demand for recreation, then potential future project effects on recreation could be greater. The level of future effects under the No Project Alternative are thus potentially lower and potentially higher, depending on the scope and timing of recreation and water project development.

5.12 Traffic

5.12.1 Environmental Setting

Except in the cities and towns, traffic is sparse on all roads except the major highway system. Average daily traffic on Interstate 15, which links the Los Angeles Basin to Las Vegas, ranges from 38,000 to 115,000. Subtracting truck traffic and assuming an average of two passengers per car, this volume of traffic represents about 20% to 70% of the population of MWA's service area. Much of the traffic on the major highways is thus commute traffic to major cities and through traffic involving non-residents.

Like many rapidly developing urban-suburban areas, the Victor Valley area, and to a lesser extent Barstow, are experiencing traffic congestion as a result of rapid development. As an example, average Daily Traffic on State Highway 18 through Apple Valley is approximately 33,000 to 43,000 cars per day. Peak traffic hours account for a majority of this traffic (CalTrans 2004). Weekday traffic on major arterials such as Bear Valley Road and Apple Valley Road is characterized by a morning and evening rush hour with substantial delays at controlled intersections and through commercial areas. Accordingly, there are a number of highway projects underway or planned in Hesperia, Victorville, Adelanto, and Apple Valley.

5.12.2 Facilities Impacts

5.12.2.1 Mechanisms for Effect

Traffic to and from construction sites would add 15-30 one-way rush-hour trips per project to the local road system. In addition, delivery of water to remote construction sites would involve several highway water trucks operating on a constant basis daily. There would be traffic associated with hauling construction equipment to construction sites. The level of traffic impact associated with construction traffic would depend on how many project facilities were being constructed at a given time.

The primary construction-related traffic impact would occur for construction of pipelines within local roads. This would generally involve construction in a single lane, with traffic controls in effect on other lanes. On two-lane roads, one lane would be blocked and traffic control would involve (a) alternating delay in one direction while traffic from the other direction is allowed to pass or (b detouring traffic around the construction site. With either approach, delay would generally be brief, as the construction zone will be from 200 to 300 feet at maximum; the maximum detour distance would be several blocks, resulting in a delay of not more than one minute. On four-lane roads, traffic in one lane would be blocked, leaving three active lanes. Traffic control under these circumstances would generally involve alternating the available lanes to accommodate rush-hour traffic, with two lanes open in the predominant rush hour direction.

5.12.2.2 Minimum Facilities Alternative

The Minimum Facilities Alternative would involve construction at three sites: (a) the Mojave River Well Field, (b) Well Field Delivery Pipelines, and the Unnamed Wash.

On the west side of the Mojave River, the Mojave River Well Field and Delivery Pipelines would involve construction along Carob and Orchid Avenue in Hesperia and along Jess Ranch Parkway and across undeveloped lands to the south of the Jess Ranch Country Club. There is also potential well construction along the undeveloped portion of the floodplain downslope from Orchid Street and south along Wilson Road. Wells along Wilson Road would be connected to the main well-field pipeline along Orchid Ave via Talisman Street. From Orchid Street, the Well Field Delivery Pipeline would run west along Eucalyptus Street to Santa Fe and then turn south to Mesa Street. The Mesa Street alignment would then be followed under Interstate 15, and continue west to connect to the California Aqueduct.

There will be four side lines from Eucalyptus Street and Mesa Street to (a) County Service Facility 64 (via Santa Fe), (b) Victor Valley Water District Reservoirs via Pinion Street, (c) Victor Valley Water District reservoirs via Amethyst Street, and (d) Hesperia Plant 14.

Talisman Street, Carob Avenue, Orchid Street, Wilson Road, Pinion Street and Amethyst Street are two-lane local streets with traffic serving local neighborhoods. Alternative access to neighborhoods served by these streets is (respectively) via Peach Avenue, Jacaranda Street, Lemon Street and Peach Avenue, and Sycamore Street. In this area, traffic delay would affect few people, because alternative routes through the neighborhood are readily available, requiring drivers to make short detours through local streets. No arterial roads would be affected. Eucalyptus Street is an east-west local road, with limited access and a few segments of unpaved road. On Eucalyptus, there is alternative internal neighborhood access via Sycamore Street and local traffic may also be diverted around the pipeline construction area, with no lane controls required. When the pipeline transitions to Mesa Street, levels of traffic decline. Mesa Street carries local traffic and was recommended by City of Hesperia officials primarily for this reason. On the east side of the well field, well and pipeline construction would run along the west and south side of Jess Ranch Parkway, a local road that serves a country club. Wells and pipelines would then approximately follow the alignment of Apple Valley Road along the west side of the country club and cross undeveloped land to the terminus of Tussing Ranch Road.

Impact to traffic associated with the Mojave River Well Field and associated Well Field Delivery Pipelines would be:

- Temporary and minor delays to local neighborhood traffic, for which there are alternative travel routes;
- 1 day delays associated with construction in front of individual residences, during which time resident access to driveways may be reduced and on-street parking will be limited to one side of the street. These delays will occur only during daylight construction hours.
- Temporary minor increases in traffic on roads used by local traffic as detours around the construction zone.
- The addition of 15-30 cars per day to the local road system (for construction traffic) and traffic associated with hauling equipment to the various construction sites. The probable main arterials used to access the local road system would Bear Valley Road and Peach Avenue. The addition of traffic to Bear Valley Road in rush hour could contribute to traffic congestion, but this arterial carries thousands of cars per day, and thus the addition of construction traffic is likely to have only a minor effect, probably within the rage of variability in daily traffic.
- The addition of from 5 to 10 dump trucks per day to local road traffic for hauling spoil away from pipeline and well construction areas.
- Increased construction crew and equipment hauling traffic on access roads for the facilities at the Unnamed Wash (via Arrowhead Lake Road).

Because the Mojave River Well Field and the Well Field Delivery Pipelines have been sited to (a) minimize pipeline length and (b) avoid major arterial roads, traffic impacts will be limited in time and scope. Well construction will result in local drivers having to divert around the well site for no more than about 30 days. Access to homes and driveways will not be blocked. Pipeline construction will affect only a 300-400 foot long section of road at any given time, and the duration of traffic impacts for any given site will be 3-4 days.

Operation and inspection of facilities once constructed will involve routine water quality monitoring and inspection of wells. A Pump Station on undeveloped land at the east end of Eucalyptus Street will be visited by staff daily. Traffic generated by this level of routine work will amount to not more than 10 daily trips along the pipeline alignments.

5.12.2.3 Small Projects Alternative

The Small Projects Alternative will generate construction related traffic, including hauling of construction equipment to the site, along the following routes:

- For the Off-Channel Mojave River Recharge and Pipelines: (West Alignment) Arrowhead Lake Road and arterial roads leading to it (Bear Valley Road and Rock Springs Road); (East Alignment) Deep Creek Road and arterial roads leading to it (Rock Springs Road).
- For Oro Grande Wash: Main-Street/Phelan Road and arterial roads leading to it.
- For Cedar Avenue Detention Basin: Escondido Street and Cedar Avenue
- For Antelope Wash at Ranchero Road: Ranchero Road

Major arterial access to these sites will vary by facility, and for construction-related traffic increases, even simultaneous construction of all Small Projects Alternative facilities would result in construction traffic increases of only 20-30 trips per day to each site, with access via a variety of arterials. This would represent a fraction of the traffic carried by the major north-south and east-west arterials.

Except for the roads leading to Off-Channel Mojave River Recharge, construction itself will not affect traffic, except that (a) off-highway construction vehicles such as water trucks and (b) construction crews will enter the road and may cause momentary delay during construction hours.

Construction delays along the alignment of the pipeline for the west site for Off-Channel Mojave River Recharge would be (a) brief delay along Glendale and Calpella roads (because there are alternative local roads into and out of the area and detours around construction will involve delay of about 1 minute) and (b) moderate delays along Arrowhead Lake Road (because construction will generally be feasible in the public right of way along the road, and construction in the road will be minimized). Some delay due to driver curiosity may occur. Detouring around Arrowhead Lake Road is not feasible in the affected reach.

Traffic impacts associated with the east site for the Off-Channel Mojave River Recharge would occur along Deep Creek Road, which is primarily used by local traffic and does not carry significant traffic during weekday hours. There is no convenient detour via paved roads. Use of Deep Creek Road for pipeline construction will therefore involve traffic delay associated with traffic control. Delays of up to several minutes are possible.

Operations of all Small Projects Facilities would involve routine inspection and maintenance as well as management of several recharge facilities. This would involve daily/weekly routine access to these sites. Traffic generated by this level of routine work will amount to approximately 20 daily trips along the pipeline alignments and to the 4 recharge basins.

5.12.2.4 Large Projects Alternative

The Large Projects Alternative involves off-road work at three relatively remote locations. The traffic-related effects of this work would be:

- Increased construction crew and equipment hauling traffic on access roads for the Oeste and Alto Recharge Basins and Pipelines (Highway 18);
- Increased construction crew and equipment hauling traffic on access roads for the Antelope Wash Recharge (via Ranchero Road);

The addition of construction traffic on Highway 18 could cause short delays on this busy arterial.

At Antelope Wash, the construction and operation of recharge basins would not involve work in the public roads, and only about 20-30 trips per day per facility are likely to occur. The probable access to both the upstream recharge site and the Ranchero Road recharge site is Ranchero Road and the dirt road running along MWA's Mojave River Pipeline alignment. Given similar patterns of access, no substantial change in traffic related to commuting construction crews and hauling of construction equipment to and from the site would occur as a result of relocating upstream recharge capacity to a downstream recharge site as described in Chapter 4.

5.12.3 Operations Effects

Operations will have very small effects on traffic. Routine operations traffic associated with personnel commuting to work would add 2-5 trips per day on any given road. There will be infrequent movement of maintenance equipment between sites, but this is likely to result in addition of 1-2 vehicles per move and to occur infrequently. Operational traffic will probably increase marginally as the magnitude of the banking and exchange program increases. None of these increases would result in significant traffic effects.

5.12.4 Mitigation and Significance of Impacts after Mitigation

5.12.4.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant traffic effects if activities were to:

- Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections);
- Exceed, either individually or cumulatively, a level of service standard established by the

county congestion management agency for designated roads or highways;

- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks;
- Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment);
- Result in inadequate emergency access;
- Result in inadequate parking capacity;
- Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?

The project has no mechanism for causing effects related to parking, hazards related to road design; alternative transportation plans or programs, or air traffic patterns. Its effects are only related to short-term impacts on traffic as a result of construction crews and equipment hauling and to work in the public right-of-way.

5.12.4.2 Mitigation and Significance after Mitigation

To minimize potential traffic effects associated with construction and operation of facilities, MWA will comply with all local encroachment permit requirements. In addition, MWA will:

- Schedule hauling of construction equipment (and water, if feasible) to and from the various construction sites prior to or following rush hours;
- Use off-road rights-of-way (road shoulders and sidewalks) for construction to the extent feasible;
- Encourage construction crews to carpool to construction sites;
- Identify and clearly mark emergency access routes around sites where construction takes place within the public right-of-way;
- On a daily basis, inform local emergency services of the location of all sites involving construction in the public right-of-way; and
- If the Minimum Facilities Alternative pipeline for delivery from the Mojave River Well Field is implemented, it will be installed under Interstate 15 using directional drilling or "jack and bore" techniques.

Because construction crew traffic and long-term operations traffic will represent a minor fraction of total traffic on access roads to the proposed facilities, because traffic may be detoured around a majority of the construction sites which are in or adjacent to public roads, impact associated with most elements of the Proposed Project would be considered less-than-significant before mitigation. With implementation of the above mitigation measures, including compliance with terms and conditions of road encroachment regulations and rules, all of the elements of the proposed project would have traffic impacts considered less-than-significant.

5.12.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The effect of the No Project Alternative on construction-related and operations-related traffic is likely to vary, depending on the level of facility development pursued under the No Project Alternative and the timing of this development. An extended period of water recharge and conveyance facility development would reduce traffic impacts because they could be spread out over a longer period of time. At the same time, probable increases in development over this time will result in greater traffic congestion. It is probable that traffic impacts associated with future development of some of the facilities proposed would be approximately the same as those for the Proposed Project, and after mitigation would be less-than-significant.

5.13 Water Resources (Water Quality)

5.13.1 Environmental Setting

Surface water supplies in the MWA service area are unreliable and water users in the MWA service area rely on groundwater for agricultural, residential, and commercial/industrial use. Treatment facilities for surface water supplies are not available and therefore MWA delivers supplemental supplies as surface water to only two power plants, which utilize supply for cooling. Other supplies must be recharged and subsequently extracted.

Under the 1996 Adjudication, MWA functions to provide supplemental water to producers who require additional supplies to offset their production in excess of that allowed under the adjudication. By 2020 to 2025, MWA projects that it will, on average, utilize its entire SWP Table A allocation to meet these requirements.

Under current operations, MWA has limited flexibility in managing its SWP Table A allocations and other available water. It has limited recharge capacity, in part because there is an effective limit of about 60,000 acre-feet of recharge on the Mainstem Mojave River unless some of this recharge is subsequently extracted before passing through the Narrows. In addition, MWA has limited financial capacity to pre-delivery groundwater. Thus, MWA does not currently take all of its SWP Table A supplies.

Current water use practices have the effect of concentrating minerals in soils and groundwater. First, when groundwater is extracted and used for domestic or agricultural irrigation, it is subject to evaporation and transpiration, which results in concentration of the minerals in the water. Second, domestic and industrial water use result in evaporation and concentrations of salts as waste which will then be discharged to sewage treatment facilities, where treatment results in evaporation. These supplies, with higher concentrations of minerals, are then recharged into the groundwater. To the extent that supplies from the Regional Aquifer are extracted and then discharged as treated water to the Regional Aquifer, there is a progressive increase in mineral concentrations in this aquifer.

In their initial screening of alternatives for recharge facility sites, Bookman-Edmonston (2004b) reviewed the available literature on recharge conditions in the MWA service area. They noted that artificial recharge of the Mojave River Floodplain Aquifer and indirectly to the Regional Aquifer has been proposed by several sources (citing Lines 1996 and Stamos, Martin, and Predmore, 2002). Bookman-Edmonston (2004b) describes the general conditions at the sites evaluated for potential recharge.

<u>The Mainstem Mojave River</u>: The Mojave River is the primary source of natural recharge to the MWA service area, with surface water recharging to the Floodplain Aquifer rapidly and moving downstream and laterally to the adjacent Regional Aquifer. Groundwater quality is good, with low TDS and low salts in general, reflecting source water quality. The Mojave River bed consists of unconsolidated sands to a depth of 100+ feet and is connected hydraulically to the Regional Aquifer. There are few clay lenses in the Floodplain Aquifer and, consistent with results from MWA's 2003 pilot project, recharge rates are estimated to range from 5 to 40 feet per day per acre (LRWQCB 2001, citing Durbin and Hardt 1974; USDA 1986; and Pirnie 1988). Horizontal transmissivity to the Regional Aquifer has been estimated using the USGS Mojave River Basin Model (MWA 2004, in Bookman-Edmonston 2004b) and maximum annual recharge and extraction rates for the reach between Mojave Forks Dam and the Narrows, with no controls for water depth and liquefaction, have been estimated at 150,000+ acre-feet and 130,000+ acre feet, respectively. This is clearly a high estimate, but it illustrates the high transmissivity of the soils in the floodplain aquifer. Soil characteristics in this area minimize potential for recharged water to leach minerals into groundwater. Soil characteristics on flood bench on the east side of the river are similar to those of the river itself, sandy with low clay content. The floodplain bench on the west side of the river has higher potential for loam and clay-loam soils and thus has lower permeability and potential for mineral concentrations that could be leached during recharge.

Bookman-Edmonston's (2004b) review of available literature and well logs is consistent with Stamos, Martin, and Predmore (2002) in finding no water quality conditions in the Mojave River Mainstem above the Narrows that would affect use of this reach for artificial recharge.

<u>The Regional Aquifer (Oeste, Alto, Cedar Avenue Detention Basin, Oro Grande Wash, Antelope Wash)</u>. The Regional Aquifer has not been as well characterized as the Floodplain Aquifer. Depth to groundwater in this heavily overdrafted area can be as high as 400 to 600 feet in some areas. There are maps showing concentrations of minerals in wells throughout the MWA service area (Christensen and Fields-Garland 2002, cited in Bookman-Edmonston 2004b) which provide indications of potential for mineral content in the soils overlying the Regional Aquifer. In addition, Bookman-Edmonston (2004b) note that recharge to the Regional Aquifer may be affected by fine-grained materials that (a) may inhibit percolation and (b) contain minerals with

high solute potentials (leaching). Based on characterizations of soils underlying Oro Grande Wash, Izbicki, Radyk, and Michel (2000, cited in Bookman-Edmonston 2004b) conclude that recharge in washes where natural recharge occurs would provide for higher infiltration rates and reduce the potential to encounter concentrations of minerals such as chlorides, heavy metals, and arsenic that may leach out during recharge. Given that runoff is concentrated in washes and has the greatest energy near the mountains, larger fractions of sediment load would settle out in upstream areas of the washes and the potential for clay deposits would be expected to increase with distance from washes and distance downstream. This general trend is confirmed by investigations of groundwater recharge in downstream areas, which found extensive clay layers associated with historic lake-type flooding (Bookman-Edmonston 2004b).

Morongo Basin/Lucerne Valley. The Colorado Regional Water Quality Control Board Basin Plan (CRWQCB 2002, Section VI. A.) describes groundwater hydrology in the Lucerne Valley Planning Area, noting that the area contains numerous small drainage basins. Groundwater is stored principally in unconsolidated alluvium and is generally unconfined. Alluvial deposits are generally hundreds of feet deep and in some areas are known to be 1200 feet deep. Depth to groundwater ranges from flow at the surface to 445 feet. Groundwater generally flows in the general gradient of the land, except where influenced by heavy extraction which creates a localized cone of depression. In this portion of MWA's service area, an overriding objective of CRWQCB is to "minimize the quantities of contaminants reaching any ground water basin and to maintain the existing groundwater quality where feasible. CRWQCB notes that there is groundwater overdraft in the Lucerne Valley and that recycling of groundwater results in "an increase in mineral concentrations such as total dissolved solids (TDS), nitrate etc." Bookman-Edmonston (2004b) did not specifically evaluate hydrogeology of the existing spreading basins in the Morongo Basin/Yucca Valley.

Site Specific Analyses. With the exception of recharge basins in the Morongo Basin, MWA's existing recharge sites that would be used in the banking and exchange program are within the Mojave River Floodplain Aquifer, and have characteristics of this aquifer -- sandy soils, relatively high recharge rates, minimal presence of clay and fine-grained materials that would result in leaching of minerals into groundwater. These conditions also exist in the Mainstem Mojave River reach proposed for recharge and in soils adjacent to this reach, although there are clays beneath portions of the west bank of the Mojave River that could affect recharge rates and leaching potential at this site.

With regard to Regional Aquifer sites, portions of the Oeste and Alto areas adjacent to the California Aqueduct are known to have clay and fine-grained materials between the two proposed recharge sites (Bookman-Edmonston 2004b). But driller's logs do not indicate clays in the areas proposed for recharge.

The hydrogeology of Antelope Wash is not well documented, but Slade and Associates (2004, cited in Bookman-Edmonston 2004b) show 400 feet of sand and gravel beneath Antelope Wash in the City of Hesperia, suggesting that recharge to this wash would recharge the Regional and the Floodplain aquifers. This is not an unexpected finding given the high energy of flows through this wash which would deposit larger fractions of sediments in the wash and finer sediments downstream where the floodplain widens. Recent drilling for the new Westbay well also shows this area to be underlain primarily with sand and gravel.

MWA has recently conducted recharge tests at Oro Grande Wash and found that recharge is not substantially constrained by soil conditions. Soils beneath the wash itself are sandy and recharge rates are adequate to sustain a recharge program. The frequent inundation and natural recharge of the wash results in low potential for soluble minerals and thus leaching problems associated with recharge outside of washes would be avoided.

5.13.2 Analysis of Water Supply and Water Quality Effects

5.13.2.1 Mechanisms for Effect

Biological Effects of Recharge: Recharged surface water may contain bacteria, viruses, and other microorganisms such as *giardia* and *cryptosporidium*. Surface water, and groundwater under the direct influence of surface water, must thus be treated to inactivate these harmful microbes. The federal Surface Water Treatment Rule defines "groundwater under the direct influence of surface water" as:

> "any water beneath the surface of the ground with: (1) significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia*, or (2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions."

Groundwaters found to be under the influence of surface water must be treated to bring them into compliance with drinking water regulations. Recharge may raise groundwater levels and bring them under the direct influence of surface waters, affecting biological water quality.

Recharged water is bioremediated as it flows vertically and laterally through the unsaturated soil zone during recharge. During movement through the soil, harmful bacteria and viruses are inactivated via a number of aerobic biodegradation processes which are strongly influenced by dissolved oxygen and temperature (Metge 2002). The processes for this are similar to the widespread process of slow sand filtration for treatment of sewage.

Bioremediation rates depend on a variety of factors: rate of water movement through the unsaturated zone, temperature, salinity, dissolved oxygen, pH, microbial size and species, predation, metal/nutrient availability, and microbial growth. The bacteria in surface waters may be effectively inactivated relatively rapidly as groundwater moves through the subsurface soils. For example, at the Montebello recharge basin in Los Angeles, Anders et al (2002) found that bacterial viruses (bacteriophages) were removed (7-log removal standard) from recharged recycled water after traveling only 100 feet downstream. Similarly, the State of Washington Division of Environmental Health (2004) identifies groundwater under the *potential* influence of surface water as groundwater less than 50 feet deep within 200 feet of surface water. This reflects the ability of bioremediation processes to remove harmful bacteria in surface waters within a relatively short distance from the water source. Much of the bioremediation is associated with factors such as bacterial attachment to the surface of sediments in the upper layers of the soil (Rogers 2002).

Potential for the banking and exchange program to cause groundwater to be under the influence of surface water is limited to recharge into the Mainstem Mojave River in the Alto subarea. At other recharge sites, vertical and lateral infiltration rates and groundwater depths effectively eliminate the potential for water extracted from areas near recharge sites to be under the influence of surface water. Prior to construction, MWA will identify and properly decommission any existing wells that could result in introduction of recharge water directly to the groundwater basin. This will effectively eliminate this potential pathway for surface water influence on the aquifer. The potential for recharged water in the Mainstem Mojave River is related to the high potential volume of recharge, rising groundwater levels, and the relatively rapid downstream and lateral movement of recharged groundwater in this reach of the Mojave River Floodplain Aquifer and the adjacent Regional Aquifer.

In the Mojave River Floodplain Aquifer, natural surface water flow is intermittent and thus for a majority of the time, there is no potential for groundwaters to be influenced by surface flows. During periods of high flow, such as occurred in the winter of 2005, the river may have surface flow for several months. There will be surface flow during artificial recharge as well. In the 2003-2004 demonstration project involving ramped releases of up to 500 cfs from Silverwood Lake over a period of about 30 days (November-December) and simultaneous discharges from the Rock Springs Outlet, surface flow was initially recharged rapidly in the upstream portion of the river, but extended from Mojave Forks Dam to near Bear Valley Road at flows of 500 cfs.

Based on MWA's USGS model studies (Bookman-Edmonston 2004b), horizontal conductivity in the Mojave River Aquifer is estimated at 100 feet per day, and the Mojave River Aquifer could contributes 130,000+ acre-feet per year to the adjacent Regional Aquifer, although lateral penetration of this aquifer is at a lower rate. Downstream migration of groundwater percolated into the Mojave River Aquifer in the reach above Rock Springs would therefore take approximately 50 days to reach the upstream edge of the well field and longer to reach wells set off-channel in the zone between the Regional Aquifer and the Floodplain Aquifer. Flow towards the well fields located in the Regional Aquifer would be slower. Recharge would not be undertaken during periods of natural flow.

<u>Physical and water chemistry effects of recharge</u>: In addition to inactivating bacteria and viruses, recharge affects water chemistry in a variety of complex ways. Water for recharge is often of different water quality than that of natural runoff, and variable water quality may affect the chemical and physical characteristics of the subsurface soils.

The most obvious physical effect associated with recharge is the slow formation of an organic layer at the recharge basin site as macro-organic material in recharged water collects in the top

10 cm of the soil (Leenheer 2002). Much of this is a result of adsorption to the surface of the soil grains. Organic carbon removal in this upper layer of the soil may be 25% of the total carbon load in the recharged water (Quanrud et al 1996 cited in Leenheer 2002). This removal of complex organic compounds in the upper layer of recharge basins includes degradation of organic hydrocarbon pollutants. Leenheer (2002) notes that 30-40% of the organic carbon in recharge supplies may be colloids from bacterial cell walls and that virtually all of this carbon is removed in the first one foot of infiltration. Citing Bower et al (1974) and others, Leenheer (2002) notes that DOC removal may be from 48% to 90% as recharged water percolates into the ground and moves horizontally through the soil. These reductions are a function of adsorption and biodegradation. These processes have been found to be enhanced by high dissolved oxygen concentrations in recharged water (Ding et al 1999 cited in Leenheer 2002); SWP supplies typically have high dissolved oxygen concentrations (8.5 to 9.5 mg/l). DOC removal in sand and sandy loams has been measured at 48% and 44% (Rostad 2002, citing Quanrud et al 1996).

Fine sediments may also clog the pore spaces in the recharge basin soils. A vast majority of this potential "clogging" of the recharge basin with organic matter and fine sediments occurs in the upper 1-foot of the soil. Recharge basins in use for decades, such as the recharge basins at Arvin-Edison Water Storage District and North Kern Water District which have been in operation for 40 to over 50 years, require periodic scraping to remove the upper layers of the recharge basin, followed by ripping of the soil to reduce compaction. These routine maintenance activities rapidly restore recharge capacity, suggesting that the physical effects of recharge occur primarily in the upper foot or two of the basin.

Recharge with acidic water may also leach minerals from subsurface soils and result in higher levels of dissolved solids in groundwater (Colorado River Regional Water Quality Control Board 2003 Basin Plan). This is unlikely with SWP supplies, which have pH outside of the acidic range (pH 7.2 to pH 8.0). High levels of dissolved oxygen may also help to mobilize minerals in soil and cause leaching into groundwater. SWP supplies have dissolved oxygen levels of from 8.5 to 9.5 mg/l. These are not higher than natural runoff from the Mojave River watershed in the San Bernardino Mountains and thus no increase in the rate of leaching is likely to occur.

There are a variety of complex chemical processes that occur as recharged water percolates through the subsurface soils. Decomposition of organic compounds occurs (a) in the upper aerobic zone where available oxygen allows aerobic microbes to degrade organic compounds to simpler compounds such a carbon dioxide and (b) in the anaerobic zone where the oxidized forms of inorganic compounds are used by microbes. These oxidation/reduction reactions change the chemistry of the recharged water (reducing concentrations of complex organic compounds) and the chemistry of the soils (such as leaching of minerals from soils into the groundwater). For example, the iron and manganese oxides that are found in most sand and gravel aquifers (Cozzarelli 2002) may be affected by organic matter oxidation, resulting in higher concentrations of dissolved iron and manganese in the receiving groundwater.
Arsenic, a mineral of concern in the MWA service area due to high concentrations in some wells, may be affected by recharge operations in several ways. Leaching of arsenic involves mobilization of the mineral from the solid to aqueous phase, and is facilitated by (a) highly

alkaline conditions (pH > 8); (b) high phosphate concentrations, and (c) anaerobic environments (Bostick and Fendorf 2005). At the same time, Oremland (2002) notes that in the presence of oxygen, iron, and nitrates (but low organics), bacteria may reduce the mobility of arsenic compounds. The rate at which, and conditions under which, leaching and/or mineralization of arsenic may occur are not well quantified and thus the net effect of recharge on arsenic is both site dependent and not predictable at this time.

Indigenous groundwater in the MWA service area affected by the proposed project facilities has a pH range of from 7.7 to 8.3; SWP supplies have approximately the same range, although they seldom exceed pH of 8.0. Import of SWP supplies will therefore probably not increase mobilization of arsenic related to pH values.

Altering Groundwater Levels: Recharge may raise groundwater levels with unintended consequences. For example, recharge at the Yucca Valley recharge basins has raised groundwater levels by 240 feet, and has been associated with high nitrate concentrations and turbidity in water extracted (Densmore and Bohlke 2002). Although nitrate concentrations in the recharged water were low, high nitrate concentrations were an indirect effect of rising groundwater encountering high-nitrate water from nearby septic systems. High turbidity was an indirect result of recharged water becoming saturated with air during recharge, resulting in high levels of dissolved gas in the water pumped from the rising aquifer. Such indirect effects may occur under a wide variety of conditions.

Mass Loading: Finally, recharge of water results in mass loading; that is, minerals in the recharged water will tend to accumulate in groundwater. Subsequent extraction and use of this water can result in evaporation and associated concentration of minerals in the surface soil or use, treatment, and recharge of treated water, resulting in increasing concentrations of minerals in the groundwater. The concentration of minerals in the groundwater basin will ultimately degrade groundwater quality for human use unless the basin drains away from the area of human use.

Various elements of the Project involve import of SWP supplies, recharge into the Mojave River Floodplain Aquifer, and subsequent extraction from this aquifer for use in lieu of extractions from the heavily overdrafted Regional Aquifers and Floodplain Aquifer. To the extent that the Project provides different quality supplies for use, mass loading and concentration of minerals in the MWA service area would vary.

Summary of Mechanisms for Effect: The physical and chemical processes by which recharge affects groundwater quality are complex and site specific. The recharge sites currently in operation and proposed have been selected for a variety of reasons:

- Soil permeability. All of the recharge sites selected are in areas of sandy/loam alluvial soils with minimal potential for clays and virtually no potential for drainage through subsurface rock. Soils in these areas are primarily silicates.

- Mineral leaching (emphasis on arsenic). Proposed recharge areas are in the Alluvial Aquifer, where arsenic levels in indigenous groundwater are lowest, or in low-arsenic areas of the Oeste and Alto Regional Aquifers.
- Mixing of indigenous and recharge supplies: Recharge supplies and indigenous water supplies are of different and variable quality. Recharge areas have been selected to minimize the potential for adverse impacts associated with mixing high quality SWP supplies with very low quality groundwater in some areas of the MWA service area.

Given these considerations, the mechanisms by which recharged water may affect water quality include:

- Bacterial contamination from surface water influence. If recharged water directly affects groundwater as described in the surface water rule, then groundwater quality may be degraded.
- Dissolved organic carbon. Surface water supplies may introduce DOC into groundwaters.
- Changed groundwater levels. Recharge may result in mounding of water, which may bring groundwater into contact with surface contaminants.
- Chemical interactions. Recharged water may leach minerals from the soils as it passes through them or may enhance the mineralization of some minerals, most significantly arsenic compounds, thus removing them from groundwater.
- Net increases in mineral loading in groundwater. Recharge may affect the concentration of minerals in the affected groundwater, either positively or adversely, depending on recharge water quality, site conditions, and operations.

5.13.2.2 Analytical Approach

<u>Priority of Water Quality Constituents for Analysis:</u> Arsenic is probably the most important constituent to address in water quality impact analysis for the MWA service area because arsenic standards have become more stringent and arsenic is a documented problem in some portions of the MWA service area. Variables that may be quantified given available water quality data are:

- Concentrations of arsenic in recharged and receiving waters
- pH of recharged and receiving waters, because pH affects arsenic mobilization
- Sulfates, because sulfur compounds mediate anaerobic reactions with arsenic in groundwater
- Chlorides and total dissolved solids (various mineral salts) because accumulation of salts in groundwater can affect the long-term suitability of groundwater for urban uses. The effects of mixing recharge water with indigenous groundwater can be evaluated in terms of mass loading; that is the total amount of TDS delivered under the base condition versus the Proposed Project alternatives.

Boron is a lower-priority constituent for analysis because SWP supplies generally have lower concentrations on average than occur in the Proposed Project recharge sites and both SWP and

Alto water supplies have concentrations well below those set in California DHS Drinking Water Standards.

Total organic carbon and bromides are of fourth-level concern because (a) their effects are related to formation of trihalomethanes (THM's) as a result of chlorination and chloramination and (b) bromides are not generally found in indigenous groundwater. These constituents would be of greater concern if groundwater must be treated (with chloramines) prior to distribution. At present groundwater is treated at subarea producer's facilities.

<u>Patterns of Water Quality in SWP Supplies</u>: The water quality of SWP supplies varies significantly from month to month and year to year. Water banking and exchange programs involve movement and use of water in specific year types and during specific parts of the year. Long-term average SWP water quality is therefore not a good predictor of actual water quality in the water delivered in banking and exchange projects.

Deliveries of supplies to water banks generally occur in wet years, or in the year immediately following a wet year when there is adequate water supply in SWP storage facilities at Oroville and San Luis reservoirs. In addition, a majority of deliveries to banking projects have generally occurred during the months of March through June, in part because in many wet years, the Department of Water Resources may not have established Table A allocations until after February, when overall precipitation and snow pack conditions are known well enough to predict net available supply. In addition, in a wet year following a dry year, agencies may want to fill surface and groundwater storage within their own service areas prior to making deliveries to third-party groundwater banks. These considerations are reflected in Table 5-22, which describes Metropolitan's historic deliveries to three groundwater banks in Kern County for the period 1993 through 2004.

In addition, banking agencies such as Metropolitan do not generally take deliveries of banked supplies unless they are needed, in part because of the added expense or conveyance to and from banks, and the loss associated with banking. As a result, Metropolitan has historically taken supplies from its Kern County water banks in dry years.

Based on Department of Water Resources monitoring at Check 41 of the California Aqueduct from 1998-2004, there is significant monthly and annual variation in concentrations of various water quality constituents (Tables 5-23 to 5-36). The general trends in SWP water quality are:

- For most constituents, SWP water quality tends to be better in above-normal and wet years. This is a result of high levels of precipitation that dilute minerals and other chemicals in runoff, the positive effects of high flows on sea water intrusion, the extended discharge of water from the Sierra Nevada snow pack (which is of high quality), and the generally higher SWP allocations which mean that more water is released from Lake Oroville and thus sea water intrusion continues to be minimized in the summer. In fall, water quality tends to decline, in part because lower agricultural demand at harvest reduces net release to the Delta and more sea water intrusion occurs (as evidenced by the rapid increase in bromides from September to October; Table 5-24).

- For most constituents, SWP water quality tends to be better in the spring and early summer. This occurs because spring and early summer supplies are dominated by snow pack runoff and high releases from reservoirs as the agricultural irrigation season begins.

Various water quality constituents of concern have different patterns of variation, probably reflecting differences in the sources and mechanisms by which they enter the water (Tables 5-23 through 5-36). They may vary monthly (reflecting factors such as snow melt and runoff to the Delta, reservoir releases, and volume of exports) or annually (reflecting annual precipitation and total runoff and outflow through the Delta). Tables 5-23 through 5-36 illustrate these variations for a 7-year period of record (1998 through 2004) that included a sequence of above normal and wet alternating with below-normal and dry years. Based on this recent period of record, some trends in water quality can be noted

- Arsenic (Table 5-23 & Table 5-39). There is a slight monthly variation apparent in the data, with marginally higher arsenic levels in SWP supplies in late summer. There is no clear dry-year/wet-year pattern. The lack of strong trends may be because arsenic levels are often at or near the level of detection. Arsenic appears to be slightly lower in months when deliveries to water banks have been highest.
- Boron (Table 5-24 & Table 5-39). Boron levels in SWP supplies tend to be highest in winter and spring. There is no clear dry-year/wet-year pattern. Boron appears to be slightly lower in months when deliveries to water banks have been highest.
- Bromides (Table 5-25 & Table 5-39). Bromides are lowest in above-normal and wet years and in the months from February through September, reflecting the effects of higher flow regimes in these months on seawater intrusion into the Delta. Bromides appear to be slightly lower in months when deliveries to water banks have been highest.
- Chlorides (Table 5-26 & Table 5-39). Chlorides are lowest in wet years and in the months from February through September, reflecting the effects of higher flow regimes on seawater intrusion into the Delta. Chlorides are slightly lower in months when deliveries to water banks have been highest.
- Chromium (Table 5-27 & Table 5-39). Chromium shows a slight trend towards higher concentrations in early winter, and in wet years. Chromium appears to be slightly lower in months when deliveries to water banks have been highest.
- Fluorides (Table 5-28 & Table 5-39). There is very little monthly or wet-year/dry-year variation in fluoride concentrations, with all measurements ranging from 0.1 to 0.2 mg/l. What variation there is tends to be in above-normal and wet years, when spring concentrations may be 0.2 mg/l. Fluoride appears to be slightly higher in months when deliveries to water banks have been highest.
- Iron Table 5-29 & Table 5-39). Iron levels are seasonally highest in December-March and are generally at or below detectable levels in the remainder of the year. This may reflect the effects of runoff from lower elevations of the Central Valley and surrounding mountains as a result of winter rainfall. Iron levels are slightly lower in months when deliveries to water banks have been highest.

- Lead (Table 5-30 & Table 5-39). There is no measurable variation in lead concentrations in SWP supplies. Measurements in 1998-2004 were below 0.001 mg/l (1 ppb).
- Nitrates (Table 5-31 & Table 5-39). Nitrates in SWP supplies tend to be lower in spring and summer (reflecting the influence of snowmelt runoff) and to be lower in wet years, reflecting the influence of high overall runoff. Nitrates appear to be slightly lower in months when deliveries to water banks have been highest.
- pH (Table 5-32 & Table 5-39). There is no obvious seasonal pattern for pH in SWP supplies, but pH appears to be lower in wet years than dry years. pH appears to be slightly higher in months when deliveries to water banks have been highest.
- Selenium (Table 5-33 & Table 5-39). There is very little variation in selenium concentrations in SWP supplies, either monthly or annually. Selenium appears to be slightly lower in months when deliveries to water banks have been highest.
- Sulfate (Table 5-34 & Table 5-39). Sulfate. Sulfates tend to be highest in the winter and early spring and were particularly low in the wet year of 1998. Sulfate appears to be slightly lower in months when deliveries to water banks have been highest.
- Total dissolved solids (Table 5-35 & Table 5-39). TDS levels vary with season and by year type, with better water quality in wet years and in spring-summer. TDS appears to be slightly lower in months when deliveries to water banks have been highest.
- Total organic carbon (Table 5-36 & Table 5-39). There is no obvious seasonal or annual pattern for TOC in SWP supplies. TOC appears to be slightly lower in months when deliveries to water banks have been highest.

These monthly and annual difference in SWP water quality are important because Metropolitan deliveries to banking programs vary monthly (Table 5-22) and by year type, with almost all deliveries to banking occurring in above-normal to wet years and a majority of water delivered during the months of March through August (Tables 5-37 and 5-38).

The Pearson's Rank correlations shown on Table 5-38 and the weighted averages calculated for Table 5-39 suggest that water delivered to banking operations would have generally lower concentrations of arsenic, bromides, chlorides, chromium, iron, lead, selenium, sulfate, total dissolved solids, and total organic carbon than water delivered in equal installments over 12 months. That is, the timing of bank deliveries results in better-than-average water quality for these constituents. Banking deliveries would have higher-than-average concentrations of boron, fluoride, and pH. Pearson's rank correlations are a relatively simple but reliable indication of significance. They reflect the strength of the relationship, but not the magnitude of the difference. The importance of the variation in water quality in banked versus average water supply may be evaluated by comparing differences in concentrations of the various constituents to the water quality objectives of the Lahontan Regional Water Quality Control Board (LRWQCB 2004) and the Colorado River Regional Water Quality Control Board (Tables 5-39 and 5-40)

Table 5-22. Monthly Metropolitan deliveries to water banking programs (Arvin-Edison, Semitropic, and Kern Delta), 1993-2004 in acre-feet. Data from Department of Water Resources, SWPAO Branch, 2005. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1993 AN	0	7,458	29,039	13,503	0	0	0	0	0	0	0	0	**50,000**
1995 W	0	0	0	0	18,500	31,500	0	0	0	0	0	0	**50,000**
1996 W	7,004	17,442	19,295	22,700	13,559	0	0	0	2,094	11,000	1,906	0	**95,000**
1997 W	0	7,162	25,522	24,392	20,821	0	5,000	5,000	19,650	12,673	4,780	1,4960	**139,960**
1998 W	12,806	1,103	12,750	10,000	14,000	0	150	1,759	12,519	4,147	0	0	**69,234**
1999 AN	850	7,950	18,161	33,956	51,184	14,155	0	0	2,958	137	4,292	4,369	**177,333**
2000 AN	12,049	4,475	0	10,801	0	21,130	24,803	16,675	17,166	21,119	15,752	5,761	**149,731**
2003 BN	0	0	0	0	32,415	30,827	28,230	59,706	1,400	1,520	675	170	**154,943**
	32,709	**45,590**	**104,767**	**115,352**	**150,479**	**97,612**	**58,183**	**83,140**	**55,787**	**50,596**	**27,405**	**25,260**	

Table 5-23. Arsenic in SWP supplies at the Tehachapi Afterbay (Check 41), January 1998 to December 2004 (from DWR 2005), in micrograms/liter (parts per billion). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	2	2	3	1	3	3	2	3	3	2	2	2	**27**
1999 W	3	3	1	2	2	2	2	2	2	2	2	2	**25**
2000 AN	2	2	2	2	1	2	3	2	2	2	2	2	**24**
2001 D	2	2	2	3	2	2	2.25	3	3	3	4	3	**31.25**
2002 D	2	2	2	3	2	2	2	3	3	1	1	1	**24**
2003 BN	2	2	2	2	2	2	2	2	2	2	1	2	**23**
2004 D	2	2	2	2	2	3	3	3	4	4	4	2	**33**
Total	**15**	**15**	**14**	**15**	**14**	**16**	**16.25**	**18**	**19**	**16**	**16**	**14**	
Mean	**2.14**	**2.14**	**2.0**	**2.14**	**2.0**	**2.3**	**2.3**	**2.6**	**2.7**	**2.3**	**2.3**	**2.0**	**2.24**

Table 5-24. Boron in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.02	0.02	0.02	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	**1.06**
1999 AN	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	**2.1**
2000 AN	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	**1.9**
2001 D	0.2	0.2	0.2	0.2	0.2	0.2	0.19	0.1	0.1	0.2	0.17	0.2	**2.16**
2002 D	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	**2.1**
2003 BN	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	**1.9**
2004 D	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	**1.9**
Total	**1.22**	**1.22**	**1.22**	**1.3**	**1.3**	**1.2**	**0.79**	**0.8**	**0.7**	**1.1**	**1.07**	**1.2**	
Mean	**0.17**	**0.17**	**0.17**	**0.19**	**0.19**	**0.17**	**0.11**	**0.11**	**0.1**	**0.16**	**0.15**	**0.17**	**0.155**

Table 5-25. Bromides in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million or ppm). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.34	0.24	0.22	0.01	0.01	0.01	0.07	0.19	0.11	0.06	0.06	0.08	**1.4**
1999 AN	0.17	0.13	0.13	0.15	0.18	0.13	0.10	0.11	0.11	0.22	0.27	0.27	**1.97**
2000 AN	0.24	0.16	0.07	0.01	0.18	0.13	0.12	0.12	0.12	0.22	0.27	0.35	**1.99**
2001 D	0.40	0.34	0.31	0.42	0.18	0.13	0.21	0.19	0.19	0.40	0.34	0.31	**3.42**
2002 D	0.24	0.13	0.17	0.23	0.25	0.24	0.15	0.31	0.31	0.47	0.39	0.29	**3.18**
2003 BN	0.32	0.20	0.14	0.13	0.21	0.09	0.10	0.10	0.12	0.28	0.30	0.35	**2.34**
2004 D	0.32	0.11	0.11	0.12	0.20	0.22	0.16	0.17	0.23	0.29	0.14	0.27	**2.34**
Total	**2.03**	**1.31**	**1.15**	**1.07**	**1.21**	**0.95**	**0.91**	**1.19**	**1.19**	**1.94**	**1.77**	**1.92**	
Mean	**0.29**	**0.19**	**0.16**	**0.15**	**0.17**	**0.14**	**0.13**	**0.17**	**0.17**	**0.28**	**0.25**	**0.28**	**0.198**

Table 5-26. Chlorides in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	100	81	77	4	4	2	22	57	37	21	20	25	**450**
1999 AN	48	42	26	49	58	62	44	31	37	71	78	79	**625**
2000 AN	75	61	34	40	64	50	48	46	40	67	85	103	**713**
2001 D	124	106	66	53	64	50	71.5	63	59	134	105	93	**988.5**
2002 D	79	46	59	120	74	80	50	92	92	113	113	98	**1016**
2003 BN	99	62	50	41	79	34	35	35	40	86	94	111	**766**
2004 D	99	46	52	48	73	72	53	57	69	90	76	84	**819**
Total	**624**	**444**	**364**	**355**	**416**	**350**	**323.5**	**381**	**374**	**582**	**571**	**593**	
Mean	**89**	**63**	**52**	**51**	**59**	**50**	**49**	**54**	**53**	**83**	**82**	**85**	**64.0**

Table 5-27. Chromium in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.060**
1999 AN	0.005	0.007	0.005	0.005	0.005	0.007	0.005	0.005	0.005	0.006	0.005	0.006	**0.066**
2000 AN	0.006	0.007	0.006	0.005	0.005	0.006	0.006	0.005	0.005	0.005	0.005	0.006	**0.067**
2001 D	0.005	0.005	0.005	0.005	0.007	0.006	0.0035	0.004	0.006	0.005	0.004	0.002	**0.0575**
2002 D	0.001	0.005	0.006	0.004	0.004	0.004	0.002	0.003	0.003	0.004	0.004	0.004	**0.044**
2003 BN	0.007	0.004	0.002	0.002	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.002	**0.027**
2004 D	0.007	0.002	0.002	0.001	0.002	0.004	0.002	0.002	0.003	0.002	0.004	0.002	**0.033**
Total	**0.036**	**0.035**	**0.031**	**0.027**	**0.030**	**0.033**	**0.0255**	**0.025**	**0.028**	**0.029**	**0.028**	**0.027**	
Mean	**0.0051**	**0.005**	**0.004**	**0.0038**	**0.0043**	**0.0047**	**0.0036**	**0.0036**	**0.004**	**0.0041**	**0.004**	**0.0038**	**0.004**

Table 5-28. Fluoride in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.1	0.1	0.2	0.1*	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	**1.5**
1999 AN	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.3**
2000 AN	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2001 D	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2002 D	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2003 BN	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2004 D	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
Total	**0.7**	**0.8**	**0.8**	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	
Mean	**0.1**	**0.11**	**0.11**	**0.1**	**0.11**	**0.11**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.10**

* No fluoride record was taken on this date. The average value for this month has been substituted.

Table 5-29. Lead in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
1999 AN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2000 AN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2001 D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2002 D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2003 BN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2004 D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
Total	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	
Mean	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	

Table 5-30. Iron in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l. Data summarized from automated sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.021	0.009	0.006	0.005	0.006	0.027	0.022	0.005	0.005	0.005	0.005	0.005	**0.121**
1999 AN	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.017	**0.072**
2000 AN	0.031	0.027	0.026	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.014	**139**
2001 D	0.023	0.018	0.017	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.103**
2002 D	0.020	0.047	0.012	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.125**
2003 BN	0.016	0.005	0.022	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.091**
2004 D	0.016	0.034	0.010	0.005	0.005	0.005	0.005	0.005	0.005	0.010	0.005	0.023	**128**
Total	**0.106**	**0.131**	**0.098**	**0.039**	**0.036**	**0.057**	**0.052**	**0.036**	**0.035**	**0.040**	**0.035**	**0.074**	
Mean	**0.015**	**0.019**	**0.014**	**0.0056**	**0.0051**	**0.0081**	**0.0074**	**0.0051**	**0.0050**	**0.0057**	**0.0050**	**0.0076**	**0.0086**

Table 5-31. Nitrates in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	1.4	1.7	1.9	0.5	0.63*	0.09	0.12*	0.65	0.50	0.64	0.66	0.79	**3.24**
1999 AN	0.54	0.36	0.76	0.76	0.44	0.48	0.44	0.36	0.35	0.58	0.73	0.86	**6.66**
2000 AN	0.99	1.60	1.10	0.72	0.59	0.65	0.45	0.28	0.04	1.13	0.82	1.0	**9.37**
2001 D	1.1	1.4	1.2	1.1	0.59	0.65	0.6	0.52	0.4	0.4	0.53	0.66	**9.15**
2002 D	1.2	1.1	1.0	1.07	0.76	0.9	0.58	0.26	0.26	0.39	0.61	1.0	**9.13**
2003 BN	1.5	1.6	1.0	0.68	0.72	0.58	0.51	0.28	0.17	0.22	0.28	0.83	**8.37**
2004 D	1.5	0.99	1.64	0.58	0.66	0.69	0.41	0.34	0.41	0.66	1.09	1.01	**9.98**
Total	**8.23**	**8.75**	**8.6**	**5.41**	**4.39**	**4.04**	**2.99**	**2.69**	**2.13**	**4.02**	**4.72**	**6.15**	
Mean	**1.18**	**1.25**	**1.23**	**0.77**	**0.62**	**0.58**	**0.43**	**0.38**	**0.30**	**0.58**	**0.67**	**0.88**	**0.74**

*No data for these months at Check 41. Average for month substituted.

Table 5-32. The pH of SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	7.6	8.0	7.9	7.9*	7.8	7.6	8.0	7.5	7.6	7.4	7.1	7.6	**92**
1999 AN	8.7	8.0	7.4	7.4	7.6	7.6	7.2	7.0	7.5	8.0	7.4	7.2	**91**
2000 AN	7.8	8	7.2	7.2	8	7.5	7.7	7.7	8.3	7.3	8.0	8.1	**92.8**
2001 D	8	8	8.0	8.3	8.2	8.3	8.1	7.5	8.0*	7.9*	8.0	8.0	**96.3**
2002 D	7.7	7.7	8.1	8.3	8.0	7.9	8.3	8.2	8.2	8.2	7.9	7.8	**96.3**
2003 BN	7.9	7.8	7.8	8.0	8.1	7.7	8.0	8.0	8.2	8.1	8.2	8.1	**95.9**
2004 D	7.9	7.9	7.8	8.2	8.3	8.2	8.3	7.8	8.1	8.3	8.2	7.9	**96.9**
Total	**55.6**	**55.4**	**54.2**	**55.3**	**56**	**54.8**	**55.6**	**53.7**	**55.9**	**55.2**	**54.8**	**54.7**	
Mean	**7.94**	**7.91**	**7.74**	**7.9**	**8**	**7.8**	**7.94**	**7..67**	**7.98**	**7.88**	**7.82**	**7.81**	**7.86**

*Data for this month not available. The value used is the monthly average for the other 6 years.

Table 5-33. Selenium in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.001	0.001	0.001	0.001*	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	**1.2**
1999 AN	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	**1.2**
2000 AN	0.001	0.001	0.001	0.001*	0.001	0.001	0.001*	0.001	0.001*	0.001*	0.001	0.002	**1.3**
2001 D	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001*	0.001*	0.001*	0.001*	0.001	**1.3**
2002 D	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	**1.2**
2003 BN	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	**1.2**
2004 D	0.001*	0.001*	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	**1.3**
Total	**0.008**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.008**	**0.008**	
Mean	**0.0014**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.0014**	**0.0014**	**0.0011**

*No data for these months at Check 41. Data from upstream Check 29 substituted.

Table 5-34. Dissolved sulfate in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	48	60	59	10	6	4	20	34	27	22	20	22	**332**
1999 AN	44	47	36	55	24	38	29	22	19	27	32	38	**411**
2000 AN	39	49	41	45	40	32	29	28	22	26	29	45	**425**
2001 D	51	58	57	56	41	33	42	30	18.5	38	48	49	**521.5**
2002 D	41	43	54	43	44	45	30	24	24	39	38	50	**475**
2003 BN	49	50	54	35	44	26	22	17	16	26	36	49	**424**
2004 D	49	42	58	35	42	41	25	21	28	34	37	41	**453**
Total	**321**	**349**	**359**	**279**	**241**	**219**	**197**	**176**	**154.5**	**212**	**240**	**294**	
Mean	**45.8**	**49.9**	**51.3**	**39.9**	**34.4**	**31.3**	**28.1**	**25.1**	**22.0**	**30.3**	**34.3**	**42**	**36.2**

Table 5-35. Total dissolved solids (TDS) in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	345	317	334	193*	89	73	114	219	198	139	137	152	**2310**
1999 AN	234	223	143	230	249	230	193	157	166	258	257	266	**2606**
2000 AN	309	280	193	210	236	219	207	208	167	241	262	301	**2833**
2001 D	374	337	280	275	239	227	291	228	327	362	329	313	**3582**
2002 D	348	247	276	286	265	291	227	309	309	384	384	368	**3694**
2003 BN	350	291	264	219	299	181	183	170	177	253	302	338	**3027**
2004 D	350	233	263	221	259	277	203	200	245	311	289	292	**3143**
Total	**2310**	**1928**	**1753**	**1441**	**1636**	**1498**	**1418**	**1491**	**1589**	**1310**	**1960**	**2030**	
Mean	**330**	**275**	**250**	**206**	**234**	**214**	**203**	**213**	**227**	**187**	**280**	**290**	**242**

*Data for this month not available. The value used is the average for the other 6 years.

Table 5-36. Total Organic Carbon in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million). Data summarized DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	5	4.6	4.5	4.2	3.1	3.3	4.4	3.4	3	2.6	2.5	2.5	**43.1**
1999 AN	9.3	3.2	3.4	3.2	3.2	3.3	3.1	2.8	2.3	2.4	2.2	2.6	**41**
2000 AN	3.5	5.4	5.1	3.2	3.6	3.8	2.9	3.0	2.4	2.2	3.5	4.7	**43.3**
2001 D	5.9	5.3	5.0*	3.7	3.4	3.5	3.0	3.8	2.8	2.5	3.0	2.3	**39.2**
2002 D	5.2	6.4	7.0	4.0	2.8	6.4	4.2	2.8	2.8	3.4	3.3	2.7	**51**
2003 BN	3.4	3.2	3.5	3.0	3.6	2.9	3.0	3.4	2.4	2.5	2.4	3.0	**36.3**
2004 D	3.4	4.5	6.3	3.0	3.4	3.3	2.7	2.8	2.6	2.4	2.4	3.8	**40.6**
Total	**35.7**	**32.6**	**34.8**	**24.3**	**23.1**	**26.5**	**23.3**	**22**	**18.3**	**18**	**19.3**	**21.6**	
Mean	**5.1**	**4.7**	**4.97**	**3.5**	**3.3**	**3.8**	**3.3**	**3.1**	**2.6**	**2.6**	**2.8**	**3.1**	**3.57**

* No data for this month. Average of other 6 months substituted.

Table 5-37. Comparison of Metropolitan deliveries to existing water banks (total deliveries by month for 1993-2003) and mean monthly water quality data for 1998-2004.

PARAMETER	MEAN MONTHLY VALUE											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Metropolitan Water Bank Delivery (af)	**32,709**	**45,590**	**104,767**	**115,352**	**150,479**	**97,612**	**58,183**	**83,140**	**55,787**	**50,596**	**27,405**	**25,260**
Arsenic (ppb)	2.14	2.14	2.0	2.14	2.0	2.3	2.3	2.6	2.7	2.3	2.3	2.0
Boron (mg/l)	0.17	0.17	0.17	0.19	0.19	0.17	0.11	0.11	0.1	0.16	0.15	0.17
Bromides (mg/l)	0.29	0.19	0.16	0.15	0.17	0.14	0.13	0.17	0.17	0.28	0.25	0.28
Chromium (mg/l)	0.0051	0.005	0.004	0.0038	0.0043	0.0047	0.0036	0.0036	0.004	0.0041	0.004	0.038
Chlorides (mg/l)	89	63	52	51	59	50	49	54	53	83	82	85
Fluoride (mg/l)	0.1	0.11	0.11	0.1	0.11	0.11	0.1	0.1	0.1	0.1	0.1	0.1
Iron (mg/l)	0.015	0.019	0.014	0.0056	0.0051	0.0081	0.0074	0.0051	0.0050	0.0057	0.0050	0.0076
Lead (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrates (mg/l)	1.18	1.25	1.23	0.77	0.62	0.58	0.43	0.38	0.30	0.58	0.67	0.88
pH	7.94	7.91	7.74	7.9	8	7.8	7.94	7.67	7.98	7.88	7.82	7.81
Selenium (mg/l)	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008
Sulfate (mg/l)	45.8	49.9	51.3	39.9	34.4	31.3	28.1	25.1	22.0	30.3	34.3	42
TDS (mg/l)	330	275	250	206	234	214	203	213	227	187	280	290
TOC (mg/l	5.1	4.7	4.97	3.5	3.3	3.8	3.3	3.1	2.6	2.6	2.8	3.1

Table 5-38. Relationship between monthly Metropolitan deliveries to water banks (1993-2003) and monthly mean water quality in SWP supplies at Check 41 of the California Aqueduct (Pearson's rank correlation). A negative correlation (r-squared values in bold) indicates SWP water delivered to banks was associated with lower constituent levels.

RELATIONSHIP	R-SQUARED
Monthly Bank Deliveries vs Arsenic	**-0.20**
Monthly Bank Deliveries vs Boron	+0.41
Monthly Bank Deliveries vs Bromides	**-0.67**
Monthly Bank Deliveries vs Chlorides	**-0.67**
Monthly Bank Deliveries vs Chromium	**-0.12**
Monthly Bank Deliveries vs Fluorides	+0.54
Monthly Bank Deliveries vs Iron	**-0.22**
Monthly Bank Deliveries vs Lead	No relationship
Monthly Bank Deliveries vs Nitrates	**-0.13**
Monthly Bank Deliveries vs pH	+0.03
Monthly Bank Deliveries vs Selenium	**-0.64**
Monthly Bank Deliveries vs Sulfate	**-0.05**
Monthly Bank Deliveries vs TDS	**-0.49**
Monthly Bank Deliveries vs TOC	+0.07

Table 5-39. Comparison of SWP water quality to Lahontan Regional Water Quality Control Board Water Quality Objectives for the Mojave River Basin. Weighted mean annual value reflects the seasonal distribution of Metropolitan's banking deliveries per Table 5-22. Bold type indicates improved water quality associated with banking when compared to average annual values for 1998-2004.

WATER QUALITY ELEMENT	LRWQCB WATER QUALITY OBJECTIVES (MOJAVE RIVER AT VICTORVILLE)		SWP WATER QUALITY 1998-2004			
	Average Annual	Maximum (90th percentile)	Annual Mean	Annual Weighted Mean	Range of Monthly Variation	Range of Annual Variation (% of annual WQ Objective)
Arsenic (ppb)	NA	NA	2.24	**2.22**	1-4	1.92-2.60
Boron (mg/l)	0.2	0.3	0.155	**0.153**	0.02-0.2	0.09-0.18 (45%)
Bromides (mg/l)	NA	NA	0.198	**0.178**	0.01-0.47	0.12-0.29
Chlorides (mg/l)	75	100	64	**58.8**	2-134	37.5-84-7 (88%)
Fluoride (mg/l)	0.2	1.5	0.10	0.105	0.1-0.2	0.1-0.0.125 (12%)
Iron (mg/l)	NA	NA	0.0086	**0.0080**	0.005-0.047	0.006-0.011.6
Lead (mg/l)	NA	NA	<0.001	<0.001	No monthly variation	
Nitrates (mg/l)	5	NA	0.74	**0.72**	0.09-1.13	0.27-0.83 (11%)
pH	NA	NA	7.86	7.87	7.1-8.7	7.58-8.08
Selenium (mg/l)	NA	NA	0.0011	**.00104**	0.001-0.002	0.001-0.0011
Sulfate (mg/l)	40	100	36.2	**35.98**	4-60	27.7-43.4 (39%)
TDS (mg/l)	245-312	440	242	**231.4**	73-384	192.5-307.8 (37%)
TOC (mg/l	NA	NA	3.57	**3.29**	2.2-9.3	3.03-3.61

Table 5-40. Comparison of SWP water quality to Colorado River Regional Water Quality Control Board Water Quality Objectives for the Lucerne Basin. Weighted mean annual value reflects the seasonal distribution of Metropolitan's banking deliveries per table 5-22. Bold type indicates improved water quality associated with banking when compared to average annual values for 1998-2004.

WATER QUALITY ELEMENT	CRWQCB WATER QUALITY OBJECTIVES (MUNICIPAL SUPPLIES)		SWP WATER QUALITY 1998-2004			
	Average Annual	**Maximum**	**Annual Mean**	**Annual Weighted Mean**	**Range of Monthly Variation**	**Range of Annual Variation (% of annual WQ Objective)**
Arsenic (ppb)	NA	5	2.24	**2.22**	1-4	1.92-2.60 (14%)
Barium	NA	1.0	0.05	**NA**	NA	NA
Boron (mg/l)	0.2	0.3	0.155	**0.153**	0.02-0.2	0.09-0.18 (45%)
Bromides (mg/l)	NA	NA	0.198	**0.178**	0.01-0.47	0.12-0.29
Chlorides (mg/l)	NA	NA	64	**58.8**	2-134	37.5-84-7 (88%)
Chromium (mg/l)	NA	0.010	0.004	**0.0039**	0.001-0.007	0.0022-0.0056 (34%)
Dissolved oxygen (mg/l)	5-8	5-8	SWP does not routinely report DO in monthly grab sampling. Field sampling data suggest SWP DO is routinely 8.5 to 9.5 mg/l			
Fluoride (mg/l)	0.2	1.5	0.10	0.105	0.1-0.2	0.1-0.0.125 (12%)
Iron (mg/l)	NA	NA	0.0086	**0.0080**	0.005-0.047	0.006-0.012 (75%)
Lead (mg/l)	NA	0.05	<0.001	<0.001	No variation, below detection level of 0.001	
Mercury (mg/l	Not measured in SWP supplies					
Nitrates (mg/l)	NA	10	0.74	**0.72**	0.09-1.13	0.27-0.83 (6%)
pH	6-9	6-9	7.86	7.87	7.1-8.7	7.58-8.08 (8%)
Selenium (mg/l)	NA	0.01	0.0011	**0.00104**	0.001-0.002	0.001-0.0011 (1%)
Sulfate (mg/l)	NA	NA	36.2	**35.98**	4-60	27.7-43.4
TDS (mg/l)	NA	NA	242	**231.4**	73-384	192.5-307.8
TOC (mg/l	NA	NA	3.57	**3.29**	2.2-9.3	3.03-3.61

As illustrated on Tables 5-39 and 5-40, from 1998 through 2004 average annual water quality of SWP supplies never violated either Lahontan Regional Water Quality Control Board or Colorado River Regional Water Quality Control Board water quality objectives. However, the seasonal and annual variation in SWP water quality may be important for chlorides, for boron, sulfates, and for total dissolved solids because (a) there is some potential for Lahontan Regional Water Quality Board water quality objectives to be exceeded for these constituents in some years, and (b) water banking reduces the potential for levels of boron, chlorides, sulfates, and total dissolved solids to exceed water quality objectives. For other constituents, water quality objectives of the two Regional Water Quality Control Boards would not be substantially affected by monthly or inter-annual variation in SWP supplies. For all but boron, chlorides, sulfates, and total dissolved solids, the inter-monthly and inter-annual variations in SWP supplies are not great enough to cause water quality to exceed standards even on a monthly basis.

Tables 5-39 and 5-40 also show the effects of banking on average annual quality of SWP supplies delivered. The figures in bold are the weighted average annual values for SWP water quality constituents. If supplies are delivered per the historic banking pattern (Table 5-22), more supplies are delivered in months with generally better quality than in other months. Note that for fluoride and pH, banking deliveries are marginally detrimental in terms of water quality. For the remainder of the constituents, banking deliveries would improve water quality.

The analysis above describes the probable outcome of banking and exchange, and additional recharge and extraction facilities would also allow MWA to manage to preferentially take SWP supplies during periods when water quality is better. The actual delivery schedule may vary from that analyzed here. That said, a banking and exchange program would probably improve the water quality in SWP deliveries made to MWA's service area as a result of (a) allowing for greater deliveries during March through August and (b) allowing for greater deliveries during above-normal-to-wet years. These improvements would be most significant for chlorides, sulfates, and total dissolved solids. For these constituents, SWP supplies are near limit of the Regional Water Quality Control Boards' water quality objectives, and improvements associated with banking are thus particularly important. Banking and exchange programs would improve SWP water quality for arsenic, bromides, chlorides, sulfate, and TDS, but would result in worse water quality in regard to total organic carbon.

<u>Banking and Groundwater Quality</u>. Both the Lahontan Regional Water Quality Control Board and the Colorado River Regional Water Quality Control Board water quality objectives include provisions that are intended to protect groundwater. In general, their basin plans stress non-degradation of groundwater.

The difference in SWP water quality and indigenous water quality is thus an additional basis for comparing the effects of alternatives, because the mixing of SWP and indigenous water may affect the overall quality of water available for use. For this comparison (Table 5-41), it may again be assumed that SWP supplies delivered as part of a banking program would have water quality reflecting the weighted average water quality shown on Tables 5-39 and 5-40, not average SWP water quality.

Table 5-41. SWP above-normal-to-wet-year water quality (in mg/l) compared to average indigenous water quality, by subarea (Alto Floodplain, Alto Regional, Alto Transition Zone, Oeste Regional, Centro Floodplain, Baja Floodplain, Copper Mountain, Johnson Valley, Means/Ames Valley, and Warren Valley). Local subarea averages from 2004 PEIR.

Constituent	Concentration of Water Quality Constituents (mg/l)										
	State Water Project 1998-2004 (above normal to wet years)	**Alto Floodplain**	**Alto Regional (west)**	**Alto Transition Zone**	**Oeste Regional**	**Centro Floodplain**	**Baja Floodplain**	**Copper Mountain**	**Johnson Valley**	**Means/Ames Valley**	**Warren Valley**
Arsenic	0.0022	**.0052**	**0.0118**	**0.0062**	**0.004**	**0.0063**	**0.0104**	**0.0049**	0.0019	**0.0038**	**0.0043**
Boron	0.153	0.081	0.037	**0.531**	0.058	**0.772**	**0.931**	**0.133**	**0.525**	**0.157**	0.068
Bromides	0.178	Not routinely measured in local supplies.									
Chlorides	58.8	17.3	2.4	**80.8**	16.3	**132.2**	**132.7**	22.4	**147.3**	19.9	24.4
Fluoride	0.105	**0.580**	**0.697**	**1.297**	**0.627**	**0.651**	**0.707**	**1.612**	**1.355**	**1.380**	**0.518**
Iron	0.008	**0.020**	**0.076**	**0.732**	**0.013**	**0.214**	**0.119**	**0.044**	**0.058**	**0.0098**	**0.015**
Lead	<0.001	Not routinely measured in local supplies.									
Nitrates	0.72	0.35	0.09	0.24	0.45	**3.50**	**6.13**	**2.21**	**0.73**	**6.06**	**8.51**
pH	7.87	**7.9**	**8.5**	7.8	**8.2**	7.6	7.7	**8.1**	7.7	7.6	**7.9**
Selenium	.00104	Not routinely measured in local supplies.									
Sulfate	35.98	17.4	24.7	**123**	**192.5**	**217**	**169.7**	**48.8**	**389.1**	**59.6**	23.2
TDS	231.4	156.0	**245.5**	**518**	**395.6**	**785**	**562.6**	**241.2**	**912.7**	**275.7**	**219.2**

In a program in which banked water is returned entirely by exchange, recharge of SWP supplies per the delivery schedule shown on Table 5-22 would result in enhancement of indigenous groundwater for some constituents and degradation of groundwater in terms of some other constituents. For the nine constituents for which there is consistent data on water quality, recharged water would enhance indigenous groundwater quality in 72% of cases.

- Arsenic: Recharged SWP supplies would be of better quality than indigenous groundwater in 9 of the 10 basins receiving direct recharge. In the Johnson Valley, recharged water would vary from indigenous groundwater by 0.0003 mg/l.
- Boron: Recharged SWP supplies would be of better quality than indigenous groundwater in 5 of the 10 basins receiving direct recharge. In the five basins in which indigenous groundwater would be of better quality, recharged water would have boron concentrations of 15% to 205% higher than the indigenous groundwater.
- Chlorides: Recharged SWP supplies would be of better quality than indigenous groundwater in 4 of the 10 basins receiving direct recharge. Chloride levels in SWP supplies would be substantially higher than those in the remaining 6 groundwater basins.
- Fluoride: Recharged SWP supplies would be of better quality than indigenous groundwater in all 10 of the basins receiving direct recharge.

- Iron: Recharged SWP supplies would be of better quality than indigenous groundwater in all 10 of the basins receiving direct recharge.
- Nitrates: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 5 of the 10 basins receiving direct recharge, and of substantially lower quality in the other 5 basins.
- pH: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 5 of the 10 basins receiving direct recharge, and of substantially lower quality in the other 5 basins.
- Sulfate: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 7 of the 10 basins receiving direct recharge, and of substantially lower quality in the other 3 basins.
- TDS: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 8 of the 10 basins receiving direct recharge, and marginally lower quality in the other 2 basins.

5.13.3 Effects of the Proposed Project, General

The groundwater effects of banking operations need to be considered from two perspectives:

- First, would the Proposed Project result in violations of DHS drinking water standards?
- Second, in what ways and to what extent would the Proposed Project affect indigenous groundwater?

5.13.3.1 Drinking Water Standards

Department of Health Services drinking water standards establish maximum limits for selected constituents. Table 5-42 compares these standards to average SWP water quality. Table 5-42 does not address DHS and EPA standards for a very long list of pollutants associated with point-source discharges and contaminated groundwater. California Department of Water Resources routinely tests for these contaminants and SWP supplies do not violate them.

Table 5-42 compares DHS drinking water quality standards to the average and maximum concentration detected in SWP supplies at Check 41 on the California Aqueduct (upstream of MWA's diversions). Note that Department of Water Resources does not routinely monitor for some constituents. Data are from DWR (2001, 2005 as indicated). For all primary inorganic chemical standards, the both average and maximum concentrations in SWP water delivered to MWA were below DHS standards. Average SWP concentrations are less than 50% of DHS drinking water standard levels for all measured constituents.

Table 5-42. California Department of Health Services drinking water standards compared to the highest concentrations of mineral constituents in SWP supplies (1998-2004).

Constituent	CONSTITUENT CONCENTRATION AT CHECK 41 OF THE CALIFORNIA AQUEDUCT (in mg/l)			
	DHS Maximum Level (DHS 2003)	SWP Concentration		Average concentration in SWP water as a % of DHS Maximum Concentration
		Average	Maximum	
Aluminum	1.0	0.01(a)	0.01	1%
Antimony	0.006	Not Measured	Not Measured	NA
Arsenic	0.005	0.0022 (b)	0.004	44%
Asbestos	7 MFL	Not Measured	Not Measured	NA
Barium	1.0	0.05(a)	0.05	5%
Beryllium[c]	0.004	<0.001	<0.001	<25%
Cadmium	0.005	0.001(a)	0.001	20%
Chromium	0.05	0.004(a&b)	0.007	8%
Cyanide	0.15	Not Measured	Not Measured	NA
Chloride	250	64(b)	134	26%
Copper (CAL)	1.0	0.002(a)	0.003	<1%
Fluoride	2.0	0.1 (a&b)	0.2	5%
Iron (CAL)	0.3	0.09	0.27	30%
Lead	0.15	<0.001(a&b)	<0.001	<1%
Manganese	0.05	0.005(a)	_0.005	10%
Mercury	0.002	0.0002(a)	0.0002	10%
Nitrate + Nitrite	10	0.85 (a&b)	1.9	9%
Nitrates	10	0.74	NA	7%
pH	8.5	7.8 (b)	NA	Percent comparison not appropriate
Selenium	0.05	<0.002(a&b)	0.002	4%
Silver (CAL)	0.1	0.001(a)	0.001	1%
Sulfate	250	36 (a&b)	60	14%
TDS	500	242 (a&b)	384	48%

Notes:

CAL = Refers to Consumer Acceptance Limits, which are secondary levels of drinking water standards
a. = Data from 1998-1999 in DWR Annual Report (2001)
b. = Data from 1998-2004, as summarized on Tables 5-22 through 5-36
c. Beryllium measured from April 2000 through December 2004

5.13.3.2 Effects of the Proposed Project on indigenous groundwater

Dissolved Organic Carbon Introduction to Groundwater. TOC and DOC levels are not specified in the Basin Plan Objectives for either the LRWQCB or the CRWQCB, but SWP supplies will introduce dissolved organic carbon compounds to receiving groundwaters. As noted in discussion of mechanisms for Proposed Project effects, bacterial interactions with carbon compounds rapidly remove as much as 50% of TOC from recharged water. Banking and exchange will involve import of supplies of better-than-average SWP water quality in regard to

TOC and will therefore reduce introduction of TOC to groundwater when compared to the No Project Alternative.

Changed Groundwater Levels. Rising groundwater levels are an objective of recharge, and groundwater levels in the vicinity of recharge sites will rise. Bookman-Edmonston (2004b) cites estimates of mounding beneath recharge basins resulting in groundwater levels rising up to 90 feet. Long-term groundwater levels in existing recharge basins will probably not be raised significantly beyond levels projected for the No Project Alternative, because banked and exchanged water will be delivered to these basins in amounts needed to meet local water supply needs and returns will be made via exchange of SWP supplies that would otherwise be delivered to these sites. Nonetheless, pre-delivery of banked supplies and the 10% loss factor associated with banking operations will mean that groundwater levels at existing facilities will rise somewhat, with local producers extracting supplies in-lieu of new deliveries during years when banked supplies are returned to Metropolitan. The known nitrate contamination problem in the Morongo Basin, caused by rising groundwater levels encountering concentrations of nitrates from septic tank discharges, will be monitored and deliveries to this basin managed to ensure that water banking does not exacerbate this potential problem.

In the Alto and Oeste areas, groundwater levels in the Floodplain Aquifer can be expected to rise beneath recharge basins and beneath the Mainstem Mojave River. In the Regional Aquifer, where lateral movement of supplies is low, recharge may result in mounding and substantial increases in groundwater levels. Given the heavy overdraft conditions of the Regional Aquifer, this would be seen as a benefit. At best, groundwater levels would be expected to rise 100+ feet. Given current groundwater depths of 200 to 600 feet, this would not cause potential liquefaction effects. In addition, with the exception of Oeste and Alto recharge basins of the Large Projects Alternative, groundwater basins are being sited in locations where natural recharge occurs and there is on-going extraction of stored groundwater. There is no present evidence that rising groundwater levels in these areas would encounter contaminated surface water or soils, but monitoring of extractions from these areas for water quality would rapidly identify potential problems associated with rising groundwater levels encountering influences of surface water and/or existing soil contamination. If this is identified, recharge may be shifted to other sites while the problem is analyzed and addressed.

Chemical Interactions: Arsenic Mobilization Potential. SWP supplies have higher iron concentrations and dissolved oxygen than indigenous groundwater, and in the Alto and Oeste subareas are higher in nitrates. Based on Oremland (2002), this suggests that recharge of these supplies will reduce rather than increase arsenic mobilization. In addition, recharge sites have been selected to avoid areas with clays and fine-grained soils in which soluble mineral concentrations are high and leaching is likely to occur. SWP supplies are also low in arsenic compared to much of the groundwater in MWA's service area, and may dilute arsenic concentrations in receiving groundwater. The effect of the Proposed Project on leaching of minerals from soils, particularly arsenic, is likely to be minor.

Mass Loading of Chemical Constituents. The import of water to a closed groundwater basin (one that does not discharge to the ocean) inherently involves the net import of salts (Colorado River Regional Water Quality Control Board, 2003 Basin Plan). There are potential detrimental long-term impacts associated with a net increase in minerals in the groundwater. As noted Table 5-42, the effect of banking and exchange programs is to pre-deliver water for later use, thereby extending the period during which MWA may meet replacement water requirements with its average annual SWP supply of 58,400 acre-feet. Under the No Project Alternative, MWA would not be able to pre-delivery as much water and would not be able to focus those deliveries in wet years and only during months of better water quality. The accelerated development of recharge and associated facilities proposed for the water banking and exchange project allows MWA to pre-deliver high-quality supplies. But, throughout the 20-30-year period of the proposed project, MWA would use approximately the same volume of water to meet its replacement water obligations. Given MWA's isolation from other sources of supply, when MWA's replacement water obligations begin to exceed available SWP contract allocations sometime after 2020, MWA would probably meet water supply needs by acquiring additional SWP supplies through transfers, from the DWR water bank, or from Article 21 supplies. All of these are SWP sources and, over the long-term, would have the same average annual water quality.

The effect of water banking and exchange on mass loading of chemical constituents in the groundwater basins is therefore to provide slightly better water quality through pre-delivery of water in wet years, with returns via exchange in dry years. The probable monthly variation in deliveries will also enhance water quality. Mass loading of minerals as a result of banking and exchange will therefore be lower than under the No Project Alternative.

A second perspective on mass loading is suggested by the Basin Plan for the Colorado River Regional Water Quality Control Board (2003), which notes that the alternative to importing water to recharge groundwater basins is extraction and use of more groundwater. Continued overdraft means pumping from greater depth. Monitoring in the MWA service area indicates that pumping from greater depth is associated with poorer quality water. Urban uses of this groundwater result in evaporation, addition of some chemical constituents such as nitrates from fertilizers, and then recharge of this lower-quality water back to the groundwater basin following treatment. The result of re-use of groundwater is a progressive increase in the concentrations of chemicals in indigenous groundwater. Imported SWP water if of better quality than existing groundwater in 72% of cases (Table 5-41) and thus has the effect of diluting indigenous groundwater, improving its overall quality. This dilution effect is particularly important in terms of arsenic, sulfate, and TDS, where indigenous groundwater in many areas is already above recommended levels for drinking water.

The banking and exchange project will therefore slightly reduce the net import of chemical water constituents when compared to the import of average-quality SWP supplies, will dilute indigenous groundwater, and will dilute reclaimed water being recharged.

The beneficial effects of banking and exchange in terms of mass loading will be most pronounced in areas where indigenous groundwater is of lower quality. In the Alto subarea

Mojave River Floodplain Aquifer, import of SWP supplies will increase levels of boron, chlorides, nitrates, sulfates, and TDS, but this water will be extracted on a continuous basis at the boundary of the alluvial and regional aquifer. Its use will reduce use of groundwater from the regional aquifer, which is of poorer quality than that of the floodplain aquifer. As a result, regional aquifer supplies may be less utilized and recharge of concentrated regional aquifer supplies in reclaimed water may be reduced. This will affect key water quality constituents such as arsenic, which will be diluted by SWP supplies.

Impacts associated with mass loading are therefore best expressed as trade-offs. Given the advantages of pre-delivery of supplies made possible by the expended recharge capacity of the banking and exchange project, the net impact of the banking and exchange project on indigenous water quality will be beneficial. No significant mass loading impacts are anticipated.

Banking Operations and Water Supply. For impact analysis, water supply and water quality with banking and exchange must be compared to water supply and water quality without banking and exchange. With a banking and exchange program, MWA would import more SWP supplies than it currently does. The general effects of these increased imports on water supply are analyzed below.

With the exception of supplying about 5,000 acre-feet of surface water to two regional power plants, MWA imports of SWP supply (or other supplies available to it) are always recharged to (a) replace water produced in excess local supplies (b) store water for future use. At present, MWA has limited capacity to import water to offset groundwater overdrafting, although pre-delivery of SWP supplies occurs. Without a banking program and facilities to allow import of relatively large amounts of water in a short period of time to take advantage of surplus conditions during wet years, MWA will import supplies at a rate approximately equal to demand; that is, it will use the portion of its SWP supply and other available supply necessary to meet local demand and accomplish storage for future use.

Over a period of 25 to 30 years, this approach would result in a slow increase in MWA's SWP imports and recharge, until, sometime after 2020, average annual demand for supplemental supply is approximately equal to average annual SWP supply. At this point, MWA will either (a) need to acquire and recharge additional supplies to meet demand for replacement water or (b) use pre-delivered groundwater supplies to supplement available SWP supplies.

With a water banking program which enhances MWA's recharge and extraction facilities, particularly a program that involves return of banked supplies via exchange of SWP allocations and not direct return of groundwater, MWA would pre-deliver more SWP and other supply to address groundwater overdraft. To the extent that returns of banked supplies can be made via exchange, water pre-delivered to recharge in excess of replacement demand would offset groundwater overdraft and, following 2020, allow MWA to meet demands for replacement water for an extended period of time without obtaining new supplies. Thus, for example, if banking and exchange operations allow MWA to import 60,000 acre-feet of supply more than required for on-going demand between 2005 and 2020, and this banked water can be returned via exchange, MWA could use this pre-delivered water to help meet post 2020 demand, without seeking new supplies. Assuming an average annual SWP Table A supply of 58,400 acre-feet, and an annual increase in demand for replacement water of 1,500 each year following 2020, the 60,000 acre-feet of pre-delivered water would extend MWA's ability to meet demand as shown on Table 5-43. Banking and exchange programs do not, therefore, result in a net increase in projected groundwater supply, they only change the timing of delivery and recharge.

Table 5-43. Hypothetical extension of MWA supply reliability with a net 60,000 acre-foot pre-delivery from banking/exchange programs.

YEAR	REPLACEMENT DEMAND (af)	SWP SUPPLY (af)	SUPPLY DEFICIT (af)	WITHDRAWAL FROM BANK (60,000 af balance)	REMAINING BANK BALANCE (af)
2021	59,900	58,400	1,500	-1,500	58,500
2022	61,400	58,400	3,000	-3,000	55,500
2023	62,900	58,400	4,500	-4,500	50,000
2024	64,400	58,400	6,000	-6,000	44,000
2025	65,900	58,400	7,500	-7,500	36,500
2026	67,400	58,400	9,000	-9,000	27,500
2027	68,900	58,400	10,500	-10,500	17,000
2028	70,400	58,400	12,000	-12,000	5,000
2029	71,900	58,400	13,500	-5,000	0 (DEFICIT)

5.13.3.3 Water Quality from Wells in the Vicinity of Proposed Project Facilities

The following analysis was added to the FEIR to address a request for clarification in Department of Water Resources comments on the draft EIR.

To the extent that MWA makes returns to Metropolitan using supplies pumped from groundwater, it will need to ensure that these supplies meet any DWR requirements for introduction to the California Aqueduct. The data to address the potential for introduction of groundwater is generally provided in the EIR, but we appreciate DWR's suggestion that we clarify this issue. As the EIR notes in Chapters 3 and 4, the project could involve pump-back to the California Aqueduct from the Mojave River Aquifer upstream of the Mojave Narrows and from wells sited adjacent to potential groundwater recharge facilities. Proposed operations at these sites would generally involve import and recharge of SWP supplies and MWA would seek to optimize the water quality of the supplies delivered through scheduling. Given that wells would be located within about 0.5 miles of the river and within about 0.25 miles from the inland groundwater recharge basins, a vast majority of the supply returned to the California Aqueduct for delivery to Metropolitan via direct pump back would be a mix of SWP supply and indigenous groundwater with some potential for leaching of minerals during recharge.

Deliveries to the California Aqueduct would, however, probably be dominated by exchange, and groundwater pumped back would be monitored and managed to ensure that resulting water quality in the Aqueduct was not degraded. The mix of SWP water and indigenous water in the Mojave River Aquifer (see Table 5-41) would enhance water quality when compared to that in the Aqueduct for some constituents. For other constituents, there would be potential lowering of water quality. A 50-50 mix of SWP and indigenous groundwater from this aquifer would routinely result in a blend that meets DHS drinking water standards for mineral constituents because the water quality of both sources is good.

Pump-back of a mix of SWP water and indigenous groundwater from the Alto and Oeste portions of the Regional Aquifer (Table 5-41) would be of marginally poorer quality, given general levels of some mineral constituents in this aquifer, including arsenic. However, recharge basins have been sited to avoid soil types that contain high levels of arsenic, and indigenous groundwater quality in these areas would be less affected by arsenic as a result. It is thus likely that a mix of SWP water and indigenous groundwater at these recharge sites would result in a blend that would meet DHS drinking water standards for mineral constituents.

The water quality criteria for acceptance of non-project water into the State Water Project are discussed in the *Interim Department of Water Resources Water Quality Criteria for Acceptance of Non-Project Water Into the State Water Project* (dated March 1, 2001) and *Implementation Procedures for the Review of Water Quality from Non-Project Water Introduced into the State Water Project* (dated March 14, 2001). Under these criteria, the quality of the non-SWP water is compared to the ambient water quality of SWP water for the period 1988 through 2004. The criteria reflect that the ambient quality can vary by season and by year-type. If the water is accepted, then monitoring is required to confirm that the water continues to meet the requirements.

DWR has used a two-tier approach for accepting non-project water into the California Aqueduct. Tier 1 programs have a “no adverse impact” criteria and are tied to historical water quality levels in the California Aqueduct. Programs meeting the Tier 1 criteria would likely be approved by DWR. Tier 2 programs would have water quality levels that exceed the historical water quality levels in the California Aqueduct for at least one or more constituents, and so could cause adverse impacts to state water contractors. Tier 2 programs would be referred to a state water contractor facilitation group, which would review the program and make recommendations for DWR’s consideration of the project. Under Tier 1, all constituents of non-project water should be within the historical water quality levels measured at the O’Neill Forebay Outlet (formerly measured at Check 13) on the SWP as measured by DWR’s water quality monitoring program.

The EIR analysis in Section 5.13.2 and 5.13.3.1. and 5.13.3.2 (above) was based on aggregate groundwater quality data from a number of local wells in the Mojave River Floodplain Aquifer and the adjacent Alto Regional Aquifer. The EIR notes that data from wells located adjacent to groundwater recharge basins is likely to be of better quality, primarily because the proposed recharge sites have been sited to avoid areas with known soils/mineral problems. To clarify this point, MWA has identified a number of wells in the vicinity of the proposed project facilities and has evaluated recent (2004 and 2005) water quality data for these wells. The results of this evaluation are discussed below, with an explicit comparison between current DWR water quality criteria and Department of Health Services drinking water standards. See Tables A through G, in Appendix A, for details.

Indigenous groundwater quality compared to DWR criteria and DHS drinking water standards.

a. Oeste Recharge Basins

Data on indigenous water quality from two wells located about 1 mile downgradient from the proposed Oeste recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). Only one data point (a maximum value for manganese at well number 05N07W28L01) was in excess of DHS drinking water criteria. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-A. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies. These data are the only representative data currently available nearby. Development of any recharge locations would necessarily entail addition geohydrologic site investigations, including site-specific water quality analysis.

Table 5-A. Indigenous water quality from two wells located about 1 mile downgradient from the proposed Oeste recharge basins.

CONSTITUENT	SWP WQ 1988-2004 (GUIDELINES)			INDIGENOUS WATER QUALITY	
	MEAN	MIN	MAX	MIN	MAX
Aluminum (ug/l)	30	4	527	1	100
Antimony (ug/l)	3	1	5	**6**	**6**
Arsenic (ug/l)	2	1	4	2	2
Barium (ug/l)	50	37	68	**40**	**100**
Beryllium (ug/l)	1	1	1	1	1
Bromide (ug/l)	NA	NA	NA	NA	NA
Cadmium (ug/l)	4	1	5	1	1
Chromium (ug/l)	5	1	11	**10**	**15**
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	**0.17**	0.32
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	**180***
Mercury (ug/l)	0.8	0.2	1	**1**	1
Nickel (ug/l)	1	1	4	**10**	**10**
Nitrate (mg/l)	3.5	0.6	9.6	1	7.9
Selenium (ug/l)	1	1	2	**5**	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	1.9	**184**
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

* Exceeds DHS MCL

b. Alto Recharge Basins

Data on indigenous water quality from one well located to the west and downgradient about a mile from the proposed Alto recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were exceeded in one sample for arsenic. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-B. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-B. Indigenous water quality from one well located to the west and downgradient about a mile from the proposed Alto recharge basins.

CONSTITUENT	SWP WQ 1988-2004 (GUIDELINES)			INDIGENOUS WATER QUALITY	
	MEAN	MIN	MAX	MIN	MAX
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	2	**14***
Barium (ug/l)	50	37	68	0	100
Bromide (ug/l)	NA	NA	NA	NA	NA
Beryllium (ug/l)	1	1	1	0	1
Cadmium (ug/l)	4	1	5	0	1
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	**0.38**	**0.8**
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	0.95	3.9
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	31	87.4
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

* Exceeds DHS MCL

c. Oro Grande Recharge Basins

Data on indigenous water quality from four wells located in the general vicinity of the proposed Oro Grande Recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). Wells were located upstream (H01), downstream (M01 and E08) and in a developed area to the east (13J01). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-C. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies, although bromides were evaluated at several of the Oro Grande wells.

Table 5-C. Indigenous water quality from four wells located in the general vicinity of the proposed Oro Grande Recharge basins

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	60
Antimony (ug/l)	3	1	5	ND	0
Arsenic (ug/l)	2	1	4	1.6	**5.7**
Barium (ug/l)	50	37	68	0	8.4
Beryllium (ug/l)	1	1	1	ND	0
Bromide (ug/l)	0.21	0.05	0.54	0.16	0.5
Cadmium (ug/l)	4	1	5	ND	0
Chromium (ug/l)	5	1	11	0	**42.9**
Copper (ug/l)	5	2	28	ND	0
Fluoride (mg/l)	0.11	0.01	0.55	0.2	**27**
Iron (ug/l)	47	5	416	0	127
Manganese (ug/l)	10	3	60	0	**161**
Mercury (ug/l)	0.8	0.2	1	0	0
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	0.02	0.52
Selenium (ug/l)	1	1	2	ND	0
Silver (ug/l)	4	1	5	0	0
Sulfate (mg/l)	43	17	99	3	34
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	ND	0

d. Cedar Avenue Detention Basin

Data on indigenous water quality from a well located about 1.5 miles downslope and to the west of the proposed Cedar Avenue Recharge basin were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-D. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-D. Indigenous water quality from a well located about 1.5 miles downslope and to the west of the proposed Cedar Avenue Recharge basin

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	0	**10**
Barium (ug/l)	50	37	68	0	**100**
Beryllium (ug/l)	1	1	1	0	**1.8**
Bromide (ug/l)	0.21	0.05	0.54	0	0
Cadmium (ug/l)	4	1	5	0	1.75
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	0.08	0.4
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	0.5	3.2
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	1.8	10.8
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**70**

e. Antelope Wash recharge Basins

Data on indigenous water quality from a well located about a mile downgradient and to the west of the proposed Antelope Wash recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-E. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-E. Indigenous water quality from a well located about a mile downgradient and to the west of the proposed Antelope Wash recharge basins

CONSTITUENT	SWP WQ 1988-2004 (GUIDELINES)			INDIGENOUS WATER QUALITY	
	MEAN	MIN	MAX	MIN	MAX
Aluminum (ug/l)	30	4	527	0	0
Antimony (ug/l)	3	1	5	0	0
Arsenic (ug/l)	2	1	4	0	0
Barium (ug/l)	50	37	68	0	0
Beryllium (ug/l)	1	1	1	0	0
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	0
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	0
Fluoride (mg/l)	0.11	0.01	0.55	0.1	0.2
Iron (ug/l)	47	5	416	0	0
Manganese (ug/l)	10	3	60	0	0
Mercury (ug/l)	0.8	0.2	1	0	0
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	4	6
Selenium (ug/l)	1	1	2	0	0
Silver (ug/l)	4	1	5	0	0
Sulfate (mg/l)	43	17	99	3.7	3.9
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	0

f. Green Tree Recharge Basin

Data on indigenous water quality from a well located within the site of the proposed Green Tree recharge basin were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-F. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-F. Indigenous water quality from a well located within the site of the proposed Green Tree recharge basin

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	50
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	0	**8**
Barium (ug/l)	50	37	68	0	**100**
Beryllium (ug/l)	1	1	1	0	1
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	1
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	0.1	0.12
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	2.1	2.7
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	6.7	8.7
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

g. Mojave River Well Field

Data on indigenous water quality from 3 wells located near the proposed Mojave River Well Field were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-G. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-G. Indigenous water quality from 3 wells located near the proposed Mojave River Well Field

CONSTITUENT	SWP WQ 1988-2004 (GUIDELINES)			INDIGENOUS WATER QUALITY	
	MEAN	MIN	MAX	MIN	MAX
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	0
Arsenic (ug/l)	2	1	4	0	**10***
Barium (ug/l)	50	37	68	0	**500***
Beryllium (ug/l)	1	1	1	0	0
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	5
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50***
Fluoride (mg/l)	0.11	0.01	0.55	**0.23***	0.4
Iron (ug/l)	47	5	416	0	110
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	0.7	9.33
Selenium (ug/l)	1	1	2	0	**5***
Silver (ug/l)	4	1	5	0	**10***
Sulfate (mg/l)	43	17	99	3	16.1
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50***

* Values from Well 04N04W24G01, south and a mile inland from the river channel.

The summary data on Tables 5-A through 5-G are detailed on Tables A through G (Appendix B). The data on the detailed tables suggest (a) there is substantive variation in indigenous groundwater quality from well site to well site. For example, all of the values in excess of current DWR pump-back criteria shown on Table 5-G (Mojave River Well Field) are from a well a mile inland from the Mainstem River and at the southern boundary of the probable well field. These data are probably not representative of the water quality likely from the Mojave River Well Field; based on the data from the two wells closer to the river and further downstream, water in the Mojave River Well Field is of consistently better quality (See Table G in Appendix A).

The data also show that indigenous groundwater quality in the vicinity of the major washes (Oro Grande and Antelope Wash) is of better quality, probably reflecting the influence of natural recharge of good quality runoff from the mountains through a sandy substrate.

The data also show that, with only three exceptions, the indigenous water quality in existing wells near the proposed recharge basins is equal to or better than Department of Health Services drinking water criteria. In addition, indigenous water quality is equal to or better than DWR historic water quality at O'Neal Forebay (1988-2004) from many constituents. This is particularly true for the Mojave River Well Field and Antelope Wash. It is also notable (see Tables A through G in Appendix A) that indigenous water quality in the Floodplain and Alto Regional aquifers has consistently low levels of hydrocarbon constituents such as petroleum products and pesticides and herbicides.

In general, these data are consistent with the more generalized findings in the DEIR. They suggest that indigenous groundwater at the proposed sites is of generally better quality than the SWP pump-back guidelines for aluminum, cadmium, iron, manganese, mercury, nitrate, and sulfate and may generally exceed pump-back guidelines for antimony, barium, copper, fluoride, nickel, selenium, silver, and zinc. The well data suggest that maximum concentrations of mineral constituents are the primary issue related to pump-back operations.

These data suggest that pump-back of water from the Antelope Wash and Mojave River Well Field would meet or exceed pump-back guidelines. Water from these sources may be blended with water from other recharge areas to bring overall pump-back into compliance with current pump back guidelines. It should also be noted that wells would be sited to intercept recharged groundwater and that much of the water pumped back to the California Aqueduct would be a mix of indigenous groundwater and banked SWP supplies. It is likely that mixing of SWP and indigenous water supplies would result in a lower potential for maximum levels of various constituents to be in excess of current pump-back guidelines.

As noted in the Project Description, MWA would site wells to optimize water supply and quality and would routinely monitor groundwater quality. Where stored supplies may be used for pump-back of supplies to the California Aqueduct, this monitoring would include monitoring for all relevant constituents identified by DWR as water quality criteria for acceptance of Non-Project Water Into the State Water Project. Based on this monitoring, MWA believes that it could operate to supply water to the California Aqueduct that would meet current and future DWR pump back criteria or guidelines.

5.13.4 Alternative Impacts

5.13.4.1 Minimum Facilities Alternative

For recharge in the Baja, Centro, and Morongo Basin subareas, the Minimum Facilities Alternative would result in deliveries to existing recharge basins of approximately the same amount of water that would be imported and recharged for MWA to meet its replacement obligations.

In the Alto subarea, the Minimum Facilities Alternative, with its emphasis on use of the Mojave River bed for recharge and on continuous extraction of recharged water at the interface of the two aquifers, would mean that water introduced into the Mojave River Floodplain Aquifer would be extracted and used within several years of its recharge, with some potential loss to the Narrows and to the downstream subareas. To some extent, banked water deliveries would thus be utilized in lieu of extractions from other portions of the Regional Aquifer.

Biological Water Quality. Biological water quality is an issue in the Morongo Basin, where rising groundwater levels at recharge sites have in some areas co-mingled with water moving into recharge areas from septic systems. The banking program would have no effect on this problem (compared to normal operations) because banked water would be delivered at the same rate as required replacement water deliveries.

The potential for rising groundwater levels in the Mojave River Floodplain Aquifer to affect water quality in existing and new wells would depend on well siting, well depth, and the characteristics of the soils into which the well has been drilled. To the extent feasible, MWA will site wells near the interface of the Mojave River Floodplain Aquifer and the Regional Aquifer to optimize the potential for removal of bacteria, viruses, and other biological elements of concern, consistent with the need to extract groundwater at a rate approximately equal to the recharge rate. The interface of the recharge and extraction operations can generally be managed to ensure that surface flows do not occur in the vicinity of the well field for an extended period of time. Downstream underground flow rates in the Mojave River are estimated at 100 feet per day, with lateral flow rates (flow away from the river channel towards the Regional Aquifer) being substantially lower. Assuming that lateral flow rates in the Mojave River Floodplain Aquifer are about 50 feet per day and wells will draw water from a depth of several hundred feet, it is likely that wells located off channel will not intercept water until it has migrated through the ground for a period of 10 to 40 days, depending on well placement.

Bacterial water quality is therefore not considered a significant problem for new wells proposed. There may be some surface influences at existing wells, particularly shallow wells which draw directly from the Mojave River Floodplain Aquifer.

Leaching of Minerals during Recharge. Leaching of minerals during Mainstem Mojave River recharge is unlikely to occur because this area is routinely inundated, contains no lenses of fine grained materials that are generally associated with leaching of soluble minerals.

Banking and Exchange versus Normal Operations. The Minimum Facilities Alternative will result in import of about 183,000 to 270,000 acre-feet of SWP supplies, primarily during periods when SWP supplies are of better quality than average year/season supplies. The maximum capacity of the Minimum Facilities Alternative for pumping and return of banked groundwater to the California Aqueduct is 18,000 acre-feet per year. The remainder of returns to Metropolitan would be via exchange, in which dry-year SWP supplies would be delivered to Metropolitan and MWA producers utilized banked groundwater. The net result of banking and exchange would be import of optimal quality SWP supplies per the typical delivery schedule shown on Table 5-22 and the return of (a) MWA SWP dry-year supplies of poorer quality than those delivered for banking and (b) a blend of SWP and Floodplain Aquifer supplies pumped from the Mojave River Well Field. Under normal operations, MWA would import SWP supplies resulting in import of water of generally poorer water quality for most constituents. The water quality difference in with project versus normal operations can be expressed as a set of tradeoffs (Table 5-44).

Table 5-44. Minimum Facility Alternative water quality tradeoffs: Banking versus normal operations.

CONDITION	EFFECT OF BANKING ON MWA SUPPLY	
	Benefit	Detriment
Import of SWP supplies per Table 5-22 compared to average annual SWP water quality	Lower arsenic, boron, bromides, chlorides, chromium, iron, nitrates, sulfate, selenium, TDS, and TOC	Higher fluoride and pH
Return of banked water via pumping a mix of SWP and MR Floodplain Aquifer supplies	Net export of arsenic, fluorides, and iron	Net import of boron, bromides, chlorides, sulfate, TDS and TOC

<u>Mixing of SWP supplies with Indigenous Groundwater: SWP Water Quality versus Indigenous Water Quality</u>. To the extent that recharged supplies are not used to make direct returns to Metropolitan, they will slowly move down gradient and mix with indigenous groundwater. Indigenous groundwater that would receive banked supplies from the SWP is of varying quality; no basin has identical water quality and SWP supplies that would be delivered for banking purposes. Again, the effect of mixing SWP and indigenous water supplies is best expressed as a set of tradeoffs, by subarea (Table 5-45). In addition, there is a potential for rising groundwater in the Yucca valley area to mix with nitrate-rich groundwater migrating into the recharge areas from septic systems. This potential mixing concern may limit use of some recharge areas in the Morongo Basin to prevent groundwater levels from rising to the point where they will be affected.

Table 5-45. Minimum Facility Alternative water quality tradeoffs: SWP versus indigenous groundwater.

SUBAREA	EFFECT OF BANKING ON MWA SUPPLY	
	Benefit	Detriment
Alto Floodplain	Lower arsenic, fluorides, iron, & pH	Higher boron, chlorides, bromides, nitrates, TOC, sulfates, & TDS
Alto Regional	Lower arsenic, fluorides, iron, pH, & TDS	Higher boron, chlorides, bromides, nitrates, sulfates, & TOC
Centro Floodplain	Lower arsenic, chlorides, iron, sulfate, & TDS	Higher bromides & TOC
Baja Floodplain	Lower arsenic, chlorides, iron, sulfate, & TDS	Higher bromides & TOC
Warren Valley	Lower arsenic, iron, & TDS	Higher bromides, chlorides, TOC, & sulfate

5.13.4.3 Small Projects Alternative

The Small Projects Alternative affects the distribution of recharge among project subareas, allowing for more recharge of the Alto subarea Regional Aquifer. It would affect groundwater quality by blending SWP supplies with indigenous groundwater.

Biological Water Quality. Under the Small Projects Alternative, there is virtually no potential for recharge to affect biological water quality in receiving groundwater (above that of the Minimum Facilities Alternative) because, Regional Aquifer groundwater movement rates are quite slow and groundwater levels are quite deep, even at the potential Off-Channel Mojave River Recharge basin. No surface water influence is anticipated. To the extent that the Off-Channel Mojave River Recharge is used in lieu of recharge to the river itself, it may reduce potential downstream influence of surface water, and reduce the potential for impacts to wells downstream.

Leaching of Minerals. All sites were selected to avoid clay and fine-grained sediments, based on the best available records, including recent well-drilling logs from local agencies. There may be minor differences in soil composition at the west and east sites for Off-channel Mojave River Recharge. Mineral leaching associated with recharge is thus unlikely to be significant.

Banking and Exchange versus Normal Operations. Under the Small Projects Alternative, the only difference in banking and normal operations would be that banked SWP water would be of better quality in terms of arsenic, bromides, chlorides, sulfate, and TDS and of poorer water quality in terms of iron and TOC.

Mixing: SWP Water Quality versus Indigenous Water Quality. The blending of SWP supplies with indigenous groundwater in the Alto Regional Aquifer would result in lower arsenic, iron, and TDS levels in the groundwater and higher levels of chlorides, bromides, TOC, and sulfates.

5.13.4.4 Large Projects Alternative

The Large Projects Alternative affects only the Alto and Oeste Regional Aquifers, allowing for some additional recharge (252,000 to 333,000 acre-feet) and for higher return capacity. It would provide up to 16,500 additional acre-feet of direct return of groundwater to Metropolitan.

Biological Water Quality. Under the Large Projects Alternative, there is virtually no potential for recharge to affect biological water quality in receiving groundwater because Regional Aquifer groundwater movement rates are quite slow and groundwater levels are quite deep.

Leaching of Minerals. Based on Bookman-Edmonston (2004a) characterizations of the Alto, Oeste, and Antelope Wash geology and soils, the selected sites have a low potential for encountering significant lenses of clay and fine-grained soils that contain soluble minerals that could be leached during recharge.

Banking and Exchange versus Normal Operations. The Antelope Wash facility for the Large Projects Alternative would function only as a recharge site. No direct return would be provided. For this facility, the difference between banking and normal operations would be limited to import of wet-year versus all-year SWP supplies, resulting in import of SWP water of better quality in terms of arsenic, bromides, chlorides, sulfate, and TDS and of poorer water quality in terms of iron and TOC.

The Oeste and Alto facilities for the Large Projects Alternative could function as recharge-only facilities or recharge-direct-return facilities. If these facilities were operated such that recharged water was delivered to MWA producers, then the only benefits to MWA would be associated with import of SWP water of better quality in terms of arsenic, bromides, chlorides, sulfate, and TDS and of poorer water quality in terms of iron and TOC.

If these facilities were operated to provide direct return of banked water to Metropolitan, and this water is assumed to be a 50-50 mix of recharged water and indigenous groundwater, then operation would result in net import of bromides, chlorides, and TOC, and net export of arsenic, iron, sulfate, and TDS to Metropolitan in return water.

Mixing: SWP Water Quality versus Indigenous Water Quality. Mixing of projected SWP supplies with indigenous groundwater would affect the Oeste Regional and Alto Regional groundwater basins differently. The blending of SWP supplies with indigenous groundwater in the Alto Regional would result in lower arsenic, iron, and TDS levels in the groundwater and higher levels of chlorides, bromides, TOC, and sulfates. Blending would be particularly beneficial in terms of arsenic levels. Blending of SWP and indigenous Oeste Regional Aquifer groundwater would result in lower arsenic, iron, sulfate, and TDS and higher levels of bromides, chlorides, and TOC. Blending would be particularly beneficial in terms of sulfates and TDS.

5.13.5 Effects on Metropolitan Water Supplies and Water Quality

In banking programs, Metropolitan delivers relatively high-quality SWP supplies to banks and frequently takes lower quality supplies in return, although direct return of banked groundwater may result in improved water quality in terms of some constituents, as it may for the Proposed Project. Metropolitan therefore seeks to obtain a balance of return water that provides for good water quality. Metropolitan optimizes its own use of available SWP supply, taking all that it can in above-normal to wet years for in-basin use and storage. Water delivered to banks represents supply that Metropolitan would not be able to deliver and/or store within its own service area. Thus, banking has no adverse effects on Metropolitan supplies in normal-to-wet years, and in years of low supply, allows Metropolitan to meet a portion of dry-year demand that would otherwise require conservation (rationing) to be greater. The effects of banking on Metropolitan's supply reliability are therefore positive.

In terms of water quality, Metropolitan's dry-year primary use of SWP exchange supplies and secondary use of direct returns from groundwater optimizes supply conveyance, because all facilities are available for returns involving banking-partner SWP supplies. Metropolitan's alternative water supplies are also not likely to be of substantially better quality. Metropolitan has no access to Central Valley Project supplies or to supplies of riparian rights holders in central and northern California. In addition, there are significant supply deficits in the San Joaquin Valley in all year types, and obtaining dry-year supplies from this region is complicated by legal constraints on export of supplies from the region. Metropolitan's alternative sources of dry-year supplies are therefore limited to acquisition of supplies via transfer from other State Water Project contractors, use of DWR's water bank, and/or acquisition of supplies from entities north of the Delta. In many cases, Metropolitan would take initial delivery of these supplemental dry-year supplies via the State Water Project facilities and water quality would be identical to that provided by using banking-partner's SWP supplies in exchange for banked supply. The operation of the proposed water banking and exchange program would therefore not adversely affect the quality of water delivered to Metropolitan's service area, in either wet or dry years.

5.13.6 Effects of Changes in Project Magnitude on Water Quality

Three factors affect Proposed Project magnitude in a manner that could affect water quality: the magnitude of banking, the magnitude of time-shift exchanges, and the magnitude of MWA's own deliveries to groundwater replenishment. The capacity of facilities for recharge and the methods of making return to Metropolitan may be affected by these factors.

MWA and Metropolitan will use State Water Project supplies for virtually all aspects of the Proposed Project. As explained above, these supplies are of significantly better quality in (a) wet years and (b) in the spring and early summer. For SWP purposes, wet years are defined by precipitation in the Central Valley Watershed, and both the higher wet year quality and higher spring-summer water quality are related to snowpack conditions. Larger snowpack conditions lead to longer periods of higher runoff from the high mountains. These flows have lower mineral concentrations than flows from runoff from the valley floor and their higher volume in wet years and in the spring and early summer tends to repel seawater intrusion into the Delta, resulting in lower concentrations of chlorides, bromides, and other constituents associated with saline conditions in the Delta.

As recharge capacity of the Proposed Project increases, the potential for import of Metropolitan supplies for banking, exchange, and MWA's own potential SWP supply, increases. The Minimum Facilities Alternative would accommodate annual recharge of about 90,000 acre-feet, but this would require recharge over a 10-11 month period. The opportunity to take water in the spring and summer, when water quality is best, increases as facility capacity increases, because more recharge can be accommodated in a shorter period of time. The opportunity to optimize wet year deliveries also increases for the same reason. In short, as the magnitude of the Proposed Project increases, in terms of recharge capacity and in terms of overall exchange, the potential to import and store the best quality SWP supplies increases. The effect of adding facilities and adding to the magnitude of the banking project is therefore to allow MWA operators to schedule deliveries, to the extent that supply is available, in fewer months and thus to focus on obtaining supplies during the periods when the SWP is under the greatest impact of snowpack melt and water quality is best.

The magnitude of the proposed project has water quality implications associated with return deliveries as well. MWA's SWP allocations vary by year type, and MWA's ability to make returns via exchange of SWP supplies will be determined based on DWR allocations in return years. For a small project, involving modest amounts of banked water, MWA may be able to make all returns via exchange, even in critical dry years. As project magnitude increases, Metropolitan's average return request will increase, and there will be a greater potential for direct return of groundwater supplies. The exact mix of returns by exchange and returns by pumping of groundwater back to the California Aqueduct is impossible to predict.

In general, wells constructed and operated to make direct returns of groundwater to Metropolitan will be sites around recharge sites. In these areas, groundwater will mound under the recharge area, migrating downgradient. In the Mojave River, the mounding will result in lateral movement of supplies towards wells sited along the boundary of the Floodplain and regional Aquifers. In other areas, wells will generally be sited somewhat downgradient of the recharge basins. When there is to be direct return of supplies to Metropolitan via pumping to the California Aqueduct, then, the pumped supplies will be predominantly SWP supplies previously banked. Some supplies delivered for recharge by MWA may mix with Metropolitan banked supplies. Recharged supplies from both sources may be affected by the recharge process and by some mixing with indigenous groundwater, but given the localized mounding of recharged water and the siting of wells to intercept water as it migrates away from the mounded area, mixing with indigenous groundwater will be limited. In the Mainstem Mojave River, recharged water will mound to within about 30-35 feet of the surface at mid channel in the Mojave River Well Field reach and will be extracted adjacent to this reach in an area where the net flow is from the Floodplain Aquifer to the Regional Aquifer (USGS 2001). Extracted water will therefore be predominantly recharged supply, although some mixing of recharged water and water from surface flow in the Mojave River will occur. In the Alto and Oeste basins, it is likely that mixing of indigenous groundwater and recharged water will be minimal because natural recharge is slow and indigenous groundwater is deep from overdrafting. In both areas, recharge will exceed extraction rates for direct pumping back to the California Aqueduct because much of the return to Metropolitan will be accomplished via exchange.

The net effect of recharge and direct return of pumped water to Metropolitan will be that Metropolitan will receive previously banked supplies only moderately altered by the recharge process and some minor mixing with indigenous supplies. As noted on Table 5-44 and 5-45, recharged supplies may have slightly different characteristics than the supplies returned due to this minor mixing during recharge, and this will mean changes to both indigenous groundwater quality and the quality of recharged supplies.

A second aspect of water quality related to recharge and returns is that SWP supplies delivered to recharge are likely to be better than SWP supplies used to make returns to Metropolitan via exchange. Direct pumping of stored groundwater and return of this water via the California Aqueduct will mean extraction of good quality wet-year supplies, moderately affected by recharge processes. Pumped groundwater will probably have lower total dissolved carbon due to the processing of this constituent during recharge, and may have lower levels of nitrates and nitrites due to breakdown of these constituents. Some minerals may leach from the soil during recharge, and increase mineral concentrations in the wet-year SWP supplies. In general, the direct pumping and return of banked wet year supplies as part of the overall banking and exchange program would be expected to enhance water quality when compared to the quality of SWP dry year supplies, although concentrations of some minerals may be higher. Arsenic leaching as a result of recharge is not anticipated to be a significance issue because (a) the recharge sites have been sited to avoid areas with soils likely to have high concentrations of arsenic, (b) SWP supplies have pH and DO concentrations likely to minimize mobilization of arsenic, and (c) there is likely to be only incidental mixing of recharged supplies and indigenous groundwater as a result of well siting to preferentially intercept recharged supplies.

As the magnitude of the banking element of the proposed project increases, the potential for return water by direct pumping increases, and this generally enhances the quality of water returned to Metropolitan, when compared to the quality of dry-year SWP supplies. The magnitude of the time-shift exchange element does not affect water quality because all exchanges are of SWP supplies. The magnitude of MWA's own use of facilities does not affect water quality associated with returns because no returns are made.

5.13.7 Significance of Impacts

5.13.7.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant effects to water quality if activities were to:

- Violate any water quality standards or waste discharge requirements; or
- Otherwise substantially degrade water quality.

5.13.7.2 Significance of Impacts

As Tables 5-39 and 5-40 indicate, the Proposed Project does not violate surface water quality objectives of the LRWQCB or the CRWQCB. Nevertheless, water quality clearly varies from region to region, river to river. These variations mean that any banking and exchange program will result in pluses and minuses. Each partner will receive slightly different water quality than is received in return. The water quality data for the Proposed Project banking and exchange elements, and for MWA's own use of facilities, shows that operations of the Proposed Project facilities will result in changes in groundwater quality.

Although recharged water would vary in quality when compared to indigenous groundwater and would be of lesser quality for several constituents (depending on groundwater basin characteristics), the net effect of recharge would be to improve indigenous groundwater quality 72% of the time, including very substantial improvements in arsenic, fluoride, and iron in almost all cases. Banked water delivered in above-normal and wet years, and on the general schedule shown on Table 5-22 would be of better quality than the annual average SWP water that would otherwise be imported to meet MWA supplemental water demands in dry years. The net effect of banking on water quality is therefore generally positive. This is particularly true for arsenic, which is substantially lower in SWP supplies than in indigenous groundwater (except in Johnson Valley, where SWP supplies are higher in arsenic by 0.3 parts per billion). Arsenic supplies in SWP water are about 55% better than drinking water standards.

The Proposed Project would not violate surface water quality objectives of the Lahontan Regional Water Quality Control Board or the Colorado River Regional Water Quality Control Board (Tables 5-39 and 5-40). In short, SWP water is considered Class 1 water suitable for all domestic water uses. Its import will generally improve water quality in the basin. The Proposed Project neither violates water quality standards nor substantially degrades water quality. This is consistent with Lahontan Regional Water Quality Control Board findings related to MWA's 2003-2005 pilot project as well. No significant impacts to MWA surface or groundwater would therefore occur.

For Metropolitan, banked water would be water it would otherwise not take delivery of; return water would be of similar quality to the supplies available to Metropolitan from other sources. Metropolitan would therefore experience no significant change in quality of water imported. Direct returns, if any, would be blended with SWP supplies and the resulting mix could improve water quality to Metropolitan except for arsenic, but would also not violate water quality objectives in Metropolitan's service area.

The impacts of banking and exchange on water supply are to pre-deliver substantial supplies for storage and to extend the period over which MWA can meet replacement obligations with current SWP contract supplies and pre-delivered groundwater. No significant impacts to water supply for MWA would occur.

As noted in Section 5-13.1, the alluvium underlying Antelope Wash is deep sand and gravel, and there are no indications of significant variation in alluvium conditions between the upstream Antelope Wash recharge site and the downstream, as described in Chapter 4, page 4-31. Thus, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to water quality.

5.13.8 Mitigation and Significance of Impacts after Mitigation

Because SWP water quality associated with water banking and exchange is superior to that which would otherwise be imported under the No Project Alternative, the implementation of a banking and exchange program would be beneficial compared to the No Project Alternative. There is some potential for groundwater recharge to percolate through clay and fine-grained soils and result in leaching of minerals into indigenous groundwater. This potential is low, given the analysis of proposed site conditions, but water quality in production and monitoring wells will be monitored to detect such potential influences. Wells will also be monitored for potential surface water influence, and recharge will be managed to reduce any effects identified. As noted in Chapter 4, there is potential for some runoff from construction sites; these will be addressed by preparation and implementation of a Storm Water Pollution Prevention Plan based on the guidance in the Caltrans *Storm Water Pollution Prevention Plan and Water Pollution Control Plan Preparation Manual*, March 2003. With these mitigations, impacts will be mitigated to a level of less than significant.

In response to comments from the Lahontan Regional Water Quality Control Board and San Bernardino County Department of Public Works, Environmental Management Division and Water Resources Division. MWA notes that, based on preliminary geotechnical analyses, MWA selected a number of potential recharge basin sites, focusing on areas with characteristics likely to avoid areas with high arsenic concentrations in subsurface soils. These evaluations included analysis of groundwater data from wells in the vicinity of the proposed recharge sites, including evaluations as part of MWA pilot projects at Oro Grande Wash. MWA will confirm these analyses during pre-design and construction geotechnical analyses, when corings at potential well sites will be made and cores examined to ensure that subsurface soil conditions do not result in recharge to areas with high potential arsenic concentrations. If corings identify high arsenic concentrations in soils, then MWA may evaluate and select recharge sites in adjacent areas.

In regard to the potential for recharge in the Mainstem Mojave River to result in surface water influence on groundwater, the proposed project, if fully implemented, would result in a system of over 30 existing and new wells along the river, monitoring of which will provide a coherent view of the effects of the proposed project on groundwater. The Department of Health Services (DHS) "*Drinking Water Source Assessment for Surface Water Sources*" August 18, 2000 describes a number of different protocols for assessing whether a well is under surface water influence. DHS may request various assessment techniques, depending on their judgment of the potential for a well to be under surface water influence. These protocols, or any updated DHS protocols, will be implemented, as appropriate, in consultation with local producers, the County of San Bernardino, and DHS.

5.13.9 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA. Under the No Project Alternative, MWA would, in the long term, import SWP supplies equivalent to those provided in an accelerated manner as a result of the banking and exchange project. These would be average year water quality supplies, and the No Project Alternative therefore would result in import and recharge of generally poorer quality SWP supplies than those likely to be imported as a result of banking and exchange.

5.14 Water Resources (Hydrology)

5.14.1 Environmental Setting

Surface runoff and river flow in the MWA service area are dominated by infrequent very wet conditions, both as a result of winter storms from the northwest and as a result of summer/fall monsoonal influences associated with subtropical moisture from the south creating short-term periods of locally-heavy rainfall. Locally-heavy summer precipitation has little regional effect. *Per* comments from County of San Bernardino (Appendix A), according to the most recent FEMA Flood Insurance rate Maps, the proposed project may cross areas within Zone A, special flood hazard areas which may be inundated by a 100-year storm event, and zone X.

Infrequent wet years, such as 2004-5, may bring substantial and extended flow to the Mojave River and to local washes that drain to the river. As a result, groundwater levels in the Mojave River Floodplain Aquifer rise and may stay elevated for a period of time while water moves laterally into the Regional Aquifer and downstream into the Narrows.

5.14.2 Mechanisms for Effect

1. Recharge basins sited along the various washes would be subject to infrequent scouring flows which may erode berms and result in sediment transport downstream. This may occur during high flows in Oro Grande Wash and Antelope Wash. Recharge basins in these washes will be constructed using existing soils in the basins and thus the net volume of sediment in these washes will remain constant; high flows that erode recharge basin berms will thus rapidly re-distribute these soils and peak flows in the washes will not be affected by the berms. There is thus no mechanism by which in-basin berms would significantly affect flooding.

2. In Unnamed Wash, the use of the wash to convey up to 500 cfs for an extended period of time will alter the condition of the channel in the wash, resulting in a somewhat incised channel in some locations and reducing potential for overland sheet flow. Development of an incised channel would result in increased recruitment and transport of sands and gravels to the Mainstem Mojave River until an equilibrium condition was achieved.

3. Groundwater recharge and banking have the potential to affect Mojave River Hydrology primarily by raising groundwater levels and therefore reducing the infiltration of flood waters during periods of high natural flow, potentially increasing surface flow.

5.14.3 Potential Project Effects

Potential project effects to hydrology are limited to the Unnamed Wash and the Mainstem Mojave River. In Unnamed Wash, there will be sediment recruitment and transport associated with sustained flows of up to 500 cfs. Where this flow crosses sands and gravels, there will be erosion and an incised channel will be formed. Once this channel has been formed, erosion will be minimal. Deliveries from the California Aqueduct will be suspended during periods of substantial natural runoff, and thus there will be no change in the peak flow down the channel as a result of the project. The incised channel will contain relatively high flows and reduce the potential for sheet flow across the floodplain. Such sheet flow occurs infrequently and changes in sheet flow distribution should not affect vegetation communities, which consist of desert scrub.

Where the wash discharges to the Mainstem Mojave River, there will be an initial discharge of sediment associated with channel formation, resulting in a short term build up of a small alluvial fan at the outlet. This alluvial fan will be rapidly eroded and the sediment transported downstream by moderate flows in the Mainstem Mojave River. Although not significant, this additional sediment may somewhat offset losses in sediment recruitment and transport which have occurred as a result of changes in flow rates associated with lower-than-natural flood flows below Mojave Forks Dam.

Potential project effects on flooding are limited to the Mainstem Mojave River, where MWA may recharge up to 44,400 acre-feet in any given year. The potential for this recharge to affect flood flows depends on two factors:

- The timing of recharge and flooding
- The capacity of recharge into the mainstem during flooding to affect potentially damaging flood flows.

5.14.3.1 The Effects of Recharge Delivery Schedule.

The schedule of recharge for banking and exchange is described in Table 5-22, which illustrates the historic and probable future pattern of Metropolitan deliveries to water banking programs. As Table 5-22 shows, Metropolitan has not routinely delivered substantial amounts of water to banking programs in December, January, or February. Deliveries begin to be ramped up in March. Metropolitan's deliveries to banking peak in May and then generally have declined from May through November.

This historic delivery pattern would have three effects on groundwater levels in the Mainstem Mojave River. First, in wet years, deliveries in March or April would not be made if there was already substantial flow in the river; MWA would divert such deliveries to other recharge basins because banking deliveries and surface flows would flow too rapidly downstream and would not percolate effectively. Thus, even a late winter storm would not be affected by on-going recharge. Second, most deliveries would be made during periods when major flooding on the mainstem river would not occur -- during the late spring and early summer. Finally, a majority of potential Metropolitan deliveries of water to the mainstem river would decline in September, October, November, and December.

The result of the delivery pattern would be that banked water would be recharged and would be moving laterally into the Regional Aquifer for a period of at least 4 months before the rainy season begins in earnest in January. In the alluvial aquifer, lateral movement is relatively rapid, and much of the recharged water would therefore be moving into the Regional Aquifer by the time the rainy season begins.

5.14.3.2 Recharge of flood flows into the Mojave River Floodplain Aquifer

The primary concern related to recharge of banking supplies in the mainstem river is that recharge rates in the Mojave River are high and that, under natural conditions, flood flows are reduced substantially by recharge into the riverbed. The concern is that artificial recharge would "use up" some of this recharge capacity and that flooding would be affected.

Flood flows of significance, such as occurred in 1983, 1996, and 2005, are the result of extreme and extended precipitation. USGS Daily Streamflow data for the Mojave River near Hesperia and Victorville at the lower Narrows (USGS 2005) show a pattern of flood events that suggests that initial storms result in runoff that rapidly fills available recharge capacity of the Mainstem Mojave River in the Proposed Project reach. In 1983 (Table 5-46), there were six separate events when flows in the Mainstem Mojave River exceeded 1,000 cfs, including one two-day period of flow in excess of 11,000 cfs.

The comparison of the USGS stream flow data for Hesperia and Victorville at the Narrows in 1983 (Table 5-46) reveals several patterns related to flow and recharge:

- Early in the year and during the period when flows are rising, flow at Hesperia (upstream) is substantially higher than flow at Victorville in the Lower Narrows. This suggests that during the early part of the rainy season, recharge is reducing flows in the river.
- During peak flow periods, when flows exceed 1,000 cfs, there is a rather large difference in flow rate upstream and downstream, with flows at Hesperia often exceeding those at the Narrows by a factor of 10 or 20. This reflects the rapid spreading of floods across the floodway before they pass through the narrow canyon at the head of the Narrows.
- As the flood begins to recede, there is a brief period when flows downstream are greater than flows upstream. This reflects the draining of the floodway as input from the mountains declines and the flood peak passes downstream.
- After the peak has passed downstream, the difference between flow at Hesperia and flow in the Narrows is relatively stable. Flow at Hesperia is about 80 to 250 cfs higher than flow at the Narrows.

The difference between net flow at Hesperia and net flow at Victorville at the Lower Narrows is a reasonable indicator of total recharge in the river between the two locations, although there is minor evaporation loss (which reduces recharge) and there is some potential for error in stream flow measurements, particularly at high flows. Nevertheless, a large portion of the water in the river at Hesperia that does not reach the lower Narrows may be assumed to be recharged. This groundwater may later become surface flows at the Narrows, but this would occur well after there was any potential for flooding. Most of this recharge occurs during periods of flow in excess of 1,000 cfs (Table 5-47); that is, at higher flows, the flow at Hesperia is proportionally greater than flow in the Narrows. When flows were in excess of 1,000 cfs, the difference in flow at Hesperia and flow at Victorville at Lower Narrows ranged from 509 acre-feet per day to 4,162 acre-feet per day. In periods when flow at Hesperia was less than 1,000 cfs, the average daily difference in flow at the two sites was 306 acre-feet. There also appears to be a strong relationship between flow and recharge. This is probably related to the spreading of very high flows across the wide floodway. The data from 1983 are not precisely representative of data sets from other flood years, but the general patterns of flooding and apparent recharge are also reflected data sets for other wet years. These data suggest:

- After an initial recharge during the first storm of the season, recharge to the river channel is closely related to inflow and to the total area of channel and floodplain that is flooded.
- Following peak flows, and the relatively large volumes of recharge they generate, apparent recharge declines rapidly to from 80 to 300 cfs (159 acre-feet/day to 596 acre-feet per day).
- Given the short duration of flooding outside of the mainstem channel when flows substantially exceed 1,000 cfs, recharge is rapid because this portion of the floodplain has not been saturated by previous flow and percolation rates are therefore high.

These patterns of flow and apparent recharge also suggest that recharge during high flows when flows escape the main channel and cross the floodplain may cause damages to property, occurs in the unsaturated upper layers of the floodplain soils. Given peak flood durations of 3-6 days, and off-channel percolation rates of from 2 to 5 feet per day, flood recharge would occur within the upper 6 to 30 feet of the floodplain alluvium.

5.14.3.3 Potential Effects on Flood Recharge of the Mojave River

Metropolitan deliveries to the proposed banking and exchange program will generally peak in March, April, May, and June. Water recharged in this period will percolate rapidly into the alluvial aquifer and migrate laterally to the regional aquifer over a period of at least 4 months before the start of the potential flood season. During this time, there will be on-going extractions of groundwater from the Mojave River Well Field. The net effect of this type of recharge will be that banked water would (a) move vertically down into the aquifer and laterally away from the river channel. Groundwater levels in the river and in the adjacent floodplain will be maintained at below 20 feet and, as discussed in the analysis of potential liquefaction effects, are likely to be even lower due to on-going extraction. Thus there will be substantial capacity to recharge the upper 20-40 feet of the alluvial aquifer when peak flood flows spread out over the floodway. There will likely also be adequate capacity in the mainstem channel to accommodate flows from the initial storm of the season, after which recharge to the river channel itself will be relatively stable.

There is some potential for active recharge in the late summer and fall to affect the capacity of the river to absorb the first high flow of the rainy season. However, the first storm of the season has historically been a relatively small event, and this potential lack of early season recharge capacity could result in more flow through the Narrows during and following the initial storm, but would not affect subsequent flood flows. In short, recharge operations may have effects on recharge of flows during the initial storm of the season, but would have very little effect on potentially hazardous flooding which occurs following saturation of the watershed following a series of storms.

Table 5-46. Difference between flows at Hesperia (USGS site 10261100) and Victorville (USGS site 10261500) at the lower Narrows (downstream), January 20, 1983 to May 10, 1983. A"+" indicates that flow in the Narrows was greater than flow upstream at Hesperia. (http://nwis.waterdata.usgs.gov/nwis/discharge)

DAY	APPROXIMATE FLOW IN CFS		DIFFERENCE IN FLOW IN CFS
	Hesperia	Lower Narrows	
1-20	56	46	+10
1-21	48	49	-1
1-22	46	49	-3
1-23	262	51	-211
1-24	266	46	-220
1-25	322	48	-274
1-26	250	49	-201
1-27	2090	175	-1915
1-28	1140	836	-304
1-29	1360	1220	-140
1-30	508	629	+121
1-31	358	343	-15
2-1	224	195	-29
2-2	211	104	-107
2-3	217	117	-100
2-4	187	102	-85
2-5	165	67	-98
2-6	162	56	-106
2-7	194	58	-136
2-8	1280	561	-719
2-9	680	631	-49
2-10	692	405	-287
2-11	836	635	-201
2-12	805	659	-146
2-13	801	651	-150
2-14	727	658	-69
2-15	805	617	-188
2-16	799	673	-126
2-17	800	680	-120
2-18	782	687	-95
2-19	770	673	-98
2-20	758	659	-99
2-21	754	651	-103
2-22	753	651	-102
2-23	754	651	-103
2-24	752	651	-101
2-25	748	644	-104
2-26	781	644	-137
2-27	4040	1480	-2560
2-28	4240	2450	-1790

3-1	11600	6400	-5200
3-2	11700	8950	-2750
3-3	6060	4370	-1690
3-4	2920	-2700	-220
3-5	1640	2000	+360
3-6	1380	1700	+320
3-7	840	1560	+720
3-8	789	1100	+311
3-9	828	748	-80
3-10	761	715	-46
3-11	636	675	+39
3-12	685	690	+5
3-13	886	765	-120
3-14	977	786	-191
3-15	1210	796	-414
3-16	1280	828	-462
3-17	1250	817	-433
3-18	1470	817	-653
3-19	1470	917	-553
3-20	1430	1090	-340
3-21	1460	1180	-280
3-22	990	1020	+30
3-23	1120	851	-269
3-24	1290	1010	-280
3-25	1190	1060	-130
3-26	1140	1020	-120
3-27	1140	1010	-130
3-28	1150	1010	-140
3-29	1160	1060	-100
3-30	928	991	+63
3-31	743	556	-187
4-1	755	514	-214
4-2	605	459	-146
4-3	536	459	-77
4-4	395	353	-42
4-5	296	243	-53
4-6	262	213	-49
4-7	243	204	-39
4-8	227	180	-47
4-9	217	164	-53
4-10	221	167	-54
4-11	218	173	-45
4-12	207	167	-40
4-13	215	152	-63
4-14	268	173	-95
4-15	277	177	-100
4-16	281	186	-95
4-17	290	189	-101
4-18	641	309	-332
4-19	502	450	-152
4-20	618	365	-253
4-21	1380	825	-555
4-22	1020	672	-348
4-23	923	636	-287
4-24	856	560	-296

4-25	517	450	-67
4-26	425	262	-163
4-27	454	298	-156
4-28	439	278	-161
4-29	1500	513	-987
4-30	1530	1390	-140
5-1	1060	952	-98
5-2	717	650	-67
5-3	574	456	-118
5-4	543	440	-103
5-5	496	392	-104
5-6	451	367	-84
5-7	437	338	-99
5-8	439	324	-115
5-9	439	347	-102
5-10	425	338	-87
	115445 (229,158 acre-feet)	**79828 (158,458 acre-feet)**	**35,623 (70,717 acre-feet)**

Table 5-47. Volume of inflow in acre-feet to Hesperia and Victorville at the Lower Narrows, January 20, 1983 through May 10 1983.

INFLOW DATES (DAYS)	**INFLOW VOLUME IN ACRE FEET**		**DIFFERENCE IN ACRE FEET**	**AVERAGE DAILY DIFFERENCE IN CFS/ACRE-FEET**
	Hesperia	**Victorville at Lower Narrows**		
Six flood events (flows greater than cfs)				
Jan 23-31 (8)	13014	6743	6271	395/784
Feb 7-12 (6)	8907	5,854	3053	256/509
Feb 27-Mar9 (11)	91383	66414	24987	2097/4162
Mar 15-29 (15)	37218	28754	8463	284/564
Apr 18-24 (7)	11,791	7577	4214	303/602
Apr 29 - May 1 (3)	8119	5667	2452	412/817
TOTAL	**170,432**	**121,009**	**49440**	**988/1977**
Non-Flood periods (flows of less than 1,000 cfs)				
71 days	**58,726**	**37,449**	**21277**	**154/306**

5.14.4 Significance of Effects and Mitigation

5.14.4.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant effects on non-water quality aspects of hydrology if activities were to:

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- Cause inundation by seiche, tsunami, or mudflow.

The Proposed Project: (a) will increase groundwater levels rather than decrease them; (b) will not affect the course of an existing stream or river; (c) will not create runoff exceeding the capacity of drainage systems (existing or planned); (d) will not place housing in a 100-year floodplain; (e) will not place within a 100-year flood hazard area structures which would impede or redirect flood flows; (f) will not expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; and (g) will not cause inundation by seiche, tsunami, or mudflow.

Off-channel Mojave River Recharge will be placed outside of the floodway maintained by San Bernardino County Flood Control and thus will not affect the 100-year flood.

Although recharge late in the summer and fall could affect alluvial aquifer capacity to recharge flows from the first storm of the season, recharge of the Mainstem Mojave River during banking and exchange operations would have little effect on the very large flows that may cause damages in the Hesperia reach of the mainstem river. No significant impacts are anticipated.

5.14.5 Mitigation and Significance of Effects after Mitigation

Although instream recharge will have no clear effect on flooding in the Mainstem Mojave River, MWA will monitor groundwater levels in the Mojave River Well Field for evidence of high groundwater levels in the floodplain outside of the mainstem channel. If there is substantial evidence that recharge is raising these levels to within 20 feet of the surface in this location and at the beginning of the storm season, then MWA would adjust operations by diverting some banked supplies to other recharge facilities. This is unlikely to occur because on-going extractions will help maintain groundwater levels below 20 feet.

Given on-going monitoring of groundwater levels adjacent to the Mainstem Mojave River and the capacity to shift deliveries of SWP supplies to other recharge sites, MWA anticipates no significant effects of recharge on flooding in the Mainstem Mojave River.

In its response to comments from San Bernardino County, Department of Public Works (DPW), MWA recognizes the need to coordinate design and construction of facilities that may affect drainage. MWA does not anticipate that facilities, as described in the EIR, will significantly affect drainage or flooding in washes, but for facilities within the Mainstem Mojave River channel and in washes, MWA will coordinate with the Flood Control District during design to ensure that facilities do not become an obstruction to flows or adversely affect adjacent or downstream properties. A number of the cities in the Proposed Project area have Master Plans of Drainage. MWA will also work with local communities during design, construction, and implementation of the proposed project facilities.*

The Ranchero Road detention basin has been designed to control flow into the constrained channel downstream by retarding flood flows. A secondary effect of this flood control structure, which may impound water to a depth of up to 22 feet, is to negate any significant surface hydrologic effect associated with use of this facility for recharge of imported water. Also, as noted in MWA's response to comments by County of San Bernardino, Department of Public Works (Water Resources Division), "The low berms MWA would construct at these sites [recharge sites in washes] would thus be constructed in areas where flows will already be significantly constrained by downstream structures that effectively create flood detention basins. No significant effect from project facilities on flood passage at these sites is thus anticipated." In response to WRD, MWA reaffirmed that it has always been committed to working with local flood control officials to ensure that the berms constructed for recharge with imported water will not become obstructions to flood flows. Thus, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to hydrology.

5.14.6 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site some of them because of development that would constrain siting options for MWA.

Under the No Project Alternative, deliveries to the Mainstem Mojave River would probably be initially lower, until a Mojave River well field was eventually developed in cooperation with local agencies. Both the capacity for recharge of the alluvial and adjacent regional aquifers and capacity to extract recharged supplies would likely be lower than under the Proposed Project. The result would be marginally lower groundwater levels below the Mainstem Mojave River and thus some increase in "first storm of the season" recharge, with less potential for downstream movement of this supply to the Narrows.

5.15 POPULATION, HOUSING and GROWTH

5.15.1 Environmental Setting

The 2004 PEIR analyzed the potential indirect effects of overall water management programs on growth and reached the following general conclusions:

- Since 1975, there has been substantial development and population growth in the overall MWA Service area, but populations in the Copper Mountain Valley and Warren Valley actually declined from 1990 to 2000 at a rate of -0.6% and -4.9%, respectively;
- SCAG projects additional growth by 2020, with growth concentrated in the Adelanto, Hesperia, Victorville, Apple Valley; and Barstow;
- Growth in the Baja and Morongo Basin/Johnson Valley will be slowest;
- Agricultural water use has declined rapidly since 1990 and this decline was more rapid than projected by the 1994 Regional Water Management Plan;
- Overall industrial consumptive use of water increased from 1995 to 2001, rising from 10,700 acre-feet per year to 12,800 acre-feet per year (20%).

The 2004 PEIR note that by about 2020, projected water use is approximately equal to the average annual water supply from all sources, including average annual SWP supply of about 58,600 acre-feet.

The 2004 PEIR suggests that overall water management may have growth accommodating impacts and documents their indirect effects. The 2004 PEIR notes that the effects of projected growth have been assessed in the General Plans and associated Environmental Impact Reports of San Bernardino County, the City of Adelanto, the Town of Apple Valley, the City of Barstow, the City of Hesperia, the City of Victorville, and the Town of Yucca Valley. These agencies, responsible for planning in the MWA service area, have determined that some of the indirect effects of projected and approved population growth and development would be significant and unavoidable, including effects to air quality, biological resources, geology and soils, cultural resources, land use, mineral resources, population and housing, public services and utilities, recreation and open space, transportation and traffic, and utilities and service systems. The determination of whether these general growth-related impacts would be significant under CEQA has thus been evaluated and formal findings made at the county and local level. The 2004 PEIR notes that full implementation of the 2004 Regional Water Management Plan could have significant and unavoidable impacts, but that MWA does not have authority to implement mitigation actions for these effects.

The 2004 PEIR analyzes the potential for a general water banking program involving MWA and Metropolitan Water District of Southern California, concluding that:

> *In Summary, future water banking agreements with MWA are identified in the most recent IRP [Integrated Resources Plan] prepared by Metropolitan. The MWA banking agreement -- and others like it with other SWP contractors -- are mutually beneficial arrangements that assist Metropolitan in meeting its future dry-year demand. Metropolitan supports growth planned by its member agencies. Local member agency General Plans identify local growth trends and policies and evaluate the secondary effects of growth within their jurisdictions."*

The Proposed Project would take place within the context of the growth management plans adopted by regional and local planning agencies in the MWA service area and in the Metropolitan service area. These plans provide for continued managed growth in southern California and specify general approaches to mitigation of the adverse indirect effects of growth. From 2005 through 2020, population in MWA's service area is anticipated to grow at an overall rate of 2.5% per year, from 373,000 in 2005 to 527,700 in 2020 (an increase of 29%). This growth would continue to be concentrated in the southern portion of MWA's service area, and near major highways and military bases.

Water demand is anticipated to grow at a slower rate. In the Mojave Basin, total water consumption is anticipated to grow as well, but at a slower rate. If agricultural consumption stabilizes at 2005 rates, the total increase in consumptive use is projected to grow from 114,700 in 2005 to 142,500 acre-feet per year in 2020, an increase of about 24%. If agricultural consumption continues to decline as it has during recent years, the increase would be lower, from 112,200 acre-feet per year in 2005 to 120,100 acre-feet per year in 2020, an increase of 9%. In the Morongo Basin, consumptive use is projected to increase from 3,100 acre-feet per year in 2005 to 4,000 acre-feet per year in 2020, an increase of 29%. There is no current or projected agricultural use in this basin.

Growth and water demand in MWA's service area occur within the context of overall growth in California. From 1941 through 2004, California growth rates varied from 9.97% to 0.60%, with the highest growth rates occurring during World War II and the subsequent baby boom years of 1945 through 1960, when crude birth rates were in excess of 20% per year (California Department of Finance, Demographic Research Group). From 1960 through 2004, overall population increase varied from 3.46% to 0.60 percent, with crude birth rates generally in decline and below 20%. From 1941 to 2004, both birth rates and death rates declined in a relatively stable pattern, reflecting the inelasticity in population changes resulting from internal growth. Migration to and from California was more variable, with migration rates of from 8.6% to 81.6% from 1941 through 1960. From 1960 through 2004, net migration varied from -4.7% to 19.7%.

In response to comments from Department of Water Resources (Appendix A), MWA notes that in the Regional Water Management Plan adopted by MWA's Board of Directors in early 2005, MWA describes its legally-mandated role in regional planning and its coordination with local and regional governments to address issues related to water supply and growth. As noted in Chapter 1 of the DEIR (Introduction), MWA's mandate is to provide supplemental supplies for use by local producers throughout the Agency. Further the Mojave Basin Area Judgment imposes restrictions on local groundwater production and requirements that local producers purchase supplemental supplies when these restrictions are exceeded. Given the cost of imported supplemental supplies (see Chapter 2), this requirement constitutes a substantial economic incentive to conserve and to manage growth and water supply intelligently.

As the agency designated to provide supplemental supply, MWA is working with local governments, water purveyors, educational institutions, and local community groups to address water conservation. For example, MWA has on-going cooperative programs to promote urban and agricultural water conservation, providing funds to the local RCD. MWA also lends assistance to, and participates in, local programs to enhance water supply through source protection and blending, to eradicate non-native plants that adversely affect supply and native riparian areas, and to monitor groundwater supply and water quality. MWA provides educational materials and economic incentives for water conservation programs. These activities are described in detail in the Regional Water Management Plan and have been incorporated into the supply/demand projections in the Regional Water Management Plan.*

5.15.2 Facilities and Operational Impacts

5.15.2.1 Mechanisms for Effect

There is no mechanism by which the Proposed Project would displace substantial numbers of people or housing, and thus the Proposed Project would have no direct effect on population, housing, or growth. Indirectly, water supply may accommodate growth to the extent that there is available supply in excess of demand and to the extent that other factors necessary for growth to occur (jobs, transportation, utilities, etc.).

5.15.2.2 Proposed Project Effects

Water banking and exchange programs are a response to California's highly variable climate and precipitation, where statistically average years are uncommon. Instead, California's climate is characterized by alternating wet and dry conditions, such as the 1987-1994 drought, which was followed by a period of generally wet years from 1995 through 2000. In an environment of fluctuating water supplies, water banking and exchange programs are intended to ensure a minimum level of supply reliability. Water from wet years is thus captured and stored for use in dry years. The result is thus to reduce the *fluctuations* in supply, that is, to provide supply conditions that approximate average-year conditions on a reliable basis. Water banking and exchange programs thus reduce the potential adverse impacts associated with drought, such as:

- They reduce the frequency and severity of rationing;
- They reduce loss of landscape planting and agricultural production;

- They reduce the potential for groundwater overdraft and subsequent land subsidence; and
- They reduce potential for loss of riparian habitat.

In addition, to the extent that banking and exchange programs allow for the import and storage of supplies which would otherwise not be available due to lack of recharge capacity or funding for their transport, they provide for delivery of average annual levels of supply over a longer period of time (Table 5-42 above). The effects of banking and exchange programs on population growth and development are therefore to allow average annual yearly demand to be met on a more reliable basis over a longer period of time before new supplies must be sought in order to address projected higher demands.

This enhanced water supply reliability provided by water banking and exchange is not well correlated with growth in California. Comparing migration rates to water year-type data from California Department of Water Resources with a standard linear regression shows no relationship between water year type and rate of migration ($r^2 = 0.027$); that is more supply does not induce migration and less supply does not discourage migration. Fluctuations of water supply do not appear to affect population trends in California, which appear more related to economic events, such as the 1993 to 1996 recession in Southern California, which resulted in net migration out of California during a period with 3 wet years and one critical dry year. In contrast, some of the highest recent rates of emigration to California occurred from 1987 through 1992, when there was an extended critical drought.

The Proposed Project also does not create new supply. MWA has had access to SWP supplies in excess of demand since 1978, but has not delivered substantial supplies in excess of demand because of cost and demand considerations. There is no evidence that the mere availability of water has increased net demand or growth within MWA. From 1990 to 2000, although MWA had access to excess SWP supply, there was net growth in the Hesperia, Victorville, Adelanto, and Apple Valley area, but a decline in population in the Baja subarea, suggesting that population was responding to factors other than water supply. The declines and shifts in population during this period thus appear unrelated to MWA's available supply.

Because birth rates, death rates, and migration rates are clearly unrelated to water supply fluctuations, banking and exchange programs that minimize these fluctuations would not induce or accommodate growth. They may ameliorate drought-year conditions, but these conditions do not appear to affect migration into or out of California. Thus there is no mechanism by which banking and exchange programs would affect growth and development. Given this general conclusion, expanding recharge at the Antelope Wash Ranchero Road site in lieu of developing the upstream recharge site would also have no effect on proposed project impacts related to population and housing.

5.15.3 Significance and Mitigation

5.15.3.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have a significant impact on population, housing, and growth if it were to:

- Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure);
- Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere;
- Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?

5.15.3.2 Significance of Effects

The Proposed Project does not displace substantial numbers of existing houses or people.
In terms of indirect growth inducement effects, the banking elements of the Proposed Project have no potential to induce or accommodate growth because they provide no net increase in water supply availability, except for the increase in groundwater replenishment associated with the 10% loss factor, which may over a period of about 20 years result in 15,000 acre-feet of additional supply (about 750 acre-feet per year). This is about 1% of MWA's Table A allocation and less than 1% of annual water use in the MWA service area. Much of the water associated with the 10% loss factor will likely pass through the Narrows to the transition zone, where its primary benefit will be to riparian vegetation communities. Thus banking has a minimal potential to affect net water supply. No significant effects on growth are anticipated from this aspect of the Proposed Project.

The exchange element of the proposed project will involve MWA and Metropolitan mutual exchanges of SWP supplies to optimize use of their available SWP supplies. This element of the Proposed Project will allow MWA to take delivery of available Table A contract supplies that it would otherwise not pre-deliver to storage due to facility and cost constraints. This water would be stored throughout MWA's service area and would extend the period of time for which MWA's existing SWP Table A supplies would be adequate to meet projected imported water demands. In this sense, the exchange program accommodates growth.

MWA's own use of the Proposed Project facilities will be to further enhance pre-delivery of available SWP supplies, both by taking more of MWA's existing Table A allotments and by taking supplemental SWP supplies available under programs such as the Article 21 program. These supplies would be stored for future use and would extend the period of time for which MWA's existing SWP Table A supplies would be adequate to meet projected demands for imported water. In this sense, MWA's use of the Proposed Project facilities would accommodate growth, but only to the extent that MWA was able to finance delivery of such supplies.

The 2004 PEIR notes that MWA has no authority to manage and/or mitigate for planned growth and that this authority rests with:

- Southern California Association of Governments
- Caltrans
- US EPA
- US Army Corps of Engineers
- County of San Bernardino
- Local cities in MWA's service area
- The Local Agency Formation Commission
- The Lahontan and Colorado River Regional Water Quality Control Boards
- The State Department of Health
- San Bernardino County Flood Control District
- California Air Resources Control Board
- Mojave Desert Air Quality Management District

The 2004 PEIR notes that there are significant and unavoidable impacts associated with growth. The 2004 PEIR further notes that growth is planned and mitigated through the above agencies. One element of their mitigation programs is to charge MWA with mitigation for the effects of planned growth on groundwater resources, water supply, and water quality.

The Proposed Project is part of MWA's mandate to mitigate for past, present, and future growth and its indirect effects on groundwater resources by providing replenishment water and by operating to optimize the quality of water that is imported. The Proposed Project enhances pre-delivery of SWP supplies to groundwater storage and thus helps to remediate long-term overdraft. It also enhances MWA's ability to import SWP supplies in times when they are highest quality. Both of these effects are considered to contribute to mitigation of the adverse direct and indirect of growth planned and approved by other entities.

The 2004 PEIR concludes that the impacts of planned and approved growth in MWA's service area are significant and unavoidable, and that MWA's mitigation obligation is to "implement the 2004 Regional Water Management Plan to address the effects of planned growth on groundwater resources and water supply services within the service area." The Proposed Project is part of MWA's mitigation obligation and MWA has no authority to implement other mitigations for growth planned and approved by others. This Project EIR concurs with the conclusions of the 2004 PEIR. No further mitigation is required.

5.15.4. No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site some of them because of development that would constrain siting options for MWA.

The No Project Alternative would have the same effect on population, housing, and growth as the Proposed Project. MWA would continue to meet all imported water obligations with its SWP supplies, until at some future date the currently available level of SWP supplies proves inadequate to meet obligations. The Proposed Project somewhat delays this event and allows MWA greater opportunities to accommodate demand as technological advances are made in technologies such as desalination and water reuse. Neither of these effects would significantly alter projected growth.

5.16 Use of Energy and Energy Conservation

5.16.1 Environmental Setting

The Proposed Project takes place in the context of high national and regional energy use and rising prices for all forms of hydrocarbon based energy.

5.16.2 Mechanisms for Effect

The Proposed Project may affect energy use directly in three ways:

- The construction of all potential facilities would result in construction energy use of about 920,000 gallons of diesel and gasoline.
- The recharge of water will temporarily raise groundwater levels in some areas, and result in lower water extraction costs in these areas.
- The availability of recharge capacity will allow for MWA to import more of its own SWP supplies in wet years and in the spring of all years. During these times, electrical power production by hydropower is greatest. To the extent that deliveries of SWP supply can be focused on delivery during these periods as a result of greater recharge capacity, deliveries may be deemphasized during some periods of peak electrical power demand and low hydropower availability (potentially August through October).

Exchanges of MWA and Metropolitan supplies will not affect overall energy use associated with delivery of water from the SWP except that pre-delivery of some of MWA's existing SWP Table A supplies to Metropolitan may enhance storage in Metropolitan's service area during periods when MWA has such available supplies, which will generally be in above-normal years. This may reduce Metropolitan's need to import dry year supply, and thus reduce hydrocarbon based energy use for conveyance of supplies in dry years.

5.16.3 Proposed Project Effects

5.16.3.1 Minimum Facilities Alternative

The Minimum Facilities Alternative will utilize about 290,000 gallons of gasoline and diesel fuel for construction of conveyance and recharge facilities. The use of the Mojave River for recharge on an annual basis, with extractions from the Mojave River Well Field matched to recharge volume, will allow for very high rates of recharge and will optimize MWA's capacity to take water in the March through July period, and in wet years, when hydropower is most available. In addition, MWA's new well field will (a) replace some older wells currently in use with more efficient wells and (b) raise groundwater levels at the boundary of the Mojave River Floodplain Aquifer and the Regional Aquifer, further reducing energy use in extraction.

5.16.3.2 Small Projects Alternative

The Small Projects Alternative would increase total Proposed Project construction energy use by about 200,000 gallons of gasoline and diesel fuel. It would further increase MWA's ability to take wet year and wet season deliveries from the SWP, when hydropower is most available. It would raise groundwater levels in the Regional Aquifer in the Victor Valley, and thus reduce energy needs for extraction of stored supplies.

5.16.3.3 Large Projects Alternative

The Large Projects Alternative would increase total Proposed Project construction energy use by about 430,000 gallons of gasoline and diesel fuel. It would further increase MWA's ability to take wet year and wet season deliveries from the SWP, when hydropower is most available. It would raise groundwater levels in the Regional Aquifer in the Victor Valley, and thus reduce energy needs for extraction of stored supplies. The consolidation of recharge at one expanded Antelope Wash facility in the vicinity of Ranchero Road could marginally reduce the total area of construction, and expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site could potentially reduce project use of energy during construction.

5.16.4 Significance, Mitigation, and Significance after Mitigation

5.16.4.1 Significance of Impacts

Assuming construction over a 2-year period for the Minimum Facilities Alternative, for a 3 year period of the Small Projects Alternative, and a 4 year period for the Large Projects Alternative, annual construction fuel use would be equivalent to:

- Minimum Facilities Alternative: 10,000 100-mile truck trips
- Small Projects Alternative: 11,400 100-mile truck trips
- Large Projects Alternative: 16,000 100-mile truck trips

Annual construction fuel consumption is thus equivalent to not more than one day's average heavy truck traffic in the MWA service area. Construction fuel consumption impacts clearly rise as the magnitude of the alternatives increases. But, in the context of overall energy consumption in the MWA service area and in Southern California in general, they represent a tiny fraction of total energy use, and they are temporary.

In addition, construction fuel use under the Proposed Project may be offset by long-term energy savings associated with (a) use of the Mojave River Well Field and (b) lower energy use during conveyance of SWP supplies to MWA as a result of focusing deliveries in wet years and the wet season.

The magnitude of long-term energy savings related to use of the Mojave River Well Field to replace production from wells drawing supplies from the Regional Aquifer to the west of the river can be illustrated by comparing the probable operations and maintenance costs associated with new wells that may be constructed at Oeste and Alto to the new wells that may be constructed near the Mojave River. In a facilities cost estimate, Bookman Edmonston (2005d) estimated per-acre-foot costs for operation and maintenance (O&M) of wells at these two locations. Per-acre-foot O&M costs for wells at Oeste and wells installed as part of the Mojave River Well Field were estimated at $178 and $125, respectively. Because all wells would be new and have similar life cycle costs, the difference in costs, about $50 per acre-foot extracted, is primarily energy cost to pump from groundwater at different elevations.

If it is assumed that 67% of the $53 lower cost for O&M cost at the Mojave River Well Field would be due to energy cost savings, the energy cost savings is about $35 per acre-foot. Bookman-Edmonston used a power cost of $0.12 per kilowatt hour (kWh). Thus, $35 in energy savings is the result of saving about 291 kWh per acre-foot. Using standard conversions for kWh to gallons of diesel fuel, this is equivalent to about 6.7 gallons of diesel fuel for each acre-foot pumped.

Over the term of the Proposed Project, the annual recharge-extraction of the Mojave River Well Field may be up to 44,000 acre-feet per year. If only half of this capacity is assumed (22,000 acre-feet), and only half of this capacity is used to offset pumping from deeper wells in the Regional Aquifer (11,000 acre-feet), then at 6.7 gallons per acre-foot, annual operation of the Mojave River Recharge and Mojave River Well Field would reduce energy use by the equivalent of about 73,700 gallons per year. Over a 20-year period of operation, this energy savings alone would more than offset construction energy use. At the same time, recharge in the Oeste and Alto areas would also result in rising groundwater levels, with further resulting energy savings.

A second estimate of potential energy savings can be made based on the timing and magnitude of hydropower generation at SWP facilities (DWR 2001). Over a 20-year period, hydropower operations at DWR's Hyatt-Thermalito Generation facility (at Oroville Reservoir) have generated from about 4.8 billion kWh (in 1983) to less than 0.8 billion kWh (in 1991). Hydropower generation at this facility is routinely between 2.5 billion and 4.8 billion kWh in wet years and 0.8 billion to 1.9 billion kWh in dryer years. In addition, peak hydropower availability routinely occurs in May-August. To the extent that MWA can use additional recharge to allow it to take deliveries in wet years and in the wet season of all years, it can optimize use of available hydropower. In other times, DWR must frequently buy power. This is particularly true in the summer of dry years, when operation of the SWP can affect peak demand for electricity in the Central Valley.

The effect of added recharge and well fields is therefore to reduce pumping costs at a local level and to reduce energy demand on the SWP during peak energy demand years and seasons. In this context, the energy use associated with construction is at least offset by the reduced energy consumption associated with long-term operation and is less than significant.

5.16.4.2 Mitigation

Although this analysis suggests that net energy impacts of the Proposed Project will be insignificant and perhaps beneficial, MWA has also committed to an Air Quality mitigation program to reduce emissions during construction (see Section 5.3). This commitment to best management practices includes measures to ensure that equipment is not idled when not in use. This, and other measures to reduce air quality impacts, will further contribute to minimizing energy use.

5.16.4.2 Significance after Mitigation

Net Proposed Project energy use over the 20-25 year term of the project is insignificant and will be reduced further by implementation of construction best management practices for Air Quality. No significant impacts to energy use will occur.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 6: CUMULATIVE IMPACTS

6.1 Environmental Setting

Under CEQA, an EIR is required to assess the "cumulative impact" of a project when the project's incremental effect is cumulatively considerable. A cumulative impact consists of an impact that is created as a result of the combination of the project evaluated in the EIR together with other closely related past, present, and reasonably foreseeable future probable projects causing related impacts. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time. Cumulative impacts are thus "additive." The question addressed in a cumulative impacts analysis is: Does the proposed project contribute to an adverse trend in impacts that, when the proposed project's impacts are added to the probable impacts of other past, present, and future actions, could cause significant adverse impacts?

Section 15130(b) (1) of the CEQA Guidelines describes elements necessary for an adequate discussion of cumulative impacts:

> (1) Either
>
> > (A) A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside of the control of the agency, or
> >
> > (B) A summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or area wide conditions contributing to the cumulative impact. Any such planning document shall be referenced and made available to the public at a location specified by the lead agency.

Cumulative impacts of a large suite of potential water resources projects were evaluated by MWA as documented in the 2004 Regional Water Management Plan PEIR. This PEIR documented the cumulative impacts analysis for the County of San Bernardino General Plan and for the general plans of local jurisdictions in which the Proposed Project would have potential effects. The potential for water resources projects to contribute to cumulative impacts was evaluated in the context of these general plans, which take into account past, present, and projected development in the MWA service area within the reasonably foreseeable future. Potential cumulative effects were analyzed for:

- Aesthetics
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Hydrology and Water Quality
- Hazards
- Land Use
- Mineral Resources
- Noise
- Population and Housing
- Public Services and Utilities
- Recreation and Open Space
- Transportation and Traffic

The analysis of cumulative effects of the Proposed Project is based on, and elaborates on, the analysis in the 2004 Regional Water Management Plan PEIR. In several cases, the conclusions of this EIR are not consistent with those of the 2004 Regional Water Management Plan PEIR, primarily because analysis on a site-specific basis and at a higher level of detail suggests that the generally valid conclusions of the 2004 Regional Water Management Plan PEIR related to cumulative impacts are not applicable. The project-specific analysis therefore supercedes the analysis in the 2004 Regional Water Management Plan PEIR for (only) the specific facilities and operations described in this project-level EIR.

The various general plans outline general trends in development and the impacts related to development. These general trends are discussed in the 2004 Regional Water Management Plan and are the context in which project-level effects are evaluated below.

6.2 Mechanisms for Effect and Effects

6.2.1 Aesthetics

Some elements of the Proposed Project involve conversion of habitat and open space to recharge basins and conveyance facilities. Other elements involve placement of facilities within an urban matrix. The visual-aesthetic effects of the Proposed Project take place within a context of urban and suburban development which, in many locations, may have a cumulative effect of changing a natural viewscape to an urban viewscape. As noted in the 2004 Regional Water Management Plan PEIR, most of the potential projects would not contribute to the on-going change of the regional character. This conclusion is reinforced by MWA's proposed mitigations for various facilities, which would integrate proposed project facilities into the largely urban and suburban settings in which they would be constructed.

Site-specific evaluation, however, suggests that one element of the Proposed Project could contribute to the general trend of conversion of open-space aesthetic characteristics to urban aesthetic characteristics, with potential significant loss of viewshed. At Antelope Wash, south of the California Aqueduct, the potential 100-acre recharge basin would affect an area of aesthetic value which could, in the future, be within the viewshed of many people as the City of Hesperia expands development to the south. Relocation of the upstream Antelope Wash recharge basin to a downstream area as described in Chapter 4, page 4-31 would substantially lower the potential for cumulative impacts to aesthetic values. The loss of about 8 acres of desert wash habitat at Unnamed Wash would be a minor contribution to the long-term loss of habitat in the hills around Summit Valley as a result of future development. MWA's proposed mitigations for these habitat-related impacts will mitigate project-specific impacts. Their contribution to overall cumulative impacts associated with loss of scenic views would be less than significant, although the cumulative trend itself would result in significant loss of scenic views.

6.2.2 Air Quality

As noted in the 2004 Regional Water Management Plan PEIR, construction of proposed project facilities may have significant impacts to air quality related to emissions from construction equipment and fugitive dust. These impacts would occur within the context of additional growth, construction, and economic expansion in the MWA service area. Project-level impacts would be short term and there is potential for operations of recharge basins to have long-term minor beneficial effects in terms of fugitive dust emissions in the MWA service area, because recharge facilities have some potential to trap blowing dust. The Proposed Project would thus have a less-than-significant potential for cumulative effects related to air quality. The relocation of upstream Antelope Wash recharge to a downstream site could reduce construction area and emissions during construction. Adoption of this mitigation measure could further reduce potential for cumulative air quality impacts.

6.2.3 Biological Resources

As noted in the 2004 PEIR, various elements of the proposed project would involve loss of habitats and open space; this project-level EIR confirms these effects and concurs with the 2004 Regional Water Management Plan PEIR. The long-term habitat loss documented in the numerous general plans would result in loss of habitat availability and would reduce wildlife populations in the developing areas of MWA's service area. The 2004 Regional Water Management Plan PEIR concludes that the potential direct effects of the suite of water project facilities evaluated would be cumulatively significant. This Project EIR concurs with this evaluation, but notes that, given the siting of facilities in predominantly urban and urbanizing areas, proposed mitigation would result in conservation of resources in areas with higher long-term potential to support threatened and endangered species. Relocation of upstream Antelope Wash to a downstream site as described in Chapter 4 would reduce potential for cumulative impacts to biological resources.

6.2.4 Cultural Resources

Regional development addressed in the various general plans for the MWA service area has the potential to affect surface and buried cultural resources, particularly in areas where Native American and early European peoples would have congregates, such as near water sources. Significant cultural resources would be likely in many areas. All of the general plans evaluated in the 2004 Regional Water Management Plan PEIR conclude that potential cumulative effects on cultural resources will be less than significant (in some cases, with mitigation). This assumes that significant resources identified during planning and construction will be either avoided or treated in a manner consistent with current law and regulation. The analysis in this project-level EIR draws the same conclusion. The monitoring, excavation, and treatment of cultural resources, and the appropriate reburial of buried human remains found during excavations, will reduce project-level impacts to a level of less-than-significant. Taken in the context of other similar monitoring, excavation, and treatment activities, the cumulative effect of the project may be to contribute to overall understanding of the cultural history of peoples of the MWA service area. No significant adverse cumulative effects on cultural resources are therefore likely as a result of the Proposed Project.

6.2.5 Geology and Soils

As outlined in the 2004 Regional Water Management Plan PEIR, the primary mechanisms by which projects may affect regional geology and soils are (a) to increase potential for damage related to seismic events and (b) to reduce access to mineral resources. Potential seismic damage related to the Proposed Project is primarily related to raising groundwater levels in areas of development, and thus creating a higher risk of soil liquefaction during a seismic event. This potential is only associated with recharge of the Mojave River Floodplain Aquifer, where high rates of recharge could raise groundwater levels. Operational protocols for the Mainstem Mojave River recharge and related Mojave River Well Field would maintain groundwater levels at least 30 feet below ground level in the channel and deeper off-channel.

The potential for cumulative effects related to seismic-related liquefaction effects depends on whether there is substantial development in the floodplain of the Mainstem Mojave River. Given that flooding affects a broad area of this floodplain, substantial new development is unlikely. If a Mojave River Off-channel Recharge basin is constructed, this would reduce potential for development in the floodplain, and thus reduce potential for cumulative effects for seismic-liquefaction-related impacts.

The potential for loss of access to mineral resources is related to the total area of land developed in areas where there are substantial, commercially valuable, mineral resources. The Proposed Project would not affect access to oil and gas, as drilling for these minerals could be undertaken adjacent to the project sites. Quarrying would not be affected, as the project sites are not on lands with significant rock resources (such as limestone or granite). Recharge basins would not affect access to sand and gravel; periodic cleanout of basins is a potential source for local use.

The Proposed Project is unlikely to contribute towards trends related to development in areas with potential for seismic-liquefaction effects or to the severity of these effects. No cumulative effects are anticipated. The Proposed Project will also not contribute to the trend towards reduced access to mineral resources.

6.2.6 Hazards and Hazardous Materials

As development occurs, there is a potential for increases in hazards and exposure to hazardous materials. The City of Victorville General Plan EIR notes that cumulative impacts associated with hazards and hazardous materials may be significant and unavoidable. The Proposed Project's potential for these impacts is limited to the construction period. In the long-term, the Proposed Project will have virtually no potential for impact. It cannot therefore make a significant contribution to cumulative effect related to regional hazards and hazardous materials.

6.2.7 Land Use

In the context of the various regional and local general plans, there is a long-term trend towards conversion of open-space to development, although the various general plan EIRs indicate that cumulative land use changes are less than significant or mitigated to a level of less than significant. The Proposed Project will not contribute to this cumulative conversion, because it will not convert land permanently to development. Recharge facilities would be designed to be compatible with proposed development to the extent feasible, but would not themselves result in or indirectly affect the development trends.

6.2.8 Noise

The trend towards development is accompanied by a cumulative trend towards higher ambient noise levels due to traffic and congestion and other aspects of a generally mechanized life style. This trend is reflected in the noise standards for commercial/industrial areas versus standards for residential areas. Noise levels of 70 dBL or greater are expected in commercial and industrial areas, while noise levels of 70 dBL are considered excessive in suburbia. The Proposed Project will have temporary effects associated with noise, but permanent effects will be quite small, potentially smaller than if the properties developed for recharge and wells were developed. A well site would, for example, be quieter than a neighborhood gas station. Similarly, noise generated during operation of a recharge basin, including noise from use of construction equipment within the basin (with sound transmission blocked by external levees) would be less than if the recharge site was a normal commercial development like a shopping center. In short, the Proposed Project's noise impacts are related to short-term construction. The long-term operation of facilities is likely to generate lower noise levels than the commercial and residential lands uses projected in the various general plans for MWA's service area. MWA's facilities will thus not contribute to cumulative noise effects of growth and development.

6.2.9 Public Services and Utilities

Based on the EIRs for regional and local general plans, the development planned for MWA's service area would cause significant cumulative impacts on public services such as police, fire, schools, and hospitals and demand for utility services (gas, electric, water, cable, trash, telephone). These services are affected by growth, which increases demand for such services and complicates delivery of services by extending the area/distance which must be covered to deliver such services. This is not an unexpected cumulative trend. The Proposed Project has no mechanism by which it would contribute to this trend. It will neither cause local growth and demand for service nor reduce levels of public services.

6.2.10 Recreation

Recreation is a public service particularly sensitive to population growth. The development trends identified in the various regional and local general plans within MWA's service area suggest that there will be an increasing demand for urban-focused recreation such as local parks and open space, and also for large open-space areas. Projected development that increases population density tends to place more pressure on existing parks and open-space. Projected development that results in urban or suburban sprawl tends to require the development of new facilities. The Proposed Project does not significantly affect growth trends, either population density or urban sprawl. It will not affect the demand for recreation or the demand for new recreation facilities.

6.2.11 Traffic

Based on the EIRs for regional and local general plans, the development planned for MWA's service area would cause significant cumulative impacts on traffic and transportation facilities. The Proposed Project's impacts on traffic will be transitory and long-term maintenance traffic will constitute a miniscule fraction of total daily traffic. Project facilities will not generate significant new traffic. The Proposed Project will not contribute to the cumulative trend toward more traffic, higher peak traffic, and/or traffic congestion.

6.2.12 Water Resources (Water Quality)

Based on the EIRs for regional and local general plans, the development planned for MWA's service area would cause significant cumulative impacts on groundwater quality. The groundwater pumping, use, and then recharge following treatment tends to concentrate minerals in the recharged wastewater and result in long-term build up of these minerals. This has occurred in the past and will occur in the future. The recharge of treated wastewater will increase in response to growth.

The Proposed Project will somewhat remediate this potential for buildup of minerals in groundwater because it will bring generally higher-quality SWP water into the service area for banking. Banked water will be used in MWA's service area during dry years and MWA will then return generally lower-quality SWP water to Metropolitan. If there is direct return of stored water from MWA to Metropolitan, the return will involve a mix of indigenous groundwater and SWP water, which in many cases will involve a net export of minerals to Metropolitan as well. With direct return of groundwater from the Mojave River Well Field there would be some benefits to MWA (net export of minerals) and some effects (net import of minerals). But this aspect of the Proposed Project represents only about 25% to 50% of the total volume of banking and exchange water. In general, the Proposed Project would enhance groundwater when compared to the no project alternative. In this context, the Proposed Project thus does not contribute to the cumulative effects of concentration of minerals in groundwater.

6.2.13 Water Resources (Hydrology)

Surface flow in the MWA service area is infrequent and tends to be flashy, reflecting short-term runoff from high-intensity low duration flows. Even general flooding associated with major Pacific storm systems tends to be of low duration, with peak flows lasting only several days. Planned development would increase surface flows because developed areas do not absorb rainfall, and thus runoff is increased. In addition, improved storm drains tend to increase the speed with which local runoff is conveyed to the river. Development thus has the cumulative effect of increasing peak flood flows, particularly floods generated by short-term local runoff. Flood generated by snow melt and runoff in the local mountains are not affected by development in the basin below.

Proposed recharge facilities may affect local runoff by collecting precipitation and preventing its runoff. This will run counter to the trend towards more rapid runoff of water from urban and suburban landscapes. No cumulative effects on runoff and local flooding are thus likely to occur as a result of proposed facilities.

As noted in Chapter 5 (Section 5-14) and in the rationale for the Proposed Project in Chapters 2 and 3, groundwater levels have generally been declining within MWA's service area for decades. The Proposed Project banking and exchange program will reverse this decline to some extent. There is a reasonable potential for the exchange element of the Proposed Project, for example to allow MWA to import as about 100,000 acre-feet of supply it would otherwise be unable to receive and recharge due to both facility constraints and financial constraints. This would help to reverse groundwater declines. The Proposed Project will thus not contribute to the long-term decline in groundwater levels or to the problems associated with them such as land subsidence and increasing energy costs to extract water.

The 2004 Regional Water Management Plan PEIR does not address potential for project elements to affect Mainstem Mojave River flooding. Projected development in the various general plans for MWA's service area will affect peak runoff, particularly during periods of high local precipitation. The Instream Mojave River Recharge element of the Proposed Project could contribute to this cumulative increase in surface flow to the Mainstem Mojave River. As noted in Section 5-14, this increase will generally affect only the first storm. If there has been recent recharge and space in the groundwater basin immediately below the channel is filled with recharged water, then less of the first storm of the season will percolate into the groundwater and there will be more surface flow. However, once there is continuous flow in the river channel, the rate of recharge remains relatively stable at 150 to 300 cfs. River conditions during very high and damaging flows, which require saturation of the upper watershed and thus do not generally occur as the first storm of the season, are not likely to be affected by recharge operations. Thus the Proposed Project does not contribute to the long-term trend towards higher flood runoff and higher peak flood flows in the Mainstem Mojave River.

6.2.14. Growth

The various regional and local general plans address the issue of cumulative impacts associated with planned growth and address potential mitigations. The effect of water on growth is constrained in MWA's service area by the Mojave Basin Area Judgment. Under the Judgment, MWA's function is to provide replacement water to local producers whose extractions from groundwater exceed defined production allowances. MWA's function is thus to provide portions of the available 75,800 acre-feet of SWP supply to ensure a regional water balance.

At present, and for the last 30 years, MWA delivers less water than it has available through its SWP contract. It will continue to have surplus supply for approximately 15-20 years. The volume of supply delivered to producers will be determined by the producer, based on already projected demand. The availability of additional supply as a result of enhanced facilities and deliveries of banking and exchange supply, will thus occur within the context of planned growth and will not contribute to the growth effects defined in the various regional and local general plans. MWA notes that the effect of the banking and exchange project is likely to be that demand may be accommodated for a greater period, thus deferring efforts to develop new supplies. The Proposed Project therefore does not have a mechanism by which it may affect planned growth.

6.2.15 Energy Use and Conservation

Although construction will involve use of up to 920,000 gallons of diesel fuel, energy savings associated with pumping supplies from the Mojave River Well Field and from basins where recharge has raised groundwater levels suggest that the Proposed Project's net effect on regional energy use is at least neutral and potentially beneficial. No cumulative effects to energy use will occur over the term of the Proposed Project.

6.2.16 Significance of Impacts, Mitigation, and Significance after Mitigation

After mitigation, significant impacts of the Proposed Project are related to air quality during construction. As noted above, these impacts are transitory and would not contribute to long-term cumulative effects. Some reduction in wind-borne dust is probable as a result of recharge facilities and their operations. No cumulative effects are therefore likely as a result of Proposed Project construction.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 7: COMPARISON OF ALTERNATIVES

7.1 Introduction

CEQA (Section 15126.6) requires an assessment of a range of reasonable alternatives to a project that would meet most of the project objectives and could avoid or substantially lessen any significant environmental impacts associated with the proposed project. CEQA also requires that an EIR assess the No Project Alternative.

As described in Chapter 3 (Initial Screening of Alternatives), MWA has pursued a systematic and incremental approach to alternative development and analysis. The 2004 PEIR examined a wide range of potential project alternatives and operational scenarios (2004 PEIR Chapter 2), and identified 43 potential projects throughout MWA's service area. The Proposed Project includes elements of the 2004 PEIR potential supply enhancement projects which were considered to be appropriate for a water banking and exchange program.

Concurrent with completion of the 2004 PEIR, MWA initiated a screening-level engineering and environmental review of potential water banking projects (Bookman Edmonston 2004a, 2004b, 2005a, 2005b, 2005c, 2005d). This analysis began with a general analysis of tens of thousands of acres of potential recharge, conveyance, and water management facilities such as wells and pumping plants. These were evaluated based on engineering and operational feasibility; facilities unable to meet a substantial portion of banking and exchange program objectives at reasonable cost were eliminated.

The screening-level review initially resulted in identification of approximately 6,000 acres of potential recharge sites, with associated wells, pipelines, and other facilities, including use of the Mainstem Mojave River. These sites were then evaluated to determine, based on engineering and environmental screening, which specific parcels of land would be included in the array of Proposed Project facilities. Criteria for this screening were:

- Distance of recharge from the California Aqueduct. Parcels were sited as close to the California Aqueduct as feasible to reduce pipeline length, associated construction impacts on air quality, associated impacts to land use, associated impacts to biological resources, and associated impacts on buried cultural resources.
- Distance from known desert tortoise populations. Although the initial screening of alternatives identified a number of recharge sites north of Highway 18, the final array of alternatives does not include new facilities north of this demarcation zone in the West Mojave Plan.

- Avoidance of arroyo toad and riparian habitat impacts on the Mainstem Mojave River. The two potential off-channel recharge basin sites were selected to avoid high value riparian sites near Mojave Forks Dam, which may support arroyo toads.
- Avoidance of existing development. Recharge basins were sited to minimize the number of houses which would be adjacent to recharge. Thus, for example, the 330 acres of recharge basin sites for Oeste Recharge were selected to avoid sites with small parcel size and potential for short-term development.

After this initial narrowing of potential sites for recharge and associated facilities, MWA staff further reduced potential project scope and defined the acreage to be considered at each potential recharge site. Individual parcels at the various recharge sites were then selected for further evaluation, primarily based on proximity to the California Aqueduct and avoidance of potential impacts to desert tortoise and Mohave ground squirrel. Biological surveys and cultural resource surveys were then conducted, and several sites for Off-channel Mojave River Recharge were evaluated at a higher level of detail in terms of their hydrogeologic characteristics and appropriateness for recharge. During this process, all new recharge sites were sited to be south of State Highway 18 to (a) avoid and minimize potential for impacts to desert tortoise and Mohave ground squirrel and (b) to minimize costs associated with pumping return supplies into the California Aqueduct.

As a result, off-channel alternative recharge facilities carried forward for detailed analysis were downsized from the original 6,000 acres (Bookman-Edmonston 2004a) to about 800 acres. Three sites were then considered for the potential 100-acre Off-Channel Mojave River Recharge, with a site in the vicinity of Mojave Forks Dam being eliminated from detailed consideration following cultural and biological surveys which suggested that this site would have high potential of significant cultural and biological resources impacts, including impacts to the endangered arroyo toad and potential loss of riparian wetlands along the river channel.

The recharge and associated pipeline and well facilities carried forward for detailed analysis therefore represent a small subset of the originally considered alternatives, with other sites eliminated from consideration in an effort to (a) reduce potential environmental impacts and (b) reduce construction and long-term operations and maintenance costs.

7.2 Methodology

7.2.1 Facility-by-Facility Impact Analysis

The alternatives described in this Project EIR represent a continuum of project capacity and facilities from a No Project Alternative to a banking and groundwater replenishment program involving approximately 800 acres of new facilities. This continuum of new facility components was broken into three distinct alternatives for the purpose of evaluating relative impacts of logical increments of facility development and to accommodate modeling of the water management aspects of the Proposed Project. However, throughout the EIR, impacts have been described in terms of each increment of facility development so that the relative impacts of any combination of facilities could be rapidly determined by the Mojave Water Agency Board of Directors. The logical progression represented by the three groupings of facilities -- from the Minimum Facilities Alternative with permanent effects to land use of less than 20 acres to the Large Projects Alternative with permanent effects to land use of over 800 acres -- provides MWA's Board of Directors with a set of progressively higher impact choices, but MWA may choose in the final analysis to construct a project composed of components of, for example, the Minimum Facilities Alternative plus one or another of the facilities from the Small Projects Alternative.

In selecting an alternative for final evaluation, MWA will utilize the facility-by-facility impact analysis provided in this Project EIR and compare the benefits and costs associated with a given combination of these facilities, making findings and determinations regarding the relative benefits of the proposed alternative when compared to the relative impacts.

7.2.2 No Project Alternative

Section 3.4.2 describes the No Project Alternative and notes that it is likely that under this alternative there would be development of recharge and associated facilities, consistent with the Proposed Project for:

- Mainstem Mojave River Recharge
- Mojave River Well Field and Pipelines (with a shorter pipeline)
- Cedar Avenue Detention Basin
- Antelope Wash Detention Basin (Ranchero Road)
- Oro Grande Wash
- Antelope Wash

The No Project Alternative description also indicates that recharge basin siting for off-channel Mojave River recharge and recharge at Alto and Oeste could be affected under the No Project Alternative by prior development of the sites described in the Proposed Project.

7.3 Comparison of Effects

The following comparison of alternatives (Tables 7-1 to 7-5) is structured to provide MWA with a basis for selection of a preferred alternative and the environmentally superior alternative.

7.3.1 Comparison of Project Alternatives

Evaluation of the relative environmental effects of the various Proposed Project alternatives depends on the importance assigned to the various categories of effect. For example, an argument may be made that the biological effects of the various alternatives are not of high priority, given the West Mojave Plan's low priority given to preserving habitats and special-status species in the area south of Highway 18. If biological resources and land use are given low priority and water quality impacts are given high priority, then the Large Projects

Alternative could be considered the environmentally superior alternative (among the three Proposed Project Alternatives).

On the other hand, if biological, aesthetic, and air quality effects were given high priority and water quality was given lower priority, then the Minimum Facilities Alternative would be the environmentally superior alternative. In short, the designation of environmentally superior alternative depends on the importance that decision makers attach to various categories of impact. The impact-related trends to be considered by decision makers in this evaluation are:

Aesthetics:	Impacts **increase** with project size.
Air Quality:	Temporary impacts **increase** with project size.
Biological Resources:	Impacts **increase** with project size.
Cultural Resources:	Impacts are not significantly affected by project size.
Geology and Soils:	Impacts are not significantly affected by project size.
Hazards and Hazardous Materials:	Impacts are not significantly affected by project size.
Land Use:	Impacts **increase** with project size.
Noise:	Impacts are not significantly affected by project size.
Public services and utilities:	Impacts are not significantly affected by project size.
Recreation:	Impacts are not significantly affected by project size.
Traffic:	Impacts are not significantly affected by project size.
Utilities and Service Systems:	Impacts are not significantly affected by project size.
Water Resources (Quality)	Impacts **decrease** with project size.
Water Resources (Hydrology)	Impacts **decrease** with project size.

The rationale for these conclusions is discussed briefly below:

<u>Aesthetics:</u> Aesthetic impacts tend to increase with project size because additional recharge facilities are required and these would abut some existing development and thus there are more people affected by changes in view as project size increases. Except at Antelope Wash, aesthetic impacts are all mitigated to a level of insignificance through aesthetic treatments.

<u>Air Quality:</u> Air quality impacts increase with project size and result in increasingly significant and unavoidable impacts. These impacts are temporary, related to construction. Long-term effects of recharge may be beneficial due to an increase in wetted area and to recharge basins capturing wind-borne dust.

<u>Biological Resources:</u> Both direct and indirect biological impacts increase with project size due to increased habitat loss and increased fragmentation of habitat and potential for facilities to affect wildlife movement. Primarily due to siting of facilities in disturbed areas to avoid impacts and elimination of areas with high biological sensitivity, potential impacts are low. Biological resource impacts would therefore have a low priority in selection of the environmentally superior alternative.

Cultural Resources: Cultural resources impacts are not significantly affected by project size because the added facilities are not in known sensitive areas and are increasingly distant from a water source. In a desert environment, significant settlement is not likely in the flat open space and dry washes that are used to expand recharge capacity.

Geology and Soils: Geology and soils impacts are not significantly affected by project size because new recharge would be located in non-sensitive areas, with little potential for liquefaction, mineral leaching, soil erosion, and other geologic effects. Potential for liquefaction along the Mainstem Mojave River, the only geologic impact that may be of any importance, is probably reduced if high volumes of recharge may be spread out over multiple facilities.

Hazards and Hazardous Materials: Impacts related to hazards and hazardous materials are most likely to occur in the urbanized areas and associated with pipeline construction and construction of pumping plants and similar facilities. These are neither significant nor significantly affected by project size.

Land Use: Land use impacts clearly increase as more land is required to expand recharge capacity, but none of the facilities are in conflict with existing and planned uses. Recharge and development are compatible uses. This increase in impacts may thus not be significant.

Noise: Noise impacts are not significantly affected by project size because a majority of the people affected by potential construction noise would be affected by the Minimum Facilities Alternative. Facilities added by the Small Projects Alternative and Large Projects Alternative are in more remote locations and would not affect many people for any extended period of time.

Public services and utilities: Impacts to public services and utilities do not significantly increase with project size because a majority of potential service impacts are in the urban areas affected by the Minimum Facilities Alternative and the Small Projects Alternative. Impacts at the remote locations for Large Project Facilities will be minor.

Recreation: Impacts to existing recreation are only affected by the Minimum Facilities Alternative and are thus not significantly affected by project size.

Traffic: Traffic impacts are not significantly affected by project size because facilities added to increase project recharge and conveyance capacity are not sited in areas where traffic is high and because they do not involve construction in or adjacent to roads that have high volumes of traffic.

Utilities and Service Systems: Impacts to utilities will be greatest in the urban areas affected by the Minimum Facilities Alternative. Potential for accidental impacts to utilities are lower where development is more sparsely distributed.

Water Resources (Quality): Water quality impacts decrease with project size because more recharge and conveyance capacity will allow MWA to import supplies during shorter periods of time, when SWP water quality is seasonally of better quality. A larger project also allows MWA to recharge supplies when the capacity of the Mainstem Mojave River has been filled (either by recharge or by storm events). These positive effects of increasing project magnitude are somewhat offset by the increasing need to provide for pumping of groundwater to make returns to Metropolitan.

Water Resources (Hydrology): The minor potential for recharge in the Mainstem Mojave River to affect groundwater levels and thus affect flood flows decreases if, prior to the rainy season, MWA has expanded opportunities to recharge at other locations. Erosion and sediment transport effects on Unnamed Wash also decrease with project size due to lower reliance on deliveries to the Mojave River Mainstem.

A second and major consideration in comparing the Proposed Project Alternatives is the significance of impacts after mitigation. All project impacts are mitigated to a level of less than significant except aesthetic impacts associated with recharge at Antelope Wash and air quality impacts associated with construction. Considering only impacts after mitigation would lead to designation of the Minimum Facilities Alternative as the environmentally superior alternative.

A third consideration is that water quality impacts may not be significant under CEQA, but they are important to MWA, subarea producers, consumers, and the Regional Water Quality Control Boards. Thus while all of the Proposed Project Alternatives would allow MWA to improve the quality of water delivered to recharge, the improvement is enhanced by increased recharge and conveyance capacity. The ability to (a) take maximum SWP supplies in all years and (b) focus recharge on the months of March through July would optimize the quality of water delivered to recharge. In addition, greater project magnitude recharge capacity would allow for pre-delivery of more supplies to storage.

Energy Use and Energy Consumption: Construction energy use increases with Proposed Project magnitude, but the potential for reduced energy costs associated with rising groundwater levels also increases as the magnitude of the project increases. Thus, the net effect of the project on energy use and conservation does not vary significantly from alternative to alternative.

7.3.2 Comparison of Upstream and Downstream sites for Antelope Wash Recharge

Per the draft EIR Section 5.4.7.2, MWA considered relocation of the upstream Antelope Wash recharge basin to a downstream site. As described in Chapter 4 page 4-31, this would involve expanding recharge at the Ranchero Road site in lieu of developing the upstream Antelope Wash recharge site. The analysis of this option (Table 7A) suggests that it would not affect recharge capacity substantially and that subsurface soils conditions and groundwater water quality at the two sites is probably similar. This relocation would reduce pre-mitigation impacts to aesthetics, biological resources, and air quality (marginal), and use of energy (marginal). There would be a marginal and temporary increase in temporary noise impacts because there is more development in the vicinity of the Ranchero Road recharge site than at the upstream site, but implementation of best management practices for noise management will reduce this temporary impact to a level of less-than-significant. Given that biological resources impacts to the sensitive and protected Joshua Tree/juniper habitat at the upstream recharge site would be avoided, the need for mitigation of project impacts at this site would also be substantially reduced. This would eliminate the need to purchase and provide for management of at least 68 acres of Joshua Tree/juniper habitat.

Table 7-A. Summary comparison of the effects of expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site.

CATEGORY OF EFFECT	NET CHANGE IN PROJECTED IMPACT FROM EXPANDING RECHARGE AT THE RANCHERO ROAD SITE IN LIEU OF DEVELOPING THE UPSTREAM RECHARGE SITE.
Aesthetics	Reduction in impact
Air Quality	Marginal reduction in impact
Biological Resources	Reduction in impact
Cultural Resources	No change
Geology and soils	No change
Hazards and hazardous materials	No change
Land use	No change
Noise	Marginal increase, mitigated
Public services and utilities	No change
Recreation	No change
Traffic	No change
Water resources (water quality)	No change
Water resources (hydrology)	No change
Population, housing, and growth	No change
Use of energy	Marginal reduction in impact
Cumulative impacts	No change

7.3.2 A Summary Decision Analysis

Table 7-1 is a decision matrix that summarizes the considerations outlined above, focusing on the most important aspects of the impact analysis, as discussed above and detailed on Tables 7-3 through 7-6.

7.3.2.1. Evaluation of sites for Off-Channel Mojave River Recharge.

Preliminary to selecting an alternative, it is appropriate to evaluate the relative impacts associated with the two potential sites for Off-Channel Mojave River Recharge (Small Projects Alternative). These sites have approximately equivalent potential for impacts related to:

- Aesthetics
- Air Quality
- Biological Resources
- Cultural Resources
- Hazards and Hazardous Materials
- Geology and Soils
- Noise
- Public Services and Utilities
- Recreation
- Utilities and Service Systems
- Water Resources (Water Quality)
- Water Resources (Hydrology)
- Energy Use and Energy Conservation

Any difference between these two sites in terms of the above CEQA impact categories is insignificant because impacts in these categories are mitigated to a level of less-than-significance. The two sites do vary somewhat in terms of their potential for impacts on land use. The east site is identified as partially agricultural in the California Digital Conservation Atlas (2004). The west site is designated as open space. Based on field surveys in 2005, actual use of the east site is no longer agricultural, although there is evidence of past use. The site is disturbed non-native grasses and disturbed Mojavean desert scrub, reflecting past agricultural use. The west site is dominated by non-native grassland and weedy species, reflecting its past use as a wastewater facility. Neither site has any history of public use. The primary open-space value of these sites would be in preserving views of the river and surrounding mountains from nearby housing and for people traveling along Arrowhead Lake Road. Agricultural use is inhibited to some extent by high percolation rates, which would mean that active farming would require high application of irrigation. Proposed Project effects to (a) 60 acres of marginal and currently unused land designated for agriculture and 40 acres of unoccupied land designated for low-density housing may thus be balanced by the (b) effects to 100 acres of designated open space that has been used in the past as a wastewater treatment facility. Given that recharge basins at either site will not affect scenic resources, these changes in land use are not significant.

In terms of environmental impacts, the distinction between the east and west sites for Off-channel Mojave River Recharge is thus insignificant. Both sites may be carried forward for final site evaluations, which would include comprehensive geotechnical studies and determinations of optimum recharge rates, costs, and benefits. Selection of either site may be made on the basis of findings related to these practical considerations; the sites may be considered as equivalent in terms of impacts.

7.3.2.2 Evaluation of Alternatives

If impacts that are not mitigated to a level of less-than-significant are focused on, the decision related to environmentally superior alternative depends entirely on the priority given to temporary construction-related air quality impacts versus SWP water quality impacts.
Table 7-1 illustrates the sensitivity of alternative analysis to the priority placed on these two categories of impact where impacts are not mitigated to a level of insignificance.
For this summary analysis, "scores" have been calculated for air quality impacts based on total fuel consumption (a measure of total emissions) and total recharge capacity (a measure of project operational ability to take better quality SWP supplies rapidly during wet years and wet seasons). Assuming 300 acres of annual construction of berms in the Mainstem Mojave River, these impacts are:

	Air Quality (Gallons of Fuel)	Water Quality (Recharge Capacity)
Minimum Facilities Alt.	291,100	92,275 af
Small Projects Alt.	474,211	122,775 af
Large Projects Alt.	914,900	182,175 af

These raw numbers can be converted to relative "score" by setting the lowest air quality value to 1 and assigning proportional scores to the higher values. This gives a proportional index of impacts; that is, the impacts associated with the Small Projects Alternative and Large Projects Alternative are expressed as a percent increase of the impacts of the Minimum Facilities Alternative. A similar index can be calculated for water quality benefits. Construction air quality impacts are "negatives" and can be assigned a negative value. Since higher scores are "better" for water quality, they can be assigned a positive value. Using this scoring summary method, the sensitivity of the alternatives can be compared (Table 7-1).

Table 7-1. Sensitivity of priority given to construction air quality and SWP water quality. Highest TOTAL score is best.

ALTERNATIVE	IMPACTS		
	Construction Air Quality	**SWP Water Quality**	**TOTAL SCORE**
SWP Water Quality Priority = Construction Air Quality			
Minimum Facilities	-1	1	**0**
Small Projects	-1.63	1.37	**-0.26**
Large Projects	-3.14	1.98	**-1.16**
SWP Water Quality Priority = 2 X Construction Air Quality			
Minimum Facilities	-1	2	**1**
Small Projects	-1.63	2.74	**1.11**
Large Projects	-3.14	3.96	**0.82**
Construction Air Quality = 2 X SWP Water Quality Priority			
Minimum Facilities	-1	1	**0**
Small Projects	-3.26	1.37	**-1.89**
Large Projects	-6.28	1.98	**-4.3**

Table 7-1 shows that, on a percentage basis, the relative total emissions from construction equipment increase more rapidly than the relative benefits of the project in terms of recharge capacity. Thus, only when SWP water quality is given high priority does increasing recharge capacity yield a higher score, and there is a drop-off in relative benefits versus air quality impacts for the Large Projects Alternatives. The benefits increase, but at a higher proportional increase in air quality impacts.

Larger projects will be constructed over a longer period of time, and the relative benefits versus impacts analysis is sensitive to construction schedule (Table 7-2). Making the reasonable assumption that construction fuel consumption is spread out over 2 years for the Minimum Facilities Alternative, 3 years for the Small Projects Alternative, and 4 years for the Large Projects Alternative, then annual fuel consumption (and related vehicle emissions) increase at a lower rate:

Minimum Facilities Alternative:	146,000 gallons
Small Projects Alternative:	158,000 gallons
Large Projects Alternative:	228,000 gallons

Table 7-2. Annual air quality impacts (fuel consumption) compared to SWP water quality (recharge capacity). Highest TOTAL score is best.

ALTERNATIVE	IMPACTS		
	Construction Air Quality	SWP Water Quality	TOTAL SCORE
SWP Water Quality Priority = Construction Air Quality			
Minimum Facilities	-1	1	**0**
Small Projects	-1.08	1.37	**0.29**
Large Projects	-1.56	1.98	**0.42**
SWP Water Quality Priority = 2 X Construction Air Quality			
Minimum Facilities	-1	2	**1**
Small Projects	-1.08	2.74	**1.66**
Large Projects	-1.56	3.96	**2.40**
Construction Air Quality = 2 X SWP Water Quality Priority			
Minimum Facilities	-1	1	**0**
Small Projects	-2.16	1.37	**-0.79**
Large Projects	-3.12	1.98	**-1.14**

Tables 7-1 and 7-2 suggest that the relative importance of air quality and water quality effects of the Proposed Project depends to a large extent on (a) the way in which air quality impacts are measured (total emissions versus annual emissions) and (b) the priority assigned to air quality impacts versus water quality benefits. It is interesting to note that if air quality is assigned a higher priority than water quality, the Minimum Facilities Alternative is always preferred. If water quality is assigned a higher priority, then the larger projects are preferred, although for the last increments of recharge, incremental benefits may be only marginal.

Table 7-3 suggests a different perspective. For the Minimum Facilities Alternative, with an annual recharge capacity of 92,275 acre-feet, simultaneous delivery of MWA's 2006 demand of about 36,000 acre-feet and a banking delivery of 50,000 acre-feet from Metropolitan (86,000 acre-feet in total) would take almost all year to deliver. The almost doubling of recharge capacity associated with the Large Projects Alternative would, however, allow this 86,000 acre-feet to be delivered in less than 6 months, allowing MWA and Metropolitan to focus on deliveries when water quality was best. In short, the water quality benefits of the Proposed Project depend on MWA's ability to take and store deliveries rapidly.

The disproportional benefits of greater recharge capacity are also related to balancing banking deliveries throughout MWA's service area. Much of the capacity of the Minimum Facilities Alternative lies in portions of MWA's service area where current annual capacity for recharge exceeds current annual demand. Repeated peak deliveries of banking supplies to these areas would therefore result in an unbalanced distribution of supplies, and lower ability to make returns to Metropolitan without affecting groundwater levels. Thus, while gross recharge capacity may reflect the capacity for recharge during an initial year, it may not reflect practical capacity over the term of the banking program. Based on these considerations, an alternative perspective on benefits is summarized on Table 7-3.

Table 7-3. Benefits of increasing recharge capacity.

ALTERNATIVE	BENEFITS				
	Alto Area Recharge	Other Area Recharge	Capacity for Delivery when Mojave River is Running		Months to recharge 90,000 acre-feet
			Alto	Other	
Minimum Facilities	48,000	44,275	0	44,275	11.7
Small Projects	76,500	44,275	28,500	44,275	8.8
Large Projects	137,900	44,275	89,900	44,275	5.9

As Table 7-3 suggests, increasing recharge in the Alto-Oeste area is critical to banking high volume deliveries in three respects: (a) taking deliveries in the Alto area where demand is greatest, (b) taking deliveries when the Mojave River is flowing, and taking combined MWA and Metropolitan deliveries simultaneously at a rate that allows for optimization of water quality. From this perspective, only the Large Projects Alternative (or at least a project somewhat greater than the Small Projects Alternative) allows for simultaneous delivery of MWA and Metropolitan banking supplies. From this perspective, the Minimum Facilities Alternative would not be assigned a baseline "score" of 1, as it was on Table 7-1.

Finally, Tables 7-4 through 7-9 summarize impacts of each element of the Proposed Project and detail mitigation commitments. Both construction and mitigation commitments impose an increasing environmental and financial cost on each increment of recharge. Although environmental impacts are mitigated to a level of less-than-significant, the magnitude of mitigation commitments needed to accomplish this is a measure of the total increase in impacts associated with increasing project scope. Mitigation costs should be considered as a measure of total impact and considered in the final decision analysis.
In addition, the Board should consider the difference between the Proposed Project and the No Project alternative and the analysis of the Environmentally Superior Alternative, discussed below.

7.3.3 Comparison of Project and No-Project Alternatives

The comparison of the Proposed Project alternatives to the No Project Alternative is strongly influenced by the problems associated with deferring construction of projects in a rapidly developing environment. First, at present, MWA has options for siting of facilities and has selected sites that avoid and minimize cultural and biological resource impacts. All new facilities are sited south of Highway 18 in an area of low potential for threatened and endangered species. Off-channel recharge along the Mainstem Mojave River has been sited well north of sensitive cultural resource sites and biological resources. Land use conflicts are, at present, relatively minor. While it is somewhat speculative to define impacts associated with potential re-siting due to prior development of the sites described in this Project EIR, the pattern of development in the Apple Valley/Hesperia area has been towards developing to the south and to the west. Thus, deferring the Proposed Project facilities under the No Project Alternative would probably mean facilities would be sited in the context of development of land to the south of Apple Valley and to the south and west of Hesperia. This trend is in fact encouraged in the pending West Mojave Plan which designates a no survey zone south of Highway 18 and provides for lower mitigation measures for development in these areas than for areas north of Highway 18. There are thus sound reasons to expect that, if facilities are not developed now and are needed later, the current sites may not be available. Moving off-channel recharge along the Mainstem Mojave River to the south and Alto and/or Oeste recharge basins to the north would involve substantial potential environmental and cultural resource impacts.

Second, for factors such as noise and construction traffic, it does not appear prudent to defer facility development. In a rapidly growing region with limited road infrastructure, construction traffic effects cannot be expected to improve as development occurs and traffic increases. Similarly, more development would mean that more people would be exposed to construction and to construction-related noise.

Third, these increases in potential for impacts associated with the No Project Alternative would not be offset by decreases in impacts in other CEQA impact categories, except for construction-related effects to daily air quality impacts. For air quality, deferring projects results in the potential for phasing of construction and, therefore, a reduction in the intensity of emissions from construction equipment and from fugitive dust. This reduction in intensity of emissions from phasing and from probable improvements in diesel emissions control technology is attained by extending the duration of impact. The only factor which results in a net reduction in emissions over the 20-to-25-year project life is the potential for emissions control technology to result in lower diesel emissions. Otherwise, the net emissions of the Proposed Project and the No Project Alternative would be similar.

Fourth, all of the Proposed Project alternatives have a clear advantage over the No Project Alternative in terms of groundwater quality because they emphasize delivery of large quantities of SWP water during years and seasons when SWP water quality is better in terms of almost all constituents.

Fifth, the extent to which the No-Project Alternative may result in avoidance of impacts resulting from decisions not to pursue some facilities also needs to be explored. The Metropolitan modeling analysis suggests that from a water banking perspective, the additional recharge of the Small Projects Alternative does increase the magnitude of a banking program, but the management flexibility provided by additional recharge may be important to MWA in terms of managing groundwater levels along the Mainstem Mojave River, as outlined above. In terms of deferring facilities under a No Project Alternative, then, it is most likely that MWA would choose not to develop some of the larger recharge facilities of the Large Projects Alternative. This would reduce a range of effects -- aesthetics, air quality, biological resources, cultural resources, land use, noise, and others. The decrease in levels of these impacts would be associated with lower peak recharge capacity and lower operational flexibility.

A number of factors complicate this analysis. The actual recharge performance of recharge basins is difficult to predict precisely until recharge has been on-going for several years. Thus, monitoring during initial periods of operations would be required to determine whether to reduce overall project scope. Second, there is no way to predict California's weather, and thus the timing and magnitude of Metropolitan deliveries to banking may not be known. Average annual precipitation seldom occurs, and weather in California is more characterized by extremes of wet and dry. Banking programs may need seemingly "excess" capacity to move and recharge water rapidly and in large volumes. In addition, all of the facilities of the Large Projects Alternative may prove to be necessary to provide recharge and conveyance capacity for MWA's 75,800 acre-feet of SWP contract supply.

Finally, the No Project Alternative does not compare favorably to the Proposed Project alternatives because the facilities for these alternatives will probably be pursued at some level over the 20-25 year term of the proposed banking and exchange program. MWA will require conveyance and recharge capacity for up to 75,800 acre-feet. This is roughly equivalent to the capacity required for MWA's planned 2006 supplemental water deliveries and an initial 40,000 acre-feet of Metropolitan water for banking. The nominal 90,000+ acre-feet of capacity for the Minimum Facilities Alternative and 120,000+ for the Small Projects Alternative would seem, by this measure, to be in excess of need, but these capacities has been estimated assuming 10 or 11 months of continuous operation. In many years it may be necessary to accommodate higher volumes of delivery under both the with-and-the-without project conditions. For example, in a wet year following drought, DWR may not declare a year to be "wet" and release 90% to 100% of contract amounts until March or April. Thus, the peak supply available for the year may only be available for the remainder of the year. Under either a banking and exchange program or MWA's own long-term program for water management, it may thus be necessary to have recharge capacity in excess of 75,800 acre-feet per year. It is probable, then, that MWA would site and construct recharge facilities to raise its total recharge capacity of up to 120,000+ acre feet per year, with the understanding that these facilities may be in use only 6-8 months out of the year.

In this context, the No Project Alternative and the Proposed Project Alternatives have offsetting effects:

Category of Effect	Preferred Alternative
Air Quality:	No Project Alternative
Hazards/Hazardous Materials:	No project Alternative
Noise:	Proposed Project Alternatives
Traffic:	Proposed Project Alternatives
Water Quality:	Proposed Project Alternatives

Given the uncertainty related to supply from Metropolitan and the recharge capacity of any set of recharge facilities, it is not possible to conclude with any certainty that the No Project Alternative would result in permanent deferral of Proposed Project facilities, although this seems to be more likely under the No Project Alternative than under the Proposed Project due to funding constraints. In addition, the No Project Alternative would not enhance groundwater quality as would occur for all three Proposed Project alternatives.

7.3.4 Designation of the Environmentally Superior Alternative

CEQA requires that an EIR identify the environmentally superior alternative of a project. Although the distinctions among alternatives are not strong, groundwater impacts of the No Project Alternative may offset the construction-related impacts of Proposed Project alternatives. The remaining distinctions among alternatives are small, and designation of the environmentally superior alternative depends on the priority placed on critical impact categories such as construction air quality and SWP water quality.

If priority is placed on permanent water quality effects rather than temporary (but significant) air quality effects, then the Large Projects Alternative (or variations of it involving scaling back of recharge development at Oeste, Alto, or Antelope Wash) may be considered the environmentally superior alternative.

If priority is placed on avoidance of significant air quality impacts, then the Small Projects Alternative, with phasing of recharge basin construction to reduce daily emissions may be considered the environmentally superior alternative.

As discussed above, the Proposed Project, Large Projects Alternative has been modified, as an impact avoidance/mitigation measure, to provide for expansion of recharge at the Ranchero Road site in lieu of developing the upstream recharge site. With this modification, Proposed Project pre-mitigation biological resource and aesthetic impacts would be reduced substantially, and construction-related air quality impacts and use of energy could be reduced marginally.

In addition, in response to comments from Department of Water Resources, MWA performed additional clarifying water quality analyses (Appendix A). This analysis focused on comparing indigenous groundwater quality in wells located near proposed recharge facility sites with average State Water Project water quality for the period 1988-2004. The analysis generally confirmed the draft EIR conclusion that water banking would have substantial water quality benefits, particularly in reducing concentrations of some mineral constituents in local groundwater. The analysis also tended to confirm that pump-back of a mix of groundwater and SWP supplies from recharge sites should be feasible. This additional analysis strengthened the conclusion that there would be substantial long-term benefits to water supply and water quality associated with the proposed project. In addition, the comments received from the Lahontan Regional Water Quality Control Board noted that "Board staff believes that the proposed groundwater banking project has many positive aspects for local water supply needs."

Given that the Large Projects Alternative has been modified to reduce pre-mitigation impacts to biological resources and aesthetics (as provided for in the draft EIR), given that the Large Projects Alternative provides for the highest potential level of permanent water quality benefits, given that the Large Projects Alternative's significant air quality impacts are of a temporary nature, and given that there was no public comment regarding the selection of the environmentally superior alternative, the Large Projects Alternative is designated as the environmentally superior alternative.

7.3.5 Designation of the Proposed Project

The draft EIR deferred identification of a Proposed Project Alternative, evaluating three facility and operational alternatives and the No Project Alternative. This was done to allow for public, organization, and agency comment on this issue so that MWA could take this comment into account before selecting a Proposed Project Alternative. There were not comments regarding this issue made during (a) the CEQA scoping process following the issuance of the Notice of Preparation in April of 2005 or (b) the draft EIR review during the period of October 28 through December 13.

The environmentally superior alternative, the Large Projects Alternative as modified by adoption of a mitigation measure providing for relocation of upstream Antelope Wash recharge to a site downstream as described in Chapter 4 page 4-31, is designated as the Proposed Project Alternative. *Per* the draft and final EIR discussion of air quality impacts and potential mitigations, MWA may phase adoption and implementation of various facilities included in the Large Projects Alternative.

Table 7-4. MWA Water Banking and Exchange Program, summary of environmental effects and mitigation, by facility. See Table 7-8 for detailed summary of mitigation commitments.

5.2 Aesthetics Effects

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	No effect	No effect	No effect	No effect
Instream Mojave River Recharge	Temporary minor effect	Not significant	No mitigation proposed	Less than significant
SWP Delivery via Unnamed Wash	Effects of drop structures, unpaved maintenance road, and low levees will be minor.	No significant	No mitigation proposed	Less than significant
Mojave River Well Field	Pipelines will be buried. Well structures will be visible in urban areas.	No effect	Wells and other structures will be housed in structures compatible with local development	Less than significant
Off-Channel Mojave River Recharge: West	Land slopes away from road. No views affected.	No effects	No mitigation proposed	Less than significant
Off-Channel Mojave River recharge: East	Land slopes away from road. No views affected.	No effects	No mitigation proposed	Less than significant
Oro Grande Wash Recharge	Recharge basins may alter the view from adjacent housing.	No effects	Planted with drought-tolerant natives along perimeter maintenance roads.	Less than significant
Cedar Avenue Detention Basin Recharge	Levees on south and west will be closer to housing than current condition.	No effect	Planted with drought-tolerant natives along perimeter maintenance roads.	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	No effects: project will be constructed only if detention basin is built by City.	No effects	No mitigation proposed	Less than significant
Oeste Recharge and Wells	Low berms visible from nearby roads. Well structures visible.	No effects	Wells will be housed in structures compatible with local development	Less than significant
Alto Recharge and Wells	Low berms visible from nearby roads. Well structures visible.	No effects	Wells will be housed in structures compatible with local development	Less than significant
Antelope Wash Recharge	Recharge basins would alter the view of numerous people in an adverse manner; water view in some periods.	No effects	Outer berms will be contoured perimeter of basin maintenance road will be planted. MWA may consider other sites. Alternative downstream site selected.	Less than significant

5.3 AIR QUALITY

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post-Mitigation
Existing Recharge Facilities	No effect	No effect	No mitigation proposed	Less-than-significant
Instream Mojave River Recharge	Significant PM10 (fugitive dust)	Less-than-significant effects during construction	Fugitive dust management	Less than significant
SWP Delivery via Unnamed Wash	Significant PM10 (fugitive dust)	No effect	Fugitive dust management	Less than significant
Mojave River Well Field	Significant NOx emissions if 2+ units constructed at a time.	No effect	Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Off-Channel Mojave River Recharge: West	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Off-Channel Mojave River recharge: East	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Oro Grande Wash Recharge	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Cedar Avenue Detention Basin Recharge	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions PMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Antelope Wash Detention Basin (Ranchero Road)	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Oeste Recharge and Wells	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Alto Recharge and Wells	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**
Antelope Wash Recharge	Significant PM10 (fugitive dust) Significant NOx if 2+ units constructed at a time.	No effect; some potential trapping and reduction of dust during operations	Fugitive dust management Emissions BMP, including use of highway diesel fuel.	**Significant if 2+ units constructed at a time.**

Facility	Direct Impacts	5.4 BIOLOGICAL RESOURCES Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	No effect	No significant change in operations	None proposed	Less than significant
Instream Mojave River Recharge	No suitable resident habitat for wildlife will be affected.	More frequent surface flow and low potential to affect wildlife movement.	None proposed	Less than significant
SWP Delivery via Unnamed Wash	Loss of 6-8 acres of desert wash habitat. Temporary loss of non-native grasslands below road. Low potential for T&E species effects.	Less than significant effect on north-south wildlife movement due to proposed bridge crossings.	Habitat loss mitigated consistent with Las Flores Ranches pending HCP or 1:1	Less than significant
Mojave River Well Field	Loss of 1-2 acres of highly disturbed habitat. Low potential for T&E species effects.	No indirect effect	None proposed	Less than significant
Off-Channel Mojave River Recharge: West	Loss of 100 acres of disturbed non-native grassland. Low potential for T&E species effects.	Less than significant effect on north-south wildlife movement; east side of river movement unaffected.	Pre-construction survey. Habitat mitigation for special-status plants and animal species.	Less than significant
Off-Channel Mojave River recharge: East	Loss of 100 acres of disturbed non-native grassland and desert scrub. Low potential for T&E species effects.	Less than significant effect on north-south wildlife movement; west side of river movement unaffected.	Pre-construction survey. Habitat mitigation for special-status plants and animal species.	Less than significant
Oro Grande Wash Recharge	Loss of habitat: 13 acres disturbed; 37 acres desert scrub; 30 aces Joshua Tree. Low potential for T&E species effects.	Potential effect on north-south movement; less than significant because wildlife may effectively use levees.	Pre-construction survey. Habitat mitigation for special-status plants and animal species.	Less than significant
Cedar Avenue Detention Basin Recharge	Loss of 60 acres disturbed desert scrub. Low potential for T&E species effects.	No effect	Pre-construction survey. Habitat mitigation for special-status plants and animal species.	Less than significant
Antelope Wash Detention Basin (Ranchero Road)	Not applicable because initial construction of detention basin by City of Hesperia would remove all habitats.			

Oeste Recharge and Wells	Loss of habitat: 9 acres disturbed; 330 acres desert scrub Low potential for desert tortoise effects. Low to moderate potential for Mojave ground squirrel effects	Low potential for movement effects. Moderate to high potential raven use, and distance to known desert tortoise is <2 miles. Potential significant effects.	Pre-construction survey. Habitat mitigation for special-status plants and animal species.	Less than significant
Alto Recharge and Wells	Loss of habitat: 10 acres disturbed; 140 acres desert scrub. Some Joshua Tree habitat. Low potential for desert tortoise effects. Low to moderate potential for Mojave ground squirrel effects	Low potential for movement effects. Moderate potential raven use, and distance to known desert tortoise is <3 miles. Potential significant effects.	Avoidance of Joshua trees or mitigation for habitat loss. Pre-construction survey. Habitat mitigation for special-status plants and animal species.	Less than significant
Antelope Wash Recharge	Loss of habitat: 4 acres disturbed; 28 acres desert scrub; 68 acres Joshua Tree Low potential for T&E species effects Downstream site: 60 acres disturbed; 40 acres desert scrub	Potential effect on north-south movement; less than significant because wildlife may effectively use levees. Downstream site, low potential to affect wildlife movement.	Joshua Tree habitat loss mitigated at 1:1. MWA may consider other sites. Other site selected to reduce impacts.	Less than significant

5.5 CULTURAL RESOURCES

Facility	Potential for Buried Cultural Resources	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	None	No mitigation proposed	Less than significant
SWP Delivery via Unnamed Wash	Moderate	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Mojave River Well Field	Moderate to high	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Off-Channel Mojave River Recharge: West (including pipeline)	Moderate	Monitoring during construction Compliance with Federal and State	Less than significant

		requirements for cultural resources treatment	
Off-Channel Mojave River recharge: East (including pipeline)	Moderate	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Oro Grande Wash Recharge	Low, disturbed	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Cedar Avenue Detention Basin Recharge	Low	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	Low	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Oeste Recharge and Wells	Low	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Alto Recharge and Wells	Low	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant
Antelope Wash Recharge	Low	Monitoring during construction Compliance with Federal and State requirements for cultural resources treatment	Less than significant

5.6 GEOLOGY AND SOILS

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	Low potential liquefaction effects at existing facilities. Low potential for seismic-related damage to facilities. No soil erosion impacts	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	Low to moderate potential liquefaction effects.	None	Monitoring to maintain groundwater levels below 20 feet of surface.	Less than significant
SWP Delivery via Unnamed Wash	Some erosion and sediment transport at Unnamed Wash.	Some reduction in potential for sheet flow across floodplain.	Drop structures and levees to contain flow within 100-year floodplain.	Less than significant

Mojave River Well Field	Very low potential for construction related erosion.	None	Construction best management practices.	Less than significant
Off-Channel Mojave River Recharge: West (+pipeline)	Low potential for construction related erosion.	None	Construction best management practices.	Less than significant
Off-Channel Mojave River recharge: East (+ pipeline)	Low potential for construction related erosion.	None	Construction best management practices.	Less than significant
Oro Grande Wash Recharge	Very low potential for construction related erosion.	None	Construction best management practices.	Less than significant
Cedar Avenue Detention Basin Recharge	Very low potential for construction related erosion.	None	Construction best management practices.	Less than significant
Antelope Wash Detention Basin (Ranchero Road)	Very low potential for construction related erosion.	None	Construction best management practices.	Less than significant
Oeste Recharge and Wells	Very low potential for construction related erosion. Some sheet flow from recharge if seismically damaged.	None	Construction best management practices.	Less than significant
Alto Recharge and Wells	Very low potential for construction related erosion. Some sheet flow from recharge if seismically damaged.	None	Construction best management practices.	Less than significant
Antelope Wash Recharge	Very low potential for construction related erosion.	None	Construction best management practices.	Less than significant

5.7 HAZARDS AND HAZARDOUS MATERIALS

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	Potential for fuel and lubricant leaks during construction. Potential for surface water to affect groundwater.	None	Construction best management practices. Monitoring and local agency treatment as required.	Less than significant
SWP Delivery via Unnamed Wash	Potential for fuel and lubricant leaks during construction.	None	Construction best management practices	Less than significant
Mojave River Well Field	Potential for fuel and lubricant leaks during construction. Potential to encounter contaminated buried soils.	None	Construction best management practices	Less than significant

Off-Channel Mojave River Recharge: West (including pipeline)	Potential for fuel and lubricant leaks during construction. Potential to encounter contaminated buried soils.	None	Construction best management practices	Less than significant
Off-Channel Mojave River recharge: East (including pipeline)	Potential for fuel and lubricant leaks during construction. Potential to encounter contaminated buried soils.	None	Construction best management practices	Less than significant
Oro Grande Wash Recharge	Potential for fuel and lubricant leaks during construction.	None	Construction best management practices	Less than significant
Cedar Avenue Detention Basin Recharge	Potential for fuel and lubricant leaks during construction. Low potential to encounter contaminated buried soils.	None	Construction best management practices	Less than significant
Antelope Wash Detention Basin (Ranchero Road)	Not applicable. Excavation and grading would be done by City of Hesperia during detention basin construction.			
Oeste Recharge and Wells	Potential for fuel and lubricant leaks during construction.	None	Construction best management practices	Less than significant
Alto Recharge and Wells	Potential for fuel and lubricant leaks during construction.	None	Construction best management practices	Less than significant
Antelope Wash Recharge	Potential for fuel and lubricant leaks during construction.	None	Construction best management practices	Less than significant

5.8 LAND USE

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	None	None	No mitigation proposed	Less than significant
SWP Delivery via Unnamed Wash	None. Conveyance down wash is compatible with open space and floodplain use.	None	Continue coordination with Rancho Las Flores and lower watershed landowners.	Less than significant
Mojave River Well Field	Potential 0.11 acres of well structures in urban residential area.	None	Coordinate with adjacent property owners to minimize land-use conflict.	Less than significant
Off-Channel Mojave River Recharge: West	None. Recharge is a compatible use.	None	No mitigation proposed.	Less than significant

(including pipeline)				
Off-Channel Mojave River recharge: East (including pipeline)	None. Recharge is a compatible use.	None	No mitigation proposed	Less than significant
Oro Grande Wash Recharge	None. Recharge is a compatible use.	None	No mitigation proposed.	Less than significant
Cedar Avenue Detention Basin Recharge	None. Recharge is compatible with flood detention.	None	No mitigation proposed.	Less than significant
Antelope Wash Detention Basin (Ranchero Road)	None. Recharge is compatible with flood detention.	None	No mitigation proposed.	Less than significant
Oeste Recharge and Wells	330+ acres of low-density residential zoning converted to recharge	None	Coordinate with local officials to design recharge to be compatible in terms of noise, visual character, operation and maintenance	Less than significant
Alto Recharge and Wells	150+ acres of low-density residential zoning converted to recharge	None	Coordinate with local officials to design recharge to be compatible in terms of noise, visual character, operation and maintenance	Less than significant
Antelope Wash Recharge	None. Recharge is a compatible use in open space.	None	Coordinate with local officials to design recharge to be compatible in terms of noise, visual character, operation and maintenance.	Less than significant

5.9 NOISE

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	Noise effects to up to 50 residences: 2-3 weeks per year.	None	Construction noise minimization best management practices	Less than significant
SWP Delivery via Unnamed Wash	Low noise effects to <10 residences	Maintenance may involve vehicle use and low noise levels.	Construction noise minimization best management practices	Less than significant
Mojave River Well Field	Moderate noise effects for short periods of time to up to 750 residences	Low potential noise from wells.	Construction noise minimization best management practices. Wells to be placed in noise reducing structures.	Less than significant
Off-Channel Mojave River Recharge: West	Low noise effects to <15 residences	None	Construction noise minimization best management practices	Less than significant

(including pipeline)				
Off-Channel Mojave River recharge: East (including pipeline)	Low noise effects to <15 residences	None	Construction noise minimization best management practices	Less than significant
Oro Grande Wash Recharge	Low noise effects to 60+ residences	Potential for maintenance noise to be heard at residences along the rim of the wash.	Construction noise minimization best management practices	Less than significant
Cedar Avenue Detention Basin Recharge	Low noise effects to <40 residences	Potential for maintenance noise to be heard at residences along the rim of the wash.	Construction noise minimization best management practices	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	Following City of Hesperia construction, additional low noise effects to <30 residences	Low potential for maintenance noise to be heard at residences along the rim of the wash.	Construction noise minimization best management practices	Less than significant
Oeste Recharge and Wells	Low noise effects to <5 residences	Low potential for maintenance noise at nearby residences.	Construction noise minimization best management practices	Less than significant
Alto Recharge and Wells	Low noise effects to <10 residences	Low potential for maintenance noise to be heard at nearby residences.	Construction noise minimization best management practices	Less than significant
Antelope Wash Recharge	Low noise effects to <60 residences and to airport	Low potential for maintenance noise to be heard at residences along the rim of the wash.	Construction noise minimization best management practices	Less than significant

5.10 PUBLIC SERVICES AND UTILITIES

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	None	None	No mitigation proposed	Less than significant
SWP Delivery via Unnamed Wash	None	None	No mitigation proposed	Less than significant
Mojave River Well Field	Short term delay and detouring of emergency vehicles along pipeline routes. Potential accidental damage to utility lines during construction	None	Selection of pipeline alignment with minimal potential for traffic and utility impacts. Traffic controls (see traffic discussion). Daily notification of all public	Less than significant

			services of location and timing of construction activities	
Off-Channel Mojave River Recharge: West (including pipeline)	None. Construction off road.	None	Traffic controls (see traffic discussion).	Less than significant
Off-Channel Mojave River recharge: East (including pipeline)	None. Construction in seldom used unpaved road.	None	Traffic controls (see traffic discussion).	Less than significant
Oro Grande Wash Recharge	None	None	No mitigation proposed	Less than significant
Cedar Avenue Detention Basin Recharge	None	None	No mitigation proposed	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	None	None	No mitigation proposed	Less than significant
Oeste Recharge and Wells	None	None	No mitigation proposed	Less than significant
Alto Recharge and Wells	None	None	No mitigation proposed	Less than significant
Antelope Wash Recharge	None	None	No mitigation proposed	Less than significant
		5.11 RECREATION		
Facility	**Direct Impacts**	**Indirect Impacts**	**Mitigation Proposed**	**Significance Post- Mitigation**
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	Increase in West Fork Mojave River flow in fall and winter may affect swimming an fishing, may enhance rafting or kayaking.	None	Notification of recreation facilities on West Fork of pending releases from Silverwood Lake. Ramping of releases to avoid sudden changes in conditions.	Less than significant.
SWP Delivery via Unnamed Wash	No adverse effect. May provide recreation for future residents if development occurs.	None	No mitigation proposed.	Less than significant
Mojave River Well Field	Construction related effects on existing recreation along river.	None	Siting to reduce impacts as feasible. Const. best management practices.	Less than significant

Off-Channel Mojave River Recharge: West (including pipeline)	Construction related effects on existing recreation along river.	None	Siting to reduce impacts as feasible. Construction best management practices.	Less than significant
Off-Channel Mojave River recharge: East (including pipeline)	Construction related effects on existing recreation along river.	None	Siting to reduce impacts as feasible. Construction best management practices.	Less than significant
Oro Grande Wash Recharge	None	None	No mitigation proposed	Less than significant
Cedar Avenue Detention Basin Recharge	None	None	No mitigation proposed	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	None	None	No mitigation proposed	Less than significant
Oeste Recharge and Wells	None	None	No mitigation proposed	Less than significant
Alto Recharge and Wells	None	None	No mitigation proposed	Less than significant
Antelope Wash Recharge	None	None	No mitigation proposed	Less than significant

5.12 TRAFFIC

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	None	None	No mitigation proposed	Less than significant
SWP Delivery via Unnamed Wash	Construction crew traffic on Arrowhead Lake Road. Non-significant.	None	No mitigation proposed	Less than significant
Mojave River Well Field	Construction crew traffic. Traffic delays associated with short detours around construction in public rights of way. Temporary (1-day) parking and access delays as construction passes residences. Dump truck and other construction traffic on local roads.	None	Low-traffic pipeline alignment selected. Compliance with local traffic management requirements.	Less than significant
Off-Channel Mojave River Recharge: West	Construction crew traffic. Traffic delays associated with short detours around construction	None	Low-traffic pipeline alignment selected. Compliance with local traffic	Less than significant

(including pipeline)	in public rights of way. Dump truck and other construction traffic on local roads.		management requirements.	
Off-Channel Mojave River recharge: East (including pipeline)	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Low-traffic pipeline alignment selected. Compliance with local traffic management requirements.	Less than significant
Oro Grande Wash Recharge	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Compliance with local traffic management requirements.	Less than significant
Cedar Avenue Detention Basin Recharge	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Compliance with local traffic management requirements.	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Compliance with local traffic management requirements.	Less than significant
Oeste Recharge and Wells	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Compliance with local traffic management requirements.	Less than significant
Alto Recharge and Wells	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Compliance with local traffic management requirements.	Less than significant
Antelope Wash Recharge	Construction crew traffic. Dump truck and other construction traffic on local roads.	None	Compliance with local traffic management requirements.	Less than significant

5.13 WATER RESOURCES (WATER QUALITY)

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
GENERAL	No violation of Lahontan or Colorado River Basin Water Quality Objectives			Less than significant
Existing Recharge Facilities: Centro and Baja	Lower arsenic, chlorides, iron, sulfate, and TDS *versus* higher bromides and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Existing Recharge Facilities: Alto Floodplain	Lower arsenic, fluorides, iron, sulfate, and pH *versus* higher boron, chlorides, bromides, nitrates, TOC, sulfates, and TDS Low potential for surface water influence of groundwater.	Net improvement in SWP water quality versus No Project Alternative	Monitoring of groundwater quality in wells along Mojave River; treatment by local agencies if surface water influence is detected.	Less than significant
Existing Recharge Facilities: Alto Regional	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher	Net improvement in SWP water quality versus No Project	No mitigation proposed	Less than significant

	boron, bromides, chlorides, nitrates, sulfates, and TOC	Alternative		
Existing Recharge Facilities: Warren Valley	Lower arsenic, iron, and TDS versus higher bromides, chlorides, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Instream Mojave River Recharge	Lower arsenic, fluorides, iron, sulfate, and pH *versus* higher boron, chlorides, bromides, nitrates, TOC, sulfates, and TDS	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
SWP Delivery via Unnamed Wash	Lower arsenic, fluorides, iron, sulfate, and pH *versus* higher boron, chlorides, bromides, nitrates, TOC, sulfates, and TDS	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Mojave River Well Field	NA	NA	NA	NA
Off-Channel Mojave River Recharge: West (including pipeline)	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Off-Channel Mojave River recharge: East (including pipeline)	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Oro Grande Wash Recharge	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Cedar Avenue Detention Basin Recharge	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Antelope Wash Detention Basin Recharge (Ranchero Road)	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Oeste Recharge and Wells	Lower arsenic, fluoride, iron,	Net improvement in SWP water	No mitigation proposed	Less than

	pH, sulfate, and TDS *versus* higher boron, chlorides, and nitrates	quality versus No Project Alternative		significant
Alto Recharge and Wells	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Antelope Wash Recharge	Lower arsenic, fluorides, iron, pH, and TDS *versus* higher boron, bromides, chlorides, nitrates, sulfates, and TOC	Net improvement in SWP water quality versus No Project Alternative	No mitigation proposed	Less than significant
Effects on Metropolitan Water District Water Quality	None. Alternative supplies available to Metropolitan are SWP dry-year supplies or other banked supplies of similar water quality.	None	No mitigation proposed	Less than significant

5.14 WATER RESOURCES (HYDROLOGY)

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post-Mitigation
Existing Recharge Facilities	None	None	No mitigation proposed	Less than significant
Instream Mojave River Recharge	May reduce flood infiltration to the mainstem channel during initial winter storms. No effect on later floods which occur after watershed has been saturated.	Potential for some increase in early-season flows past the Narrows.	Monitoring to detect potential effects of rising groundwater levels; management of input as needed.	Less than significant
SWP Delivery via Unnamed Wash	Increased flow and frequency of flow will create incised channel and reduce floodplain overbank flow. Sediment recruitment and transport increased.	None	Monitoring and use of drop structures to reduce excess erosion.	Less than significant
Mojave River Well Field	None	None	None	Less than significant

Off-Channel Mojave River Recharge: West (including pipeline)	May reduce effects of Mainstem Recharge on flood infiltration by allowing late season SWP deliveries to be routed to other recharge sites.	None	None	Less than significant
Off-Channel Mojave River recharge: East (including pipeline)		None	None	Less than significant
Oro Grande Wash Recharge		None	None	Less than significant
Cedar Avenue Detention Basin Recharge		None	None	Less than significant
Antelope Wash Detention Basin (Ranchero Road)		None	None	Less than significant
Oeste Recharge and Wells	May reduce effects of Mainstem Recharge on flood infiltration by allowing late season SWP deliveries to be routed to other recharge sites.	None	None	Less than significant
Alto Recharge and Wells		None	None	Less than significant
Antelope Wash Recharge		None	None	Less than significant

5.15 GROWTH

Facility	Direct Impacts	Indirect Impacts	Mitigation Proposed	Significance Post- Mitigation
All Facilities	None	Effect of banking is to extend the period during which MWA can meet projected demands without seeking additional supplies. Project mitigates the adverse effects of planned growth on groundwater supplies and water quality. Metropolitan has alternative (if marginally more costly) sources for supplemental dry-year water via short-term transfers in dry years. The effect of banking and exchange is to marginally reduce cost of dry-year water supplies only.	None	Less than significant
Energy Use and Energy Conservation	Construction Fuel Impacts	Lower energy use associated with pumping from higher groundwater table. Lower fuels use associated with deliveries to banking and MWA during periods when hydropower is available.	None. Air Quality mitigations will minimize energy use during construction.	Less-than-significant

Table 7-5. Summary Matrix of Impacts, by Facility (LTS = Less than Significant after mitigation; S = Significant after Mitigation. Significant impacts are shaded for emphasis.)

FACILITY	POST-MITIGATION SIGNIFICANCE OF ADVERSE IMPACTS															
	Aesthetics	Air Quality	Biological	Cultural	Geology & Soils	Hazards & hazardous materials	Land Use	Noise	Public Services & Utilities	Recreation	Traffic	Water resources (Water Quality)	Water Resources (Hydrology)	Growth	Energy Use and Conservation	Cumulative Effects
Existing Recharge Facilities	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Instream Mojave River Recharge	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
SWP Delivery via Unnamed Wash	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Mojave River Well Field	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Off-Channel Mojave River Recharge: West	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Off-Channel Mojave River recharge: East	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Oro Grande Wash Recharge	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Cedar Avenue Detention Basin Recharge	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Antelope Wash Detention Basin Recharge (Ranchero Road)	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Oeste Recharge and Wells	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Alto Recharge and Wells	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Antelope Wash Recharge	LTS	S	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS

Table 7-6. Comparison Minimum Facilities Alternative versus No Project Alternative, by Category of Impact

CATEGORY OF IMPACT	MINIMUM FACILITIES ALTERNATIVE	NO PROJECT ALTERNATIVE	PREFERRED ALTERNATIVE
Aesthetics	Minor effects in Mainstem Mojave River and at Unnamed Wash. Well structures visible in urban areas	Same level of projected impact	None
Air Quality	Significant if 2+ units of pipeline are constructed along with other facilities	Probably lower level of impact due to shortened pipeline (no connection to California Aqueduct)	**NO PROJECT**
Bio. Resources	Loss of 7-9 acres of habitat, low potential for impacts to threatened and endangered species	Same level of projected impact and mitigation	None
Cult. Resources	Potential for buried resources	Same level of projected impact	None
Geology and Soils	Low potential liquefaction effects. Some erosion and sediment transport. Some construction-related erosion.	Same level of projected impact	None
Hazards/Hazardous Materials	Potential lubricant and fuel leaks. Potential to encounter contaminated buried soils.	Marginally lower level of projected impact due to shortened pipeline	**NO PROJECT**
Land use	Compatible uses except for wells in residential.	Same level of projected impact	None
Noise	Construction noise along pipeline and well alignments	Phasing of construction could reduce number of people affected at one time. Delay may increase the number of people affected along the pipeline alignment.	**PROPOSED PROJECT**
Public Services and Utilities	Emergency vehicles may need to detour around construction. Potential accidental damage to utilities during construction.	Same level of effect	None
Recreation	Reservoir releases may affect type of recreation in West Fork. Potential construction effects on recreation along river.	Same level of effect	None
Traffic	Impacts during construction in public rights of way. Some construction related traffic (crews)	Same construction traffic, deferred projects would mean future construction when traffic volumes are heavier.	**PROPOSED PROJECT**
Water Resources: Water Quality	Banking deliveries will have better water quality than average SWP. Net import of some mineral constituents; net export of others.	Imported SWP supplies would be of poorer water quality versus Proposed Project deliveries.	**PROPOSED PROJECT**
Water Resources: Hydrology	May reduce flood infiltration into mainstem groundwater (first storm only). No probable effects on major flows. Incised channel may be created in Unnamed Wash.	Same, except that effects on mainstem infiltration will be somewhat deferred by delay in implementation of maximum recharge.	None
Growth	No direct effects. Project mitigates for effects of planned development.	None	None

Table 7-7. Comparison of Proposed Project Impacts, Small Projects Alternative versus No Project Alternative, by Category of Impact

CATEGORY OF IMPACT	SMALL PROJECTS ALTERNATIVE	NO PROJECT ALTERNATIVE	PREFERRED ALTERNATIVE
Aesthetics	Minor effects in Mainstem Mojave River and at Unnamed Wash. Well structures visible in urban areas. Some levees and recharge basins will alter views from adjacent housing.	Same level of projected impact.	None
Air Quality	Significant if 2+ units of any type of facility are constructed at the same time. Higher levels of impact than for other alternatives. Extended period of impact.	Probably lower level of impact due to shortened pipeline (no connection to California Aqueduct). More potential for phasing to lower daily emissions.	**NO PROJECT**
Bio. Resources	Loss of about 250 acres of habitat, low potential for impacts to threatened and endangered species	Same level of projected impact and mitigation, except that potential re-siting of off-channel Mojave River recharge would likely involve impacts to higher value resources to the south.	**PROPOSED PROJECT**
Cult. Resources	Potential for buried resources	Same level of projected impact, except that potential re-siting of off-channel Mojave River recharge would likely involve impacts to higher value resources to the south.	**PROPOSED PROJECT**
Geology and Soils	Low potential liquefaction effects. Some erosion and sediment transport. Some construction-related erosion.	Same level of projected impact	None
Hazards/Hazardous Materials	Potential lubricant and fuel leaks. Potential to encounter contaminated buried soils.	Marginally lower level of projected impact due to shortened pipeline.	**NO PROJECT**
Land use	Compatible uses except for wells in residential. Recharge is compatible with existing low-density housing and flood channel maintenance along Mainstem Mojave River.	Same level of projected impact	None
Noise	Construction noise along pipeline and well alignments. Construction noise at recharge basins.	Phasing of construction could reduce number of people affected at one time. Delay may increase the number of people affected along the pipeline alignment and around recharge basins, especially for off-channel Mojave River recharge basins.	**PROPOSED PROJECT**
Public Services and Utilities	Emergency vehicles may need to detour around construction. Potential accidental damage to	Same level of effect	None

	utilities during construction.		
Recreation	Reservoir releases may affect type of recreation in West Fork. Potential construction effects on recreation along river.	Same level of effect	None
Traffic	Impacts during construction in public rights of way. Some construction related traffic (crews).	Same construction traffic; deferred projects would mean future construction when traffic volumes are heavier.	**PROPOSED PROJECT**
Water Resources: Water Quality	Banking deliveries will have better water quality than average SWP. Net import of some mineral constituents; net export of others.	Imported SWP supplies would be of poorer water quality versus Proposed Project deliveries.	**PROPOSED PROJECT**
Water Resources: Hydrology	May reduce flood infiltration into mainstem groundwater (first storm only). No probable effects on major flows. Incised channel may be created in Unnamed Wash.	Same, except that effects on mainstem infiltration will be somewhat deferred by delay in implementation of maximum recharge.	None
Growth	No direct effects. Project mitigates for effects of planned development.	None	None

Table 7-8. Comparison of Proposed Project Impacts, Large Projects Alternative versus No Project Alternative, by Category of Impact.

CATEGORY OF IMPACT	LARGE PROJECTS ALTERNATIVE	NO PROJECT ALTERNATIVE	PREFERRED ALTERNATIVE
Aesthetics	Minor effects in Mainstem Mojave River and at Unnamed Wash. Well structures visible in urban areas. Some levees and recharge basins will alter views from adjacent housing. ~~Antelope Wash impacts remains significant after mitigation.~~ Relocation of antelope wash eliminates substantial pre-mitigation impact.	Lower *potential* level of projected impact, depending on whether Antelope Wash recharge is determined to be essential.	~~**NO PROJECT**~~ **None**
Air Quality	Significant if 2+ units of any type of facility are constructed at the same time	Probably lower level of impact due to shortened pipeline (no connection to California Aqueduct). More potential for phasing to lower daily emissions.	**NO PROJECT**
Bio. Resources	Loss of about 750-800 acres of habitat, low potential for impacts to threatened and endangered species. Potential indirect effects on desert tortoise through predation. Effects reduced due to re-siting of Antelope Wash recharge.	Same level of projected impact and mitigation, except that potential re-siting of off-channel Mojave River recharge would likely involve impacts to higher value resources to the south. Re-siting of Oeste and Alto basins to the north could increase impacts to desert tortoise and Mohave ground squirrel. Re-siting of Antelope Wash recharge would be a benefit.	None
Cult. Resources	Potential for buried resources	Same level of projected impact, except that potential re-siting of off-channel Mojave River recharge would likely involve impacts to higher value resources to the south.	**PROPOSED PROJECT**
Geology and Soils	Low potential liquefaction effects. Some erosion and sediment transport. Some construction-related erosion.	Same level of projected impact	None
Hazards/Hazardous Materials	Potential lubricant and fuel leaks. Potential to encounter contaminated buried soils.	Marginally lower level of projected impact due to shortened pipeline.	**NO PROJECT**
Land use	Compatible uses except for wells in residential. Recharge is compatible with existing low-density housing and flood channel maintenance along Mainstem Mojave River. 480 acres of residential zoned land converted to recharge.	Same level of projected impact, except that re-siting may result in higher or lower levels of land use conflict.	None
Noise	Construction noise along pipeline and well	Construction phasing may reduce number of people	**PROPOSED**

	alignments. Construction noise at recharge basins.	affected simultaneously. Delay may increase number of people along the pipeline alignment and recharge basins and increase noise impacts for off-channel Mojave River recharge basins and basins at Alto and Oeste.	**PROJECT**
Public Services and Utilities	Emergency vehicles may need to detour around construction. Potential accidental damage to utilities during construction.	Same level of effect	None
Recreation	Reservoir releases may affect type of recreation in West Fork. Potential construction effects on recreation along river.	Same level of effect	None
Traffic	Impacts during construction in public rights of way. Some construction related traffic (crews).	Same amount of construction traffic, except that deferred projects would mean future construction when traffic volumes are heavier.	**PROPOSED PROJECT**
Water Resources: Water Quality	Banking deliveries will have better water quality than average SWP. Net import of some mineral constituents; net export of others.	Imported SWP supplies would be of poorer water quality versus Proposed Project deliveries.	**PROPOSED PROJECT**
Water Resources: Hydrology	May reduce flood infiltration into mainstem groundwater (first storm only). No probable effects on major flows. Incised channel may be created in Unnamed Wash.	Deferral of projects may result in less management flexibility in Mainstem Mojave River, inhibiting groundwater level management. Effects on mainstem infiltration will be somewhat deferred by delay in implementation of maximum recharge.	None
Growth	No direct effects. Project mitigates for effects of planned development.	None	None

Table 7-9. Detailed Summary of Mitigation Proposed

IMPACT	MITIGATION PROPOSED
Generally applicable actions incorporated into the Proposed Project Description	
General Construction Impacts	Chapter 4.5.1: Siting near existing facilities to reduce construction-related environmental impacts Chapter 4.5.3: When constructing in an urban setting MWA would comply with applicable city encroachment permit policies that specify work schedules and work practices intended to minimize construction impacts on traffic, local businesses, local residents, storm water runoff, and utilities and public services. Compliance with State General Stormwater Permit program for Construction Activities.
General Biological Impacts	Chapter 4.5.1: Siting that avoids known arroyo toad habitats and concentrates construction in the urbanizing areas of Hesperia, Victorville, Apple Valley, and Adelanto Chapter 4.5.2: Scheduling release of water from Silverwood Lake only during periods when the arroyo toad is estivating and only at rates which the 2003-2004 demonstration project showed to be fully contained within the main channel of the river Chapter 4.5.7: To prevent adverse impacts associated with wildlife incidental use of the construction area, MWA would implement the following avoidance and minimization measures where special status-species have been identified in or adjacent to the site in pre-construction surveys: a. Construction and maintenance personnel would participate in a USFWS/CDFG-approved environmental awareness program. b. Prior to initiation of construction activities, a qualified biologist would survey the area to confirm that no special-status species are present. If special-status species are present, they would be allowed to move away from construction activities.
General Cultural Resource Impacts	Chapter 4.5.3: Siting that avoids known significant cultural resource sites along the Mojave River.
General Aesthetic Impacts	Chapter 4.5.4: Where facilities would be visible, MWA would contain them in structures designed to be compatible with adjacent construction and in consultation with nearby residents.
General Air Quality Impacts	Chapter 4.5.5: MWA would adopt best management practices per the Mojave Desert Air Quality Management District.
General Noise Impacts	Chapter 4.5.6: Siting of the Proposed Project minimizes noise impacts. For areas adjacent to residential development MWA would comply with the following construction protocols: a. Permanent above-ground facilities (wells and treatment plant) would be contained within structures that would ensure that adjacent ambient noise levels are below the levels established for facilities in commercial and manufacturing areas. b. Except when more stringent standards apply to construction in the roadway, construction work would be limited to the hours from 7 AM to 7 PM, with no construction of weekends. c. Construction noise would be monitored on site by the construction contractor and portable noise attenuation barriers would be erected between construction and housing if construction noise measured at the exterior of adjacent housing exceeded 65 dBL.
Water Quality Impacts Related to Construction	Chapter 4.5.8: MWA would implement best management practices to avoid construction runoff during construction activities, including: a. Daily pre-construction inspection of all construction equipment to ensure that oil and/or gas/diesel fuel are not leaking from equipment; b. Secondary containment for fueling and chemical storage areas shall be provided during construction and Proposed Project operation; c. Secondary containment for equipment wash water shall be provided to ensure that wash water is not allowed to run off the site;

	d. Silt traps and/or basins would be provided to prevent runoff from the construction site; e. Materials stockpiles would be covered to prevent runoff; f. Loose soils would be protected from potentially erosive runoff; g. If construction equipment is used within the river channel, it will be inspected routinely and any leaks found will be repaired. If necessary, the equipment would be fitted with secondary containment materials at potential oil/fuel leakage sites; h. MWA would comply with the terms and conditions of the State's General Stormwater Permit program for construction activities. i. MWA will prepare and implement a Storm Water Pollution Prevention Plan based on the guidance in CalTrans' *Storm Water Pollution Prevention Plan and Water Pollution Control Plan Preparation Manual*, March 2003.
Specific Mitigation Commitments: Aesthetics	
Mojave River Well Field	Chapter 5.2.4.3: Wells would be enclosed in small structures designed to be consistent with structures in the immediate vicinity and/or MWA would plant screening vegetation.
Oro Grande Wash Recharge	Chapter 5.2.4.4: To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners.
Oro Grande Wash Recharge	Chapter 5.2.4.4: To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners.
Cedar Avenue Detention Basin Recharge	Chapter 5.2.4.5: To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners.
Oeste Recharge and Wells	Chapter 5.2.4.8: MWA would enclose wells in structures designed to be consistent with structures in the immediate vicinity and/or would plant screening vegetation.
Alto Recharge and Wells	Chapter 5.2.4.9: Where levee for recharge basins would be constructed adjacent to existing development, MWA would plant low vegetation on the levee berm and/or native vegetation as a screen for the levee. Wells would be sited to minimize impacts to residential areas and enclosed in small structures designed to be consistent with structures in the immediate vicinity.
Antelope Wash Recharge	Chapter 5.4.2.10: MWA would contour the outer berms of recharge facilities and would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners. Per Section 5.4.7.2, upstream Antelope Wash recharge was re-evaluated during the public comment period, as a mitigation measure to reduce biological resources impacts. The upstream site will be relocated to an expanded recharge area in Antelope Wash at Ranchero Road.
Specific Mitigation Commitments: Air Quality	
All Facilities	Chapter 5.3.8.2: MWA will implement all of the fugitive dust control measures required by Rule 403 (Fugitive Dust): a. Use periodic watering for short-term stabilization of Disturbed Surface Area (maintaining moist disturbed surfaces); b. Take action sufficient to prevent project-related trackout onto paved surfaces; c. Cover loaded haul vehicles while operating on Publicly Maintained paved surfaces; d. Stabilize graded site surfaces upon completion of grading;

	e. Cleanup project-related Trackout or spills on Publicly Maintained paved surfaces within 24-hours; f. Reduce non-essential Earth-Moving Activity under High Wind conditions g. Feasible mitigation such as use of highway diesel fuels and use of additional pollution equipment to trap exhaust particulates or NOx would be implemented as part of the project, h.. MWA would evaluate potential for phasing of construction to reduce emissions
Specific Mitigation Commitments: Biological Resources	
Facilities habitat losses	a. Pre construction surveys for special status species. If special status species are found, avoidance and minimization protocols will be initiated. Occupied habitat will be mitigated at a 1:1 ratio. For Unnamed Wash, habitat loss will be mitigated consistent with Las Flores Ranches pending HCP or 1:1. Avoidance of Joshua trees or mitigation for habitat loss. At Antelope Wash upstream site, MWA may consider other sites. Per this commitment, upstream Antelope Wash recharge was re-evaluated during the public comment period, as a mitigation measure to reduce biological resources impacts. The upstream site will be relocated to an expanded recharge area in Antelope Wash at Ranchero Road. *b. Per* response to comments from California Department of Fish and Game, for burrowing owls, MWA will implement avoidance and minimization protocols if owls are found at facility sites or, if avoidance is not feasible provide off-setting mitigation in consultation with CDFG. c. As provided in the EIR, MWA will survey for special-status species prior to construction. *Per* response to CDFG, if Mojave fringe-toed lizards are found during such surveys, MWA will notify CDFG and initiate consultation regarding appropriate avoidance and mitigation.
Specific Mitigation Commitments: Cultural Resources	
All Facilities	Chapter 5.5.5: MWA will avoid impacts if feasible on identified cultural resources including prehistoric and historic archeological sites, locations of importance to Native Americans, human remains, and historic buildings and structures. Methods of avoidance may include, but not be limited to, project re-route or re-design, project cancellation, or identification of protection measures such as capping or fencing. MWA will retain archeological monitors during construction for ground-disturbing activities that have the potential to impact significant archeological remains as determined by a qualified archeologist. Based on this policy and the results of literature search and field surveys, MWA would implement the monitoring provision above for all facilities located adjacent to the Mainstem Mojave River, including: • The Mojave River Well Field • The Well Field Delivery Pipelines • Off-Channel Mojave River Recharge (east or west site) and the supply pipeline to this site If the eastern site is selected for Off-Channel Mojave River Recharge, MWA would also design the recharge to avoid the recently identified historic farmhouse site and/or provide for a suitable archeological testing and recovery program consistent with State of California and Federal policy. Because previously unrecorded and/or unanticipated archaeological deposits, features, and Native American burials may be encountered during implementation of the Project, the Project Archaeologist would prepare a *Construction Phase Monitoring and Cultural Resources Treatment Plan* prior to Project construction. The purpose of this *Plan* would be to clearly outline and expedite the process by which the Mojave Water Agency will resolve any

	significant impacts upon newly discovered, historically significant cultural resources, including consultation with the State Historic Preservation Officer (SHPO), thereby eliminating untimely and costly delays in construction. Specifically, the *Plan* would outline the process by which cultural resource discovery notifications are made and treatment plans are implemented, describe the cultural resource classes anticipated during Project construction, describe the treatment options for each cultural resource class, and detail procedures for implementing treatment. In addition, the *Plan* would summarize the Native American involvement in the Project (including a sample Native American Burial Agreement), outline the procedures for curation of materials recovered during site treatment (including a proposed Archaeological Curation Agreement with a facility that meets California curation standards), and address report requirements. This *Plan* would be submitted to the SHPO for review and comment prior to Project construction.
Specific Mitigation Commitments: Geology and Soils	
Mojave River Recharge, Hesperia, Lenwood, and Hodge	Chapter 5.6.4.2: MWA will monitor existing well levels and establish an additional system of shallow monitoring wells to track changes in groundwater levels as the plume of recharged water moves downstream to the extraction well field. These wells will allow real-time management of recharge rates to minimize the potential for groundwater levels under developed areas to rise to within 20 feet of the surface.
All recharge areas	Chapter 5.6.3.3: To mitigate for the potential for short-term declines in local wells as a result of the project, MWA will monitor groundwater levels at all project-related extraction sites and at adjacent sites. If MWA determines that water levels at these adjacent wells have declined as a result of MWA extractions, MWA will either (a) reduce extractions or (b) compensate the owner of the affected well for the increased energy costs associated with the decline in well level.
All facilities	Chapter 5.6.4.4: To ensure minimization of potential leaks at facilities due to seismic events and provide for rapid repair, MWA will maintain a small stockpile of rock at each recharge facility where levee damage might result in minor flooding of adjacent property to ensure that any levee damage can be rapidly patched to reduce potential for erosive flows.
Unnamed Wash	Chapter 5.6.4.6: Drop structures will be constructed as part of the Proposed Project to reduce excess erosion and sediment transport. Levees will be placed along the edge of the 100-year floodplain to contain releases.
Facilities in a Flood Zone	*Per* response to comments from San Bernardino County DPW Water Resources Division, MWA will coordinate with the County Flood Control District and local flood control officials during design to ensure that facilities within a flood zone do not conflict with Master Plans of Drainage and County/Local flood management. If necessary, permits will be requested from the Flood Control District and U.S. Army Corps of Engineers. MWA will inform the Flood Control District of any substantial changes in the proposed project.
Specific Mitigation Commitments: Hazards and Hazardous Materials	
All excavations	Chapter 5.7.3.2: Prior to construction all sites will be evaluated to identify past uses that may have resulted in soil contamination. If the site assessment identifies a potential for contaminated soils, MWA would conduct further analysis to confirm this finding and would either (a) re-site or redesign the area to avoid impacts of (b) remediate the contamination to meet Regional Water Quality Control Board standards. During construction of pipelines in areas that cannot be assessed prior to construction, MWA would provide for monitoring of excavated soils and construction contracts will specify monitoring procedures and proper procedures for reporting and responding to potentially contaminated soils. Excavated materials containing hazardous waste will be handled, transported, and disposed of in accordance with applicable regulations.
All activities	Chapter 5.7.3.4: To reduce the potential for the project to affect emergency response plans or evacuation plans, MWA will implement traffic management that minimizes potential for traffic delays.

Specific Mitigation Commitments: Land Use	
Unnamed Wash	Chapter 5.8.1.2: MWA would continue to coordinate with Rancho Las Flores to ensure compatibility of the Unnamed Wash feature of the Minimum Facilities Alternative with the proposed development;
General	Chapter 5.8.1.2: MWA would coordinate with city and town officials to develop methods for ensuring long-term compatibility of recharge and associated facilities with planned existing development; and design of facilities to minimize adverse indirect effects on noise, and other factors that may affect perceived incompatibility of such facilities with residential and commercial development.
Specific Mitigation Commitments: Noise	
All facilities as applicable	Chapter 5.9.4.2: MWA will restrict construction to daylight time periods consistent with local ordinances; construction along roads in developed areas will therefore be practically limited to the period from 8:30 am to 4:30 pm. MWA will require construction contractors to utilize available noise management technology (muffling) and to maintain noise suppression equipment on construction machinery to ensure that noise emissions are minimized at the source. Equipment not in use for more than 5 minutes will be turned off. If pile driving equipment is necessary, pile holes will be pre-drilled if feasible and vibratory pile driving equipment will be used whenever possible. MWA will require construction contractors to locate fixed construction equipment such as generators as far as possible from noise-sensitive receptors. During construction of wells, pipelines, and associated facilities such as pump stations and chloramination facilities in areas where construction is within 400 feet of a residence or business, construction noise will be periodically monitored on site and at the residence or business. If noise levels are found to exceed those mandated by local ordinance, MWA will, to the extent feasible and in consultation with the resident or business, install temporary noise barriers along the boundary of the construction site to further reduce noise impacts. Barriers may be installed along the boundary of the construction zone or on private property, depending on conditions and the permission of the landowner/resident. In addition, once construction areas for fixed location construction such as well drilling pads have been cleared and construction can commence, MWA will install temporary noise barriers around the construction site, to the extent feasible, to block noise transmission. At recharge basin sites where there is adjacent development, MWA will initially construct outer levees along the boundary with adjacent development. This will allow construction of inner levees and basins behind a mound of earth, which will reduce noise levels for adjacent residents and businesses. MWA will notify residents and noise-sensitive receptors in the affected areas several weeks in advance of operations that would generate noise in excess of local standards. Information distributed will describe the operations and duration of the project. All stationary equipment will be designed, constructed, and operated to comply with all local noise ordinances.

Specific Mitigation Commitments: Public Services	
Minimum Facilities Alternative	Chapter 5.10.4.2: For the Well Field Delivery Pipeline system, MWA would implement traffic controls (as noted in the discussions of traffic and noise impacts). In addition, MWA would coordinate with providers of public services prior to initiating construction to ensure that police, fire, and emergency service providers were aware of the location of any construction activities in the public right of way. During construction in roads, this coordination would occur daily to precisely define the areas where traffic delays might occur.
Specific Mitigation Commitments: Recreation	
Minimum Facilities Alternative	Chapter 5.11.3.2: MWA will notify recreation providers along the West Fork of the Mojave River when deliveries from Silverwood Lake will be made and will ramp such deliveries up in 50-cfs increments to avoid sudden increases in downstream flow rates. A similar program will be developed for deliveries made via Unnamed Wash. MWA will coordinate siting of the potential Mojave River Well Field and associated facilities with local governments and the owners of private local facilities to minimize the effects and wells and pipelines on recreational activities along the river in this area (Bear Valley Road to Rock Springs).
Specific Mitigation Commitments: Traffic	
All facilities	Chapter 5.12.4.2: To minimize potential traffic effects associated with construction and operation of facilities, MWA will comply with all local encroachment permit requirements. In addition, MWA will: a. Schedule hauling of construction equipment (and water, if feasible) to and from the various construction sites prior to or following rush hours; b. Use off-road rights-of-way (road shoulders and sidewalks) for construction to the extent feasible; c. Encourage construction crews to carpool to construction sites; d. Identify and clearly mark emergency access routes around sites where construction takes place within the public right-of-way; e. On a daily basis, inform local emergency services of the location of all sites involving construction in the public right-of-way; and f. Jack and bore under Interstate 15.
Specific Mitigation Commitments: Water Resources (Water Quality)	
All Facilities	Chapter 5.13.8: To address potential for groundwater recharge to percolate through clay and fine-grained soils and result in leaching of minerals into indigenous groundwater, water quality in production and monitoring wells will be monitored to detect such potential influences. Wells will also be monitored for potential surface water influence, and recharge will be managed to reduce any effects identified. As noted in draft EIR Section 5.13.8 and in MWA's clarifying response to comments from the Lahontan Regional Water Quality Control Board and San Bernardino County DPW Water Resources Division: a. MWA will analyze corings from proposed recharge and/or well field sites to ensure that these facilities are not sited in areas where significant clay and fined-grained soils could result in substantial leaching of minerals into indigenous groundwater. Water quality will also be monitored routinely to detect any influence associated with leaching of minerals during recharge. b. Water quality in monitoring wells and all production wells will be monitored routinely in accordance with applicable regulations. c. For the Mojave River Well Field element of the Proposed Project, MWA will follow DHS guidance for evaluating the potential for these wells to be under the influence of surface water. d. If groundwater levels are detected rising to levels where recharge may cause water to become under the influence of surface water, MWA will divert deliveries to other facilities, or increase local extractions, as appropriate.

Specific Mitigation Commitments: Water Resources (Hydrology)	
Mojave River Recharge	Chapter 5.14.5: MWA will monitor groundwater levels in the Mojave River Well Field for evidence of high groundwater levels in the floodplain outside of the mainstem channel. If there is substantial evidence that recharge is raising these levels to within 20 feet of the surface at the beginning of the storm season, then MWA could adjust operations by diverting some banked supplies to other recharge facilities. As noted in the draft EIR and in responses to comments from San Bernardino County DPW Water Resources Division, to reduce potential for in-channel/in-wash recharge operations to affect flood flows, MWA has sited these facilities in areas where existing and planned embankments would exert substantial control over flood flows and the effects of small temporary berms should be minimal. MWA will also coordinate design and construction of in-channel/in-wash facilities with San Bernardino County Flood Control, and will obtain permits from the Flood Control District and the U.S. Army Corps of Engineers, as appropriate. In general, per response to comments from San Bernardino County DPW Water Resources Division regarding local Master Plans of Drainage, MWA will also work with local communities during design, construction, and implementation of the proposed project facilities to avoid effects to drainage plans. Regarding Unnamed Wash, per response to comments from San Bernardino County DPW Water Resources Division and as provided for in the Proposed Project description, MWA will incorporate rock energy dissipation structures into the design of the channel at Unnamed Wash to minimize erosion and channel incision.
SPECIFIC MITIGATION COMMITMENTS: USE OF ENERGY	
Best management practices associated with mitigation of air quality impacts will also serve to reduce potential construction and operation use of energy.	

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 8. REFERENCES

Note: All references are available for public review at the front desk of Mojave Water District. References with a number are provided in Notebooks 1-4. References designated as SC are individually bound.

1A. Anders, R, WA Yanko, RS Schroeder, and JL Jackson. Attenuation rates for PRD-1 and MS2 during recharge with artificial recharge with recycled water at a research basin in Los Angeles County. In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html.

1B. Cozzarelli, IM. 2002. Impact of organic contaminants on the evolution of aquifer geochemistry. In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

1C. Dunsmore, JN and JK Bohlke. 2002. Nitrate contamination and incorporation of excess air associated with artificial recharge in a desert basin, Yucca Valley, California. In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

1D. Leenheer, JA. 2002. Processes controlling attenuation of dissolved organic matter in the subsurface. In: Aiken, GR and EL Kuniansky, editors. U.A. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

1E. Metge, D. Fate and transport of bacterial, viral, and protozoan pathogens during ASR operations - What microorganisms do we need to worry about and why? In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

1F. Oremland, RS. 2002. Microbial redox cycling of arsenic oxyanions in anoxic environments. In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

1G. Rogers, JR. 2002. Why do bacteria colonize aquifer surfaces? Geotechnical and nutrient controls of bacterial colonization of silicate surfaces. In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

1H. Rostad, C. 2002. Fate of disinfection byproducts in the subsurface. In: Aiken, GR and EL Kuniansky, editors. U.S. Geological Survey Artificial Recharge Workshop Proceedings, April 2-4, 2002, Sacramento, California. Available at http://water.usgu.gov/ogw/pubs.html

2. Applied Earth Works. 2005. Cultural resources Survey for the Mojave Water Agency Water Banking Project. Hemet, CA.

3. Antelope Valley AQMD and Mojave Desert AQMD. 2002. CEQA and federal conformity guidelines. Lancaster, CA. 15 pp.

SC. Bookman-Edmonston. 2004a. Water Management Program Technical Memorandum 01.0. Initial Alternatives and Screening Matrix. Report prepared for Mojave Water Agency. Project Number 042810. Glendale, CA.

SC. Bookman-Edmonston. 2004b. Water Management Program Technical Memorandum 02.0. Preliminary engineering and hydrogeology for put alternatives. Report prepared for Mojave Water Agency. Project Number 042810. Glendale, CA.

SC. Bookman-Edmonston. 2005a. Water Management Program Technical Memorandum 03.0. MWD storage. Report prepared for Mojave Water Agency. Project Number 042810. Glendale, CA.

SC. Bookman-Edmonston. 2005b. Water Management Program Technical Memorandum 05.0. Preliminary engineering for take alternatives. Report prepared for Mojave Water Agency. Project Number 042810. Glendale, CA.

SC. Bookman-Edmonston. 2005c. Water Management Program Technical Memorandum 06.0. Local agency participation. Report prepared for Mojave Water Agency. Project Number 042810. Glendale, CA.

SC. Bookman-Edmonston. 2005d. Water Management Program Technical Memorandum 07.0. Facilities cost estimate. Report prepared for Mojave Water Agency. Project Number 042810. Glendale, CA.

4. Bostick, BC and S Fendorf. 2005. Processes controlling the cycling of arsenic in soils and sediments. Mineralogical Society Winter Meeting 2005. Environmental Minerology, Geochemistry, and Human Health. Programme and Abstract Volume, Bath Spa University, UK.

5. Cadre Environmental. 2004a. Mojave Water Agency -- arroyo toad monitoring efforts within West Fork Mojave River during winter 2003 Cedar Springs Dam releases, San Bernardino County, CA. Carlsbad, CA.

SC. Cadre Environmental. 2004b. Final arroyo toad report. Report prepared for Rancho Las Flores. Carlsbad, CA.

6. Cadre Environmental. 2005. Mojave Water Agency biological Constraints assessment of Potential Water Banking Project Sites, San Bernardino [County], California. Carlsbad, CA.

7. California Department of Finance. 2004. Population Change 1990-2000. Incorporated cities by county. California State Census Data center. Census 2000. PL94-171. Sacramento, CA.

8. California Department of Transportation (Caltrans). 2003. *Storm Water Pollution Prevention Plan and Water Pollution Control Plan Preparation Manual.* Sacramento, CA. 218 pp.

9. California Department of Transportation (Caltrans). 2004a. Manual of Uniform Traffic Control Devices, California Supplement, Part 6, Temporary Traffic Control. Sacramento, CA.

10. California Department of Transportation (Caltrans). 2005. Annual Average Daily Truck Traffic on the California State Highway System. Traffic and Vehicle Data Systems. Sacramento, CA.

11. California Irrigation Management Information System. 2005. Monthly Average ETO Report. Victorville and Barstow. Sacramento, CA.

12. City Data.com. 2005. Victorville, California Detailed Profile. Available at http://city-data.com/Victorville-California.html

13. City of Hesperia. 2003. Ranchero Road Grade Separation. http://www.ci.hesperia.ca.us

14. Colorado River Regional Water Quality Control Board. 2002. CWA section 303(d) list of water quality limited segment. Palm Desert, CA.

15. Colorado River Regional Water Quality Control Board. 2004. Basin Plan. Palm Desert, CA.

16. County of San Bernardino. 1989.County Code. Division 9. Plant Protection and Management. County of San Bernardino, San Bernardino, CA.

17. Davraz, A. R. Karaguzel, and LL Soyaslan. 2001. The importance of hydrogeological and hydrological investigations in the residential area: a case study in Burdur, Turkey. Environmental Geology 44(7): 852-861.

SC. De Barros, P. 2004. Cultural Resources Overview and Management Plan Rancho Las Flores Project, Hesperia, San Bernardino County, California. Prepared by Professional Archeological Services. Submitted to Rancho Las Flores LLC, Dana Point, California.

SC. DWR (California Department of Water Resources). 1997. Management of the California State Water Project. Bulletin 132-96. Sacramento, CA.

18. DWR (California Department of Water Resources). 2001. Annual Report. Operation of the State Water Project 1998-1999. Sacramento, CA.

19. DWR (California Department of Water Resources). 2005. Chronological reconstructed Sacramento and San Joaquin Valley water year hydrologic classification Indices 1901 through 2004. Sacramento, CA

20. DWR (California Department of Water Resources). 2005. Deliveries to water banks. Metropolitan Water District. Data from State Water Project Analysis and Operations Branch. Excel spread sheet.

21. DWR (California Department of Water Resources). 1998-2004. Water quality at selected SWP locations. Water Quality Section, Division of Operations and Maintenance. Available at: http:/wwwomwq.water.ca.gov/GrabSamplePage/GrabSampleTables.

22. Eldorado County Air pollution Control District. 2001. CEQA Guide, Proposed Final. Construction activities -- air quality impacts and mitigation.

23. Environment Canada. 2004. Fuel consumption of off-road engines. http://www.ec.gc.ca/transport/offroad2004/BSFC_e.htm

24. Genesis Engineering, Inc. 2003. Non-road diesel emission reduction study. Report prepared for Puget Sound Clean Air Agency, Oregon department of Environmental Quality, and U.S. Environmental Protection Agency. October 14, 2003. Portland, Oregon.

25. Knudsen, KL, JS Noller, JM Sowers, and WR Lettis. 2000. Maps showing Quaternary geology and liquefaction susceptibility, San Francisco, California. Report prepared by William Lettis and associates, Walnut creek, CA.

26. Lahontan Regional Water Quality Control Board. 2001. Water Body Fact Sheets for 2002. Section 303(d) List Update, Lahontan Region. South Lake Tahoe, CA

27. Lahontan Regional Water Quality Control Board. 1994. Basin Plan: (a) Water Quality Objectives for the Mojave Hydrologic Unit; Section 4.3. Stormwater runoff, erosion, and sedimentation; and Section 4.6 Groundwater Protection and Management; South Lake Tahoe, CA.

28. Lichvar, R, G Gustina, and R Bolus. 2002. Duration and frequency of ponded water on arid southwestern playas. WRAP Technical Notes Collection (ERDC TN-WRAP-02-02). U.S. Army Engineer Research and development Center, Vicksburg, MS. www.wes.army.mil/el/wrap

29. LePre, L. 2004. Desert Managers Group, Mojave River Presentation. Presentation given to the Desert Managers Group, January 14, 2004.

30. Metropolitan Water District of Southern California. 2003. Draft Integrated Resource Plan. Available at www.MWDh2o.com.

31. Metropolitan Water District of Southern California. 2005. Model Results, Conceptual operation of MWA-Metropolitan Water Bank. Los Angeles, CA.

32. Mojave Desert Air Quality Management District. 2005. Rules.

    a. Rule 219. Equipment not requiring a permit
    b. Rule 401. Visible emissions
    c. Rule 402. Nuisance
    d. Rule 403. Fugitive dust
    e. Rule 403.2 Fugitive dust control for the Mojave Desert Planning Area
    f. Rule 1103. Cutback and emulsified asphalt

SC. MWA (Mojave Water Agency). 2004a. 2004 Regional Water Management Plan. Volume 1. Apple Valley, CA.

SC. MWA (Mojave Water Agency). 2004b. Program Environmental Impact Report, Mojave Water Agency 2004 Regional Water Management Plan. Main Report. Apple Valley, CA.

33. National Park Service. 2000. Typical noise levels from construction equipment. Available at: http://www.nps/gov/yose/mrp/2000/tables/IV-1.pdf

34. Silva, W, N. Gregor, and R Darragh. 2003. Development of self consistent regional soil attenuation relations for ground motions and liquefaction parameters: an example for the basin and range region. Report prepared by Pacific Engineering and Analysis. El Cerrito, CA.

35. Town of Apple Valley. 2000. Development Code, Chapter 9.76. Plant Protection and Management. Apple Valley, CA

36. U.S. Department of Interior, Bureau of Land Management. 2005. Environmental Impact Statement. West Mojave Plan, Final Environmental Impact Statement. Riverside, CA

37. U.S. Department of Interior, Bureau of Land Management. 2005. West Mojave Plan. Species Distribution Maps for Desert Tortoise and Mohave ground squirrel and Species Accounts. Riverside, CA.

38. U.S. Department of Interior, Fish and Wildlife Service. 2004. Species Accounts for Arroyo toad and red-legged frog. Ventura, CA.

39. U.S. Department of Transportation, Federal Highway Administration. Special report -- highway construction noise: measurement, prediction, and mitigation. 1976. Available at: http://www.fhwa.dot.gov/environment/noise/highway/hcn06.htm

40. USEPA (Environmental Protection Agency). 2004. Clean Air nonroad diesel rule - facts and figures. EPA420-F-04-037, May 24, 2004.

41. USGS (United States Geological Survey). 2005. Daily mean streamflow data for Mojave River below Forks reservoir near Hesperia, CA (Station USGS 10261100) and Mojave River at Lower Narrows near Victorville, CA, January 1, 1983 through May 10, 1983. Available at: http://nwis.waterdata.usgs.gov/ca/nwis

42. USGS (United States Geological Survey). 2001. Water supply in the Mojave River Ground-Water Basin, 1931-99, and the benefits of artificial recharge. USGS Fact Sheet 122-01. Available at http://ca.water.usgs.gov

43. Washington State Division of Environmental Health. 2005. Groundwater sources under the direct influence of surface water. Available at: www.doh.wa.gov/ehp/dw/Programs/groundwater.htm

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 9: RECORD OF PUBLIC INVOLVEMENT

9.1 Public Contacts prior to the Notice of Preparation an EIR

9.1.1 2004 PEIR

The 2004 PEIR, which addresses programmatic-level effects of a wide range of potential water supply reliability and groundwater replenishment projects involved July 26, 2001 circulation of a 30-item questionnaire to solicit input to the PEIR. By November April 11, 2002, responses to the questionnaire were received (MWA received responses to the questionnaire were received from:

Public Agencies and Corporate Entities

- City of Adelanto
- Victor Valley Water District
- Jess Ranch
- City of Barstow
- Joshua Basin Water District
- Hi-Desert Water Desert
- San Bernardino County
- California Department of Fish and Game
- Colorado River Regional Water Quality Control Board
- Victor Valley Waste Reclamation Authority
- City of Hesperia
- Bighorn Desert View Water Agency
- Southern California Water Company
- City of Adelanto

Individuals

- Chuck Bell
- Paul Davis
- Norm Nichols
- Joe Monroe
- One unidentified respondent

The questionnaire elicited response to a number of issues related to the need for enhanced water management facilities, the potential cooperation of MWA and local producers, local priorities, and respondents' concerns about water supply and groundwater resources. This early input to the process helped establish priorities and criteria for analysis in the 2004 PEIR. In addition, the 2004 PEIR involved several meetings of the MWA Technical Advisory Committee where the Regional Water Management Plan was specifically addressed. These were held on:

- June 20, 2001
- July 25, 2001
- October 24, 2001
- February 13, 2002
- April 24, 2002
- June 27, 2002
- July 31, 2002
- August 29, 2002
- November 20, 2002
- December 18, 2002
- February 19, 2003
- March 19, 2003
- April 16, 2003
- August 20, 2003
- November 5, 2003
- January 7, 2004

The 2004 PEIR contains a full record of these meetings and of MWA's response to alternatives proposed and concerns raised at these Technical Advisory Committee Meetings.

9.1.2 Local Agency Participation Effort

Prior to initiation of the formal EIR process, MWA and its engineering consultants Bookman-Edmonston (Bookman-Edmonston 2004c) determined that a banking and exchange program could benefit from local participation, particularly participation of agencies with substantial groundwater production in the vicinity of the California Aqueduct. Deliveries to and from this SWP facility would be beneficial to such agencies and could benefit from and require cooperative management of facilities. Agencies consulted were:

- Hesperia Water District
- Victor Valley Water District
- Baldy Mesa Water District
- San Bernardino County Special Districts 70J and 70L

During these informal discussions, representatives from these agencies were in general agreement that:

- It was important to consider common projects now, because of the rapid growth and opportunities for purchasing land becoming more limited and expensive;
- There would be cost-sharing benefits that should be investigated;
- Use of a water treatment plant would be a high priority; and
- Water quality issues are a concern.

Three of the agencies expressed interest in all recharge and extraction elements of the Proposed Project and Victor Valley Water District expressed interest in entitlement exchange possibilities. Subsequent, on-going coordination with local agencies helped to define alternatives, including the Minimum Facilities Alternative's proposed Instream Mojave River Recharge and associated Mojave River Well Field and Pipelines. Siting and capacity of these facilities was influenced by local agency requirements for replacement water and the capacity and location of local facilities which could receive deliveries of water from the Mojave River Well Field. San Bernardino County Special Districts noted the need for recharge in the Oeste area and that recharge in some areas could raise concerns because of the potential presence of Chromium 6. Victor Valley Water District noted that it planned to use a flood detention facility on Oro Grande Wash at Green Tree and that it would provide well-drilling logs to MWA. This local agency input assisted in the formulation and siting of the Minimum Facilities Alternative.

9.1.3 Briefing and Field Visit for Regulatory Agencies

In addition to local agency coordination, on May 13 2004, MWA briefed representatives from U.S. Fish and Wildlife Service, Ventura Field Office; California Department of Fish and Game; DWR State Water Project Analysis Office (SWPAO), and Lahontan Regional Water Quality Control Board on the upcoming PEIR and on the potential for a water banking and exchange project between Metropolitan and MWA, and conducted a field tour of some of the potential facilities. Attendees included:

- Robert McMorran, USFWS
- Brian Croft, USFWS
- Douglas Treloff, USFWS
- Rebecca Jones, CDFG
- Craig Trombly, DWR SWPAO,
- Grace Cheng, DWR SWPAO
- Elizabeth Patterson, DWR SWPAO, and
- Hasam Baqai, LRWQCB

Discussion subsequent to the field tour centered on general concerns regarding water quality, impacts to sensitive habitats, and potential for water banking to benefit downstream riparian habitats in the Narrows. USFWS and CDFG representatives recommended that MWA avoid impacts to sensitive habitats and to threatened and endangered species and that MWA seek means of enhancing environmental conditions if feasible.

9.1.4 Contacts during the 2003-2005 Pilot Project

In 2003-2005, MWA conducted a Pilot Project to test the potential for releases of Metropolitan supplies from Silverwood Lake, down the West Fork of the Mojave River, to be recharged in the Mainstem Mojave River in the reach from Mojave Forks Dam and to the Narrows and from the Rock Springs Outlet. A Mitigated Negative Declaration was prepared for this pilot project, a Clean Water Act Section 404 permit was obtained from the Corps of Engineers, Los Angeles District, and during this process there was coordination with, among others:

- USFWS, which by letter dated October 8, 2003 concluded that releases of up to 500 cfs from Silverwood Lake during the period September 15 through February 15 would not impact the endangered arroyo toad provided pre-release surveys confirmed that toads were not active in the river and that the releases were contained in the existing active channel.
- CDFG, which by letter dated September 20, 2003 concluded that releases of up to 500 cfs, combined with berm construction in the mainstem Mojave River would not constitute a modification of the stream bed requiring a CDFG Section 1600 permit, provided construction of berms avoided all native vegetation.
- USACE, which issued a Section 404 Individual Permit for the construction of berms within the Mojave River mainstem.
- Lahontan Regional Water Quality Control Board, which issues a Clean Water Act section 401 water quality impact determination and concluded that the pilot project was not inconsistent with and did not violate water quality standards of its Basin Plan.
- San Bernardino County Museum, Curator of Paleontology (Eric Scott), who concluded in a letter dated 12 December 2003 that the proposed pilot project had low potential for significant impacts to paleontological resources and no mitigative program was necessary.
- Department of Water Resources, which made suggestions regarding the appropriate basis for evaluation of releases from Silverwood Lake.

These and other public and agency comments related to the 2003-2005 Pilot Project are documented in the Mitigated Negative Declaration and were considered during scoping and preparation of the Project EIR. It should be noted that no change in the timing and magnitude of releases from Silverwood Lake is proposed for the Proposed Project and that the potential for annual environmental effects of releases is therefore the same, except that the Proposed Project banking element extends over 20-25 years, rather than 2-3 years.

9.2 Public Scoping and Comments in Response to the Notice of Preparation

9.2.1 Distribution of the Notice of Preparation

Following certification of the 2004 PEIR for the Regional Water Management Plan, MWA continued on-going coordination with local agencies and conducted screening exercises leading to formulation of a set of potential water banking and exchange scenarios that would meet the objectives of the Proposed Project. MWA then prepared and issued a "Notice of Preparation of a Draft Environmental Impact Report, Mojave Water Agency Water Supply Reliability and Groundwater Replenishment Program" on April 15, 2005. This notice was mailed to 149 agencies and individuals and simultaneously emailed to 100 agencies, businesses, and individuals. MWA distributed 15 copies of the NOP to the State Clearinghouse, which then issued a State Clearinghouse number and distributed the notice to appropriate state agencies. Notice of Preparation was also published in the Daily Press, Desert Dispatch, and Hi-Desert Star newspapers on April 20, 21, and 23 and included announcement of a Public Scoping Meeting for 6 PM on April 27, 2005.

9.2.2 Presentation to the MWA Technical Advisory Committee

At a morning meeting on April 27, 2005, MWA also presented the Notice of Preparation and discussed the potential project with the MWA Technical Advisory Committee. During this meeting, comments were received on a number of issues, as outlined on Table 9-1.

Table 9-1. Summary of Comments, April 27, 2005 Technical Advisory Committee Meeting

COMMENTOR AND AFFILIATION	SUMMARY OF COMMENT	SECTION OF EIR THAT ADDRESSES ISSUE
1. Guy Patterson Baldy Mesa Water District	If a Mojave River Well Field is a feature of the Proposed Project, MWA should include a connection from the well-field to Adelanto.	Chapter 4, Minimum facilities Alternative
2. Tom Billhorn California Department of Fish and Game	a. The project is a complex issue b. Sensitivity analyses will be needed for some impacts c. Relative effects need to be clear d. The volume of supply needs to be substantial e. Are we going to have problems with returns to Metropolitan? f. How will water be stored? g. Can Metropolitan be paid back, or is the project magnitude too high? h. Need to discuss how the project fits into the Judgment. i. The decline in groundwater levels in the Transition Zone are a concern to CDFG	Chapter 5.13 Chapter 4 and 7 Chapter 4 and 7 Chapter 4 Chapter 4 and 5.13 Chapter 4 Chapter 4 and 5.13 Chapter 4 Chapter 4 and 5.4
3. Chuck Bell Agricultural representative, Lucerne Valley	a. Is the project going to provide groundwater replenishment basin-wide. b. Will the EIR cover alternatives for both delivery to MWA and returns to Metropolitan? ~~c. MWA should consider recharge in the Morongo Basin/Lucerne valley area, with returns to Metropolitan via a canal or pipeline to the Colorado Aqueduct.~~	Chapter 4 Chapter 4 and 5.13 Chapter 3
4. Jeannette Hayhurst City of Barstow	a. Will decisions about which project to adopt be made with consideration of financial and political issues, as well as environmental impacts? b. Need strong documentation that a 10% loss factor is realistic so that there is no loss of supply for MWA.	Chapter 7 Chapter 4

In addition to the April 27, 2005 Technical Advisory Committee Meeting, a Public Scoping was scheduled for 7 PM on April 27, 2005. The meeting was cancelled at 8:00 PM due to lack of attendance.

9.2.3 Written Comments Received

During the 30-day public comment period, MWA received written comments from the following:

- Lahontan Regional Water Quality Control Board (Hisam Baqai, Supervising Engineer)
- The California Native American Heritage Commission (Carol Gaubatz, Program Analyst)
- County of San Bernardino Department of Public Works (Naresh P. Varma, Chief Environmental Management Division)

Issues raised in this correspondence are summarized on Table 9-2, which identifies the section of the Project EIR in which the issue is addressed.

Table 9-2. Issues raised in written comments received during public scoping period

COMMENTOR	ISSUE	SECTION OF EIR THAT ADDRESSES ISSUE
Hisam Baqai, Supervising Engineer Lahontan Regional Water Quality Control Board	EIR should cite and discuss applicable portions of the Water Quality Control Plan for the Lahontan Region (Basin Plan)	Chapter 5.13 and Table 5-39 and 5-40
	EIR should evaluate potential impacts of the project on the attainment or maintenance of the water quality objectives contained in the Basin Plan.	Table 5-39
	Any proposed action that will disturb one acre or more of land will require the project proponent to file for coverage under the State's General Stormwater Permit program for Construction Activities.	Chapter 4.8
	The EIR should identify impacts to water quality and specify mitigation measures to prevent or minimize to a level of insignificance those impacts from the seven alternatives being considered. Impacts from the following activities should be discussed: a. Salinity increases in groundwater and/or surface water associated with replenishment with imported surface water. b. Raising of groundwater levels and resulting potential for mobilization and dissolution of natural or anthropogenic constituents in the vadose zone as the water table rises. c. Recharge activities that may provide a direct conduit for surface waters to directly enter groundwater via improperly abandoned wells.	 Chapter 5.13 tables 5-41 through 5-42 Chapter 5.13 Chapter 5.13
	The EIR should provide background information on hydrogeology and groundwater quality: a. Depth to groundwater b. Existing groundwater quality	Chapter 5.13

	c. Groundwater direction d. Location of existing wells e. Geologic lithology f. Soil and aquifer conductivity	
	The EIR needs to identify any impacts from pipeline construction in or around wetlands or vernal pools.	No vernal pools or wetlands will be affected. Chapter 5.4
Carol Gaubatz, Program Analyst, Native American Heritage Commission (NAHC)	The Following actions should be taken and the EIR should provide evidence of this: a. The appropriate California Historic Resources Information Center has been contacted and a record search conducted. b. Archeological Survey Report shall be submitted to the NAHC and the appropriate regional archeological Information Center c. The NAHC has been contacted for a sacred lands file search. d. Lead agencies shall include in their mitigation plan provisions for the identification and evaluation of accidentally discovered archeological resources. e. Lead agencies should include provisions for discovery of Native American human remains or cemeteries in their mitigation plans.	Chapter 5.5.2 Chapter 5.5.2 Chapter 5.5.2 Chapter 5.5.4 Chapter 5.5.4
Naresh P. Varma, Chief Environmental Management Division, County of San Bernardino Department of Public Works	Construction BMP's should be adequate to prevent excess sediment release and release of construction-related pollutants, and there should be adequate provisions to ensure implementation of BMP's	Chapter 4
	Water transfers using the Mojave River or other natural or unimproved drainage course should evaluate the potential erosion and sediment transport impacts that are likely to occur.	Chapter 5.6
	Water transfers should also consider habitat alteration or degradation.	Chapter 5.4
	New facilities must have well-considered maintenance programs and a secure maintenance funding mechanism.	Chapter 4
	Potential water quality impacts must be fully evaluated, including potential contamination of stormwater from urban activities or land uses.	Chapter 5.13
	Leaching of compounds from existing sediment may pose a groundwater threat.	Chapter 5.13

9.3 Review of the Draft EIR

On October 28, 2005, Mojave Water Agency (MWA) filed a Notice of Availability of its Draft Environmental Impact Report for the Mojave Water Agency Water Supply Reliability And Groundwater Replenishment Program (State Clearinghouse Number 20050411103), initiating a 47-day public and agency review period which ended at 5:00 PM on December 13, 2005. The Notice of Availability and Draft EIR were mailed (in Compact Disk format) to 101 agencies, private entities, and individuals who had previously indicated an interest in receiving the NOA and/or Draft EIR. The NOA was also published in the major regional newspapers. On

November 8th, 2005 at 6:00 PM MWA held a public meeting in the main conference room at MWA Headquarters, 22450 Headquarters Drive, Apple Valley, California 92307. On November 9th, 2005 at 10:00 AM, MWA also presented the Draft EIR and took agency and other public comment at a regular meeting of its Technical Advisory Committee at the same address.

In addition, prior to issuing the NOA and Draft EIR, MWA coordinated with the California Department of Water Resources, State Water Project Analysis Office, and received informal comments and suggestions regarding the Draft EIR. MWA also informally coordinated with the Metropolitan Water District of Southern California. Written or verbal comments to the draft EIR were received from the following:

INDIVIDUALS

- Mr. Chuck Bell, oral comments at the November 9, 2005 MWA Technical Advisory Committee meeting and written comments received during the 47-day comment period;
- Mr. Jeff Bentow, Yermo Water Company, oral comments at the November 8, 2005 public meeting and the November 9, 2005 MWA Technical Advisory Committee;
- Mr. Lou Kershberg, oral comments at the November 8, 2005 public meeting;
- Mr. Guy Patterson, oral and written comments at the November 9, 2005 MWA Technical Advisory Committee
- Mr. and Mrs. Gary E. Thrasher, written comments received during the 47-day comment period;
- Mr. Mathew Woods, oral comments at the November 8, 2005 public meeting and written comments at the November 9, 2005 MWA Technical Advisory Committee
- Mr. Joseph W. Monroe, written comment received November 17, 2005.

AGENCIES

- California Department of Fish and Game, Habitat Conservation Program, Region 6, Ms. Denyse Racine, Supervisor;
- California Regional Water Quality Control Board, Lahontan Region, South Basin Regulatory Unit, Mr. Greg Cash, Engineering Geologist
- California Department of Water Resources, State Water Project Analysis Office, Ms. Elizabeth Patterson, by email 24 October 2005.
- County of San Bernardino, Department of Public Works, Environmental Management Division, Mr. Naresh P. Varma, Chief

A full copy of each comment and MWA responses to each comment is in Appendix A. Where responses were determined to require a clarifying modification to the FEIR, these responses are found in the FEIR as noted in the list of changes to the EIR that follows the Table of Contents. The full comments and responses are incorporated by reference into the Final EIR.

In responding to the comments received, MWA notes that there were several requests for design-level information regarding aspects of the proposed project that cannot be provided until design-level studies are undertaken. MWA anticipates that design-level studies will confirm the analyses of the DEIR, but notes that if design level-studies result in substantial changes to the proposed project or identify substantial and potentially significant impacts not addressed, MWA would address these in appropriate supplemental CEQA processes.

Finally, MWA notes that, in addition to clarifications, the responses to comments included MWA commitments to several additional mitigation measures recommended. In summary, these included:

- Expansion of potential mitigation options for burrowing owl.
- Based on preliminary geotechnical analyses, MWA selected a number of potential recharge basin sites, focusing on areas with characteristics likely to avoid areas with high arsenic concentrations in subsurface soils. MWA will confirm these analyses during pre-design and construction geotechnical analyses, when corings at potential well sites will be made and cores examined to ensure that subsurface soil conditions do not result in recharge to areas with high potential arsenic concentrations. If corings identify high arsenic concentrations in soils, then MWA may evaluate and select recharge sites in adjacent areas.
- There are existing assessment and monitoring protocols for wells that may come under the influence of surface waters, described in detail in the Department of Health Services (DHS) "*Drinking Water Source Assessment for Surface Water Sources*" August 18, 2000. As described in this DHS publication, there are a number of different protocols for assessing whether a well is under surface water influence. DHS may request various assessment techniques, depending on their judgment of the potential for a well to be under surface water influence. These protocols, or any updated DHS protocols, will be implemented, as appropriate, in consultation with local producers, the County of San Bernardino, and DHS.
- MWA will conduct pre-construction surveys for burrowing owls to determine if there are occupied habitats for the species. If burrowing owls are found in the potential area of effect, MWA would consult with Ms. Rebecca Jones, CDFG Environmental Scientist (as directed by Comment). In consultation with Ms. Jones, MWA may then choose to take action to avoid impacts to burrowing owls (such as constructing outside of the nesting season and/or establishing a buffer zone between construction activity and any active nest). Recharge basins have not proved incompatible with burrowing owls (there is occupied burrowing owl habitat adjacent to recharge areas at Kern Water Bank, for example). If, in consultation with Ms. Jones, MWA finds that the impacts of its facilities would be inconsistent with the protections provided under Fish and Game Code Section 3503.5, MWA would consider feasible avoidance, minimization, and mitigation, including the protocol described by the CDFG letter, and would implement the appropriate actions.
- Although Mojave fringe-toed lizard is not anticipated to be found in the proposed project area, if special status species surveys find this species at a proposed facility site, then MWA will notify CDFG and initiate consultation regarding appropriate mitigation.
- Monitoring [of groundwater] will be required to meet Department of Health Services and California Department of Water Resources criteria, and specific monitoring plans will be developed based on results of site-specific preconstruction geotechnical studies for the siting of production and monitoring wells.
- MWA will work with local communities during design, construction, and implementation of the proposed project facilities.
- MWA will coordinate with County of San Bernardino Flood Control District during design and construction of facilities in washes and the Mainstem Mojave River and will obtain appropriate Clean Water Act, Fish and Game Code, and County permits for work in

washes and the Mainstem Mojave River. MWA will inform County Flood Control of any substantive changes in the proposed project.

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 10: LIST OF ACRONYMS AND SPECIAL TERMS

af	Acre-feet, equivalent to 43,560 cubic feet (1 acre, one foot deep)
BLM	U.S. Department of Interior, Bureau of Land Management
BMP's	Best Management Practices
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	Cubic Feet Per Second
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CRRWQCB	Colorado River Regional Water Quality Control Board
CWA	Clean Water Act
dB	Decibel
dBA	A weighted unit of decibels used to simulate the response of the human ear to various frequencies of sound
DHS	California Department of Health Services
DOC	Dissolved Organic Carbon
DWR	California Department of Water Resources
EIR	Environmental Impact Report

EPA	U.S. Environmental Protection Agency
gpd	Gallons per day
IRP	Metropolitan Water District of Southern California's Integrated Resources Plan, an evolving plan that Metropolitan updates periodically to guide its water supply and water management activities
IRP Model	A model of the Metropolitan water service system and operations. The IRP Model is an analytical tool Metropolitan uses to estimate water supply and operations, based on review of data from a 77-year period of record in southern California and in the watershed of the State Water Project
I-15	Interstate Highway 15
LRWQCB	Lahontan Regional Water Quality Control Board
LTS	Less than significant
Metropolitan	The Metropolitan Water District of Southern California
MDAQMD	Mojave Desert Air Quality Management District
mg/l	Milligrams per liter (parts per million)
µg/l	Micrograms per liter (parts per billion)
MWA	Mojave Water Agency
NEPA	National Environmental Policy Act
NOP	Notice of Preparation
PEIR	Program Environmental Impact Report
RWMP	Regional Water Management Plan
ROG	Reactive Organic Gases
SHPO	State Historic Preservation Office

SO_2	Sulfur dioxide
SWP	State Water Project
TAC	Technical Advisory Committee
TDS	Total Dissolved Solids, a measure of the mineral content of water
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
VOC	Volatile organic compound (such as methane)
WATER YEAR	October 1 to September 30 in any given year. Sacramento Valley Basin water years are characterized by the California Department of Water Resources in terms of projected April through July runoff as follows:

Wet:	Equal to or greater than 9.2 million acre-feet (maf)
Above Normal:	Greater than 7.8 maf and less than 9.2 maf
Below Normal:	Greater than 6.5 maf and less than 7.8 maf
Dry:	Greater than 5.4 maf and less than 6.5 maf
Critical:	Equal to or less than 5.4 maf

Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 11: LIST OF PREPARERS

Mojave Water Agency

22450 Headquarters Drive
Apple Valley, CA 92307

This document was prepared under the direction of:

Mr. Norman Caouette, Assistant General Manager

Additional technical review was provided by:

Mr. Lance Eckhart, Senior Hydrogeologist
Mr. Michael Limbaugh, Engineering Controller
Mr. Brian Hammer, Data Analyst II

Jud Monroe, Ph.D., Environmental Planning and Documentation

10 Stone Court
San Anselmo, CA 94960

Applied Earth Works, Inc.

3292 East Florida Avenue, Suite A
Hemet, CA 92544
Melinda Horne, Project Manager for Cultural Resources

Cadre Environmental, Inc.

701 Palomar Airport Boulevard, Suite 300
Carlsbad, CA 92011
Ruben Ramirez, Manager for Biological Resources

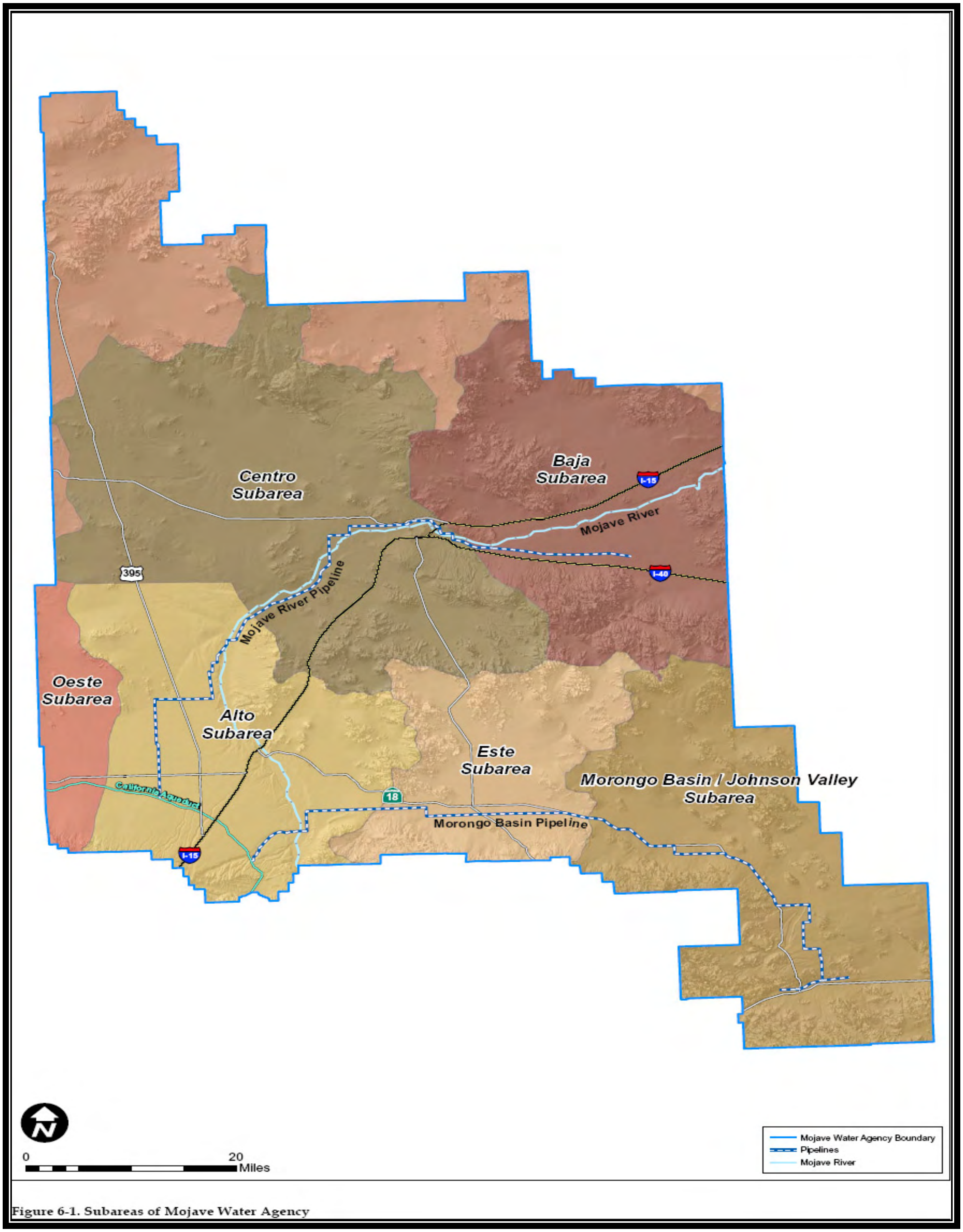


Figure 1-2. Groundwater basins in the Mojave Water Agency service area (from MWA Regional Water Management Plan)

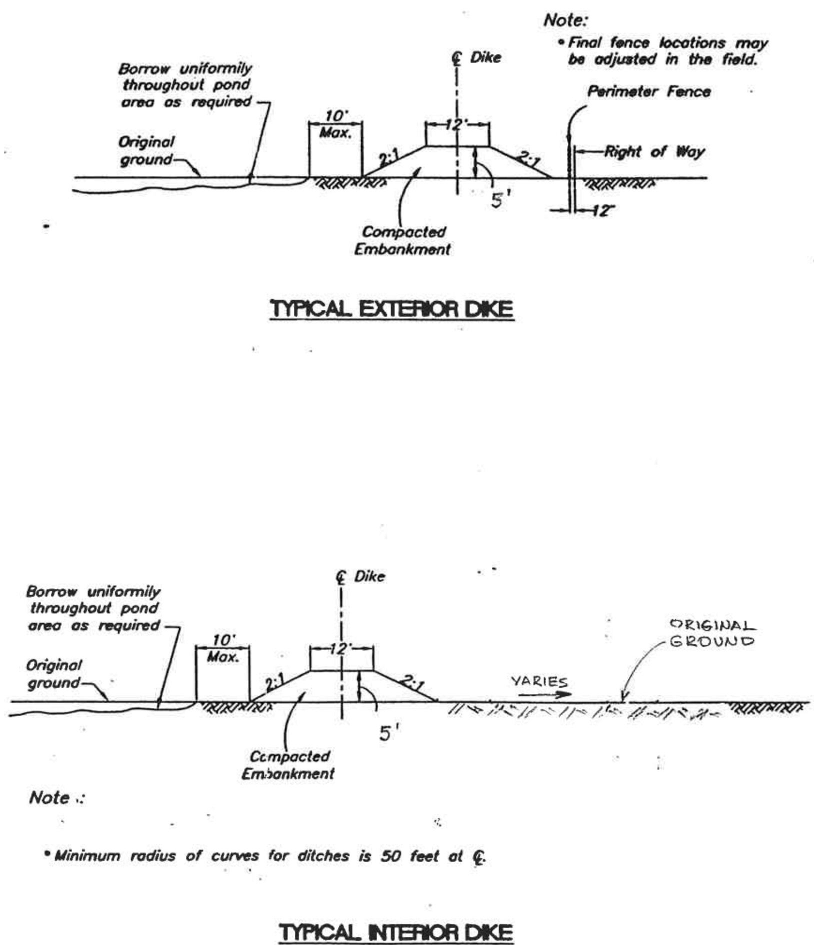


Figure 4-2. Schematic of typical levee for all recharge basins.

Figure 4-3. View of the Mainstem Mojave River during recharge operations for the 2003-2005 pilot project (typical view during Proposed Project operations).

Figure 4-4. Off-Channel Mojave River Recharge, East Site,
looking towards the river from the hills to the east of the recharge site.

Figure 4-5. Off-Channel Mojave River Recharge, West Site.

Figure 4-6. Oro Grande Wash Recharge site.

Figure 4-7. Cedar Avenue Detention Basin Recharge site

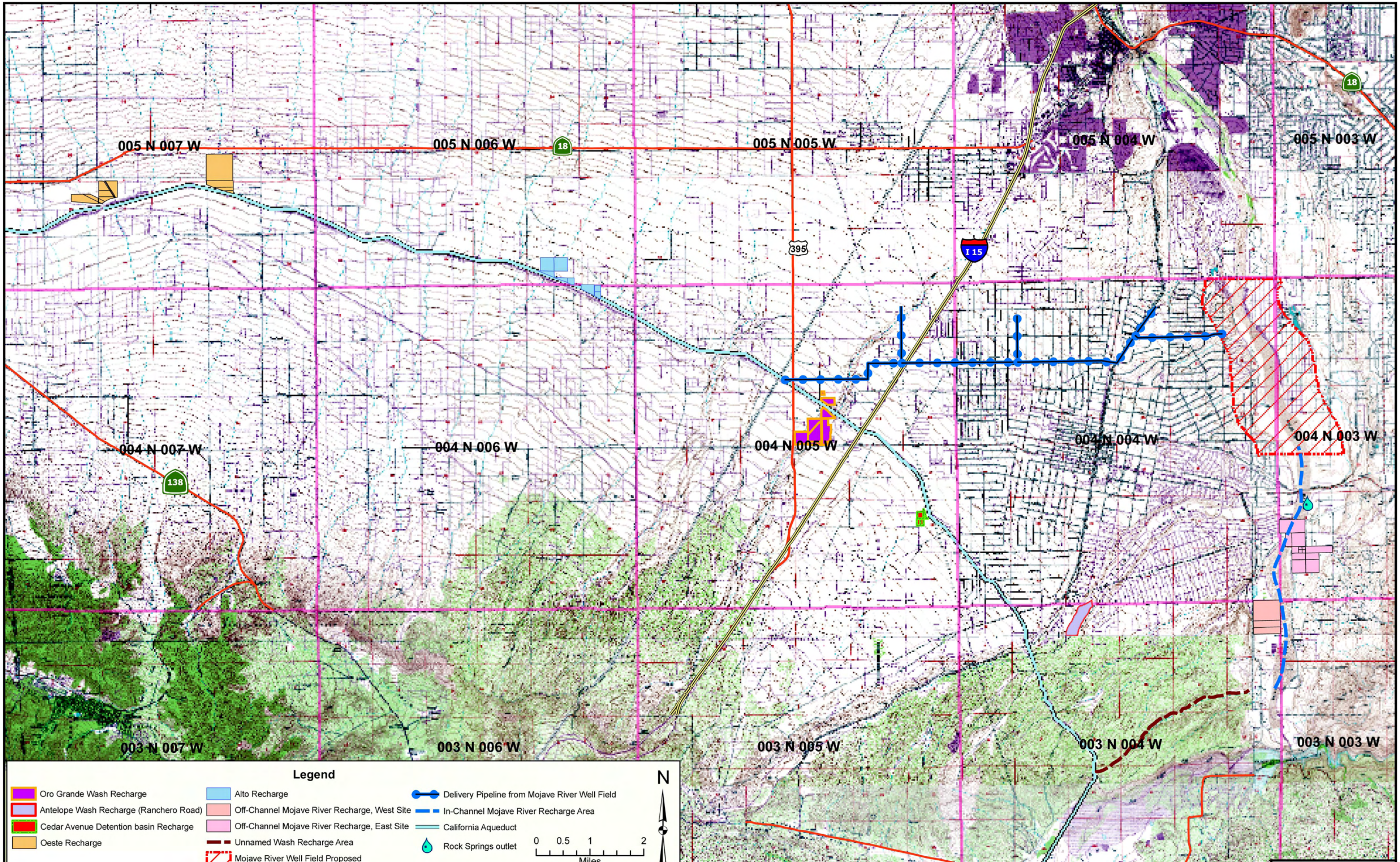
Figure 4-8. Alto Recharge Site.

Figure 4-9. Oeste Recharge Site 1.

Figure 4-10. Oeste Recharge Site 2.

Figure 4-11. Upstream Antelope Wash recharge Site, from the adjacent hills.

Figure 4-12. New Combined Antelope Wash Recharge Site
(Expansion of Ranchero Road Recharge Site)



005 N 007 W
005 N 006 W
005 N 005 W
005 N 004 W
005 N 003 W
004 N 007 W
004 N 006 W
004 N 005 W
004 N 004 W
004 N 003 W
003 N 007 W
003 N 006 W
003 N 005 W
003 N 004 W
003 N 003 W
18
395
I 15
138
Legend
Oro Grande Wash Recharge
Antelope Wash Recharge (Ranchero Road)
Cedar Avenue Detention basin Recharge
Oeste Recharge
Alto Recharge
Off-Channel Mojave River Recharge, West Site
Off-Channel Mojave River Recharge, East Site
Unnamed Wash Recharge Area
Mojave River Well Field Proposed
Delivery Pipeline from Mojave River Well Field
In-Channel Mojave River Recharge Area
California Aqueduct
Rock Springs outlet
0 0.5 1 2
Miles
N

Figure 4-1