APPENDIX D.
Programs, Projects and Activities as Part of California's Colorado River Water Use Plan

1. Quantification of Priority 3. The California Seven-Party Agreement, dated August 18, 1931 (Seven-Party Agreement), established the priority system for delivery of Colorado River water to the principal California water districts. The Seven-Party Agreement establishes seven levels of water priority among the parties to that agreement. Implementation of the Proposed SIA Action will primarily affect Priority 3 water. The six priority levels set forth in the Seven-Party Agreement are shown in Table D-1.

Table D-1. Water Priorities in the California Seven-Party Agreement of 1931

Priority Number	Agency and Description	Annual Quantity in af
1	Palo Verde Irrigation District – gross area of 104,500 acres	
2	Yuma Project (Reservation Division) –not exceeding a gross area of 25,000 acres	
3(a)	Imperial Irrigation District (IID) and lands in Imperial and Coachella Valleys to be served by All-American Canal	
3(b)	Palo Verde Irrigation District – 16,000 acres of mesa lands	Combined total
4	Metropolitan Water District, City of Los Angeles and/or others on coastal plain	3,850,000
5(a)	Metropolitan Water District, City of Los Angeles and/or others on coastal plain	550,000
5(b)	City and/or County of San Diego	550,000
6(a)	Imperial Irrigation District and lands in Imperial and Coachella Valleys to be served by All-American Canal	112,000
6(b)	Palo Verde Irrigation District – 16,000 acres of mesa lands	300,000

The Quantification Settlement Agreement places a limit in non-surplus or limited surplus years on deliveries of Colorado River water to IID and CVWD and obligates IID to undertake major conservation activities over many years. IID and CVWD will agree to place temporary delivery limits on their previously unquantified entitlements to Colorado River water during the 75 years of the Quantification Period. During the Quantification Period, the Secretary will deliver annually, after adjustments for return flows, up to 3.1 maf to IID and up to 330 thousand acre-feet (kaf) to CVWD. The Colorado River water made available by quantifying IID's and CVWD's Priority Three rights will be transferred to MWD pursuant to The Plan. In addition, the Colorado River water to be saved by the water conservation activities that IID will implement pursuant to the Plan will transfer to MWD through The Plan.

Note: The 3.1 maf available to IID pursuant to the Quantification Settlement Agreement is reduced by the 110 kaf of water from a water conservation program that was in place prior to the Quantification Settlement Agreement. IID and MWD entered into an Agreement for Implementation of Water Conservation Program and Use of Conserved Water, dated December 22, 1988 (1988 Agreement). This program resulted in the transfer of 110 kaf to MWD, IID, MWD, CVWD; and PVID entered into an Approval Agreement, dated December 19, 1989 (1989 Agreement), that transferred to CVWD 20 kaf of the water that is conserved under the 1988 Agreement. Although these transfers are already in effect, they are noted here because they are components of The Plan and must be subtracted from IID's 3.1 maf Priority 3 right.

Except as agreed in the Quantification Settlement Agreement and put into effect through legal documents entered into by the affected parties, all terms and conditions of existing water delivery contracts will remain in full force and effect through the Quantification Period. When the Quantification Period ends, the Secretary will resume delivering Colorado River water in accordance with the water delivery contracts that were in effect immediately preceding the start of the Quantification Period.

2. IID/SDCWA Water Conservation and Transfer Project. IID and SDCWA entered into an Agreement for Transfer of Conserved Water, dated April 29, 1998, that provides for IID to undertake water conservation activities in IID for the benefit of SDCWA. The conserved water will be transferred to SDCWA over several years. The initial transfer is projected to occur in 2004. The quantity of conserved water transferred will increase by 20 kaf each succeeding calendar year until the maximum amount of the transfer has been established, which will be no less than 130 kaf and as much as 200 kaf of conserved water.

There is an exchange agreement between San Diego and MWD that provides for the transfer of IID water to MWD at Lake Havasu, but since this is not a Federal action the exchange agreement is not part of this assessment.

3. IID/CVWD/MWD Conservation Program. The water conservation actions to be undertaken by IID to implement the IID/SDCWA transfer are expected to conserve up to 300 kaf. In addition to the 200 kaf to be transferred to SDCWA, 100 kaf of conserved water will be made available to CVWD in two 50 kaf increments under the quantification settlement and ancillary agreement. If CVWD elects not to accept this conserved water, it will transfer to MWD.

4. All-American Canal Lining Project. The lining of the All-American Canal was authorized by Title II of an Act of Congress dated January 25, 1988. This Act authorized the Secretary to construct a new lined canal or to line the previously unlined portions of the All-American Canal to reduce seepage of water. Title II authorizes the Secretary to determine the amount of water conserved by this canal lining. The Act further directs that the water so conserved is to be made available for consumptive use by California contractors within their service areas according to their priority under the Seven-Party Agreement. Reclamation prepared a Final Environmental Impact Statement/Final Environmental Impact Report for the All-American Canal Lining Project in March 1994. This EIS states that the preferred alternative for controlling seepage from the All-American Canal would reduce seepage by approximately 67.7 kaf per year.

Title I of this same Act of January 25, 1988, is known as the San Luis Rey Indian Water Rights Settlement Act. Title I authorizes a source of water to settle the reserved water rights claims of the La Jolla, Rincon, San Pasqual, Pauma, and Pala Bands of Mission Indians in San Diego County, California. The Act authorized the Secretary to arrange for development of a water supply for the benefit of the bands of not more than 16 kaf per year and authorized the Secretary to use water conserved from the works authorized by Title II of the Act of January 25, 1988 for this purpose.

The Quantification Settlement Agreement among the State of California, IID, CVWD, and MWD divided the 67.7 kaf of annual conserved water as follows: 56.2 kaf to MWD and 11.5 kaf for San Luis Rey Indian Water Rights Settlement Act purposes. This undertaking, which involves Federal canal rights-of-way and the San Luis Rey water settlement, is part of the proposed SIA (Table 1). The State of

California enacted legislation to fund the lining of the All-American Canal to help facilitate implementation of The Plan.

5. Coachella Canal Lining Project. The lining of the previously unlined portions of the Coachella Branch of the All-American Canal (Coachella Canal) was also authorized by Title II the Act of January 25, 1988. This Act authorized the Secretary to construct a new lined canal or to line the previously unlined portions of the Coachella Canal to reduce seepage of water. As with the All-American Canal, Title II authorizes the Secretary to determine the amount of conserved water and directs that the water so conserved is to be made available for consumptive use by California contractors within their service areas according to their priority under the Seven-Party Agreement. Reclamation prepared a Draft Environmental Impact Statement/Final Environmental Impact Report for the Coachella Canal Lining Project in December 1993. The preferred alternative for controlling seepage from the Coachella Canal would result in projected water savings of approximately 26 kaf per year.

As with the All-American Canal, Title I of the Act of January 25, 1988 authorizes use of some of the conserved water to settle the reserved water rights claims of the La Jolla, Rincon, San Pasqual, Pauma, and Pala Bands of Mission Indians in San Diego County, California.

The Quantification Settlement Agreement among the State of California, IID, CVWD, and MWD divided the 26 kaf of annual conserved water as follows: 21.5 kaf to MWD and 4.5 kaf for San Luis Rey Indian Water Rights Settlement Act purposes. This undertaking is part of the All-American Canal lining project authorized by Title II of the Act of January 25, 1988, involves Federal canal rights-of-way and the San Luis Rey water settlement, and is part of the proposed SIA (Table 3). The legislation enacted by the State of California to fund the lining of the All-American Canal includes funding to line the Coachella Canal.

6. MWD/CVWD Exchange. The Plan calls for an exchange by MWD of 35 kaf of (California) State Water Project water for 35 kaf of Colorado River water from CVWD. This action does not have a Federal nexus as to approval but is part of the programs, projects, and activities that make up The Plan.

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APPENDIX E.

Description of Preliminary Hydrologic Depletion Analysis of Backwater, Aquatic, and Riparian Changes Resulting from a 1.574 Million Acre Foot (MAF) Change in Point of Diversion Between Parker and Imperial Dams on the Lower Colorado River California and Arizona, August 2000

Backwater and Aquatic Analysis

Introduction

The potential exists that, over the next 50 years, an additional 1.574 maf of water, may be diverted at Parker Dam. This will result in a reduction of flows in the river between Parker and Imperial Dams. Flows below Imperial Dam are not expected to change. This analysis is to determine the changes in the backwater and aquatic habitat resulting from this diversion.

Purpose

The purpose of this analysis is to provide an estimate of the effects of diverting up to 1.574 million acre-feet (maf) annually at Parker Dam over the next 50 years. Incremental flow data was utilized to facilitate a pro rata analysis of the effect(s) of the diversion.

Data from this analysis were used to determine the following:

1. An estimate of the range of water surface elevation and open water surface area changes (i.e. changes in width and depth) in the river resulting from the subject diversions. Estimates included adjustment for representative seasonal and daily flows.

2. Identified affected river channel sections adjacent to concentrations of backwaters, marshes, or riparian habitat.

3. Projected changes in ground water elevations in areas adjacent to the river for the purpose of estimating the effect(s) on the riparian and marsh communities.

4. Characteristics of river channels in affected reaches with respect to degree of channelization, stabilization, and natural or non-channelized river channel conditions.

5. Characteristics of backwaters adjacent or connected to affected reaches of the river with respect to morphology, gross plan outline, and bank slope characteristics.

6. Projected changes in backwater surface area and depths at representative seasonal and daily flows.

Data Sources

Data sources utilized for the analysis included, but were not limited to:

1. Hydrologic model runs and river channel cross-sections for 20 representative type-areas distributed throughout the affected river reaches (Parker, Palo Verde, Cibola, and Imperial Divisions).

Input to the hydrologic model runs includes calendar month and average daily releases from Parker Dam. The output from the hydrologic model runs includes an hourly release pattern for Parker Dam, which is routed downstream through the Water Wheel, Taylor Ferry, and Cibola gages to Imperial Dam (Carson, July 7, 2000). A subsequent hydrologic model run was also performed to determine the annual median flows for the river in the affected reaches. The purpose of this run was to facilitate calculation of the median water surface elevations and their effect on ground water levels in areas adjacent to, but not directly connected to the river. Input for this run includes average monthly releases from Parker Dam, output includes values for annual median flows in the affected reaches.

Flows routed to each side of the river are adjusted for diversions, gains, and losses, depending on the month. The routing method used is called the 'Muskingum method', which is further calibrated for historical flows at the gages specified above. Past experience using this method for calculations has indicated good correlation and reliability of values over a wide range of flows. Elevation flow ratings at the representative channel sections were also used to compute the water surface elevations (Carson, 2000).

River channel cross-sections are a composite of surveyed channel sections (bankline to bankline) and river floodway maps (profile extending out from the bankline) (Langmaid, July 10, 2000). Criteria for selection of representative river channel cross-sections for the type-areas included: correlative similarities in channel morphology and geometry, location with respect to river flow direction (upstream) and proximity to concentrations of representative backwater acreage, availability of quantitative data (i.e. depth, channel profile, etc.) at or adjacent to the foci of representative backwaters, and other relevant information.

2. Detailed surveys of 27 representative backwaters located adjacent to or connected with the affected reaches of the river. Surveys were conducted using global positioning system (GPS) technology and traditional surveying methods. Backwater survey lines generally included several cross-sections, including profiles along the longitudinal and lateral axes.

3. Other data and related reports and reference texts including current facilities maps, recent consultant river and backwaters mapping update and vegetation mapping / GIS development reports.

Data Analysis

The analysis was accomplished by the application of a variety of methods, techniques, principles, and/or rationales. The process for determining the following results included, but was not limited to:

1. *Estimates of the range of water surface elevation and open water surface area changes* - these estimates were the results of analysis of data from a combination of incremental hydrologic modeling runs and selected representative river channel cross-sections, in combination with geographic information systems (GIS) modeling and analysis.

The projected maximum (base case), average and minimum flows and water surface elevations derived from the hydrologic modeling runs were superimposed onto the river channel cross-sections for a comparison of the qualitative and quantitative changes in river channel geometry, morphology and effect(s) on associated habitat(s).

2. *Affected river channel sections adjacent to concentrations of backwaters, marshes, or riparian habitat* - these channel sections were identified according to the criteria listed (Data Sources section; item 1). Tabulated data from the recent consultant river and backwaters mapping update (GEO/Graphics, Inc.; June, 2000) were summarized and used to identify these channel sections as foci for 'clusters' or concentrations of backwaters in the affected reaches. This data was also used to quantify and/or determine relevant backwater characteristics (i.e. total acreage, emergent vegetation, open water, type of connection with the main channel, backwater status, etc.) for the analysis. The updated backwaters maps were also used to verify the existence and characteristics of the backwaters listed. The number of backwaters associated with each of the river channel sections varies, ranging from 2 - 42 backwaters/section and averaging about 14 backwaters/section.

3. *Projected changes in ground water elevations adjacent to the river to determine the effect(s) on riparian/marsh habitat* - the changes in ground water elevations adjacent to the river were determined based on the annual median flows for the affected river reaches, as determined by the hydrologic model runs for annual median flows released from Parker Dam (Data Sources section; item 1).

4. *Characteristics of river channel related to the degree of channelization, stabilization, and natural or unchannelized conditions in affected reaches* - the river channel characteristics in the affected reaches were determined by inspection and comparison of the current facilities maps (USBR, 1994-1997) and consultant river and backwaters mapping update (GEO/Graphics, Inc., 2000). This included an estimate of the current degree of channelization and/or stabilization and the presence of 'natural' or unchannelized conditions in the affected reaches.

5. *Characteristics of representative backwaters connected to or adjacent to affected reaches of the river* - the relevant characteristics of the representative backwaters were determined by extracting, filtering, and summarizing data (i.e. longitudinal and lateral profiles, slopes, depths, gross plan outlines, acreage, etc.) for analysis, reducing the data by further analysis and inspecting the results for trends, natural groups, anomalies, or other data characteristics.

Three natural groups of backwaters were identified based on shape or gross plan outline: linear, ellipsoid, and combination (features from both groups). Analysis of bank slope (angle) data revealed a trend toward convergence of average bank slope angle values in the range of 30^0 - 39^0 from horizontal. These values closely approximate those observed and documented in the literature as the angle of repose for natural, unconsolidated slopes (Longwell and others, 1969; Bates and Jackson, 1980). The lower value (30^0) was used for determining the reduction in surface area for both the backwaters and the open river.

6. *Projected changes in backwater surface area and depths at representative seasonal and daily flows* - the reduction in backwater surface area and depth values was determined using the data obtained above (item 5 of this section and Data Sources section; item 1) in combination with geographic information systems (GIS) modeling and analysis.

7. *GIS Modeling and Analysis*

General Strategy

The primary source of information for this analysis was the study entitled "Lower Colorado Backwaters Mapping, Davis Dam to Laguna Dam, June 2000." The study was performed under contract by GEO/Graphics Inc. (2000). ArcInfo, based on Fall 1997 color aerial photography, was used to depict the backwaters of the Colorado River and their characteristics.

The purpose of the analysis was to determine the reduction in surface area of backwaters and open river resulting from a 1.574 maf flow reduction in the Colorado River below Parker Dam. The overall strategy was to 1) determine the average slope of the banks of the backwaters and river and then 2) use this slope, along with the drop in water surface elevation resulting from a 1.574 maf flow reduction, in a GIS analysis to calculate the reduced surface area of the backwaters/river. In this way, a before and after acreage summary of the conditions during normal flow and reduced flow was developed, along with a graphical depiction of those conditions.

Slope of the backwaters was determined from AutoCAD drawings of 27 representative backwaters, dated April 21, 2000. The average slope for linear-shaped backwaters is 39 degrees, and for ellipsoid-shaped backwaters is 30 degrees. Thirty degrees falls within the well-documented angle of repose for natural slopes, which rarely is less than 30 degrees or more than 39 degrees.

Tables were developed listing drawdowns in water surface elevation resulting from various flow reductions for 20 different stretches of the Colorado River below Parker Dam. Data was developed for flow reductions in three different months (April, August, and December), as well as for the annual median flow.

In total, GIS analyses were performed for 6 different scenarios: Reduction in the surface area of backwaters for the months of April, August, and December, and reductions in the surface area of the Colorado River for April, August, and December.

In their backwater study, GEO/Graphics designated backwaters as being either directly connected or indirectly connected to the open water of the Colorado River. Directly-connected backwaters have open water leading directly to the river channel. Indirectly-connected backwaters are separated from the river by an upland area, and are most likely supported through sub-surface flow from the river.

The surface elevation of the directly-connected backwaters immediately rises or falls with the river. Therefore, monthly drawdown figures for the directly-connected backwaters were used in the GIS analysis. These same monthly figures were used in the analyses of reduction in surface area for the Colorado River.

Because the indirectly-connected backwaters do not rise or fall immediately with the river, the annual median drawdown figures were used in the subsequent GIS analyses for those backwaters.

Riparian Analysis

Summary

The goal of the California Colorado River Water Use Plan (The Plan) is to put into place, during the 15 year Interim Surplus Criteria, the necessary cooperative water conservation/transfers, storage and conjunctive use and other programs that allow California to meet its Colorado River water needs within its basic apportionment. The average of the annual median flows below Parker Dam for the period 1974-1998 was 7,547,000 acre-feet. Due to the Secretarial Implementation Agreements, the annual median Lower Colorado River flow between Parker and Imperial Dams will decline over a period of 50 years by 1.574 maf. The corresponding river surface elevation drop will be between 0.08 and 1.55 feet depending on location. This, in turn, will result in a drop in groundwater elevation adjacent to the river.

Losing Reaches

The river loses water through reaches with riparian vegetation and no surface diverted river water for irrigation. In these reaches, the riparian vegetation draws on the water table which in turn induces a water table gradient away from the river. The river is essentially the only source of water for the flood plain riparian vegetation because tributary groundwater inflow is extremely small. The water table elevation decline at any location in riparian vegetation dominated reaches will be the same as a decline in river surface elevation. The small average annual tributary groundwater inflow, where applicable, and water consumption by riparian vegetation are assumed to remain constant.

Gaining Reaches

The river gains water through reaches where river water is used for irrigation on the flood plain and or within the river valley. The difference between surface diverted irrigation water and subsurface return to the river is the water consumptively used by irrigated crops. Irrigation raises the water table and the groundwater moves toward the river or any other drain.

The near-river water table decline in a river reach bounded by irrigated agriculture can be influenced by a change in cropping pattern. In these reaches the river is not the only changeable contributor to water table elevation changes. Wells near the river, pumping a thousand or more gallons per minute, can cause a depression in the near river groundwater levels.

Measured "Near-River" Groundwater Levels

Water levels in the river and in "near-river" observation wells were automatically measured every three hours during the mid-1970's in the Yuma area. Loeltz and Leake (1983) reported average annual water elevations for 1974-78 for the river and the near river observation wells in U. S. Geological Survey Water-Resources Investigations Report 83-4220. The observation wells were located 100 and 400 feet from the edge of the river on each side and were aligned in sections normal to the river. The observation well sections were about one mile apart in the Yuma area and most were washed out by the 1983 high flow.

Five of the river observation well sections clearly show the influence of river elevation on near river groundwater elevation. In many cases, however, the river is not the controlling influence. The Yuma area near river groundwater level changes in response to river level change is believed to be representative of the groundwater response in the valleys below Parker Dam because the geohydrology is the same. See U.S. Geological Survey Professional Papers 486-G (Geohydrology of the Parker-Blythe-Cibola Area...) and 486-H (Geohydrology of the Yuma Area...) for a detailed description of the river aquifer from Parker to Yuma.

Typical Groundwater Response

The river induced groundwater elevation changes in the Yuma area in the mid-1970's, as reported by

Loeltz and Leake (1983), suggest that the water table drop under the nearest field irrigated with river water will be about one half the river elevation drop. The water table drop along the river will probably be the same in the Parker, Palo Verde, and Cibola river reaches because the aquifer is essentially the same. The drop in river elevation will cause the water table to drop which in turn will impact riparian vegetation.

Estimated River Elevation Drop
Table A-1 in Appendix A shows river surface elevation from Parker Dam to Imperial Dam at annual median flow, and in reductions in increments of 200,000 af to the total 1.57 maf, and the difference. The annual median flow is based on daily flows for calendar year 1996.

Estimate of Riparian Acreage Influenced by River Flow Reductions
A hand drawn contour map of river induced groundwater drop was made by using the estimated river elevation drop and assuming one half that drop under the nearest irrigated field. In a non-irrigated reach, the groundwater elevation drop is assumed to equal the river drop. The groundwater elevation decline contour map was drawn with a 0.2 foot contour interval.

An estimate of riparian acreage influenced by a reduction in river flow was made by overlaying the groundwater decline contour map on aerial photo based vegetation type maps. Occupied Willow Flycatcher acreage influenced by the groundwater decline was also determined. This data has been stored by Reclamation as a Global Information System database in ArcView format.

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APPENDIX F.
Historical Total Selenium - Lower Colorado River

Selenium, an element left from shale sediment deposits in ancient seabeds along the Colorado River tributaries, serves as an agent to balance biochemical reactions in living organisms. Programs to control selenium have focused on the Colorado River's upper basin because of the large amounts of sediments from the source rock, Mancos shale.

Based on the historical selenium data, current Selenium levels in the waters of the LCR do not appear to be above the Department of Interior (DOI) level of concern which is 5.0 ug/l. Existing studies listed below on selenium have not identified or documented observable harmful effects to native flora or fauna in the LCR. To date, there are no fish Consumption Advisories for Selenium in the lower Colorado River**.

Below is a graph of recent selenium levels in the lower Colorado River from Lees Ferry to Morelos Dam. Predicting selenium levels based on anticipated reduced flows is not possible due to this report's time constraints and to the small amount of existing data from both the Colorado River as well as the agricultural drains entering the River below Parker Dam. Grab samples were taken at the PVID outfall drain during January 1999 and 2000 and contained 5 ug/l and 1.6 ug/l of selenium, respectively.

Selenium levels in isolated backwaters have different levels of selenium than connected backwaters and what are termed "pseudo-seep" backwaters. These differences and why they occur are important to the long-term management of these backwaters. Changes to groundwater or surface water elevations and amounts of flows may have effects to selenium deposition. More information is needed to assess this.

An indirect estimation of selenium levels using salinity as an indicator was attempted but no correlation between salinity levels and selenium concentrations in the River could be made.

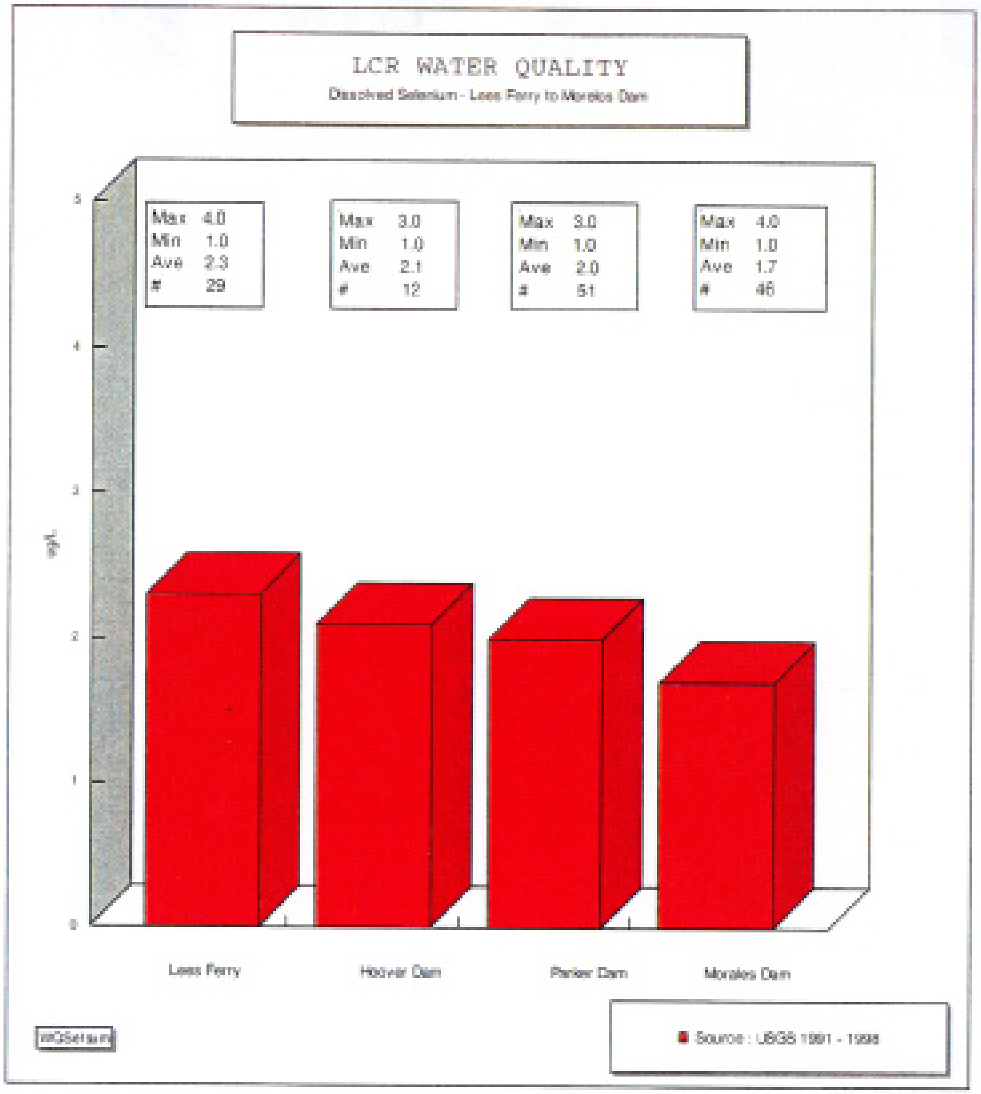
References

A USGS Water Resources Reconnaissance Investigation Report (88- 4002),1986-87, indicated similar findings (3.4 or less ug/l) for dissolved Selenium concentrations at several sites in the lower Colorado River.

DOI's Pre-reconnaissance Investigation Study, pub.cerca1992 reported similar findings (less than 3.4 ug/l) for selenium in water of the Colorado River at Pilot Knob.

USGS , IBWC Study, 1995. In the vicinity of Yuma , AZ . 18 Selenium water samples averaged 1.72* ug/l , with maximum of 8.0 and minimum value of <1.0 .

* 9 of the 18 values were reported as <1.0 .
** Kirt Ketinger, Pers. comm., AZ Game & Fish Dept.


LCR WATER QUALITY
Dissolved Selenium - Lees Ferry to Morales Dam
Max 4.0 Min 1.0 Ave 2.3 # 29
Max 3.0 Min 1.0 Ave 2.1 # 12
Max 3.0 Min 1.0 Ave 2.0 # 51
Max 4.0 Min 1.0 Ave 1.7 # 46
5
4
3
2
1
0
Lees Ferry
Hoover Dam
Parker Dam
Morales Dam
Source : USGS 1991 - 1998