RECLAMATION

Managing Water in the West

Draft Environmental Assessment

Yuma Desalting Plant Pilot Run

U.S. Department of the Interior
Bureau of Reclamation
Yuma Area Office
Yuma, Arizona

May 2009

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Draft Environmental Assessment

Yuma Desalting Plant Pilot Run

Prepared by

U.S. Department of the Interior
Bureau of Reclamation
Yuma Area Office
Environmental Compliance Group
Yuma, Arizona

U.S. Department of the Interior
Bureau of Reclamation
Yuma Area Office
Yuma, Arizona

May 2009

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Acronyms and Abbreviations

1944 Water Treaty	Treaty with Mexico Relating to the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande
ADEQ	Arizona Department of Environmental Quality
AF	acre feet
AGFD	Arizona Game and Fish Department
APP	Aquifer Protection Permit
AZPDES	Arizona Pollutant Discharge Elimination System
BLM	U.S. Bureau of Land Management
BMP	best management practice
CAA	*Clean Air Act*
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
Cienega	Cienega de Santa Clara
CWA	*Clean Water Act*
dB	decibel
DMF	dual media filter
DPOC	drainage point of connection
EA	Environmental Assessment
EPA	Environmental Protection Agency
ESA	*Endangered Species Act*
FONSI	Finding of No Significant Impact
IBWC	International Boundary and Water Commission
ITA	Indian Trust Asset
LCR	Colorado River in the Lower Basin (lower Colorado River)
Limitrophe	the 23-mile segment of the lower Colorado River that serves as the international boundary between the U.S. and Mexico
MODE	Main Outlet Drain Extension
MSCP	Multi-Species Conservation Plan
NEPA	*National Environmental Policy Act*
NIB	Northerly International Boundary
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
Pilot Run	Operation of the YDP at one-third capacity of the original design for 365 operating days during a twelve to eighteen month period
PM_{10}	particulate matter that is 10 microns in diameter or less
ppm	parts per million
PSMP	Process Safety Management Plan
RCRA	*Resource Conservation and Recovery Act*
Reclamation	Bureau of Reclamation
RM	river mile
RMP	Risk Management Plan
RO	reverse osmosis
Salinity Control Act	*Colorado River Basin Salinity Control Act*
SCR	solids contact reactor
SIB	Southerly International Boundary
SQG	small quantity generator
TDS	total dissolved solids

Acronyms and Abbreviations (cont.)

U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WQIC	Water Quality Improvement Center
WMIDD	Wellton-Mohawk Irrigation and Drainage District
YAO	Yuma Area Office
YDP	Yuma Desalting Plant

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1.0 Purpose of and Need for Proposed Action

The Bureau of Reclamation (Reclamation), Yuma Area Office (YAO) has prepared this environmental assessment (EA) to evaluate potential effects associated with short-term and limited scale operation of the Yuma Desalting Plant (YDP) primarily for data gathering purposes. The analysis presented in this EA includes evaluation of the Proposed Action, the No Action Alternative, and alternatives considered but eliminated from further discussion. This EA complies with the *National Environmental Policy Act* (NEPA) (42 USC 43421 *et seq*.), in accordance with the Council on Environmental Quality (CEQ) regulations (Title 40 of the Code of Federal Regulations [CFR] Parts 1500-1509), and the Department of the Interior and Reclamation NEPA procedures (516 DM 14).

1.1 Introduction

The *Colorado River Basin Salinity Control Act of 1974* (Salinity Control Act) authorized the construction, operation, and maintenance of certain works in the Colorado River Basin to control the salinity of water as embodied in the 1944 United States (U.S.) Treaty with Mexico Relating to the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande (1944 Water Treaty). Title I of the Salinity Control Act provides for programs downstream from Imperial Dam to implement the provisions of Minute 242 of the International Water and Boundary Commission (IBWC), U.S. and Mexico, including a desalting complex. In accordance with NEPA, Reclamation performed an analysis of potential environmental effects related to implementation of these actions, including construction and operation of the YDP, proposed under the Salinity Control Act. That analysis was published in June of 1975 as the *Final Environmental Statement Colorado River Basin Salinity Control Project Title I* (Reclamation 1975). A digital copy of this Environmental Statement is available upon request from Reclamation.

1.2 Location and Setting

As shown in Figure 1-1, the YDP is located on the northern edge of the Yuma Valley, approximately 4 miles west of Yuma, Arizona, in the historic flood plain and delta of the lower Colorado and Gila rivers. Yuma is considered one of the largest and fastest growing cities in the area with a population of approximately 93,719 (ADC 2008b). Current population estimates for other nearby communities in Yuma County are: San Luis – 27,705; Somerton – 11,377; Wellton – 2,318; and Unincorporated Yuma County – 69,660 (ADC 2008b).

The region is characterized by sparse Sonoran Desert habitat, with irrigated tracts in the river valleys and strips of riparian vegetation along the streams, canals, and drainage channels. The climate of the region is hot and dry in the summers, with average maximum daily temperatures ranging from 104° to 108° Fahrenheit. Temperatures in the winter months typically are in the mid-60s. Precipitation generally occurs from July through October in the form of isolated thunderstorms and again during the winter.

Figure 1-1. Location and Vicinity of the YDP Project Area

1.3 Background

To implement provisions of Title I of the Salinity Control Act, construction of the YDP was largely completed in 1992. Shortly thereafter, it was commissioned for operation at one-third capacity. However, plant operations were interrupted in 1993 due to the Gila River flood, which resulted in damage to the Main Outlet Drain Extension (MODE) intake canal which provides feed water to the YDP. For the next several years, high flow on the Gila River made it unnecessary to operate the YDP. The YDP has not operated since 1993 except for a demonstration run in 2007 at about ten percent of full capacity. To date, multiple technological improvements have been made to the YDP, primarily to stay current with advances in water treatment. In addition, twelve out of eighteen design deficiencies that were identified during the 1992/93 operation have been resolved as part of maintaining the YDP's ready reserve status.

1.4 Purpose and Need

Drought conditions, population growth, and the continuing need for water for municipal, environmental, and recreational uses in the lower Colorado River (LCR) have created further demand on an already stressed water supply. The drainage water from Wellton-Mohawk Irrigation and Drainage District (WMIDD), which is currently not counted towards Mexico's allocation (as delineated in the 1944 Water Treaty), could instead be used to meet 1944 Water Treaty obligations if YDP operations are resumed. Without resumption of YDP operations, LCR water supplies will continue to be depleted. Water discharged by the YDP into the Colorado River means that a like amount of water need not be released from Hoover Dam for water deliveries to Mexico. Preserved water is then available for beneficial uses in the U.S.

Reclamation has been contacted by the Central Arizona Water Conservation District, the Metropolitan Water District of Southern California, and the Southern Nevada Water Authority regarding the need to obtain information regarding the capability and operational readiness of the YDP. This can only be understood through actual operation of the facility. Without this real-time information, the municipal utilities would not be able to determine whether the YDP could reliably operate on a long-term basis and what, if any, improvements to the facility may be necessary to ensure the most efficient, cost effective and reliable long-term operation.

Long-term operation is outside the scope of this environmental assessment and would only be considered in the future, and in accordance with appropriate federal law. This future consideration will require plant cost and performance data which is not currently available. This data can only be obtained through actual operation of the YDP at a scale and for a duration which covers seasonal variation when chemical use and power consumption are highly variable. For the

purposes of this EA, this means operating the YDP at one-third capacity of the original design for 365 operating days during a twelve to eighteen month period (Pilot Run).

The purposes of the 2007 demonstration run were to demonstrate that the YDP could operate, demonstrate the plant's use of current technologies, validate cost and performance estimates for the plant, improve overall plant readiness and provide measurements of water quality impacts. The ninety-day test period did not, however, provide sufficient data to evaluate long-term operation. In addition, the demonstration run utilized a different pre-treatment process (polymer in place of lime-softening process) than original plant design. The demonstration run was conducted at an insufficient scale, limited time period and utilized an alternative pre-treatment process. Therefore, the data from this demonstration is insufficient to provide the level of cost and performance information needed to evaluate long-term operation.

1.4.1 Purpose of the Proposed Action

The purpose of the Proposed Action is to:

- operate the YDP as designed at a sufficient flow and appropriate duration to gather benchmark performance and cost data which can only be obtained through actual plant operations;
- determine whether any additional corrective actions to plant design or equipment would be necessary for long-term operation of the plant; and
- test changes and corrections (such as the fully-automated distributed control system) which have already been implemented at the YDP as part of maintaining its ready reserve status.

Each of these critical pieces of information is needed by Reclamation and all interested parties to adequately consider potential, long-term, and sustained operation of the YDP.

1.4.2 Need for the Proposed Action

The need to operate the YDP for a Pilot Run is to:

- obtain information regarding actual plant operation which will test theoretical analysis and provide information about the plant's operating capability to reliably produce product water which could be used for multiple end uses;
- verify the suitability of treatment processes and associated facilities during actual plant performance, determine baseline operating costs, test the effectiveness of completed plant improvements, and assess how plant equipment will respond to daily operation; and

- provide process related effluent and emissions data for a sufficient period of time to provide a basis to analyze, in a separate, future decision, potential environmental consequences of YDP operation.

1.5 Scope of Analysis

Some issues clearly are not affected by the Proposed Action. Section 3.0 provides a brief description of existing analyses and the reason potential environmental consequences for these resources and issues were eliminated from further detailed analysis. These issues include:

- Aesthetics
- Cultural Resources
- Geology and Soils
- Land Use
- Climate Change

Further analyses were determined to be necessary for the following resource areas and issues. Therefore, the analyses presented in Section 3.0 are focused on these topics:

- Air Quality
- Biological Resources
- Water Resources
- Hazardous Materials
- Indian Trust Assets
- Environmental Justice
- Noise

1.6 International Considerations

The Proposed Action, if selected, would reduce the amount of water that flows into the Bypass Drain and eventually flows into the Cienega de Santa Clara (Cienega) in Mexico. The Cienega is located wholly within Mexico, and Mexico has exclusive control over the water once it crosses into Mexico's sovereign boundaries. Accordingly, matters related to the Cienega are matters of foreign policy that Reclamation addresses with the U.S. Section of the IBWC, the international body responsible for addressing Colorado River matters between the U.S. and Mexico, pursuant to the 1944 Water Treaty. Specifically, Reclamation recommended that the U.S. Section and the Mexican Section consult with one another, pursuant to the 1944 Water Treaty with Mexico and its implementing protocol, Minute 242.

The U.S. and Mexico have a long history of consulting on Colorado River matters pursuant to the 1944 Water Treaty and Minute 242, particularly with respect to salinity issues and the YDP. Moreover, recent statutory authority, Section 397 of Public Law Number 109-432, re-affirms the IBWC's longstanding practice of consultation on matters occurring outside the boundary of the U.S. pursuant to the 1944 Water Treaty:

> The Treaty between the United States of America and Mexico relating to the utilization of waters of the Colorado [River] . . . and supplementary protocol . . . is the exclusive authority for identifying, considering, analyzing, or addressing impacts occurring outside the boundary of the United States of works constructed, acquired, or used within the territorial limits of the United States.

Reclamation provided available information on the Proposed Action and on the Cienega, including this EA and its Appendices, to facilitate effective consultation, and deferred to the IBWC regarding the diplomatic process that was required to address this foreign policy matter.

The diplomatic process undertaken through the IBWC resulted in a voluntary, bi-national agreement in principle to monitor conditions in the Cienega and the Bypass Drain during the proposed YDP Pilot Run. Additionally, in the broad interest of preserving the ecology of the Colorado River, its Limitrophe region and the delta, and in the interest of international comity, the U.S. and Mexico have agreed in principle to voluntarily participate in a joint effort aimed at reducing or eliminating alterations in Bypass Drain flows and salinity that could potentially occur during the proposed YDP Pilot Run.

In accordance with all applicable law, including, for example, NEPA, the 1944 Water Treaty, Section 397 of Public Law 109-432, and Executive Order 12114, this EA only addresses potential effects of the Pilot Run within the U.S. The Cienega de Santa Clara Literature Review, Appendix C, has been included as a purely voluntary assessment of potential environmental effects which could occur wholly in Mexico if the Proposed Action is selected. Nothing in this EA or its attachments should be interpreted to conflict with or modify diplomatic positions of the U.S. Any voluntary commitments made by Reclamation with regard to the Bypass Drain or the Cienega are undertaken purely in the interest of international comity and would not constitute any obligation beyond the duration of the proposed YDP Pilot Run.

1.7 Decisions to be Made

This EA will be used to determine if a Finding of No Significant Impact (FONSI) is appropriate. If a FONSI is not appropriate, an Environmental Impact Statement will be necessary before a decision to proceed with the Pilot Run can be made. If

a FONSI is appropriate, the YAO Area Manager will determine if proceeding with the Pilot Run is warranted or not, based upon the EA, FONSI, and other pertinent information.

2.0 Alternatives Considered

This chapter presents the alternatives considered for the YDP Pilot Run, including the No Action Alternative. This chapter provides the readers and the responsible official with the specifics of the proposal, displays the alternatives, a comparison of the effects of the alternatives, and any possible mitigation requirements. Alternatives considered, but eliminated from detailed study, also are presented.

2.1 No Action Alternative

Under the No Action Alternative, the YDP would remain in ready reserve mode and a Pilot Run of the process would not occur. Current management plans will continue to guide operation of the Water Quality Improvement Center (WQIC) within the YDP facility. Reclamation would not collect operational data, nor would the YDP function at an operational level adequate to identify remaining design deficiencies. Information regarding actual plant operation, which will test theoretical analysis and provide valuable new information about the plant's operating capability, would not be collected, and testing of the actual plant performance and operating costs, effectiveness of completed plant improvements, and how plant equipment will respond to daily operation would not occur. Process related effluent and emissions data for a sufficient period of time would not be collected, and analysis of potential environmental consequences of YDP operations would not be performed. Finally, Reclamation would lose the ability to maximize water use efficiency in the LCR system.

2.2 Proposed Action

Reclamation proposes to conduct a Pilot Run of the YDP. The YDP is designed to operate in increments of one-third capacity. Therefore, Reclamation proposes to operate the YDP at one-third capacity of the original design for 365 operating days. Such operating days are expected to occur within a minimum of twelve and a maximum of eighteen months. This operating duration would provide Reclamation with sufficient time to collect data while the YDP operates in a manner which demonstrates how the plant would likely run on a long-term basis. Although some equipment in the YDP has changed since the 1975 Environmental Statement (e.g., instrumentation has been updated), its fundamental design and water treatment process remain the same.

During the proposed Pilot Run of the YDP approximately 7,300 acre feet (AF) of water untreated MODE water will be discharged into the Colorado River. The water will have a salinity of approximately 2,664 parts per million (ppm) based on the historic five year mean salinity of the Bypass Drain flow.

For the Proposed Action, the MODE water will be diverted via a diversion structure on the MODE near Drainage Point of Connection (DPOC) One. This diversion structure is a permanent water management facility called Reclamation's "MODE 1 Diversion/Return Facility." The structure discharges into the Gila River Pilot Channel which intersects with the Colorado River. Figure 2-1 is a photograph of that facility.

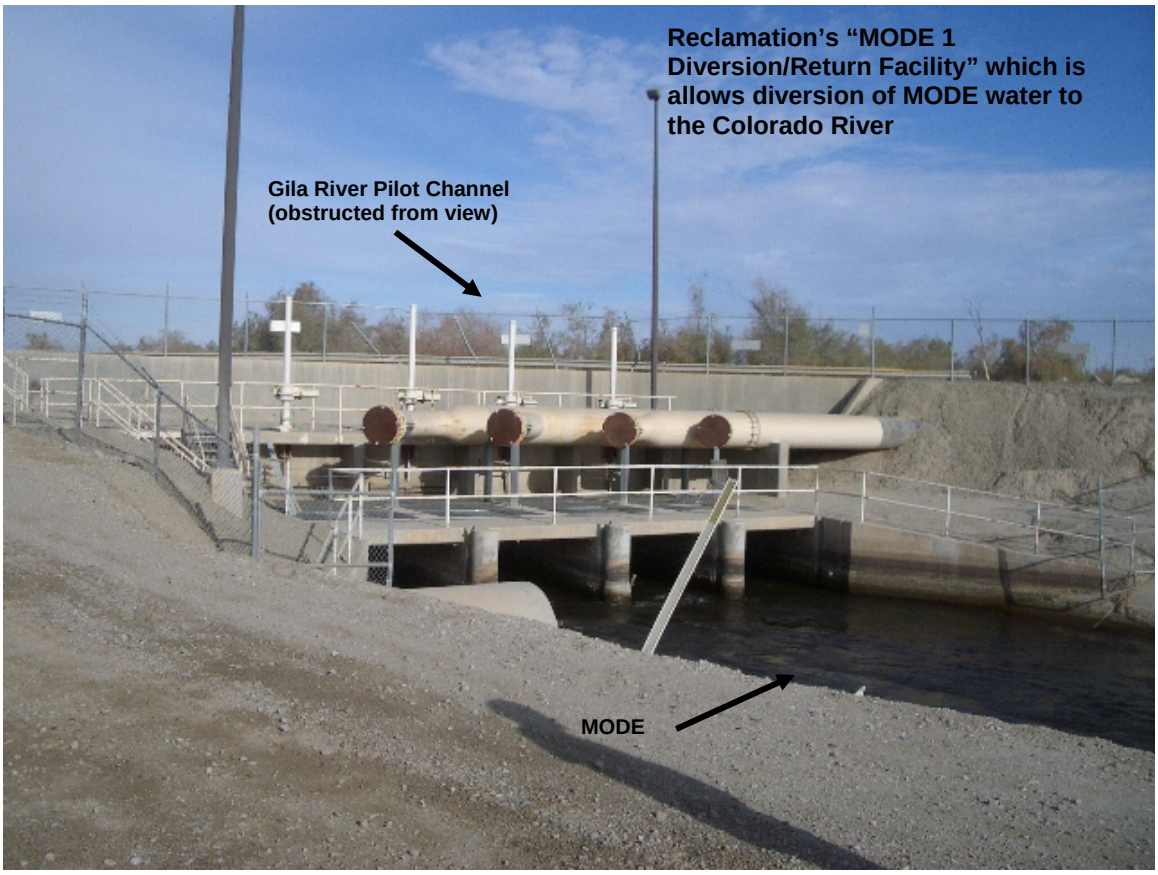

Figure 2-1 MODE 1 Diversion/Return Facility

This diversion/return facility is periodically used by Reclamation in routine and on-going water operations associated with water management in the Yuma area, regardless of the status of the YDP. For example, from January 2008 through January 2009, Reclamation discharged approximately 457 AF of MODE water to the Colorado River via this facility, which is located approximately twenty-one miles from the Northerly International Boundary (NIB). Between this facility and the NIB, there are multiple and major return flows and water orders added to the Colorado River. These include water which reaches the river through the Pilot Knob Power Plant & Wasteway, California Wasteway, Reservation Main Drain, Yuma Mesa Conduit, as well as other conveyances. Figure 2-2 is a diagram of inflows to the river from Reclamation's MODE 1 Diversion/Return Facility to the NIB.

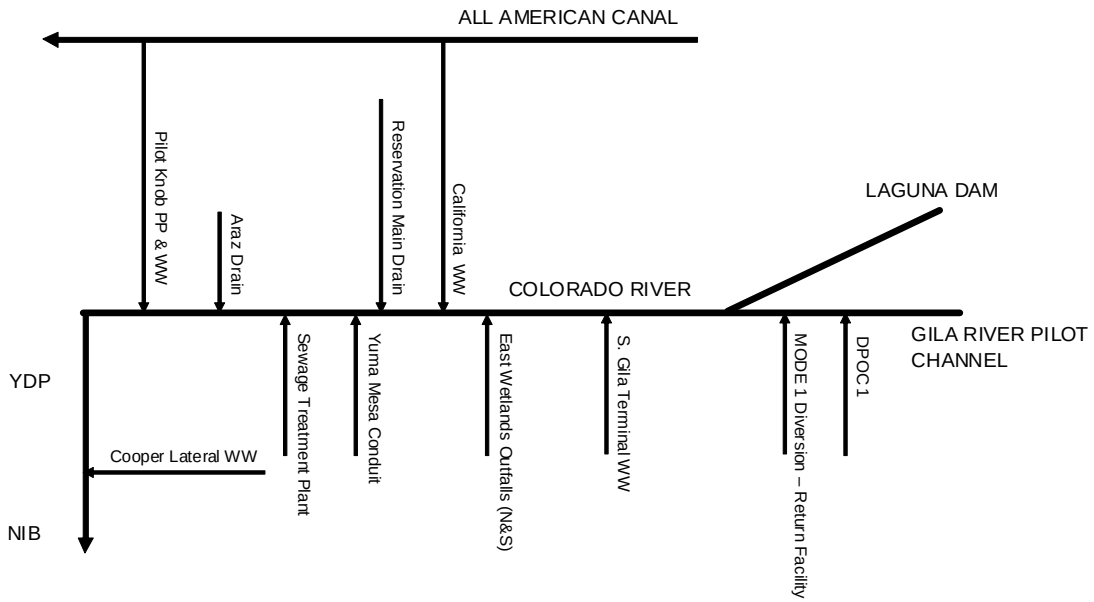

Figure 2-2 Overview of Return Flows and Water Orders to the NIB

River and agricultural conditions in the Yuma area during the proposed Pilot Run are expected to be reasonably the same as in 2008; therefore 2008 can be considered a representative year. In 2008, 436,473 AF of water were released into the Colorado River channel at Laguna Dam, with a salinity of 737 ppm. Discharges from DPOC 1 (21,362 AF at 1608 ppm) raised river salinity to an estimated 778 ppm. During the Proposed Action, about 7,300 AF of water at 2,664 ppm from Reclamation's MODE 1 Diversion-Return Facility would increase river salinity 30 ppm to 808 ppm. There is no evidence that a 30 ppm increase in salinity or 808 ppm total salinity will cause any impact to the flora or fauna of the river either at this location or downstream. Furthermore, the addition of 7,300 AF of water over twelve to eighteen months at this location will result in an incalculably small change in river level.

Downstream of the MODE 1 Diversion – Return Facility, Reclamation will continue to manage inflows to the River such that the salinity differential required in the 1944 Water Treaty is maintained.

In the twenty-one miles from the MODE 1 Diversion/Return Reclamation Facility to the NIB, several farmers do withdraw water from the Colorado River for agricultural irrigation. These withdrawals are less than 20,000 AF annually. Use of the MODE 1 Diversion – Return Facility during the proposed Pilot Run will have no impact on these water users since the salinity levels of their delivered water will be well below any that could adversely impact agriculture.

During the Proposed Action, approximately 104 AF of drainage water from the MODE will be treated daily, or a total of approximately 37,980 AF. This process will yield about 61 AF of product water per day (about 29,400 AF total). The desalinated product water will be discharged into the Colorado River. The volume of product water that will be blended from the MODE will depend on prevailing salinity conditions on the Colorado River at Imperial Dam and at the NIB. If salinity conditions continue at current levels, approximately 20 AF of blended water will be used per day. The amount of water to be discharged to the River will be included in water deliveries to Mexico and therefore is considered part of the annual scheduled allotment of water deliveries to Mexico under the 1944 Water Treaty.

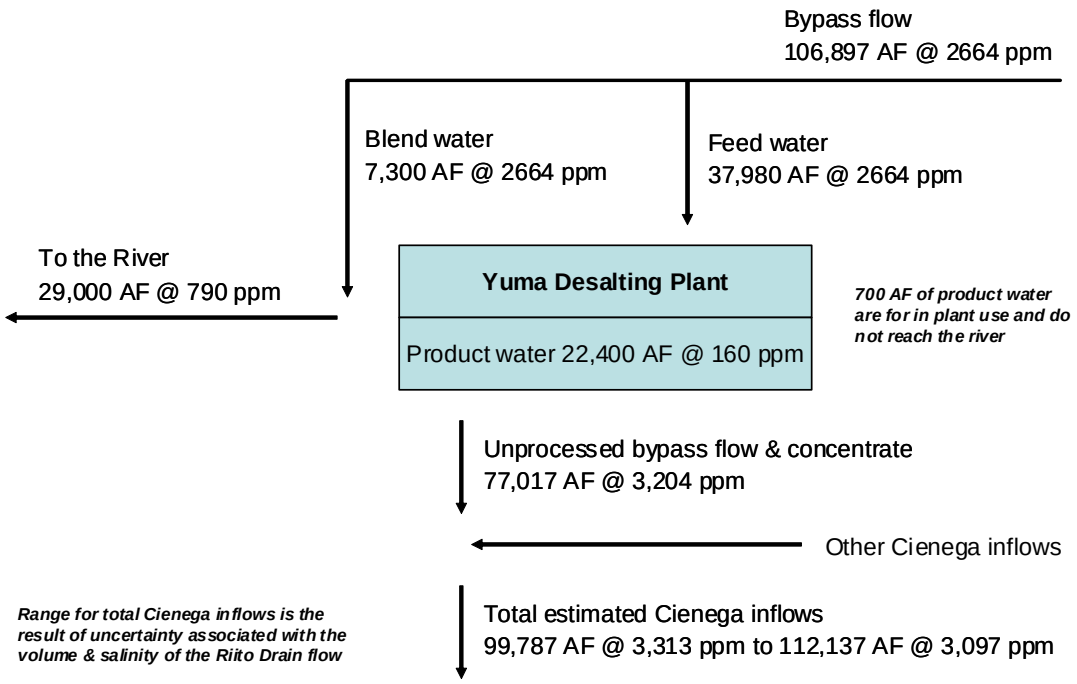

Figure 2-3. Summary Level Water Balance (Reclamation 2008).

Figure 2-3 provides a summary level water balance diagram for the Proposed Action. Beginning in the upper right hand corner of this diagram, the Bypass Drain flow from the WMIDD over the past 5 years (2004-2008) has averaged about 106,897 AF per year, at a salinity of 2,664 ppm. Over the course of the proposed Pilot Run, about 37,980 acre feet of Bypass Drain flow will enter the YDP. During the Proposed Action, the YDP will produce an estimated 22,400 acre feet of water with a salinity of about 160 ppm.

The 22,400 AF of YDP product water and approximately 7,300 feet of untreated Bypass Drain flow will be discharged into the Colorado River and included in water deliveries to Mexico.

Downstream of the YDP, the remaining flow in the Bypass Drain will be approximately 77,017 AF of water, with an estimated salinity of 3,204 ppm. Please see Table 2-1 below.

Table 2-1. Bypass Drain Flow Volume and Salinity Crossing the NIB

Description	Volume (AF)	Salinity (ppm)
MODE flow absent the Pilot Run	106,897	2,664
Feed water into the YDP	- 37,980	2,664
Untreated MODE water to the Colorado River	- 7,300	2,664
Concentrate from the YDP	+ 9,600	7,230
One month of pretreatment returned to the Colorado River	+ 4,700	2,280
Filter backwash returned to the Colorado River	+ 1,100	2,280
TOTAL	77,017	3,204

Source: Reclamation

In sum, as a result of the Proposed Action, the expected reduction in the Bypass Drain flow is approximately 29,880 AF, with an increase in salinity of about 540 ppm.

The Cienega receives between an estimated 22,770 AF to 35,120 AF of water annually from other sources like the Riito Drain and artesian wells. These sources are estimated to have a salinity level of between 3,682 ppm and 2,861 ppm. There is highly limited data associated with the volume and salinity of Mexican water sources for the Cienega (other than the Bypass Drain flow where it crosses into Mexico), so this information is subject to considerable uncertainty. Total estimated water for Cienega from all sources during the Proposed Action is estimated at between about 99,787 AF and 112,137 AF with a salinity level ranging between about 3,313 ppm and 3,097 ppm. Further discussion of volume and salinity of flows into the Cienega can be found in Appendix C, Cienega de Santa Clara Literature Review.

Byproducts of the YDP desalination include concentrate and biosolids. Concentrate consists of water and salts which have been removed during the desalination process. During the Proposed Action, concentrate is expected to total about 9,600 AF, or approximately 26 AF per day. The concentrate will be discharged to the Bypass Drain, where it will blend with the remaining drainage water flowing in the Bypass Drain. Biosolids are composed primarily of water and calcium carbonate. The amount of biosolids produced during the proposed Pilot Run is expected to total about 190 AF. The biosolids produced will be piped thru the A-22 pipeline and disposed of in existing evaporative, lined disposal cells southeast of the YDP.

Pilot operation of the YDP will commence with the plant operating at about eleven percent of full capacity, progressing to approximately twenty-two percent, reaching a maximum of about thirty-three percent of full capacity and then operating at that level for the remainder of the Proposed Action.

2.2.1 Description of the YDP Process

The purpose and fundamental design of the YDP has not changed since it was constructed. A generalized schematic of the YDP's water treatment process is presented in Figure 2-4. Water enters the facility, is treated to remove particulate, and then filtered to produce product water. A more detailed description of the pretreatment and reverse osmosis (RO) processes at YDP follows.

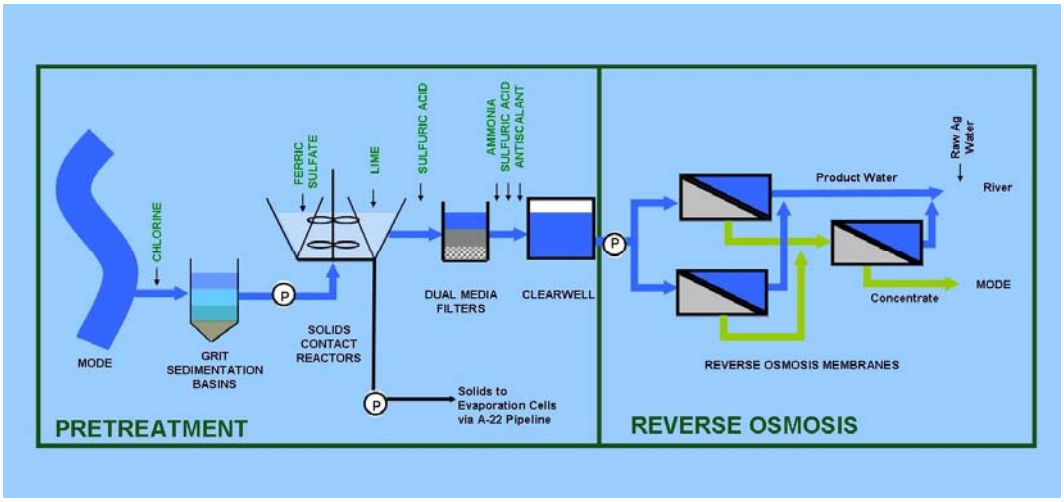

Figure 2-4. Generalized Schematic of YDP Process

The pretreatment process begins with raw feed water from the MODE passing through trash racks to prevent large debris from entering the system. Feed water is then dosed with chlorine to halt the growth of algae and microorganisms. The pretreatment process continues in the grit sedimentation basins, where the water flow is slowed to allow large particulate matter to settle out. Next, the feed water is pumped to the solids contact reactor (SCR). In the SCR, ferric sulfate and lime are added which result in coagulation and flocculation. These chemical processes cause any particulate in the water to drop to the floor of the SCR. Treated water from the SCR travels to dual media filters (DMFs) where any remaining particulate matter in the water is removed. The media filters utilize sand and anthracite coal. Water from the DMFs is dosed with ammonia, sulfuric acid and anti-scalant prior to reaching the clearwell. Ammonia converts remaining chlorine in the water to chloramines in order to protect the RO membranes. Sulfuric acid is utilized to adjust the pH for optimal conditions for RO. Anti-scalant helps prevent scale from forming on the RO membranes.

Pretreated water is stored in the clearwell. This water is particulate free, but still saline. The dissolved salts are removed by RO. Water under pressure is applied to semi-permeable membranes allowing the pure solvent (in this case the YDP

product water) to pass from the filter. The product water is then transported via gravity through 2,830 feet of concrete lined canal, and discharged into the Colorado River. The concentrate flow is discharged from the YDP into the Bypass Drain.

2.2.2 Management and Mitigation Measures

Risk Management and Process Safety Management measures are set forth in the Resource Management Plan (RMP) and Process Safety Management Plan (PSMP) for the Pilot Run. Water discharged to the Colorado River during the Pilot Run will be in full compliance with all requirements set forth in the Arizona Pollutant Discharge Elimination System (AZDPES) permit issued by the Arizona Department of Environmental Quality (ADEQ). Biosolids produced during this process will be transported to the existing A-22 evaporative and disposal cells which are permitted and conform to all applicable laws and regulations. In addition, Reclamation will operate the plant in compliance with the *Resource Recovery and Conservation Act* (RCRA), *Pollution Prevention Act*, and the *Emergency Planning and Community Right to Know Act*. For further discussion, please see Section 3.6.2.2.

2.3 Alternatives Considered, but Eliminated From More Detailed Study

2.3.1 Alternate Product Water Discharge

Reclamation considered the alternative of discharging the product water into the Bypass Drain. This alternative was eliminated from further review because it did not meet the purpose and need statement of operating the YDP under actual designed operating conditions. Specifically, discharging water into the Colorado River would be part of actual operating conditions, and as such, this alternative would not meet the criteria. Furthermore, while the Proposed Action is exclusively intended to provide benchmark data which can only be obtained through sustained plant operation, this alternative would result in approximately 29,000 AF of water not being added to the LCR system during an unprecedented drought.

2.3.2 Pilot Run at Reduced Capacity

Reclamation considered running the plant at ten percent capacity for a period of 365 operational days during twelve to eighteen months. Operating at this level demonstrates that the YDP can operate. However, the YDP was designed and constructed to operate in increments of one-third capacity. Certain equipment can run at less than one-third capacity, as shown in the 90-day demonstration run. However, running the YDP at only ten percent for an extended period of time is not cost effective because each of the SCRs must still run at thirty-three percent. Accordingly, a ten percent run would not provide the accurate cost data regarding YDP operation. In addition, operating at less than one-third of full capacity would not provide accurate operational data because the YDP was designed to

operate in one-third capacity increments. Therefore, this alternative was eliminated from further review because it did not meet the purpose and need statement of operating the YDP under actual designed operating conditions.

2.3.3 Pilot Run for a Shorter Duration

Reclamation considered running the plant at one third capacity for fewer operating days over a shorter duration. Operating at this level would allow operating the YDP as designed, but would reduce amounts of product water, concentrate and biosolids. However, this alternative would result in insufficient operating time to test changes and corrections that have already been implemented at the YDP to determine if additional corrective actions to the plant are needed, and to gather process related effluent and emissions data. Additionally, a shorter duration does not cover seasonal variation when chemical use and power consumption are highly variable. Therefore, this alternative was eliminated from further review because it did not meet the purpose and need statement of operating the YDP to provide benchmark cost and performance data for a duration which is representative of commercial scale.

2.4 Comparison of Environmental Consequences

Table 2-2. Summary Comparison of Environmental Consequences

Resource Area	No Action	Proposed Action
Air Quality	No Adverse Effect	No Adverse Effect
Biological Resources	No Adverse Effect	No Adverse Effect
Water Resources	No Adverse Effect	No Adverse Effect
Hazardous Materials	No Adverse Effect	No Adverse Effect
Environmental Justice	No Adverse Effect	No Adverse Effect
Indian Trust Assets	No Adverse Effect	No Adverse Effect
Noise	No Adverse Effect	No Adverse Effect
Aesthetics	**Not affected by, or outside the scope of, the Proposed Action.**	
Cultural Resources		
Geology and Soils		
Land Use		
Climate Change		

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3.0 Affected Environment and Environmental Consequences

This section summarizes the existing condition of the project area and the scientific and analytic basis for comparing the potential direct, indirect, and cumulative effects on the environment as a result of the Proposed Action and No Action Alternative.

3.1 Introduction

Resources and issues included for detailed analysis were identified in accordance with CEQ NEPA regulations to "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review…" (40 CFR 1501.7 (a) (3)).

3.1.1 Eliminated from Further Detailed Analysis

The following subsections summarize the resource areas which are not affected by the Proposed Action, and therefore are not included for detailed analysis in this EA.

3.1.1.1 Aesthetics

The YDP is currently built and no new construction will occur as a result of the Proposed Action. Therefore, implementation of the YDP Pilot Run will not change the existing visual character or quality of the site and its surroundings. Therefore, aesthetics are not included for further detailed analysis in this EA.

3.1.1.2 Cultural Resources

There were no known archeological or historical sites found on or near the YDP during construction. There will be no change to historical, archeological, or paleontological resources as a result of the Proposed Action. Reclamation Archaeologists have reviewed the Proposed Action and concur that no further evaluation is necessary. Therefore, cultural resources are not included for further detailed analysis in this EA.

3.1.1.3 Geology and Soils

No substantial change has occurred to the geology of the area since construction of the YDP. No new construction will occur as a result of the proposed Pilot Run. Reclamation geologists have determined that the Proposed Action would not contribute to substantial soil erosion, landslides, subsidence, liquefaction, or collapse. Therefore, geology and soils are not included for further detailed analysis in this EA.

3.1.1.4 Land Use

This issue was eliminated from further detailed study because it is outside the scope of the Proposed Action. The proposed YDP Pilot Run will not result in a change to

designated land use nor will it affect any recreational opportunities. Therefore, land use is not included for further detailed analysis in this EA.

3.1.1.5 Climate Change

This issue was eliminated from further detailed study because the scope of this action is short-term as well as geographically limited. As appropriate, climate change could be considered in future documentation if long-term operation of the YDP is proposed.

3.2 Included for Further Analysis

The environmental resources and issues discussed in the following sections were determined to require further analysis to evaluate the potential for significant effect because either these issues have the possibility to be significant or they were not covered by prior environmental review (40 CFR 1501.7 (a) (3)).

3.3 Air Quality

In accordance with the *Clean Air Act* (CAA), as amended (EPA 1990), federal and state governments have established ambient air quality standards for the protection of public health. Chlorine and anhydrous ammonia are two listed substances regulated by the CAA that would be used during the Proposed Action. Reclamation proposes to increase the amount of chlorine and anhydrous ammonia currently used and stored onsite for the proposed Pilot Run. This section presents the current environmental conditions in the project area and the analysis of potential effects associated with the Proposed Action upon local and regional air quality.

3.3.1 Affected Environment

3.3.1.1 Climate and Meteorology

The region has an arid continental climate, which is characterized by hot summers, mild winters, low humidity, and large diurnal variations in temperature. The aridity of the region is due to a combination of factors, including (1) the presence of a semi-permanent atmospheric high pressure system that shields the region from the passage of polar storm systems, (2) a cool ocean to the west that provides limited amounts of moisture, and (3) the rain shadow effects of the Coast Ranges, which block the flow of moisture into the region from the Pacific Ocean. This arid condition is responsible for the main air pollution problem in the region, fugitive dust.

3.3.1.2 Existing Conditions

The primary air pollutant of concern in Yuma County is PM_{10}. PM_{10} is defined as particulate matter that is 10 microns in diameter or less. It is mostly composed of dust particles, sulfate, and nitrates. PM_{10} is a byproduct of fuel combustion and wind erosion of soil and unpaved roads, and is directly emitted into the atmosphere through these processes. Currently, Yuma County is designated as a non-attainment area for PM_{10} by state and federal statutes (ADEQ 2009b). Due to a large thunderstorm, the EPA required

ADEQ to develop a Natural Events Action Plan. It was developed and submitted to EPA on Aug. 17, 2005. Subsequently, ADEQ submitted the *Nonattainment Areas and Attainment Areas within Maintenance Plans* (ADEQ 2009b) for the re-designation of the Yuma area as an attainment area for PM_{10}. The maintenance plan is still pending approval.

Ozone in the lower atmosphere is one of the main components of smog. Ozone is formed in the atmosphere from a combination of nitrogen oxides and volatile organic compounds in the presence of sunlight. On April 15, 2004, the Environmental Protection Agency (EPA) issued final area designations for the state of Arizona. The Yuma area is considered an attainment/unclassifiable area for 8-hour ozone (ADEQ 2009a). In 2008, EPA revised the ozone standard and lowered the previous 8-hour standard from 0.08 ppm to 0.075 ppm. ADEQ is developing a Technical Support Document to explain the recommendation to EPA on what revisions, if any, need to be made to the boundaries for the ozone nonattainment area to address the new 2008 standard. This document will be sent to the Governor of Arizona for final approval and then submitted to EPA Region 9. The deadline for governors to submit recommendations is March 12, 2009. No designations have yet been issued for the Yuma area (ADEQ 2009a).

Chlorine and anhydrous ammonia are not naturally occurring particulate matter in the Yuma area, and are not regulated as such by the ADEQ. They do, however, have the possibility to affect air quality and so will be discussed.

3.3.2 Environmental Consequences

3.3.2.1 No Action Alternative

Under the No Action Alternative, amounts of chlorine and anhydrous ammonia would not need to be increased. The quantities of both chemicals on site would continue to be below regulatory thresholds. Therefore, the No Action Alternative will not result in a change to existing compliance under the CAA, nor increased potential for adverse effect in the event of a release of chlorine or anhydrous ammonia.

3.3.2.2 Proposed Action

As discussed in Section 3.3.1, the Proposed Action is located in a non-attainment area for fugitive dust (i.e., PM_{10}), but an attainment/unclassifiable zone for ozone. Neither PM_{10} nor ozone levels will be affected by the Proposed Action. In addition, no objectionable odors are anticipated to be caused by the proposed YDP Pilot Run.

Chlorine and anhydrous ammonia are two listed substances regulated by the EPA under the CAA that will be used during the Proposed Action, and which will be onsite in threshold quantities which trigger additional compliance under the CAA (implementation of management and mitigation measures as outlined in the RMP/PSMP). These two substances are also classified as hazardous materials, and a detailed discussion of issues relating to chlorine and anhydrous ammonia is provided in Section 3.6.2.2.

3.3.3 Management and Mitigation Measures

The RMP process includes analysis of off-site consequences to the public and the environment from an accidental release. Process controls and prevention measures relating to any emergency management issues are fully outlined in the RMP and PSMP. Reclamation will follow all best management practices (BMPs) as outlined in the RMP and PSMP.

3.4 Biological Resources, Including Threatened & Endangered Species

This section presents the existing conditions related to biological resources in the project area and discusses the potential effects to threatened and endangered species.

3.4.1 Affected Environment

3.4.1.1 Terrestrial Setting

The YDP is located within the Yuma valley which consists primarily of agricultural croplands with a network of irrigation drains and ditches, and several residential areas throughout the area.

Vegetation and Wildlife

Vegetation in the vicinity is located along the Colorado River corridor. Salt cedar is the dominant vegetation along the river. Other types of vegetation include a mix of cottonwood (*Populus fremontii*), Goodding's willow (*Salix Gooddingii*), honey mesquite (*Prosopis glandulosa* var. *torreyana*), screwbean mesquite (*Prosopis pubescens*) and common reed (*Phragmites australis*). Various shrubs are found on higher, drier areas, such as arrowweed (*Pluchea sericea*), quailbush (*Atriplex lentiformis*), salt bush (*Atriplex canescens*), and creosote (*Larrea tridentata*).

The Bypass Drain is a concrete lined canal which conveys agricultural return flows from the Wellton Mohawk Valley past the YDP across the Southerly International Boundary (SIB) where it then continues approximately 35 miles into Mexico, terminating with the northern end of the Cienega. This canal is directly adjacent to the flood control levee, along the east side of the Limitrophe (the 23-mile segment of the lower Colorado River that serves as the international boundary between the U.S. and Mexico). The Bypass Drain has limited habitat value for fish or wildlife, as emergent vegetation is limited or absent. Any vegetation that grows in the Bypass Drain is regularly removed through normal Reclamation maintenance efforts. The highly saline water found in the Bypass Drain also limits use by flora or fauna.

The areas directly adjacent to the Bypass Drain are described as agricultural lands, lower Sonoran desert scrub, and riparian habitat found along the bank of the Colorado River. The Bypass Drain corridor may contain habitat for a number of small mammals and reptiles, burrowing owls, and other wildlife species. The surface of the land directly adjacent to the Bypass Drain has been heavily disturbed and is mostly void of vegetation,

limiting the quality of habitat for wildlife. Maintenance efforts by Reclamation, frequent use of vehicles on routes along both banks of the Bypass Drain, and lack of native vegetation limits the quality and quantity of wildlife habitat along the Bypass Drain's alignment.

The riparian areas of the Colorado River provide valuable stopover habitat for migratory birds, as well as a host of mammals and reptiles. Upland vegetation, and to some extent agricultural areas, can provide habitat for other mammals.

3.4.1.2 Special Status Species

Federally listed threatened or endangered wildlife species potentially occurring in the project area were identified using information from the U.S. Fish and Wildlife Service (USFWS), which lists endangered species by county. The analysis area is defined by what is commonly referred to as the Limitrophe Division of the LCR and is also designated as Reach 7 in the LCR Multi Species Conservation Program (MSCP) Habitat Conservation Plan. Reach 7 is the portion of the Colorado River that extends from the NIB downstream to the SIB. River conditions below Morelos Dam to the SIB are frequently dry, or nearly so. Flow, when present in this reach, is maintained by seepage and releases from Morelos Diversion Dam, irrigation return flows, canal wasteway discharges, and groundwater discharge (LCR MSCP Habitat Conservation Plan 2004).

A total of six Federally-listed candidate, threatened, or endangered species were identified and include the following: brown pelican (*Pelecanus occidentalis*), razorback sucker (*Xyrauchen texanus*), Sonoran pronghorn (*Antilocapra americana sonoriensis*), southwestern willow flycatcher (*Empidonax trailliiextimus*), Yuma clapper rail (*Rallus longirostris yumanensis*), and yellow-billed cuckoo (*Coccyzus americanus*). The bald eagle (*Haliaeetus leucocephalus*) is no longer Federally listed, but remains protected under the Bald and Golden Eagle Protection Act, and is included in this section.

Only three wildlife species that are federally and state listed are known or have the potential to occur along Reach 7. These species are the Yuma clapper rail (*Rallus longirostris yumanensis*), the Southwestern willow flycatcher (*Empidonax traillii extimus*), and the yellow-billed cuckoo (*Coccyzus americanus*).

Yuma Clapper Rail

The Yuma clapper rail was listed as a federal endangered species on March 11, 1967. The Yuma clapper rail, one of seven North American subspecies of clapper rails, occurs primarily along the LCR in California and Arizona. It is a fairly common summer resident from Topock, Arizona south to Yuma, Arizona (Anderson 1983). Critical habitat has not been designated for this subspecies.

In the U.S., the Yuma clapper rail is associated primarily with freshwater marshes, with the highest densities of this subspecies occurring in mature stands of dense to moderately dense cattails and bulrushes. The Yuma clapper rail begins nesting activities by February. Young hatch in the first week of June and suffer high mortality from predators

in their first month of life (Rosenberg et al. 1991). Crayfish are the primary food source of this subspecies along the LCR and may be a limiting factor restricting rail occurrence (Ohmart and Tomlinson 1977; Eddleman 1989).

The Yuma clapper rail is threatened by the lack of natural river processes which create and maintain marshes (USFWS 2006). Other threats are from wildfires and environmental contamination caused by selenium (AGFD 2006).

Surveys conducted by the Arizona Game and Fish Department (AGFD) over the past years show that Yuma clapper rails are located throughout the Limitrophe Division at various locations [i.e., Hunters Hole (approximate River Mile (RM) 2.5) and areas immediately below Morelos Dam].

Southwestern Willow Flycatcher

The USFWS listed the southwestern willow flycatcher as an endangered species on February 27, 1995 and published the final designation for critical habitat on October 19, 2004. Reach 7 (NIB to SIB) of the LCR was not included in the area designated as critical habitat for this species. The southwestern willow flycatcher is also designated as a wildlife species of special concern by the AGFD.

Southwestern willow flycatchers are neo-tropical migrants which were once widespread and locally common throughout riparian areas of the arid Southwest. Their historical breeding distribution included southern California, southern Nevada, southern Utah, Arizona, New Mexico, and western Texas (Hubbard 1987; Unitt 1987; Browning 1993).

Throughout its range, the southwestern willow flycatcher is a riparian obligate insectivore which breeds in summer along rivers, streams, and other wetlands where dense willow, cottonwood, salt cedar, or other similarly structured riparian vegetation occurs (USFWS 2002, 1995; AGFD 2005). Along the LCR, southwestern willow flycatchers begin nesting in May and continue through July (McKernan and Braden 2001). They nest in riparian vegetation characterized by low, dense shrubs, such as native willows and non-native salt cedar, usually with a sparse to dense overstory of Fremont cottonwoods or Goodding's willows; water or moist soil is usually present beneath the canopy (McKernan and Braden 2001).

Sites near the YDP where southwestern willow flycatchers were detected but not confirmed breeding in 1996, 1997, 1999, 2001, or 2002 include the Gila/Colorado River confluence, Gadsden (RM 6.4), Gadsden Bend (RM 7.0), and Hunter's Hole (McKernan 1997; McKernan and Braden 2001).

The loss and modification of habitat associated with the operation of dams and reservoirs, water diversion and groundwater pumping, channelization and bank stabilization, livestock grazing, recreation, fire, and urban and agricultural development have been identified as the primary threats affecting the southwestern willow flycatcher. Other

secondary threats of equal importance are the introduction of exotic species and brood parasitism.

Yellow-Billed Cuckoo

The yellow-billed cuckoo is a USFWS candidate species for listing under the *Endangered Species Act* (ESA) and a wildlife species of special concern in Arizona (AGFD 2005a). Yellow-billed cuckoo in the western U.S. are limited to narrow, and often widely separated, riparian cottonwood-willow galleries. Yellow-billed cuckoo use mature stands of cottonwood and willow along the Lower Colorado River Valley and, to a lesser extent, also use a mix of cottonwoods, willows, and mesquite (Rosenberg et al. 1991). Foraging yellow-billed cuckoo may use smaller mesquite and salt cedar (Rosenberg et al. 1991). The loss, degradation, and fragmentation of riparian habitat have been identified as the primary factors causing yellow-billed cuckoo declines in the western states.

The yellow-billed cuckoo arrives on its breeding grounds in mid- to late-June and departs by the end of August, spending only about one quarter of its annual cycle on its breeding territory.

Gadsden Bend and Hunter's Hole are two localities known to harbor yellow-billed cuckoos (LCR MSCP Habitat Conservation Plan); there may be others if they meet the patch size, cover, and foliage volume requirements. Yellow-billed cuckoo surveys have been conducted in the Limitrophe division since 2005. Cuckoos have been detected; however, no breeding evidence has been found. During the 2008 survey period, one yellow-billed cuckoo was detected in the Gadsden Bend area [Halterman et al. 2009 (in press)].

3.4.2 Environmental Consequences

3.4.2.1 No Action Alternative

Under the No Action Alternative, the YDP would not operate at one-third capacity. Therefore, the No Action Alternative will not result in adverse effects to endangered species.

3.4.2.2 Proposed Action

During operation of the Proposed Action, no new construction is proposed and operating activities will be confined to existing facilities. The temporary discharge of product water into the Colorado River above Morelos Dam will continue to meet the provisions for salinity set forth in Minute 242, and will not have an adverse effect on the Yuma clapper rail, southwestern willow flycatcher, or the yellow-billed cuckoo, as protected under the ESA in the U.S. Product water will meet AZPDES standards; therefore, any potential adverse effects will be mitigated. There will be no affect to vegetation or wildlife along the Colorado River below Morelos Dam because there will be no change in U.S. water operations at that location. Water delivered via the Colorado River to Morelos Dam will still be delivered in quantity and quality as described under current

agreements. Diversions by Mexico at Morelos Dam will be unchanged by this action as well.

Razorback sucker and Sonoran pronghorn do not occur in the area of the Proposed Action and would not be affected. The Proposed Action would not affect the brown pelican and bald eagle because the dry river bottom, small pools, and small flowing water habitat that is adjacent to the proposed project are not affected and are not the preferred habitat of these species. They are more likely to be found in backwaters and impoundments than river habitats.

Reduced river flows upstream could have biological impacts. A change in point of diversion of up to 1.574 million AF between Parker and Imperial Dams, and the resulting biological impacts, were considered and mitigated for in the development of the LCR MSCP (LCR MSCP Vol. I). Hence, biological impacts resulting from change in point of diversion of approximately 22,000 AF per year are not further described in this document.

Reduced flows and increased salinity in the Bypass Drain would result from implementation of the Proposed Action. Adverse effects to vegetation and wildlife resources within the U.S. would not result due to the lack of flora and fauna found within the Bypass Drain.

Noise associated with operation of the plant is not higher than ambient noise levels and would not have adverse effects to wildlife.

3.4.3 Management and Mitigation Measures

No flora or fauna in the U.S. will be adversely affected by the Proposed Action, therefore no management or mitigation measures will be necessary.

3.5 Water Resources

This section presents the existing conditions related to water resources in the project area and discusses the potential effects to surface water, water quality, and groundwater.

3.5.1 Affected Environment

3.5.1.1 Surface Water

Surface water associated with the Proposed Action primarily is comprised of the LCR above Morelos Dam and below the North Cocopah Reservation. The specific study area is located adjacent to and downstream from the YDP point of discharge, as shown in Figure 3-1 and within the Yuma and Limitrophe divisions, respectively[1]. The Yuma division begins below Laguna Dam and extends 19 miles downstream to the NIB

1. The Lower Colorado River Multi Species Conservation Program Conservation Plan uses Reach 6 (Yuma) and Reach 7 (Limitrophe) to identify these sections of the river.

(immediately above Morelos Dam). The Limitrophe Division extends from the NIB, just above Morelos Dam, approximately 23 miles downstream to the SIB. The Limitrophe Division forms the international boundary between Arizona (U.S.) and Baja California (Mexico).

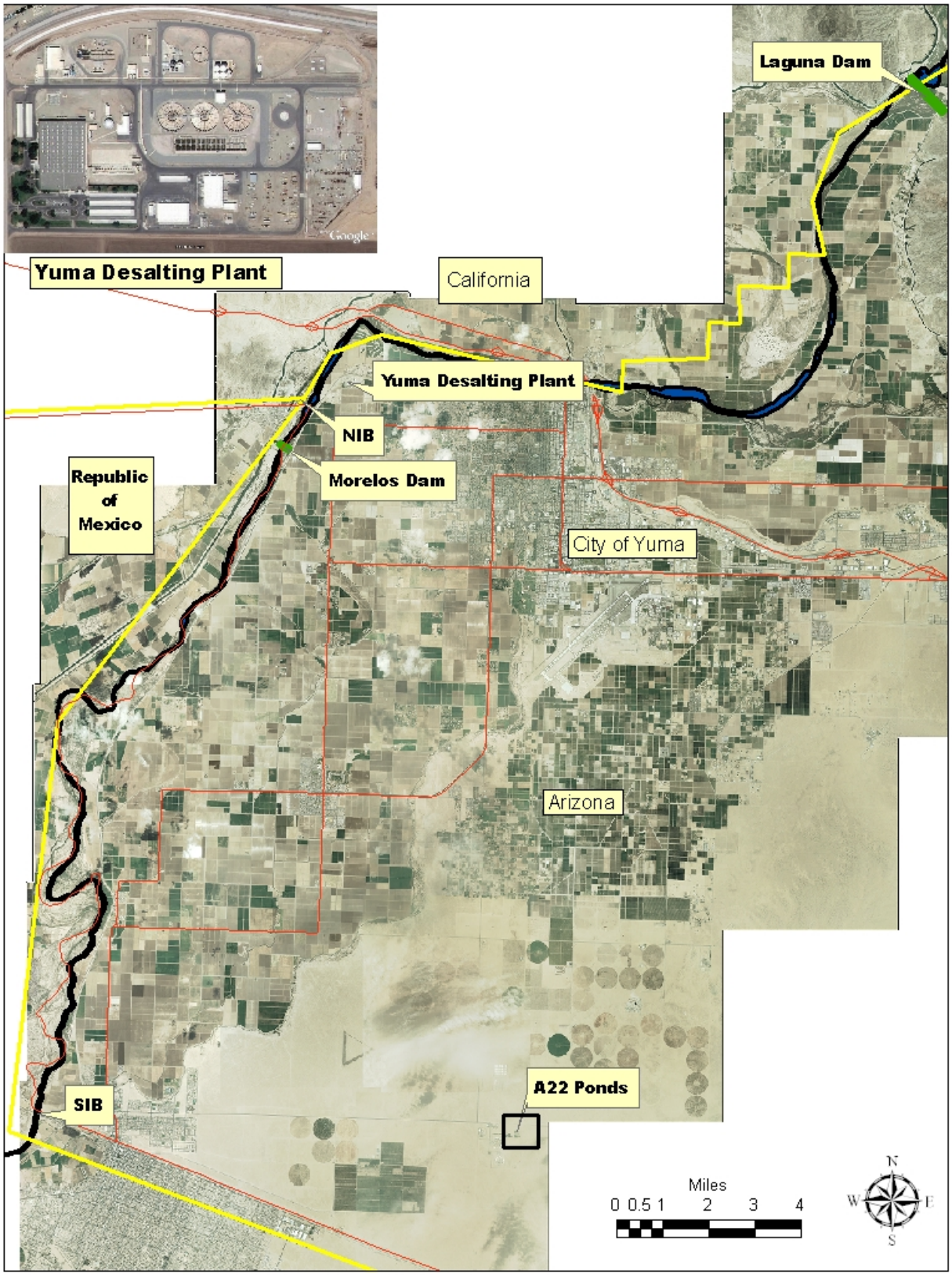

Figure 3-1. Water Resources Analysis Area

Morelos Dam is operated and maintained by Mexico, pursuant to the 1944 Water Treaty. Mexico diverts the majority of its Colorado River water supply at Morelos Dam. Average historical total flows estimated in the Limitrophe are 22,000 AF in non-flood years and 2,120,000 AF in flood years (U.S. Department of Interior et al. 2004). These flows are the result of seepage from Morelos Dam, flow releases from Morelos Dam (flood flows and excess water not diverted by Mexico), irrigation return flows from Mexico, canal wasteways in the U.S., and groundwater accumulation from both the U.S. and Mexico (U.S. Department of Interior et al. 2004). Once Colorado River water reaches Mexico, the water is under the exclusive jurisdiction of Mexico.

Drainage water from the WMIDD is agriculture return flow and is not a water of the U.S. The groundwater from the WMIDD is pumped into the Wellton-Mohawk Main Conveyance Channel, where it is then transported via gravity into the MODE and into Mexico via the Bypass Drain. The amount of water being delivered to Mexico via the Bypass Drain is not counted against the 1944 Water Treaty allotment. Average drainage flows in the Bypass Drain at the SIB are estimated to be approximately 106,900 AF annually (2004-2008 average). During this period, the flow has ranged from between about 99,000 AF and 115,000 AF. This range is primarily due to variations in agricultural practices in the WMIDD.

Although shortages and surplus flows can differ, at least 1.5 million AF of Colorado River water is delivered to Mexico, in accordance with Article 10(a) of the 1944 Water Treaty. Two delivery points exist, one at the NIB, just north of Morelos Dam, and the other at the SIB. It is at these points that U.S. jurisdiction of these waters terminates.

3.5.1.2 Water Quality

Salts in the Colorado River are naturally occurring and persistent. Generally, salinity concentrations are influenced by the volume of river flow. For example, salinity concentrations will drop when the river flow is at high levels or will increase during periods of drought. During the last five years, the salinity concentrations in the Colorado River have increased due to drought. In addition, irrigation drainage from agricultural uses has contributed to salinity concentrations. However, the salinity overall remains relatively low. Minute 242 states that, “The United States shall adopt measures to assure that … the [water] delivered to Mexico upstream of Morelos Dam, have an annual average salinity of no more than 115 p.p.m. ± 30 p.p.m. U.S. count (121 p.p.m. ± 30 p.p.m. Mexican count) over the annual average salinity of Colorado River waters which arrive at Imperial Dam….” (Minute 242 1973).

Though waters in the MODE or Bypass Drain are agricultural return flows and thus are not waters of the U.S., salinity in the Bypass Drain generally is approximately 2665 ppm. Further discussion of salinity in the Bypass Drain can be found in Section 2.2 and in Appendix C.

In accordance with the National Pollutant Discharge Elimination System (NPDES) provisions of the *Clean Water Act* (CWA), Reclamation must obtain a pollutant discharge permit. Under the CWA, the EPA is allowed to delegate this authority to the ADEQ.

ADEQ administers the NPDES program as the AZPDES permit program. Under AZPDES, any facility that discharges pollutants into the waters of the U.S. is required to obtain an individual or general permit. Therefore, Reclamation will obtain a permit from ADEQ for discharge of product water into the river.

3.5.1.3 Groundwater

Groundwater serves as a vital component to the Colorado River system. It is formed when water from precipitation, irrigation, or stream/river seepage is absorbed into the ground and then collects in aquifers. Groundwater recharge typically comes from upstream aquifers and seepage from canals, streams, irrigation, and precipitation. Generally, the groundwater in the Yuma area consists of higher salt concentrations than that of the Colorado River. Typical groundwater total dissolved solids are in the range of 1500 ppm to 1800 ppm (Reclamation 2008a). Above Morelos Dam, groundwater is pumped from the underlying alluvium.

According to the Balancing Water Needs on the Lower Colorado River: Recommendations of the Yuma Desalting Plant/Cienega de Santa Clara Workgroup (2005), the Yuma area is one of the few areas in Arizona with an excess supply of groundwater due to the influence of the Colorado River, geological conditions and commercial agricultural practices. This has resulted in negative effects to crop production due to water-logging. Water-logging occurs when agricultural land is saturated by excessive irrigation or by a rising water table. In order to alleviate this problem, wells and channels were constructed to pump excess water into open channel drains.

Certain facilities must discharge pollutants directly to an aquifer or to the land surface or vadose zone (the area between an aquifer and the land surface). These facilities may be required to obtain an Aquifer Protection Permit (APP) from ADEQ. Reclamation complies with all applicable permitting standards regarding the existing use of the A-22 ponds.

The WQIC currently produces small quantities of biosolids. Biosolids consisting primarily of water and calcium carbonate are a byproduct of YDP operations and could potentially affect the aquifer. Currently, these biosolids are transported via pipeline to the A-22 evaporative ponds, which are located approximately 20 miles southeast of the YDP (Refer to Figure 3-1). The A-22 evaporative and disposal cells are lined with a polyvinyl chloride or PVC liner and are fenced to prevent intrusion by wildlife or trespassing by humans.

3.5.2 Environmental Consequences

3.5.2.1 No Action Alternative

Under the No Action Alternative, Reclamation will not conduct a Pilot Run of the YDP. Process related effluent and emissions data will not be collected from a real-time operation of the YDP, no information regarding actual plant operation will be collected, suitability of treatment processes and associated facilities will not be verified, benchmark operating costs will not be determined, and there will be no discharge of product water to

the Colorado River. This may preclude the future operation of the YDP as it was intended.

3.5.2.2 Proposed Action

Surface Water

Under the Proposed Action, the YDP will produce about 22,000 AF of product water during the Pilot Run. About 22,000 AF of the desalinated product water will be blended with about 7,000 AF of untreated bypass flow from the MODE. The resulting approximate 29,000 AF of water will be discharged into the Colorado River, and used to fulfill Mexico's 1944 Water Treaty allotment. Reclamation will continue to meet the provisions of Minute 242 during the Proposed Action. Therefore, no adverse effects to surface water will result from the Proposed Action.

The Proposed Action could result in reduced releases from Hoover Dam. Rather than water being released from Hoover Dam, treated water would be utilized from the YDP. Reduced releases could result in lowered river elevation, decrease the amount of open water and decrease backwater areas in the lower Colorado River between Hoover and Imperial Dams. However, it is anticipated that these effects would be so small as to be unmeasurable. Studies by Reclamation found that decreasing releases from Hoover Dam by 400,000 AF each year decreased average water surface elevation by only 0.4 feet (Reclamation 2000). The Proposed Action would potentially result in a much smaller effect by reducing releases by approximately 22,000 AF. This change in releases would not conflict with water delivery obligations, cause substantial groundwater depletion, or alter existing drainage.

Water flowing into Mexico in the Bypass Drain is not counted against Mexico's 1944 Water Treaty allotment. Therefore, any change in the amount of flow will have no effect on the U.S. obligations under the 1944 Water Treaty. Water delivery obligations consistent with the 1944 Water Treaty will continue to be met. Additional information regarding flow in the Bypass Drain is provided in Appendix C.

Groundwater

The Proposed Action will produce approximately 190 AF of biosolids during the Pilot Run. These biosolids, if not disposed of properly, could affect groundwater in the Yuma area. However, the biosolids will be transported via pipeline to the existing A-22 disposal cells, and will remain there. These are lined, evaporative cells which prevent biosolids from reaching the groundwater and adversely affecting groundwater. Table 3-1 compares the current discharge to the cells with that anticipated during the proposed Pilot Run. As appropriate, Reclamation will appropriately notify ADEQ of the proposed change of amount discharged to the A-22 cells for the Proposed Action.

Table 3-1. Comparison of Biosolids Discharge

Description	No Action (Ongoing WQIC Ops)	Proposed Action Pilot Run
Annual Production (in AF)	4.5	190
Solids (wt %)	20	20
Biosolids Composition		
Calcium Carbonate	95%	95 %
Magnesium Oxide	3%	3 %
Silica	2%	2%
Ferric Oxide	<1%	<1 %
Silt	<1%	<1 %
Polymer	<1%	<1%

Source: Reclamation

Water Quality

An individual AZPDES/NPDES permit will be required by ADEQ for the discharge of product water into the Colorado River. Reclamation is coordinating with ADEQ, and the appropriate permits will be in place prior to any discharge into a water body regulated under the CWA. The Proposed Action will fully comply with AZPDES requirements set forth by the ADEQ, and all appropriate actions will be taken, pursuant to permit requirements. Any adverse effects on water quality will be mitigated through requirements set forth in the AZPDES permit.

In addition, water discharged to the Colorado River will be at total dissolved solids (TDS) levels of approximately 790 ppm. This water will meet the salinity requirements of Minute 242. Because there will be no adverse effects on water quality, this water will meet the salinity requirements of Minute 242, and it will be used to fulfill a portion of Mexico's water allocation as outlined in the 1944 Water Treaty.

Concentrate is a byproduct of the RO process of the YDP which will be released to the Bypass Drain. RO is a pressure driven process. When enough pressure is applied to a saline solution against a semi-permeable membrane, pure water molecules pass through the membrane. What is left behind on the other side of the membrane is a concentrated solution of the salts and other constituents which can not pass through the membranes. Concentrate is as the term implies: a concentrated form of the feed water which entered the plant. Concentrate flow from the YDP, consisting of dissolved salts at approximately 7,230 ppm will be discharged into the Bypass Drain. TDS of flows in the Bypass Drain will be about 3,200 ppm. However, the Bypass Drain is not subject to the salinity requirements set forth in Minute 242, and is not subject to regulation under the CWA.

Concentrate may also contain some residual levels of the chemicals used by the YDP or the byproducts of chemical reactions which occur during the water treatment process.

Chloramines, ammonia, anti-scalant, or trihalomethanes may be present at measurable levels in the concentrate. However, these may no longer be detectable by the time the Bypass Drain flow reaches the Cienega because these substances can quickly degrade; concentrate is diluted over 700 percent with raw flow water in the Bypass Drain and then mixture is exposed to over fifty-five miles of open canal before reaching the Cienega. As noted earlier, the Bypass Drain is not a water of the U.S.; therefore, it is not subject to the provisions of the CWA. Further discussion of changes in salinity in the Bypass Drain can be found in Appendix C.

3.5.3 Management and Mitigation Measures

ADEQ will promulgate all management and mitigation requirements necessary for the NPDES/AZPDES permit. Reclamation will comply with all requirements in the permit, and as appropriate, follow industry-standard BMPs.

3.6 Hazardous Materials

The hazardous materials discussion primarily relates to the transportation, storage, use, and disposal of hazardous wastes that are regulated under RCRA, Subtitle C that would likely result from implementation of the Proposed Action.

Hazardous materials include, but are not limited to: hazardous substances, hazardous wastes, and any material that may be considered harmful to human health or the environment. Hazardous wastes can appear in the form of liquids, solids, contained gases, or biosolids.

3.6.1 Affected Environment

Reclamation will use a variety of general chemical materials during the proposed YDP Pilot Run, all which are presently utilized on-site. Some are classified as hazardous by federal or state law. A chemical is deemed hazardous if it is listed by a federal, state, or local regulatory agency, or if it has characteristics defined as hazardous by such agencies.

The YAO facilities, including the YDP, currently are classified and registered with the EPA as a small quantity generator (SQG) of chemical hazardous waste. According to the EPA, SQGs generate more than 100 kilograms and less than 1,000 kilograms of hazardous waste per month (EPA 2001). Requirements for SQGs include:

- possession of appropriate permits for accumulation of hazardous waste onsite for more than 181 days (or 271 days if shipping a distance greater than 200 miles);
- the quantity of hazardous onsite waste must never exceed 6,000 kilograms; and
- a minimum of one employee always available to respond to an emergency. This employee must be the emergency manager responsible for coordinating all emergency response measures. However, SQGs are not required to have detailed, written contingency plans.

General substances such as solvents, lubricants, fuels, motor oil, grease, and adhesives already are used in the general maintenance of the plant and also will be used during the Proposed Action. These substances are not listed as hazardous materials and are not considered to be hazardous by regulatory standards. However, wastes generated from these substances are stored and disposed of in accordance with appropriate federal and state regulations.

Any hazardous wastes are not disposed of or treated onsite. Instead, Reclamation contracts to an approved independent waste disposal firm to transport waste to off-site treatment, storage, and disposal facilities.

Chlorine and ammonia are two substances which are utilized by the WQIC for day-to-day operations, as well as maintenance of the YDP. Table 3-2 provides a summary of regulations for these materials. Because of the presence of these chemicals, the Occupational Safety and Health Administration (OSHA) mandates that a PSMP and a RMP be developed and utilized. In addition, presence of these chemicals triggers certain requirements as mandated by the EPA. These requirements include: cooperation with state and local planning officials in preparing comprehensive emergency plans; reporting of accidental releases of to state and local response officials; and reporting, to local and state officials, inventories (including locations) of chemicals on their premises.

A PSMP and an RMP are currently utilized for existing quantities and uses of these chemicals. All requirements imposed by the EPA are also followed.

Table 3-2. Regulated Toxic Substances and Threshold Quantities

Chemical Name	Threshold Quantity (lbs)	Basis for Listing
Chlorine	2,500	Mandated for listing by Congress; On EHS list, vapor pressure 10mmHg or greater.
Ammonia (anhydrous)	10,000	Mandated for listing by Congress; On EHS list, vapor pressure 10mmHg or greater.

Source: Environmental Protection Agency

3.6.2 Environmental Consequences

3.6.2.1 No Action Alternative

Under the No Action Alternative, there would be no change in the amount of listed hazardous substance transported, stored, or used at the YDP. Therefore, the No Action Alternative will not result in a change to existing compliance for hazardous materials, nor increase the potential for adverse effects in the event of a release.

3.6.2.2 Proposed Action

A variety of substances will be used during the proposed YDP Pilot Run that may be considered hazardous. The procedures for the disposal of these materials include

separating incompatible materials, placing them in appropriate sealed containers, and identifying all components with approximate concentrations. The YDP will remain a SQG and will continue to meet all reporting requirements.

During the proposed Pilot Run, the YDP is projected to utilize between 391 and 521 tons of liquid chlorine and between 51 and 127 tons of anhydrous ammonia. Since the amount of chlorine onsite during the Proposed Action will be above the 2,500-lb threshold, and the amount of anhydrous ammonia will be above the 10,000-lb threshold, Reclamation will expand the existing RMP and PSMP.

The RMP focuses on analysis of off-site consequences to the public and the environment from an accidental release, as well as planned emergency response. The PMSP focuses on proactively identifying hazards and ensuring operating and maintenance procedures reduce the risk of accidental chemical releases. The RMP and PSMP are being updated in accordance with EPA and OSHA regulations which respectively administer them. Before the Proposed Action is begun, the updating process will be completed. Reclamation will be utilizing a firm well-experienced in both risk and process safety management in industrial settings to help ensure the RMP and PSMP manage hazardous chemicals in a safe and responsible manner.

The updating process begins with a gap analysis. This will identify changes necessary in the existing RMP and PSMP which are necessary as a result of the Proposed Action. The analysis covers on-site conditions, procedures, record keeping, and includes interviews with operations, maintenance and management personnel. A gap analysis that covers all these aspects allows thorough identification of necessary enhancements to the RMP and PSMP to accommodate the Pilot Run.

These enhancements form the basis of an implementation plan. The plan will detail any additional offsite consequence analysis that must be performed, any necessary revisions to operating and maintenance procedures and hazards analysis, and any needed changes to the emergency response plan. Developing and executing the implementation plan relies on heavy involvement of existing YDP personnel (both Reclamation employees and those of the O&M contractor). OSHA mandates such participation in order to ensure that documentation (e.g. procedures and response plans) accurately reflects what personnel actually know and do.

The following is a more detailed view of the dimensions of the RMP and PSMP expansion that will be covered prior to commencing the proposed Pilot Run of the YDP:

Risk Management Program

- **Hazard Assessment and Offsite Consequence Analysis**
  - Worst-case scenario
  - Alternative release scenarios
  - Modeling of worst-case and alternative release scenarios
  - Determination of offsite consequences

Emergency Response Plan Requirements
- Response and mitigation
- Notification
- Coordination with responders
- Written plans
- Drills

Process Safety Management Program

Process Hazards Analysis
- What-If/Checklist Analysis
- Failure Modes and Effects Analysis
- Hazard and Operability Analysis
- Consideration of offsite impacts

Management of Change
- Interface of PSMP with changes in Operations & Maintenance procedures
- Management of Change program

Procedure Modification
- Modification of procedures based on the Proposed Action
- New procedures based on the Proposed Action
- Design and documentation/certification rules and process
- Design and document control and change control

Incident Investigation
- Incident investigation requirements
- Evidence analysis and cause determination
- Recommendations and follow-through
- Documentation and regulatory requirements

Compliance with applicable federal, state, and local regulations would reduce the likelihood of potentially significant effects that could occur in association with the Proposed Action. Similarly, implementation of management and mitigation measures as listed in the RMP and PSMP would reduce the effects resulting from the operation of the YDP, so that no significant effects would occur.

The amount of biosolids that will be produced as a result of the YDP Pilot Run will be approximately 190 AF. These biosolids will not derive from any waste that is listed as hazardous by the EPA. Therefore, the biosolids produced will not be considered a hazardous waste pursuant to RCRA regulations. Because the A-22 cells are extant, lined disposal sites, there will be no adverse effects from the Proposed Action.

3.6.3 Management and Mitigation Measures

The BMPs currently used by YDP personnel, and those under development to prevent, respond to, and control the release of hazardous materials can be found in the current version of the RMP and PSMP. Reclamation developed these documents in accordance with provisions of the CAA (40 CFR 68.130 Subpart G) for chlorine and anhydrous ammonia stored onsite and used by the WQIC. Since quantities of hazardous materials

utilized on-site during the Proposed Action will increase, an updated version of the RMP and PSMP will be implemented, as discussed in Section 3.6.2.2.

In addition, Reclamation contracts with licensed hazardous wastes transporters to ensure that all hazardous waste generated by any of their facilities (including waste that will be generated from the Proposed Action) is transported to a licensed, off-site hazardous waste facility for treatment or disposal. Hazardous materials are routinely transported by truck. The U.S. Department of Transportation, Office of Hazardous Materials Safety, prescribes strict regulations for the safe transport of hazardous materials, as outlined in CFR Title 49. The transport of hazardous materials also is accordance with state regulations and will be monitored as appropriate.

3.7 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the U.S. for Indian tribes or individuals, or property that the U.S. is charged by law to protect for Indian tribes or individuals. In accordance with the *Indian Trusts Fund Management Reform Act of 1994*, as amended, all Department of Interior agencies, including Reclamation, are responsible for protecting ITAs from adverse effects resulting from their programs and activities. In cooperation with tribes, federal agencies must inventory and evaluate assets and mitigate or compensate for adverse effects to the asset. While most ITAs are located on reservation lands, they also may be located off-reservation. Examples of ITAs include, but are not limited to: land; minerals; rights to hunt, fish, and gather; and water rights. Though the YDP is located near a reservation, no ITAs were identified in the project area. Therefore, there are no potential adverse effects associated with the Proposed Action or alternatives.

3.7.1 Affected Environment

The YDP facility is located immediately adjacent to the North Cocopah Indian Reservation and across the Colorado River from portions of the Fort Yuma-Quechan Indian Reservation. Figure 3-2 shows the location of these reservations in relation to the YDP facilities.

Figure 3-2. Location of North Cocopah and Fort Yuma-Quechan Indian Reservations in Relation to YDP

3.7.1.1 Lands

The Proposed Action is not located on lands which are ITAs; however, it is located adjacent to the North Cocopah Reservation. While the entire Cocopah Reservation encompasses approximately 6,500 acres, the North Reservation is comprised of 640 acres (ADC 2008a). There are a small number of tribal residences on the North Reservation and one commercial enterprise, the Cocopah RV and Golf Resort. Quechan lands located across the Colorado River are mostly undeveloped and vacant. No Quechan tribal

residences are located on this land; however, there is a tribal parking lot immediately adjacent to the Los Algodones port-of-entry less than one mile from the YDP, and a newly constructed hotel and casino. These enterprises are a significant source of revenue for the Quechan Tribe, especially during the winter tourism season, when up to 15,000 people a day may cross the border or visit the casino for shopping, lodging, and entertainment.

3.7.1.2 Water Rights

Currently, the Cocopah Indian Tribe possesses perfected Federal Reserved rights to 10,847 AF per year of Colorado River water. This tribal water is diverted from the Colorado River at Imperial Dam and delivered via the Yuma Main Canal and various irrigation structures (Department of Interior 2004). In addition, the tribe has numerous well permits that allow the tribe to pump groundwater from aquifers that may be connected to the Colorado River within the boundaries of the U.S. (Department of Interior 2004).

3.7.1.3 Hunting, Fishing, and Gathering Rights

The Colorado River and its tributaries provide habitat for sensitive fish and wildlife species, especially in the riparian woodlands and marshes. Much of this habitat is located within the Cocopah Indian Reservation and is managed by the Cocopah Environmental Protection Office. Some members of the tribe collect a variety of plants, which are eaten as well as used for medicinal and ceremonial purposes, and in traditional craft production (Department of Interior 2004).

3.7.2 Environmental Consequences

In accordance with the *Indian Trusts Fund Management Reform Act of 1994*, as amended, all Department of Interior agencies, including Reclamation, are responsible for protecting ITAs from adverse effects resulting from their programs and activities. Reclamation departmental policy requires the agency to address any effects to ITAs.

3.7.2.1 No Action Alternative

Under the No Action Alternative, the proposed YDP Pilot Run will not take place. Therefore, no change to federal actions will occur that could result in an adverse effect to identified ITAs.

3.7.2.2 Proposed Action

Lands

The Proposed Action will not interfere with any lands which are ITAs. The YDP is not located on ITAs and does not affect the use or management of any tribal lands.

Water Rights

The Proposed Action will not affect with the Cocopah Tribe’s reserved water rights. The Proposed Action will not result in a change to any tribal water right, nor to the diversion or delivery of tribal water entitlements.

Currently, the Cocopah Indian Reservation performs its own water treatment operations. Tribal members receive their water from wells located within the reservation and convert the raw water from the wells into potable water. For a more detailed discussion on the potential effects to water quality from the Proposed Action, refer to Section 3.2 Water Resources. Because the Cocopah Indians receive their water from wells located on the reservation, the operation of the YDP will not affect water quality where there is a reserved water right. Therefore, no impact would occur.

Hunting, Fishing, and Gathering Rights

The proposed YDP Pilot Run will not affect any hunting, fishing or gathering rights which could be exercised by any Tribe.

3.7.3 Management and Mitigation Measures

No ITAs will be affected by the Proposed Action, therefore no management or mitigation measures will be necessary. Reclamation will coordinate with both Tribes on an as-necessary basis to ensure that ITAs remain unaffected.

3.8 Environmental Justice

Executive Order 12898 requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the U.S.

Minority populations include all persons identified by the Census of Population and Housing to be of Hispanic or Latino origin, as well as, non-Hispanic persons who are African American, American Indian and Alaska Native, or Native Hawaiian or other Pacific Islander.

Low-income populations are those that fall within the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. If the total income of a person's family is less than the threshold appropriate for that family, then the person is considered poor, together with every member with his or her family. The definition of poverty is dependent on the size of the family. For example, the poverty threshold for a family of three is $16,079; whereas, the threshold for a family of four is $20,615.

3.8.1 Affected Environment

The analysis area for assessing adverse effects to a minority population and low-income populations are the city of Yuma, the Cocopah and Fort Yuma-Quechan Indian reservations, and rural populations adjacent to the YDP facility (see Figure 3-3).

The U.S. Census Bureau estimates the 2006 population of the city of Yuma was 92,160. The population of Yuma consists primarily of Caucasians (White) and peoples of Hispanic or Latino descent. According to the Census Bureau, in the year 2000, approximately 68.3 percent of the population in Yuma were Caucasian and approximately 45.7 percent were persons of Hispanic or Latino origin. Only 5.1 percent of the population was of another race, such as African American, Asian, or Native Hawaiian or other Pacific Islander. Native Americans accounted for 1.5 percent of the population. The median household income in 1999 was $35,374; however, 14.7 percent of the population was considered to be below the poverty level. Table 3-4 summarizes the total and minority population data for the city of Yuma, the Cocopah Indian Reservation, and the Fort Yuma-Quechan Indian Reservation, including persons living below the poverty level.

Table 3-3. Total and Minority Population Data for the Analysis Area (2000 data)

Analysis Area	Total Population (2003)	Total Population (2000)	Minority Population (2000)	Percent Minority (2000)	Below Poverty Level (1999)
City of Yuma	80,580[1]	76,490[1]	39,222[1]	51[1]	14.7 %[1]
Cocopah Indian Res.	NA	1,025	1,025	1.3	NA
Fort Yuma-Quechan	--[2]	2,761	2,761	NA	NA

1. Excludes Native Americans.
2. Not available.
NA = Not applicable.
Source: U.S. Census Bureau and the Arizona Department of Commerce.

The community profile and population data for the Cocopah Indian Reservation were obtained from the Arizona Department of Commerce. Between the years 1990 and 2000, the population for the entire Cocopah Indian Reservation grew by approximately 49 percent. The current total population of the reservation is unknown; however, the population in 2000 was estimated at 1,025. Because American Indians are considered a minority group, the minority population of the reservations and the total population for the reservation are the same. The percent of Cocopah Indians living below the poverty level currently is unknown.

Historically, agriculture has been the primary source of the tribal economy and provides an annual income of about $250,000 for the tribe (ADC 2007). Other primary sources of income for the tribe are construction, manufacturing, mining, retail trade, services, forestry and fishing, casinos, and recreational activities (ADC 2007). In 2007, the Arizona Department of Economic Security estimated that about 246 Cocopah tribal members were contributing to the civilian labor force. This equates to an unemployment rate of roughly 18.3 percent for the Cocopah Tribe. The unemployment rate has decreased from 37.5 percent in 1990.

Information provided below for the Quechan Indian Reservation was obtained from the *Census 2000 American Indian and Alaska Native Summary File*. The Quechan tribe is located along both sides of the Colorado River near Yuma, Arizona, and borders the states of Arizona, California, and Baja California in Mexico. The reservation encompasses approximately 45,000 acres of which 700 acres of farmland are leased to non-Indian farmers. 2000 Census data estimates the population for the Quechan tribe at 2,761.

The reservation is largely an agricultural community. However, a large amount of the tribe's economy depends on tourism and related business. The tribe operates a commercial parking lot in Andrade, California, which is located outside the port-of-entry to Los Algodones, Mexico, as well as a newly constructed hotel and casino. These enterprises receive a vast amount of tourist traffic during the winter tourism season (ITCoA 2006). In 2000, it was estimated that roughly 979 Quechan tribal members contributed to the civilian labor force. This equates to an unemployment rate of 11.4 percent. The median household income reported in 1999 was $30,867. The Census Bureau does not have current information for Tribal members living below the poverty level.

3.8.2 Environmental Consequences

3.8.2.1 No Action Alternative

Under the No Action Alternative, the YDP Pilot Run will not take place. Therefore, no federal actions will occur that could result in a disproportionately high and adverse effect on the health or environment of minority or low-income populations.

3.8.2.2 Proposed Action

Based on previous analysis for air quality in the Air Quality section of this EA, changes in air quality resulting from the Proposed Action will not result in proportionately high and adverse effects to the environment or to the health of low-income and minority populations. For a more detailed discussion on air quality in the greater Yuma area, refer to Section 3.2 of this EA.

Based on the previous analysis for water quality in the Water Resource section of this EA, product water discharged into the Colorado River from the Proposed Action will not result in proportionately high and adverse effects to the environment or to the health of low-income and minority populations. For a more detailed discussion on the quality of water of the Colorado River, refer to Section 3.5 of this EA.

Based on the previous analysis for hazardous materials in the Hazardous Materials section of this EA, hazardous materials used in the Proposed Action will not result in proportionately high and adverse effects to the environment or to the health of low-income and minority populations. For a more detailed discussion of hazardous materials, refer to Section 3.6 of this EA.

3.8.3 Management and Mitigation Measures

No low-income or minority populations will be adversely affected by the Proposed Action, therefore no management or mitigation measures will be necessary.

3.9 Noise

3.9.1 Affected Environment

Noise is a source of pollution, and can be a public health hazard. Its effects can include various physical and psychological impacts on humans and wildlife. Residential areas, schools, libraries, hospitals, assisted living facilities, wilderness, and recreational areas are all noise sensitive. Noise Zones are delineated on the *Yuma County Noise Exposure & Compatibility Overlay* (Yuma County 2005).

The area surrounding the YDP is a rural setting. Sound levels vary within the area but are generally acceptable. As noted in Figure 3-2, small populations are located approximately one mile from the YDP, however, no sensitive receptors such as hospitals, schools or parks are in the project area. Land is predominately used for agricultural purposes, with large, diesel-powered farming equipment routinely operated. Because of the use of farming equipment, pumps, vehicle usage and the like, the YDP lies in a 65-decibel (dB) to 80 dB noise corridor.

The Yucca Power Plant is situated directly adjacent to the YDP. This facility is a contributor to ambient noise levels in the surrounding area, due to its use of five combustion turbines and one steam generator. Because of the use of combustion turbines, the noise level of the Yucca Power Plant is greater than the noise generated from the YDP facility.

Other potential noise generators in the area include the operation of Morelos Dam, the town of Los Algodones, Mexico, Interstate 8, and frequent vehicular traffic along the levee chiefly due to operations of the U.S. Border Patrol. The Border Patrol also frequently uses helicopters in the immediate vicinity of the YDP, which also contributes heavily to the ambient noise level in the area when they are in operation.

3.9.2 Environmental Consequences

3.9.2.1 No Action Alternative

Under the No Action Alternative, the proposed YDP Pilot Run will not take place. Therefore, no federal actions will occur that could result in an adverse effect noise levels in the surrounding area.

3.9.2.2 Proposed Action

Operation of the YDP will result in an increase in the ambient noise immediately surrounding the facility. Noise levels generated by the YDP are less than currently existing noise contributors in the area and will not exceed noise standards. Sensitive noise receptors are sufficiently distant from the YDP to not have any effect. The

Proposed Action will not result in construction activities, or excessive noise generation due to operation of construction equipment. The YDP will operate within acceptable ambient noise levels in accordance with applicable noise ordinances or standards, and will not result in significant negative effects due to noise.

3.9.3 Management and Mitigation Measures

Though the noise levels from the Proposed Action would not be significant, due to the use of electrical power motors, barriers such as high partition walls have been constructed to further minimize noise levels.

3.10 Cumulative Effects of the Proposed Action

Cumulative effects are the effects on the environment that result from the incremental effects of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative effects can result from "individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). Several current and planned projects either located within or in the vicinity of the planning area and having the potential to affect common resources will be addressed in this section.

3.10.1 Projects in the Area

Drop 2 Reservoir Project

The Drop 2 Reservoir Project, located in southern Imperial Valley, California, approximately twenty miles west of Yuma, Arizona, has three primary physical components: the reservoir itself, an inlet canal (approximately seven miles in length, 150 feet wide with capacity flow of 1,800 cubic feet per second), and an outlet canal (approximately 2,000 feet in length). The new inlet canal would convey water from the All-American Canal to the new storage reservoir, and later, water would be returned to the All-American Canal at a point approximately one mile downstream of Drop 2, via a new outlet canal. Both the inlet and outlet canals would be designed to use gravity flow. To maintain capacity, periodically silt would have to be removed from the bottom of the reservoir. Construction of the Drop 2 Reservoir Project commenced in October 2008. The project is located approximately fifteen miles east of the YDP. Potential effects relate to biological resources, hazardous materials, air quality, aesthetics, and cultural resources. With implementation of mitigation measures, no significant effects are expected.

Laguna Reservoir Restoration Project

The proposed Laguna Reservoir Restoration Project would increase the amount of storage capacity in the basin area from 400 AF to 1,500 AF. The project area is located immediately upstream of Laguna Dam through the excavation of accumulated sediments. Laguna Dam is located approximately twelve miles northeast of Yuma, Arizona and five miles downstream from Imperial Dam. The project is intended to provide sufficient storage space at Laguna Reservoir to allow for the release of sluicing flows from Imperial Dam that would remove sediment accumulated at the AAC headworks and the California

Sluiceway channel. The EA and FONSI for the Laguna Reservoir Restoration Project were finalized in December 2006. The Laguna Reservoir Restoration Project would have the potential to affect air quality in Imperial County, California and biological resources of the Colorado River. With implementation of Imperial County Air Pollution Control District requirements for dust control, dredging and maintenance activities of the Laguna Reservoir Restoration Project would have no significant air quality effects. Dredging and maintenance activities as part of the project could result in a loss of nesting and foraging habitat for common and sensitive wildlife species. The Laguna Reservoir Restoration Project is a covered activity under the LCR MSCP and accompanying ESA Biological and Conference Opinion for Federal covered actions. With incorporation of avoidance and minimization measures of the LCR MSCP into the proposed project description, and compensatory mitigation for all marsh wetland habitats affected, no significant effects are expected.

Hunters Hole Restoration Project

Reclamation and the Bureau of Land Management (BLM) are currently working with the Yuma Crossing National Heritage Area in the development of a restoration project at Hunters Hole. A concept plan has been developed which would accommodate habitat restoration along with border security features. Project proponents include the reestablishment of open water areas, and restoration of riparian and marsh habitats within the Hunters Hole Backwater area. The project area is located in the Limitrophe Division of the LCR. The proposed project is located approximately twenty miles downstream of Morelos Dam. With implementation of mitigation measures, no significant effects are expected.

Multi-Species Conservation Program

The LCR MSCP is a multi-stakeholder, federal and non-federal partnership that seeks to balance the use of Colorado River water resources with the conservation of native species and their habitats in compliance with the ESA. The goals of the MSCP are to:

- work towards the recovery of ESA listed species and prevent the likelihood of additional listings;
- accommodate present water diversions and power production while optimizing the future development of water and power production; and
- provide incidental take authorization under the ESA for covered actions.

The LCR MSCP covers areas up to and including the full-pool elevations of Lakes Mead, Mohave and Havasu and the historical floodplain of the Colorado River from Lake Mead to the SIB. Reclamation's "covered actions" (actions for which ESA consultation, permitting and incidental take authorization was covered under the LCR MSCP) include (but are not limited to): Reclamation's daily operations of Hoover, Davis, Parker, Senator Wash, Imperial, and Laguna dams; flood control releases on the LCR; water deliveries to Arizona, California, Nevada, and Mexico consistent with existing contracts and obligations; electric power generation at Hoover, Davis, and Parker dams; channel

maintenance from Davis Dam to the SIB; operation and maintenance of major Federal facilities, and the Laguna Reservoir Restoration Project (see above). LCR MSCP covered activities also include the potential changes in points of diversion of up to 1.574 million AF per year of Colorado River water by water contractors in Arizona, California, and Nevada (LCR MSCP Vol. I). Specific transfers for the entire 1.574 million AF per year have not been identified; therefore, the impact analysis for the changes in points of diversion is programmatic. Diversion changes are expected to occur in response to shifts in water demand during the 50-year term of the LCR MSCP Conservation Plan. It is anticipated that a shift in water diversion from the southern reaches of the Colorado River upstream to Lake Mead and to Lake Havasu will occur. Potential effects could include changes in water surface elevation along the LCR where points of diversion are changed as well as associated effects on biological resources. The Environmental Impact Statement on the LCR MSCP addressed the affects of USFWS issuing the ESA take authorization and implementation of the plan's habitat conservation measures by the LCR MSCP over an anticipated 50 year period.

BLM Hazardous Fuels Program

The BLM currently manages fire and hazardous fuels within the Limitrophe Division. These projects help to reduce the likelihood of catastrophic fires and secure the facilities and property within this reach. A number of projects including fire breaks, herbicide upkeep and fuels reduction areas have been implemented within the Limitrophe, Yuma, and Laguna Divisions of the LCR (SIB to Imperial Dam).

Border Patrol Fence Project

Border Patrol constructed a pedestrian border fence between SIB and County Road 18 (near Gadsden Bend), and a vehicle barrier fence upstream to Morelos Dam. Due to the waiver signed April 1, 2008, by Department of Homeland Security Secretary, Michael Chertoff, no environmental compliance was performed for this action. Therefore, environmental impacts were not evaluated, and mitigation and management plans were not promulgated and cannot be assessed.

Border Patrol Vegetation Treatment in the Limitrophe for Safety and Law Enforcement.

BLM issued a right-of-way license to Border Patrol that allows them to conduct vegetation treatment activities, maintenance, and mitigation in order to facilitate border security (enforcement) along the Limitrophe Division. This proposed action provides for the treatment of various vegetation types in the area, while avoiding and minimizing effects to native riparian and marsh vegetation.

Yuma Wetlands Restoration

The City of Yuma and the Yuma Crossing National Heritage Area have implemented two riparian and wetland restoration project that have also incorporate a recreational aspect along the LCR's Yuma Division (Yuma East and West Wetland projects). These projects have transformed former salt cedar thickets and degraded wetlands into functioning wetland areas and riparian forest areas while providing public access points. Projects are located approximately four miles upstream of the YDP.

Although this project is still under construction, initial findings suggest that the water diversions, vegetation treatments and invasive plant control have benefited many species of native wildlife. The Yuma East Wetlands provides regional benefits, providing alternative stop over habitat for migratory birds.

3.10.2 Effects by Resource

Air Quality

Emissions from the Proposed Action would not contribute to an exceedance of an ambient air quality standard. As a result, the Proposed Action, in combination with other foreseeable sources and projects mitigation requirements, would not produce significant cumulative air quality effects.

Biological Resources

Running the YDP for a short duration in combination with other projects would not result in loss of habitat and effects on biological resources in the area of the Proposed Action.

Water Resources

The Proposed Action and other cumulative projects would enhance Reclamation's ability to meet its obligations to water users in the U.S., while meeting the obligation to deliver Mexico's share of Colorado River water under the 1944 Water Treaty. The Proposed Action will operate for a short duration and in a manner that will not conflict with delivery obligations, and/or violate any applicable surface and groundwater water quality standards.

Hazardous Materials

Compliance with applicable federal, state, and local regulations would reduce the likelihood of potentially significant effects related to the use of chlorine and ammonia in the pretreatment process during operation of the YDP. Similarly, implementation of management and mitigation measures would reduce the Proposed Action's contribution to cumulative effects, resulting from the operation of the YDP, so that no significant effects would occur. In addition, other regional projects would also be subject to environmental review and appropriate mitigations established for each project, prior to construction. Therefore, significant cumulative hazards and hazardous materials effects would not occur.

Indian Trust Assets

No effects to ITAs were identified for the Proposed Action. Therefore, no cumulative effects to ITAs are anticipated.

Environmental Justice

The Proposed Action, in combination with other proposed or on-going projects, would not cause disproportionate cumulative effects on minority or low-income populations.

Noise

The Proposed Action, in combination with other proposed or on-going projects, would not cause cumulative effects for noise levels in this area.

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4.0 Consultation and Coordination

Scoping

In advance of the release of this document, two public scoping meetings were held on Wednesday, October 8, 2008 and Monday, February 2, 2009 (IBWC Citizen's Forum). A press release regarding the scoping meeting held on October 8, 2008 was widely distributed on September 25, 2008. Representatives from several groups which could not attend the October scoping meeting asked for further information on the Proposed Action. In response, Reclamation provided the information and requested further comments and relevant information specifically regarding the Cienega. These comments were utilized in the development of the Draft EA and associated Appendices. Finally, tours of the YDP may be arranged through YAO, during which the Proposed Action is discussed. Several groups have availed themselves of these tours, to include the U.S.-Mexico Border Field Coordinating Committee (October 2008), and the Colorado River Joint Cooperative Process, as part of their Bi-National Field Trip (January 2009).

Scoping Timeline

September 25, 2008	Press Release for Public Scoping Meeting
October 8, 2008	YDP Pilot Run Scoping Meeting, Yuma, Arizona
November 14, 2008	Initial Consultation Meeting with IBWC and Mexico
February 2, 2009	IBWC Citizen's Forum, El Centro, California
February 12, 2009	Second Consultation with IBWC and Mexico
March 30, 2009	Conference call with IBWC-US
April 8, 2009	Third Consultation with IBWC and Mexico
May 1, 2009	Release of Draft YDP EA for Public Comment • Press Release • Notification of interested parties via email • Notification postcards mailed

Distribution List

Reclamation will provide notice of the availability of the Draft EA through postcards, emails, press releases and internet postings. In addition, notice of the availability of the Draft EA will be distributed to the following individuals, organizations and agencies:

Agencies:

Arizona Department of Environmental Quality
Arizona Department of Water Resources
Arizona Game and Fish Department
California Department of Fish and Game
Center for Biological Diversity
Central Arizona Project
City of Yuma
Coachella Valley Water District
Cocopah Indian Tribe
Colorado River Board of California
CONAGUA (Mexicali, B.C., Mexico)
Defenders of Wildlife
Environmental Defense
Fort Yuma Quechan Indian Tribe
Imperial Irrigation District
International Boundary and Water Commission, U.S. and Mexican Sections
Las Vegas Valley Water District
Living Rivers/Colorado Riverkeeper
Maricopa Audubon Society
Metropolitan Water District
Pacific Institute
Research Center for Food and Development (CIAD) – Sonora, Mexico
Rural Metro Fire Department
San Diego County Water Authority
Sierra Club—Southwest Rivers Committee
Sonoran Institute
Southern Nevada Water Authority
Squires Sanders and Dempsey, LLP
The Yuma Sun
U.S. Army Corps of Engineers
U.S. Customs and Border Patrol, Yuma Sector
U.S. Customs and Border Patrol, Washington Office
U.S. Bureau of Land Management, Yuma Field Office
U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office
Western Area Power Authority
Yuma Audubon Society
Yuma County
Yuma County Water Users Association
Yuma Regional Medical Center

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R.A. Youngs

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Appendices

A. LIST OF PREPARERS
B. COMMENTS RECEIVED ON THE DRAFT EA
C. CIENEGA DE SANTA CLARA LITERATURE REVIEW

Appendix A

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Appendix B

Comments Received on the Draft EA

RECLAMATION
Managing Water in the West

Yuma Desalting Plant Pilot Run Environmental Assessment

Appendix C

Cienega de Santa Clara Literature Review

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Technical Service Center, Denver, Colorado

Cienega de Santa Clara Literature Review

Yuma Desalting Plant Pilot Run Environmental Assessment
Yuma, Arizona
Lower Colorado Region

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Acronyms and Abbreviations

AF	acre-feet
Cienega	Cienega de Santa Clara
cfs	cubic feet per second
cm	centimeters
Demonstration Run	10 percent capacity test run of the YDP during 2007
Eh	reduction-oxidation potential
ET	evapotranspiration
IBWC	International Boundary and Water Commission
ha	hectares
m^3/s	cubic meters per second
MGD	million gallons per day
mg/L	milligrams per liter
MODE	Main Outlet Drain Extension
mV	millivolts
Pilot Run	Operation of the YDP at one-third capacity of the original design for 365 operating days during a twelve to eighteen month period
ppm	parts per million
Reclamation	Bureau of Reclamation
ROE	residue on evaporation
SIB	Southerly International Border
TDS	total dissolved solids
TSC	Technical Service Center
Typha	*Typha domingensis* (cattail)
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
YCR	Yuma clapper rail
YDP	Yuma Desalting Plant
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
WMIDD	Wellton-Mohawk Irrigation and Drainage District

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I. Purpose and scope of literature review

This work summarizes a literature review conducted during December 2008 and January 2009. The review focuses on the potential environmental effects of changes to the current discharges from the Main Outlet Drain Extension (MODE)[2] and the Bypass Drain to the Cienega de Santa Clara (Cienega) in Mexico as a result of a proposed temporary Yuma Desalting Plant (YDP) operation of 365 days within 12 to 18 months at one-third capacity (Pilot Run). This review addresses the potential effects of the proposed Pilot Run on Cienega water quality, water quantity, wetland acreage, and habitat for selected fauna (desert pupfish [*Cyprinodon m. macularius, C. m. eremus*], Yuma clapper rail [*Rallus longirostris yumanesis*] [YCR], and migratory shorebirds/waterfowl).

This work reviewed existing scientific literature; no new science was performed. This literature review does not make a recommendation concerning the operation of the YDP and the Cienega; however, it does provide information to consider for such decision making.

II. Compilation of collected reports and data

The Bureau of Reclamation's (Reclamation) Technical Service Center (TSC) identified over 180 published and unpublished reports, articles, and dissertations, pertaining to the potential impacts of the YDP Pilot Run on the Cienega. Over 150 of these were reviewed. This list of identified documents is found in Section IV, Literature Review.

The quality, thoroughness, comprehensiveness, and consistency of the existing literature were noted to be highly varied. For example, several contradictions in species preference to specific habitat metrics were noted in the literature. Terms for the Cienega varied, including "marsh," "slough," "wetlands," and the Cienega. For this work, all of these terms were considered roughly equivalent.

[2] Note that this review uses "MODE" to refer to the Main Outlet Drain Extension above its endpoint at Morelos Dam, and Bypass Drain to refer to the drain from the end of the MODE to the Bypass Drain endpoint at the Cienega. The names of these drains vary in the literature.

III. Technical analysis

The Cienega is primarily comprised of *Typha domingensis* (common name "cattails" and referred to as "Typha"). Reports of the area's size ranged from approximately 8,000 to 11,000 acres.

The Pilot Run would be limited to 365 days of operation within a maximum of 18 months. The following assumptions were made:

- The YDP Plant would operate 83 percent of the time with 17 percent downtime.
- The Typha habitat and examined species would respond similarly to Pilot Run inflows as they have to previous Bypass Drain inflows.

Under these assumptions, water chemistry and hydrology for the Pilot Run would be within the historical range. The expected changes in MODE discharges would temporarily increase salinity and decrease flow volume to the Cienega.

III.A. Relationship between proposed YDP discharges to the Bypass Drain and Cienega inflows and water quality

The hydrologic assessment portion of this work reviewed historical aspects of the environment of the Cienega and the development of present-day conditions. The hydrologic evaluation also examined tidal influences within the Cienega. Provided and available data were evaluated to determine representative confidence intervals[3] to assess water quantity and water quality of MODE inflow and from the Bypass Drain. Note that these are not the only sources of water for the Cienega.

The current flow stream of the Bypass Drain is indicated to be about 107,000 acre feet per year (148 cubic feet per second [cfs]) at about 2,660 parts per million (ppm) total dissolved solids (TDS).[4] For the Pilot Run, estimated water quantity and water quality of the Bypass Drain flow stream would be about 77,000 acre feet per year (106 cfs) at about 3,200 ppm TDS. Other indicated inflows[5] to the Cienega are estimated to range from about 22,800 acre feet per year (31.5 cfs) to

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[3] Confidence intervals are used in statistical analysis to indicate the reliability of an estimate.

[4] For the Colorado River, salinity and TDS can be considered synonymous. In this appendix, the terms are used interchangeably.

[5] Includes Riito Drain and groundwater to the Cienega.

about 35,100 acre feet per year (48.5 cfs). The corresponding salinity of these other inflows is estimated to be from about 3,680 ppm TDS to about 2,860 ppm TDS (Reclamation 2008e). Current water quality within this wetland ranges from about 3,000 ppm TDS at the inflow area near the terminus of the Bypass Drain to about 6,000 ppm TDS at the southern edge of the Cienega. Figure 1 depicts the intended Pilot Run flows and consequent water quality in the MODE and flows to the Cienega. Table 1 presents the estimated annual Bypass Drain flows at Southerly International Border (SIB) from 1978 to 2008, as provided by the International Boundary and Water Commission (IBWC) and Reclamation (2008e). Data are sourced in cubic meters per second (m^3/sec) and converted to acre-feet (AF) for this table. Values are approximate.

Table 1. Calendar year annual flows of the Bypass Drain at the SIB, from 1978 to 2008 in AF.

Year	Annual Flows
1978	180,356
1979	177,920
1980	154,623
1981	148,420
1982	149,677
1983	169,577
1984	125,232
1985	129,426
1986	109,969
1987	97,627
1988	119,422
1989	138,525
1990	133,609
1991	140,682
1992	98,833
1993	61,430
1994	124,421
1995	125,341
1996	112,379
1997	89,144
1998	113,756
1999	78,667
2000	107,431
2001	103,734

Table 1. Calendar year annual flows of the Bypass Drain at the SIB, from 1978 to 2008 in AF.

Year	Annual Flows
2002	121,668
2003	114,721
2004	98,800
2005	107,421
2006	107,299
2007	105,275
2008	115,499

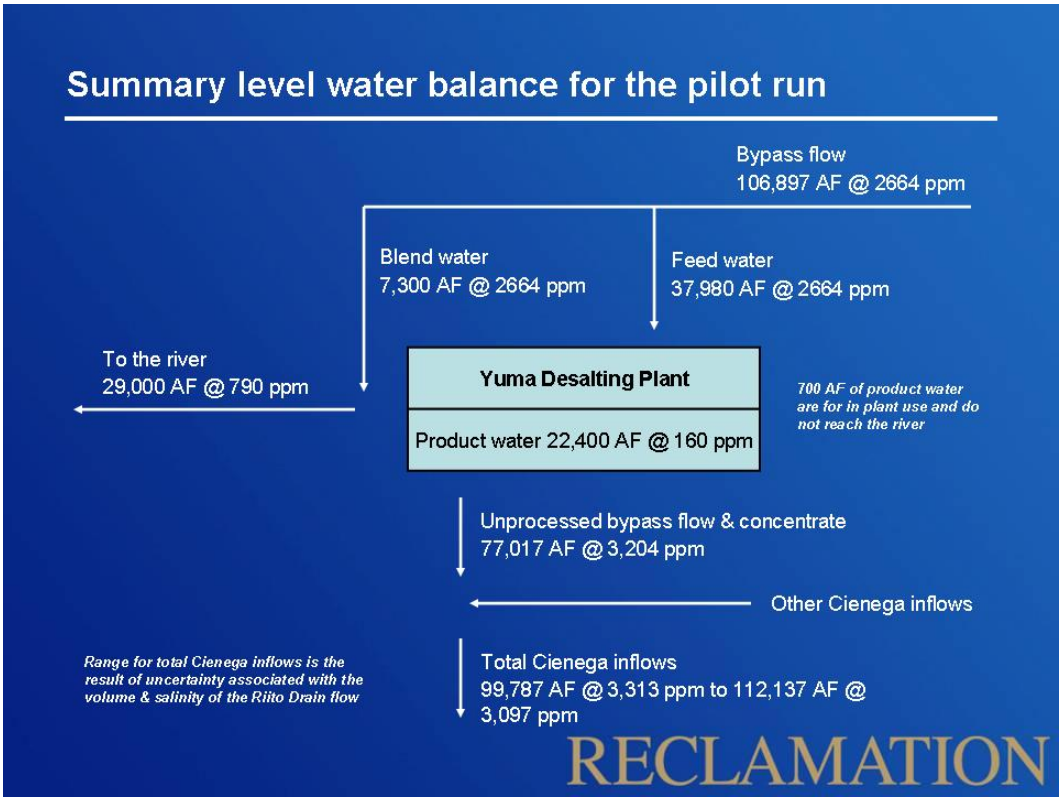

Figure 1. Summary level water balance (Reclamation 2008e).

III.B. Cienega inflow under current conditions and under proposed Pilot Run conditions

Pursuant to the IBWC Minute 242, drain-water discharges from the MODE to the Bypass Drain began in 1977. The terminal end of the Bypass Drain is at the head of the Cienega, immediately adjacent to the terminal end of the Riito Drain (as it is commonly termed in the literature).

The Riito Drain inflow is not controlled by Reclamation. The documented history of the Riito Drain's inflows is very widely varied in volume, salinity, and selenium (Cohen and Henges-Jeck 2001, Burnett et al. 1993, Burnett et al. 1997, University of Arizona 2007, and Flessa and García-Hernández 2007).

Water provided by the Bypass Drain was somewhat less saline than the inflow from the Riito Drain. Over time, the marshland attendant to the inflow from the Riito Drain expanded from the additional Bypass Drain inflow. Together, these two sources of water have produced the large wetland known as the Cienega.

The initial quality of water from the Bypass Drain (beginning in 1978) averaged about 3,500 ppm TDS. With time, water quality improved to about 2,500 to 2,600 ppm TDS as the quality of pumped drainage from the Wellton-Mohawk Irrigation and Drainage District (WMIDD) improved. From 1995 to 2007, the quantity of water delivered to the Bypass Drain has generally averaged about 150 cfs—or about an average of 108,600 AF per year. Annual flows from 1995 to 2007 ranged from a low of 78,667 AF in 1999 to a high of 125,341 AF in 1995. Flows before this time period had wider ranges (Table 1). For the Pilot Run, indicated water quantity and water quality of the Bypass Drain flow stream are currently estimated to be about 77,000 AF per year (106 cfs) at 3,200 ppm TDS. While inflow represented by the Bypass Drain is measured at the border, the terminus of the Bypass Drain is about 35 miles south in Mexico, and these flows are largely unmeasured. Thus, flows may not represent conditions at the terminus of the Cienega. It appears at this time that the MODE flows at the SIB could be slightly outside of the historic range, so estimating vegetation responses within the Cienega becomes more unreliable.

III.C. Salinity and selenium concentrations under current conditions and under Pilot Run conditions

Total dissolved solids

The historical ranges of TDS and vegetative responses to those ranges indicate how future changes in TDS will affect vegetation. If inflows from the Pilot Run are within historic ranges, then it is more likely that vegetation responses will also be within these historic parameters.

The TDS of the WMIDD drainage water (which constitutes the water conveyed by the Bypass Drain) has been monitored by either the U.S. Geological Survey (USGS) or Reclamation since 1961 (Reclamation 2008b, Reclamation 2008c, and USGS 2008). Between 1961 and 1982, the USGS monitored the water quality discharge in the Wellton-Mohawk Main Outlet Drain upstream from Morelos Dam. The USGS TDS data are shown on Figure 2 using specific conductance in microsiemens per centimeter (µS/cm). The USGS sampled the drainage variably on a weekly to monthly basis over that period.

Figure 2 shows two measures of TDS, the sum of the constituents (sum of the major ions) and the residue on evaporation (ROE).[6] The TDS data are somewhat spotty in the early record and consist of periodic calculations of the sum of constituents. There are no ROE data prior to water year 1970. To show the patterns of variation in TDS prior to their availability, specific conductance readings are also shown on Figure 2. The data collection began at the time of the initial discussion with Mexico over the TDS of the water delivered under the Treaty of 1944, which entails the delivery of Colorado River water at Morelos Dam.

As shown on Figure 2, the TDS was between 6,000 and 7,000 milligrams per liter (mg/L) at the time that Mexico began to discuss the salinity of the Colorado River. In addition, the TDS was highly variable. Over the years, both the TDS and its variability have decreased, reflecting a combination of management actions and a decrease in the TDS of the WMIDD drainage. At the end of the USGS water quality monitoring record, the TDS of the drainage was around 3,000 mg/L (Figure 2).

Reclamation began monitoring the TDS of the Bypass Drain at the SIB in 1978. The Reclamation data are plotted on Figure 3. The Reclamation data indicate that the decline in TDS of the WMIDD drain water (shown between 1961 and 1982 on Figure 2) has continued and appears to have leveled off in the mid -1990s (Figure 3).

The TDS of the water in the Bypass Drain decreased from about 3,500 mg/L to about 3,000 mg/L between 1978 and 1983 (Figure 3). There was a decrease in TDS to around 700 mg/L during much of 1983 and 1984 after large-scale flooding of the lower Colorado River. The TDS gradually increased in the following years back to around 3,000 mg/L. There was another large-scale decrease in TDS during 1993 and 1994, to between 500 and 1,500 mg/L, following flooding on the Gila River. After that flood, TDS of the Bypass Drain increased, but TDS has stabilized at around 2,500 mg/L (Figure 3). This period of relatively stability (i.e., 1995 through 2007) was used to assess the effects of the YDP on the TDS of the Bypass Drain.

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[6] ROE = weight of residual salts.

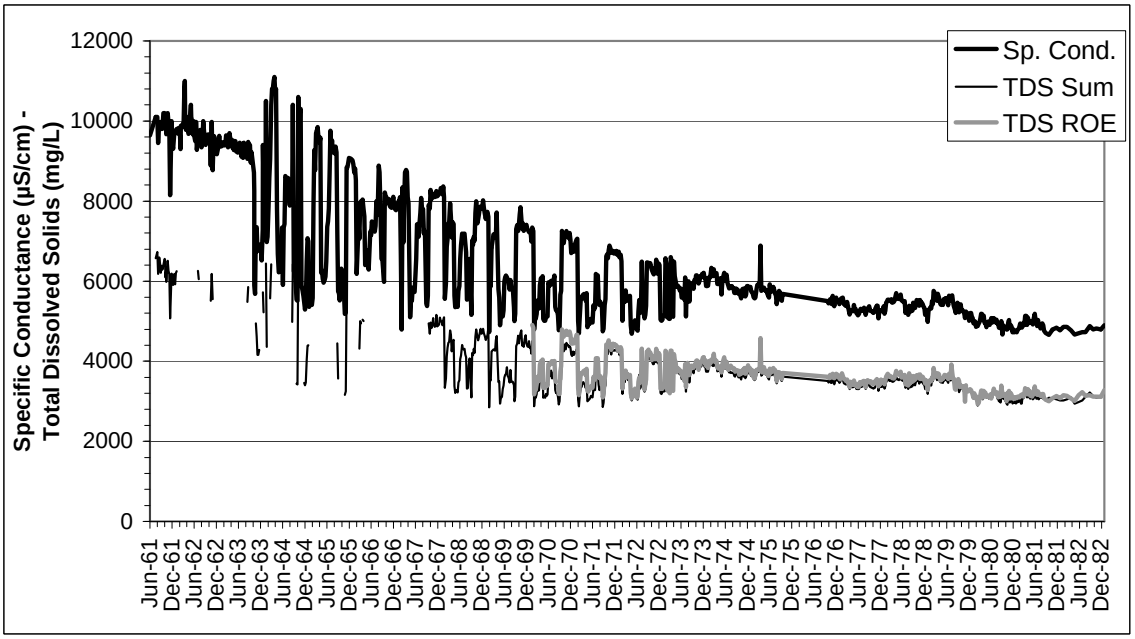

Figure 2. Specific conductance and TDS of the Wellton-Mohawk Main Outlet Drain near Yuma from June 1961 through December 1982 (data from USGS 2008).

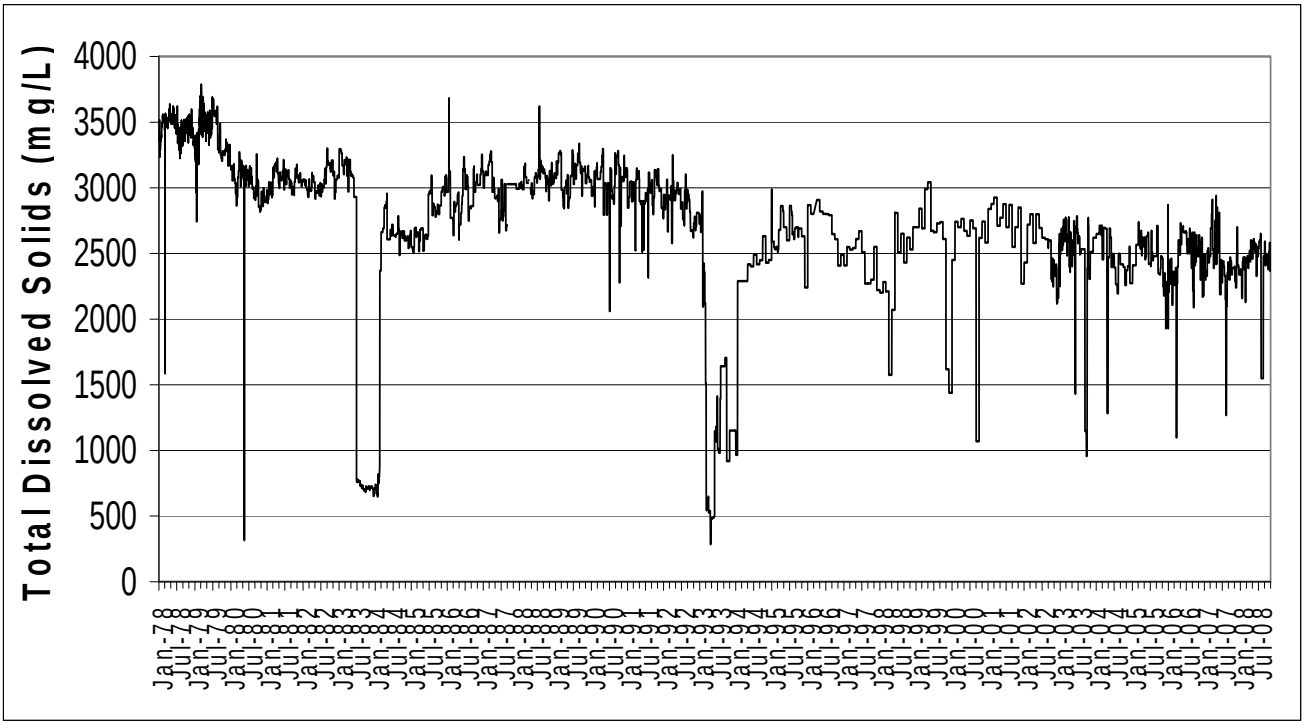

Figure 3. TDS concentrations in the Yuma Bypass Drain from January 1978 through October 2008. (Data from Reclamation 2008b and Reclamation 2008c).

The chemical composition of the WMIDD drainage has also changed. The ionic composition of the TDS from the USGS data set is shown on Figure 4. The plots, which are intended to show the general trends in the percent composition of the major ions, indicate that there was an increase in sodium at the expense of calcium and magnesium among the cations, accompanied by a large-scale decrease in chloride and increases in sulfate and bicarbonate from1961 through 1982. As a result, what was a sodium-chloride-type water in 1961 became more of a sodium-chloride-sulfate-type water by 1982. There are no ionic data available after 1982 to evaluate whether the composition has changed further.

Method of analysis

The effect of the operation of the YDP during the Pilot Run is evaluated based on information on the operation as described in Reclamation 2008b. Based on that information, the maximum diversion to the YDP was set to one-third of the 100 million gallon per day (MGD) capacity of the plant (33.3 MGD or 51.5 cfs). The diversion was partitioned into 70 percent as the product water and 30 percent to the concentrate stream. These flows amount to 36 cfs for the product water and 15.5 cfs for the concentrate stream. The YDP was assumed to operate 83 percent of the time with 17 percent of the time down for maintenance. This was simulated by running the plant for 25 days, followed by 5 days of down time.

The TDS of the concentrate stream was calculated based on assumptions about the net effect of treatment and pre-treatment in the YDP. Pre-treatment involves lime-softening and pH control to prevent scaling of the membranes. Softening was estimated to reduce the TDS of the YDP inflow to 85 percent of the TDS of the drain water. After the pre-treatment, the TDS was adjusted using a concentration factor calculated from the ratio of the reject flow to the original diversion: 15.5 cfs/51.5 cfs = 0.3. The concentration factor is the reciprocal of the ratio or 3.3. The concentrate stream was then mixed back into the depleted Bypass Drain flow and the TDS was recalculated using the standard mixing equation. If the flows in the Bypass Drain were less than 51.5 cfs, the entire flow was diverted and the TDS of the Bypass Drain was the same as the concentrate stream. However, if the flow in the Bypass Drain was very low (< 10 cfs), it was assumed that the YDP would not operate. Actually, the threshold flow at which the YDP would not operate is likely to be higher than that assumed level. However, these assumptions seem adequate for this analysis.

Effects of the Pilot Run on TDS at the SIB

The hydrologic conditions under which the Pilot Run will be operated can not be anticipated. However, it is reasonable to assume that conditions will not differ significantly from previous conditions. The changing flows from the Pilot Run could be compared to previous flows. While hydrologic conditions may differ in the future, understanding the effects that the Pilot Run would have had provides a rough estimate of what could happen.

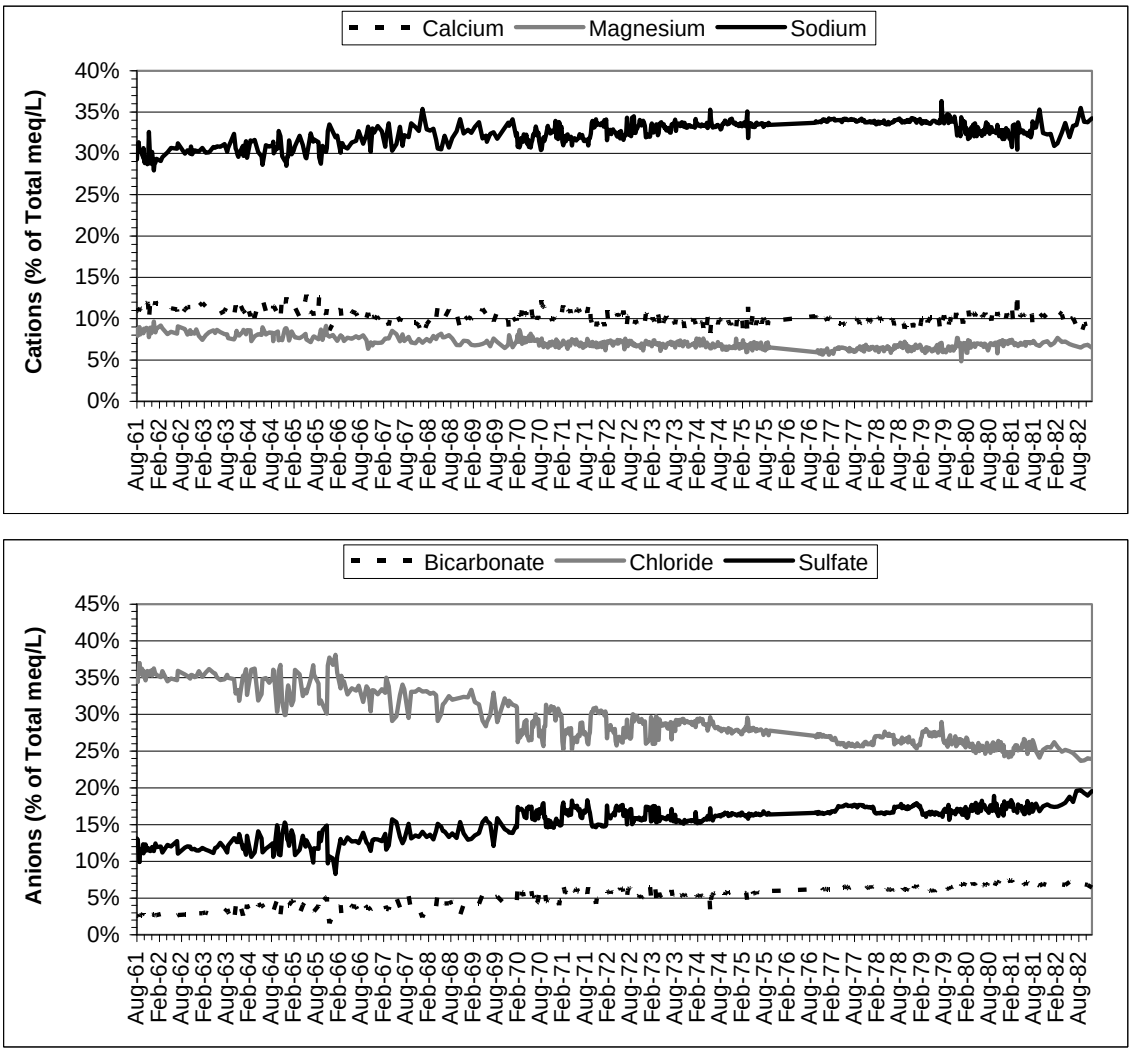

Figure 4. Percent composition of the TDS between 1961 and 1982.

The TDS changes were calculated based on simulating the conditions from the Pilot Run for previous hydrologic years (1995 – 2007). The results were broken into one year summaries. Because the data were evaluated on an annual basis and the 2008 data set was incomplete, the 2008 data were not used in this simulation. The median TDS for each of the years along with the 25th and 75th percentiles (first and third quartiles, approximately 1 standard deviation) are plotted on Figure 5. The results shown on the plot indicate that there is no overlap in the quartiles for the historic TDS and that for superimposed YDP operation in most years. Exceptions include 1998 and 2002, when there is a slight overlap in the third quartile (upper limit) of the historic TDS and the first quartile of the Pilot Run TDS. The greatest change is represented by the 1999 conditions, when the historic TDS showed very little variation as indicated by the very tight error bars for that year. The Pilot Run TDS is estimated to be about 1,000 mg/L greater under the 1999 conditions.

In most years, the TDS of the two conditions run parallel with an apparent difference in the median annual TDS on the order of 500 mg/L (Figure 5). Overall, the historic median TDS of the Bypass Drain for the period 1995 through 2007 is 2,590 mg/L. The median TDS for that period with the Pilot Run superimposed is 3,180 mg/L, a difference of 590 mg/L.

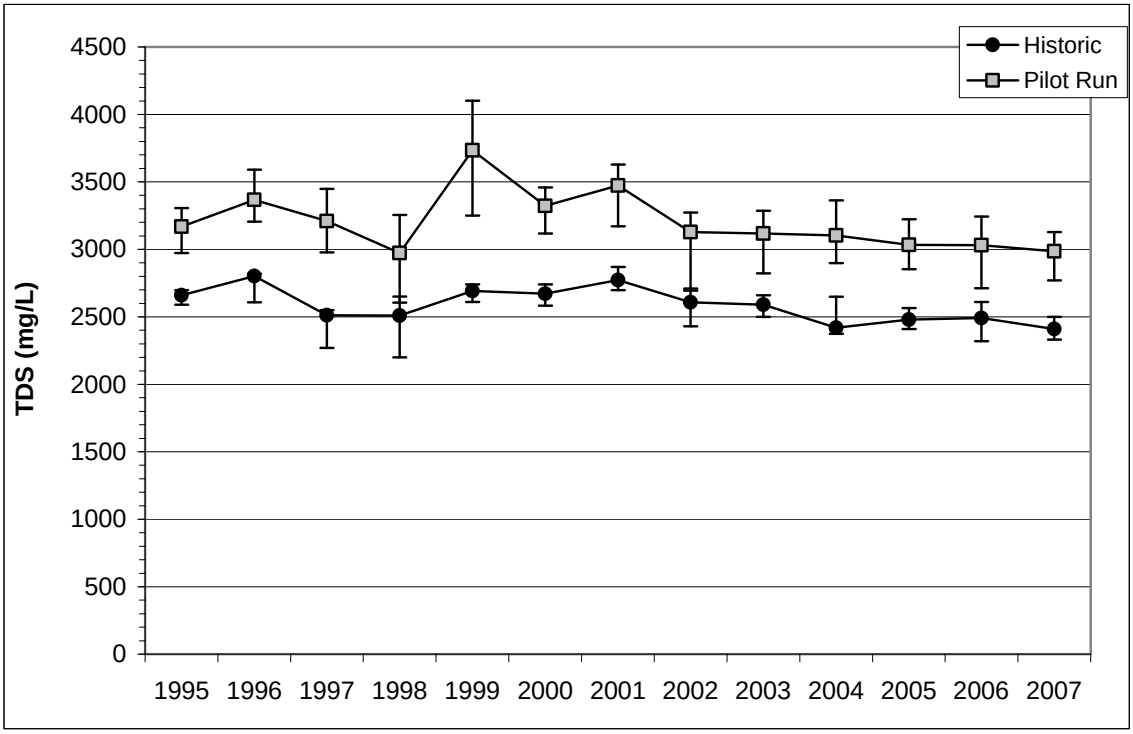

Figure 5. Historic and anticipated median annual TDS with the Yuma Desalting Plant Pilot Run under hydrologic conditions represented by 1995 through 2007.

Selenium

The U.S. Environmental Protection Agency (USEPA) criterion for selenium for freshwater aquatic life is 5 micrograms per liter (µg/L) (USEPA 2006b) and the criterion for drinking water standards is 50 µg/L (USEPA 2006a). The Mexican selenium standard for the protection of fresh water aquatic life, including wetlands, is 8 µg/L and 5 µg/L for aquatic life in coastal and estuarine waters (Translated from: Mexico, ConAgua (National Commission of Water), 2007).

Selenium data from the Bypass Drain are limited to eight samples collected at the time of the 10 percent capacity test run (Demonstration Run) of the YDP during 2007 (Flessa and García-Hernández 2007). Flessa and García-Hernández (2007) monitored "water quality at 16 stations, including the Cienega inflows (MODE and Riito), the marsh rim, and the vegetated core of the wetland. The Riito Drain was measured at points close to its entrance into the Cienega. The MODE was sampled under the last bridge before entering the Cienega." (Note that these locations were in Mexico.) The samples consisted of three prior to the Demonstration Run, four during the Demonstration Run, and one following the

Demonstration Run. The selenium concentration was slightly lower (average 1.9 µg/L) during the test, compared to an average of 2.1 µg/L in the non-test samples. The difference could reflect removal of selenium during pre-treatment at the YDP, seasonal differences, adsorption, or other factors during the two periods.

Flessa and García-Hernández (2007) also collected samples at five sites at the very beginning of the Demonstration Run. Those data showed selenium concentrations of 2.3 µg/L in the Bypass Drain and 2.1 µg/L in the Riito Drain. Selenium concentrations decreased within the Cienega – to 1.4 µg/L and then to 0.86 µg/L at the lower end of the vegetated zone. These results indicate that the selenium is being lost to either the sediments or the biota within the Cienega.

Data from García-Hernández et al. (2001a) indicate that selenium is being sequestered in the sediments within the Cienega. Other data show that there is some degree of biotic accumulation in the Cienega as well. Sediment selenium is very sensitive to the reduction-oxidation potential (Eh). Selenium solubility decreases with decreases in Eh. García-Hernández et al. (2001) investigated selenium concentrations in sediments and biota at 12 sites within the Colorado River delta, including the Cienega. The study was designed to "determine the distribution of selenium in bottom materials and ecosystems in the delta." The sediments in the Cienega were highly reducing (-90 millivolts [mV]). At that Eh and the pH (8.4) of the Cienega sediments, the selenium would be in the center of the stability field for elemental selenium in the selenium phase diagrams (Herring 1991 and Reddy and DeLaune 2008). In other words, the elemental selenium would be inert unless the Eh is raised significantly (something that is unlikely in wetlands soils).

The USGS collected two samples from the MODE upstream from the Bypass Drain in 1995 that included analyses for selenium. Those results showed selenium concentrations of 2 µg/L in March and <1 µg/L in June. These results indicate that lower selenium concentrations than those observed during the Demonstration Run are possible. However, there are no data on selenium removal by the YDP. If there is significant removal to the concentrate stream, then an increased concentration is possible. Alternatively, the data from the Demonstration Run indicate that lower selenium concentrations in the concentrate stream are also possible. The data collected during the Demonstration Run indicate that most of the selenium is lost in transit in the Cienega.

García-Hernández et al. (2001a) also investigated selenium concentrations in biota in a number of areas within the Colorado River delta. Selenium was elevated in some species but not in others. This would indicate that selenium is being lost to biota. However, species with reported elevated selenium are either not edible or are on a low trophic level (e.g. sailfin molly and brine shrimp). This suggests that there is a low probability of selenium bioaccumulation. More study would be required to accurately assess the impact of elevated selenium levels on the ecosystem's food chain.

Waterbirds exhibit some degree of species-specific variability in their sensitivity to reproductive effects of selenium. Three parts per million (ppm) is generally used as a baseline for selenium concentrations in various species of waterbird eggs from selenium-normal sampling sites. The EC_{50} (concentration where 50 percent of the population exhibits a response) for overt teratogenesis (birth defects) has been reported as 30 ppm for dabbling ducks (*Anatinae* ssp.), 58 ppm for black-necked stilts (*Himantopus mexicanus*), and 105 ppm for American avocets (*Recurvirostra Americana)* (Skorupa and Ohlendorf 1991). Rusk (1991) examined selenium concentrations in YCR from the lower Colorado River and indicated that they are at low risk of adult mortality from selenium but are highly susceptible to teratogenicity (risks of birth defects).

Selenium concentrations in waterbirds can vary even under relatively stable selenium levels in the environment, due to variable feeding habits and nesting conditions. Therefore, it is difficult determine specific effects of selenium on nesting success directly from field studies (Henny et al. 2000).

The existing information indicates that it does not seem likely that selenium levels would increase to levels that might present a biological problem in the Cienega during the Pilot Run. However, monitoring programs and comprehensive surveys would be needed to confirm this.

III.D. Relationship between Cienega inflows and wetland acreage (including open-water acreage)

Sykes (1937) described the Santa Clara Slough, the upper part of which was in approximately the same location as the present day Cienega. Sykes observed that by 1930, after the cessation of flow from the Colorado River, the Santa Clara Slough had become a vestigial, estuarine stream course within an expansive salt flat on the eastern edge of the Colorado delta. The geomorphic expression of the Santa Clara Slough was similar to a shallow, terminal basin with an overflow to the sea. Fresh-water inflows to fill this basin were essentially non-existent. A broad shoal blocked the outlet of this basin at low tide (Sykes, 1937). Occasional tidal inflow, however, would flood the slough to produce a shallow estuarine lake within this basin. Some of this water would drain back to the sea as tidal outflow, while evaporation consumed much of the water that remained—producing a vast salt-flat within the southernmost part of the Colorado River delta.

Irrigated agricultural development adjacent to the Limitrophe along the east side of the Colorado River in Mexico required drainage. The Limitrophe is the 23-mile segment of the lower Colorado River that serves as the international boundary between the U.S. and Mexico. The Riito Drain, which provides the conveyance channel for this drainage and flows through the then-abandoned Rillito Salado stream course, met this need. The Rillito Salado once carried over-

bank flood flows from the Colorado River as inflow to the head of the Santa Clara Slough. This drain discharged directly into the head of the Santa Clara Slough, having an estimated flow of 15 to 20 cfs with an average salinity of 5,200 ppm TDS (Reclamation 1975). By the early 1970s, effluent from the Riito Drain supported a small yet viable marsh about 150 feet wide and 3.5 miles long, with an area of about 75 acres. This marsh was completely isolated from the Colorado River, the Gulf of California, and seep-spring water along the base of the Desierto del Altar mesa escarpment to the east. At the terminus of this marsh in the salt flats, the salinity of the water was noted as high as 82,800 ppm TDS.

Variations in water quality and water quantity have been postulated to have a direct relationship to the area covered by viable marsh and the growth of that marsh within the wetland area of the Cienega (Burnett et al. 1993, Flessa and García-Hernández 2007, Garcia et al. 1999, Glenn et al. 1995, Tanner et al. 1997a, and Zengel et al. 1994). These studies have discussed the effect of increased salinity on the growth of Typha, with some discussion regarding the water requirements of this cattail species and the consequences of a decline in water supply. Burnett et al. (1993) presented a water budget and salt balance analysis regarding changes in marsh area due to YDP operations. Glenn et al. (1995) presented the results of greenhouse experiments with Typha that incorporated variations in salinity and observed changes in growth.

At present, given the limitations in the published literature regarding various study objectives and data about the Cienega, a clear, central hypothesis cannot be unambiguously evaluated regarding the impact to the Cienega from changes in the Bypass Drain inflow consequent to the Pilot Run operation of the YDP. These various published study objectives and data consider a range of conditions in the Cienega. For instance, a greenhouse study by Glenn et al. (1995) provided direct evidence of the effect of increased in salinity on Typha and the relative resilience of Typha specimens taken from the Cienega. Another study by Zengel et al. (1995) documented the effect of a substantial loss of inflow to the Cienega and relative resilience of the marsh to a return of the inflow. Several models are available that are based upon the hydrology and water chemistry of the marsh (e.g., Hucklebridge 2008, Burnett et al. 1993, and Tanner et al. 1997). Although these models may have similar conceptual bases, they differ in approach and in detail regarding their methodology in portraying the effect of changes in salinity and volumetric inflow to the marsh. For example, the model developed by Hucklebridge is the most comprehensive and temporally based. As stated by Hucklebridge, the model "is designed primarily as a management tool to predict large-scale changes over relatively long time scales [yet] is not precise enough to evaluate small-scale wetlands dynamics and should not be used in these types of applications." The models by Burnett et al. (1993) and Tanner et al. (1997a) are concise calculation procedures that predict the total changes in wetland area based upon the changes in the salinity and quantity of water coming into the Cienega. But these models do not consider the temporal aspect of these changes. Consequently, use of models and other various studies providing data related to

the Cienega gives no clear path for the evaluation of a central hypothesis regarding the impact of the YDP Pilot Run.

III.E. Relationship between Cienega salinity and wetland vegetation (Typha)

The relationship between Typha and salinity levels has been studied in both laboratory settings and through field observations directly on the Cienega. Zengel et al. (1995) reported that Typha is the dominant plant in the Cienega, densely covering the uppermost 10,300 acres of the wetland.

Although Typha is the predominant plant species, there are many other plant species in the Cienega that may be significant to wildlife habitat and that could also be affected by changes in salinity. A total of 24 wetland emergent plant species have been cataloged within the Cienega (Zengel et al. 1995). In addition to wetland species, many mesic[7] and upland species are known to provide habitat for a number of wildlife species. Other plant species of potential interest include rushes (*Juncus* spp.), saltgrass (*Distichlis spicata*), iodinebush (*Allenrolfea occidentalis*), saltcedar (*Tamarix*. spp.), phragmites (*Phragmites communis*), creosotebush (*Larrea tridentata),* white bursage (*Franseria dumosa*), and saltbush (*Atriplex polycarpa*).

Some of the studies have provided valuable information regarding the assessment of changes in the growth of Typha and changes in the area of vegetation due to changes in water quality and water quantity. Changes in water levels and correlating changes in salinity may affect where Typha is able to grow. Davis (1994) reported the optimal depth for Typha was 58-105 cm (19 to 34 feet).

Lab studies were conducted by the University of Arizona with root-stock of Typha taken from Cienega and treated with water of varying salinity levels (Glenn 1995). The response of Typha to increasing salinities was somewhat variable, but generally there were reductions in growth and plant vigor starting at salinities above 3,000 ppm. At 5,800 ppm, total dry matter production was reduced by 50 percent, at 8,000 ppm, new shoot initiation was reduced by 50 percent, and plant height was reduced by 50 percent at 9,500 ppm. Plants would not grow when treated with water above 10,000 to 11,000 ppm and appeared dead; only 1 out of the 4 plants recovered when treated with fresh water. These findings generally coincide with Burnett et al. (1997), who reported the salt tolerance of Typha to be 5,000 – 6,000 ppm.

Field observations of Typha and water salinity levels at the Cienega by Glenn et al. (1995) indicated that the plants were predominantly found in areas with salinities less than 6,000 ppm, although it was noted that stands in salinities

[7] Habitat with a moderate or well-balanced supply of moisture.

higher than 3,000 ppm were of reduced stature and vigor. Typha was not found in areas with salinities higher than 8,000 ppm. This correlates relatively well with the complementary lab studies done in the same publication.

Lab studies by Glenn et al. (1995) reported transpiration rates of Typha from 1.65 centimeters (cm)/day in fresh water to 0.42 cm/day at 15,000 ppm (above mortality level). Evapotranspiration (ET) was cut in half at salinities of 7,900 ppm, and water-use efficiency is reduced by 50 percent at 6,200 – 7,400 ppm. Glenn et al. (1995) extrapolated the lab-generated ET rates to the Cienega summer ET rates to 1.65 cm per day – 0.42 cm/day, which is the same as the 0 – 15,000 ppm range. However, because the discharge from the Bypass Drain is higher than 0 ppm TDS and Typha does not grow in areas of the Cienega where TDS is higher than 8,000 ppm, it is likely that the actual range of Typha ET is narrower than reported in Glenn et al. (1995). It should also be noted that the methods used by Glenn et al. (1995) are likely not a highly accurate representation of ET by plants in a natural setting. More sophisticated techniques are currently available to monitor field level ET rates using mass and energy flux measurements.

Several models of the relationship between salinity and Typha ET have been generated. Tanner et al. (1997b) explored models in which ET is a function of salinity levels alone, and in which ET is a both a function of—and contributes to—salinity levels by evaporative concentration. The output of these models is a graph of the relative value of inflow water versus salinity. Both models assumed 6,000 ppm as threshold for Typha growth, based on Glenn et al. (1995).

Typha generally shows tolerance to relatively high salinities, but as levels increase they exhibit lower vigor, growth, germination, and ET rate. As salinity levels increase, osmotic potential for water uptake through the root system declines and subsequent transpiration is thus reduced. This is the primary way that increasing salinity levels deter growth and shoot germination as well as reduce the vigor of plants.

III.F. Potential changes to selected fauna habitats and populations from a proposed Pilot Run

Selected fauna

Numerous fauna use the Cienega for breeding, feeding, and as a migration stopover. Of the most concern are the federally endangered YCR and desert pupfish. Although most studies have focused on these two species, it should be noted that other "species of concern"[8] (as classified by the U.S. Fish and Wildlife

[8] This work does not summarize the sightings of these species.

Service [USFWS])[9] have been observed at the Cienega, and may be affected by the Pilot Run. These include the California black rail (*Laterallus jamaicensis corurniculus*) and the gull-billed tern (*Sterna nilotica vanrossemi*).

Yuma clapper rail

The YCR was listed as an endangered subspecies in the U.S. in 1967 (32 FR 4001, 11 March 1967). The Yuma clapper rail recovery plan was signed in 1983 (USFWS 1983). Regarding populations of YCR in Mexico, USFWS stated: "There are significant differences in the level of protection and management afforded to the clapper rail in the United States and Mexico. United States populations are considered endangered under the Endangered Species Act and the United States' population is significant because its loss would significantly reduce the range and numbers of the subspecies" (USFWS 2006a). The Mexican population is included in NOM-059-SEMARNAT-2001 as a threatened, non-endemic species. The species is also one of the conservation priorities for the Upper Gulf of California Biosphere Reserve and the Colorado River Delta.

The YCR inhabit vegetated wetland areas with relatively stable water levels and are found primarily in Typha and cattail/bulrush stands and occasionally in common reed (*Phragmites australis)*, saltcedar, arrowweed (*Pluchea sericea*), and iodinebush. It is relatively consistently reported that water and vegetation are significant factors in determining the quality of YCR habitat. The limiting factors for the YCR have been reported as availability of suitable habitat and food (USFWS 1983).

The total number of YCR in the Cienega is unknown. Surveys conducted at the Cienega vary widely in their population estimates. These variations are due to different sampling and extrapolation methods. Table 2 summarizes the numbers of YCR found in the Cienega from various studies. Note that this table does not show all of the population estimates but samples studies to illustrate the wide diversity of numbers.

Observed relationships between multiple habitat variables and YCR populations from the existing literature are summarized here. Note that these summaries do not constitute predictions as to the probable outcome of YCR populations from the Pilot Run.

[9] "Species of concern" is an informal term that refers to species which the USFWS believes might be in need of concentrated conservation actions. Species of concern receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species.

Table 2. Estimated population densities for YCR in the Cienega.

Reference	Estimate of total area ac (ha)[1]	Methodology	Estimate of total population of YCR	Estimate of YCR per acre (ha)
Piest and Campoy 1998	3,600 (8,900)	Surveyed 7.5 percent and factored in response percentages (60 percent) and extrapolated to entire habitat.	5,300	0.60 (1.47)
Eddleman 1989	NA	1.25 km transect, assumed to represent 10-20 percent of available habitat. Assumed 100 percent response.	210-420	0.12 (0.29)
Abarca et al. 1993	4,500 (11,100)	Used Eddleman 1989 estimate of 7 ha per pair.	1,280 (640 breeding pairs)	0.11 (0.28)

[1]Converted from hectares (ha) to acres. Approximate conversion was 1 hectare = 2.47 acres.

There is some variation in the literature as to the nature of preferences to specific habitat characteristics such as shorelines, vegetation densities, and proximity to open water. Several studies report a bias of YCRs toward margin habitats (interface between land and water) such as shorelines or hummocks, attributing the preference to lower stem densities and heights in shallower areas and the presence of loafing areas for adults and rearing areas for young. Piest and Campoy (1998) observed more YCR per ha of cattails along shorelines (1.09, 0.44 per acre) than the interior (0.79, 0.32 per acre). Todd (1986) also concluded that YCR had an affinity for shorelines. Conway et al. (1993) reported an avoidance of shorelines during the late breeding season through early winter.

There are also contradictory reports of YCR inclination for cattail stem densities and habitat adjacent to open water. Conway and Nadeau (2005) state that cattails can become too dense and senescent to support high densities of YCR. In contrast, Tomlinson and Todd (1973) stated that the YCR commonly inhabit dense cattail and bulrush stands, and Rosenberg et al. (1991) reported that they prefer the tallest and densest cattail marshes. Piest and Campoy (1998) observed no preference by YCR either for or against habitat next to open water. However, Tomlinson and Todd (1973) reported that the YCR selected areas with shallow water where mud flats were prevalent for feeding grounds and that the densest populations were found in stands of vegetation divided by narrow channels of open water.

The quality of YCR habitat has been correlated with the successional stages of a wetland, which is primarily a product of hydrologic regimes and disturbances (such as fire and grazing) (Hinojosa-Huerta et al. 2008). They reported two examples:
1) changes in flow direction at the Cienega in 2003 promoted Typha growth at new sites that resulted in a population increase and shift in distribution towards these younger Typha stands and 2) a wildfire that burned 4,940 acres (2,000 ha) in the central portion of the Cienega in the early part of 2006. In the latter case, Typha was observed growing back by late spring of the same year. Yuma clapper

rail populations subsequently increased throughout the re-sprouted burned area. Other studies have shown similar Typha responses to burning and successive YCR usage of these areas (Piest and Campoy 1998 and Todd 1980). Ideally, YCR habitat would consist of a dynamic mosaic of age classes from regular disturbances such as fire to prevent senescence and overly dense vegetation (Hinojosa-Huerta et al. 2008 and Conway et al. 1993).

Both intentional and unintentional fires have been reported at the Cienega. Conway et al. (1993) theorized that the burning of marshes may benefit YCR by reducing stem densities and litter. Piest and Campoy (1998) did surveys just after a fire where an estimated 70-80 percent of cattail habitat had burned. They found that YCR use of burned and unburned habitat differed little. They reasoned that this was likely due to dramatic regrowth of the vegetation, as burned areas were visually similar to unburned areas at the time of the surveys. Todd (1980) also noted vigorous regrowth of Typha after burning, with no apparent affect on YCR densities the following season.

The literature describes nesting habitats of the YCR in various ways. Most sources report that YCR nests are found in dense vegetation along shorelines or small high sites within marshlands (Arizona Game and Fish nd). Yuma clapper rails have been noted to adapt to changes in nesting areas: Arizona Game and Fish (nd) reports that the YCR will renest if eggs are lost. Conway and Eddleman (2000) report that males may build multiple nests that "can be used for incubation if predators or high water disturb the primary nest." They noted that "adults have the extraordinary ability to carry eggs in their bills to a new nest." Conway and Eddleton (1998) reported that for clappers in general, "Nest success is typically high in high-quality habitats; flooding and predation are the principal causes of nest failure. Pairs may renest up to 5 times after failure of previous nests, allowing populations to withstand significant losses of nests." Therefore, nesting success is likely not a limiting factor for the YCR.

Yuma clapper rails are known to have a diet consisting mainly of crayfish, insects, and fish. Other preferred food items include clams, frogs, isopods, spiders, snails, small seeds, and some plant species (Arizona Game and Fish Department nd). They forage on mud flats, sandbars, and within stands of vegetation (Todd 1986).

Movement patterns of YCR (including migration and dispersal) between the United States and Mexico are not well understood. Some evidence suggests that YCR can travel significant distances and successfully disperse to new habitats (USFWS, 2006). However, some localized YCR populations may be resident (Eddleman 1989 in USFWS 2006). USFWS reports that "habitat that can be used by migrating, dispersing or transient individuals connects the [lower Colorado River], Gila River, and Mexican populations, so movement of individuals is not precluded." As migration is not precluded, Mexican populations of the YCR may be significant to U.S. populations (USFWS 2006).

Field observations and laboratory studies have demonstrated a negative correlation between increasing water salinities and Typha height, density, and vigor; as discussed above. Studies from the Cienega have found a positive association with YCR abundance and Typha and thus have correlated YCR densities indirectly with water salinity. Yuma clapper rails were not discovered in zones with salinities higher than 8,000 ppm (Garcia et al. 1999 and Hinojosa-Huerta et al. 2008).

Potential changes to YCR populations from the Pilot Run are anticipated to depend largely on changes to Typha distribution, densities, plant vigor, and senescence. However, other factors such as the presence of shallow-water areas, adjacent margins and shorelines, and food sources will also affect populations and may not follow a simple correlation with changes in Typha and/or inflow. Habitat variables exhibit an interconnecting web of relationships that are often difficult to predict.

Desert pupfish

Among numerous fish species found in the Cienega were carp (*Cyprinus carpio*), mosquito fish (*Gambusia affinis)*, red shiner (*Cyprinella lutrensis*), mollies (*Poecilia* ssp.*)*, and desert pupfish, with the desert pupfish noted as by far the most numerous species—comprising about 80 to 90 percent of the fish fauna in the marsh (Reclamation 1975).

The desert pupfish was listed as an endangered species in 1986 (50 CFR Part 17, Mar 31, 1986). The reasons for listing included: habitat loss and modification due to dewatering of streams and marshlands, stream impoundments, channelization, diversion, livestock grazing, mining, pollution and interactions with predatory and competitive non-native fishes (USFWS 1992). Desert pupfish inhabit primarily shallow (<30 to 40 cm) water with little or no emergent vegetation and soft bottoms (mud or grass) (Abarca et al. 1993). These areas are often shallow pockets of water with little or no connectivity to the main water body, where predator fish can not penetrate (Zengel and Glenn 1996). Desert pupfish are known to tolerate extreme environmental conditions, including extremes in water temperature (up to 45º C), oxygen levels (as low as 0.1-0.4 mg/L), and salinity (as high as 68,000 ppm) (Marsh and Sada 1993, Lowe et al. 1967, and Barlow 1958).

Various piscivorous birds along with the Virginia rail and the endangered YCR inhabit the Cienega (Reclamation 1975). The threat of exotic fishes to the desert pupfish in Mexico has been noted (Hendrickson and Varela-Romero 1989). Desert pupfish can not thrive in the presence of exotic fish as they are susceptible to predation and interruptions in breeding (Marsh and Sada 1993 and Hendrickson and Varela-Romero 1989). Marsh and Sada (1993) identified control of non-native aquatic species as a primary requirement for recovery of the desert pupfish throughout its range.

Increased salinity of inflows to the Cienega will likely not be detrimental to the pupfish directly. However, food sources may change in response to increased salinity (Abarca et al. 1993). Because the desert pupfish are known to have a diverse diet of macroinvertebrates, algae, etc., it is difficult to predict how changes in salinity will affect these sources and how the desert pupfish may respond to these changes. Therefore, no direct correlation can be made between possible increased salinity due to a proposed Pilot Run and a decline in desert pupfish numbers.

A potential effect of the Pilot Run to the desert pupfish would likely be from the decrease of inflow to the Cienega. Decreased flows may diminish established shallow habitats and force desert pupfish into deeper areas where exotic fish dominate. Conversely, current areas of deep water habitat may be converted into shallow habitat more suitable to the pupfish. Because detailed topographical data from the Cienega are unavailable, it is not possible to determine the changes in shallow and/or deep-water habitat. Thus, an accurate analysis of the habitat changes—and therefore the extent of changes—in predation can not be made.

Other bird species

The Cienega is used by many bird species, including shorebirds, wading birds, marsh birds, and migratory waterfowl. These birds depend heavily on benthic (bottom-dwelling) macroinvertebrates as a food source. Changes in water salinity may cause loss or degradation of these benthic communities. Additionally, changes in water salinity and outflow may reduce shoreline vegetation such as bulrush, common reed, and saltgrass. These edge habitats, shallow water, and mud flats usually have more diverse vegetation and provide foraging areas and shelter for many migrating and shore birds (Hinojosa-Huerta et al. 2001a).

There is a deficiency of information on population dynamics of the numerous bird communities at the Cienega. Without definitive baseline data on these populations, it is not possible to predict or monitor changes from the proposed Pilot Run.

However, no existing information within the reviewed literature was found that would indicate that the water quantity and quality in the Bypass Drain predicted for the Pilot Run would cause noteworthy effects or a temporary change in bird populations and species diversity.

Selenium effects

See previous section, "III.C. Salinity and selenium concentrations under current conditions and under Pilot Run conditions" for a discussion of selenium effects to wildlife.

III.G. Duration of potential effects on Cienega habitat and time needed for Cienega habitat to respond to potential inflow changes

Predicting the chain of events in a wetland that will follow changes in inflow is difficult. Initially, vegetation, macroinvertebrates, and other habitat variables will respond to inflow changes, followed by wildlife responses to these changes in habitat, each of which may have some lag between when inflow changes initiate and when effects are seen. These habitat changes will obviously depend on the rate of change in water levels and salinity, which will in turn depend on the potential inflow changes.

Variations in water quality and water quantity have been postulated to have a direct relationship to the area covered by viable marsh and the growth of viable marsh lying within the wetland area of the Cienega (Burnett et al. 1997, Flessa and García-Hernández 2007, Garcia et al. 1999, Glenn et al. 1995, Tanner et al. 1997a, and Zengel et al. 1994). These studies have discussed the effect of increased salinity on the growth of Typha, with some discussion regarding the water requirements of this cattail species and the consequences of a decline in water supply. Burnett et al. (1993) presented a discussion and simple model regarding changes in marsh area due to operation of the YDP. Glenn et al. (1995) presented the results of greenhouse experiments with Typha that incorporated variations in salinity and observed changes in growth.

A study by Zengel et al. (1995) observed recovery of wetland vegetation at the Cienega after a period of minimal to no inflows from the Bypass Drain. The Bypass Drain was shut down for repairs for a period of eight months, during which flows were estimated at 0 to <18 cfs. They observed large reductions in living above-ground vegetation two months after the flows were reduced. Net reductions in vegetation were estimated at 70 percent for the upper Cienega, 67 percent for the mid-central section, and 38 percent in the lower Cienega (mean net reduction of 58 percent) during this time. Living vegetation was restricted to narrow bands and several isolated patches around small open-water areas along the borders of channels. Eight months after the initial shut-down, the flows were restored. One month after flows were restored, it was informally noted that the

marsh area was flooded but that the vegetation had not recovered and that fire had burned large areas. Ground surveys were performed four months after flow restoration and observed full and vigorous vegetative recovery (Zengel et al 1995). Note that this study was performed in conditions that were not similar to the conditions that would prevail under the Pilot Run, as flows would still be much higher than reported in Zengel et al. (1995). However, the results from Zengel et al. (1995) do indicate that the vegetation of the Cienega can go dormant and survive for extended periods of time under dry conditions (Zengel et al. 1995). Under the temporary reduced flows of the Pilot Run, portions of the vegetated area may become dormant, albeit most likely in different patterns and on a smaller scale than Zengel et al (1995). Typha is known to be able to survive up to several years of droughty conditions (a prolonged period of low or no moisture on a local scale) (Beare and Zedler 1987, Glenn et al. 1995, and Felger 1992).

Another possibility is that these plant species may recover from longer periods of localized lower-water conditions (Beare and Zedler 1987, Glenn et al. 1995, Felger 1992, and Zengel et al. 1995). Even if existing plants exceed dormancy potentials and die, reproductive biomass (e.g., seeds, rhizomes, and tubers) may remain viable for much longer. In addition to a “bank” of these structures in the soil and litter from pre-existing vegetation, other seed sources that are wind or water-borne can colonize suitable sites across long distances. Salinity tolerances for seed germination may be less than that of rhizomes (Beare and Zedler 1987). The recovery time after flows are restored and species’ diversity and populations have returned to levels observed before the drought period depends on the level and timing of flows and salinity, as well as the amount and distribution of reproductive biomass.

Nevertheless, Typha is relatively resilient and the indications are that impacts to the marsh from the Pilot Run are likely to be temporary and probably are recoverable. No attempt has been made here to present such an evaluation or fundamental new research on these topics.

III.H. Suggestions for data and information gathering that could facilitate future analysis

Though much has been written about the Cienega, few long-term, comprehensive studies have been performed on this area. Data about the current condition of the Cienega are insufficient or non-existent. Without basic information such as a comprehensive topography of the Cienega, few conclusions can be drawn about the effect of a possible short term, limited capacity operations of the YDP, because dependable causal linkages cannot be established. A monitoring program could shed light in determining a path forward for the Cienega. Consideration should be given to conducting simple data analyses and causal hypothesis tests that support, or refute, a central hypothesis regarding impacts to the Cienega. The

further examination of existing data (e.g. historic MODE inflows and water quality and volume) could shed light on the specific relationships between MODE inflows and water quality and the Cienega's environment. Data gathering, analysis, and management planning could improve water management within the Cienega and improve habitat for migratory waterfowl, shorebirds, native fish, and endangered species. Then data could be correlated to the habitat in the Cienega and the species of concern within the habitat. Future studies could support the development of a comprehensive management plan for the Cienega. Use of this process will clarify areas of uncertainty, supporting the need for a robust monitoring plan and subsequent further research. Discussions with interested parties should be held to assist in creating this monitoring program.

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IV. Literature review

This list shows the articles, publications, and data identified during the literature search as a part of this research. Not all documents were cited in this report. Some were unavailable.

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