

FINAL

**FISH AND WILDLIFE COORDINATION
ACT REPORT**

ALL AMERICAN CANAL LINING PROJECT

IMPERIAL COUNTY, CALIFORNIA

Prepared for the

U.S. Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada

by the

U.S. Fish and Wildlife Service
Ecological Services
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PREFACE

This document constitutes the U.S. Fish and Wildlife Service's (Service) final report regarding the Bureau of Reclamation's (Reclamation) All American Canal Lining Project. It has been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act, Public Law 85-624 (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). Preparation of this report is also in keeping with the spirit and intent of the National Environmental Policy Act, Public Law 91-190 (42 U.S.C. 4321-4347).

A draft Fish and Wildlife Coordination Act Report (Report) on the All American Canal Feasibility Study was initially prepared by the Service in April, 1985. That Report analyzed the impacts associated with relocating the All American Canal or constructing a well field to recapture seepage. In May 1986, Reclamation presented a new project alternative, in-place lining of the All American Canal, for which the Service prepared a supplemental draft Report, dated January 1987. A final Report, dated January, 1988, responded to comments received by the Service on both of the draft Reports. In response to additional biological evaluations in the project area, the Service issued a second draft supplement in July, 1991.

Since the issuance of the July, 1991 draft supplement, the Service, Reclamation, California Department of Fish and Game, Imperial Irrigation District, Coachella Valley Water District, Metropolitan Water District, and Bureau of Land Management have completed additional evaluations of the biological communities in the project area. This final Coordination Act Report reflects these evaluations and the recommendations developed by an interagency work group (representing the above-mentioned agencies) which reviewed data and formulated mitigation plans. This document is intended to refine the January, 1988 final Report and the July, 1991 Supplement and bring together all pertinent information from previous Coordination Act documents. This final Coordination Act Report replaces all previous draft, final, and supplement Coordination Act Reports for this project.

Endangered species issues concerning the original project were addressed in a biological assessment, dated March 15, 1985, and in a biological opinion dated July 3, 1985. Subsequent discussions of project alternatives have been conducted with the Service's July, 1985, opinion in mind. Reclamation submitted a revised biological assessment, dated September 12, 1989, which addressed the potential impacts of the revised project. The Service responded to the assessment on February 25, 1991, and stated that formal consultation would not be required if the All

American Canal was lined only to Drop 3. If additional species or critical habitat are listed prior to completion of construction, Reclamation would be required to review its activities and initiate consultation if these species would be adversely affected. If additional species or critical habitat are proposed for listing, Reclamation must review proposed activities and conference with the Service if the continued existence of any proposed species would be jeopardized or if adverse modification of proposed critical habitat would occur.

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A. DESCRIPTION OF PROJECT AREA

The All-American Canal (Canal) lining project area is located in Imperial County, California, immediately north of the international border. The project area extends for 30 miles from just west of Pilot Knob near the Arizona border to Drop 4, about 17 miles east of Calexico, California (Figure 1).

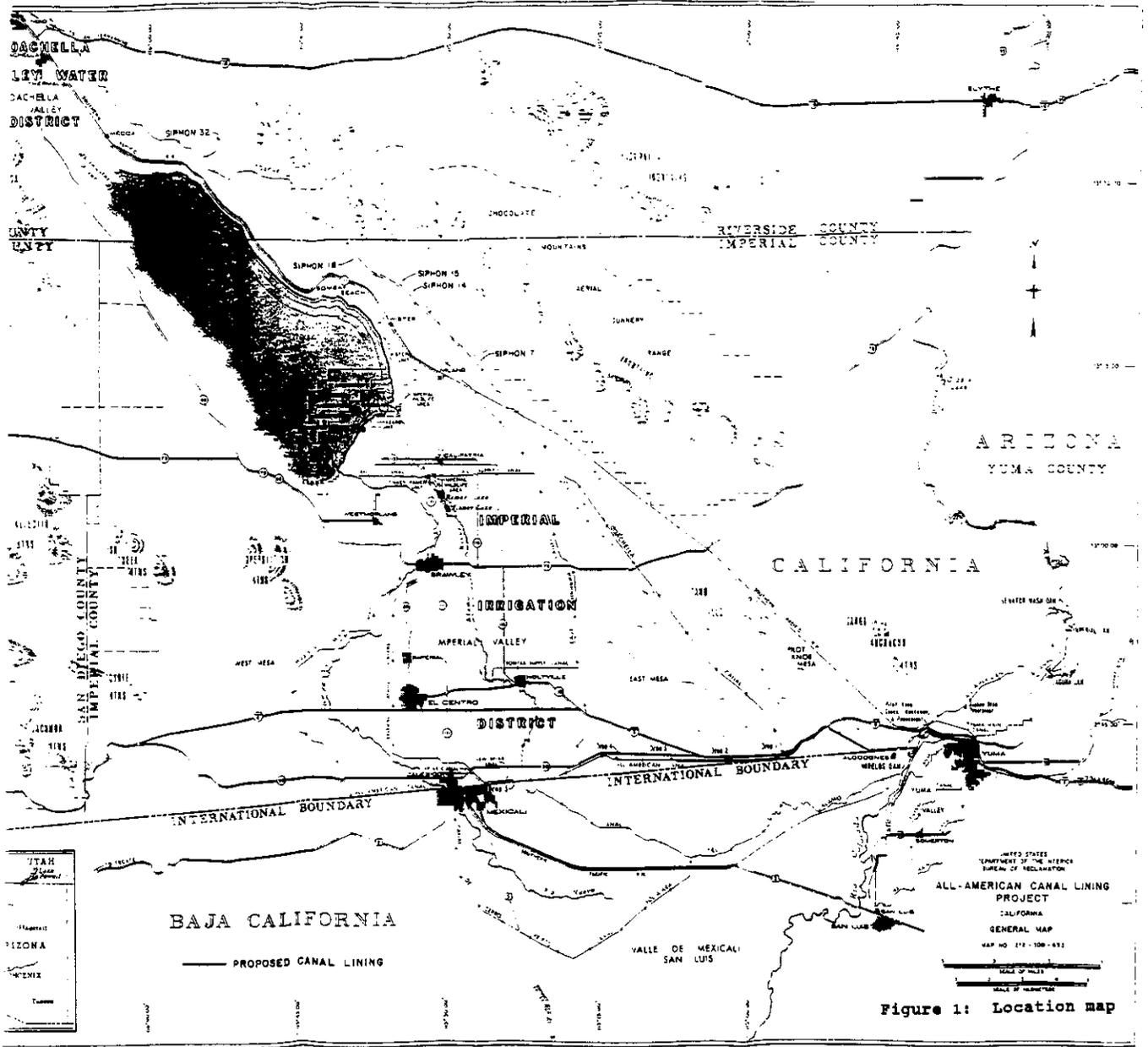
The Canal originates at Imperial Dam on the Colorado River and flows west into the Imperial Valley. It is the primary conveyance for irrigation waters to the Imperial and Coachella Valleys. The main water diversions from the Canal occur at the Siphon Drop and Pilot Knob power plants, and the Coachella, East Highline, West Highline, and Central Main canals (Figure 1). About 5 million acre-feet of water intended for irrigation enter the Canal during an average year (Engineering Science 1980a).

B. DESCRIPTION OF ALTERNATIVE PLANS

The unlined Canal loses water to seepage along its entire length, with most of the seepage occurring in the eastern 40 miles. Between Imperial Dam and Pilot Knob, this seepage eventually reenters the Colorado River. Between Pilot Knob and Drop 4, most of the water migrates underground to Mexico. About 105,000 acre-feet of water per year are lost to evaporation and seepage from the 30-mile long unlined section of the Canal from Pilot Knob to Drop 4. Approximately 70,000 acre-feet of water per year could be conserved by lining the entire 30-mile reach. The 35,000 acre-foot per year difference between the amounts of existing seepage and of potential conservation is a result of evaporation and some seepage through the concrete lining (Reclamation 1990a).

Title II of Public Law 100-675 (November 17, 1988) authorized the Secretary of the Interior to line the unlined sections of the Canal or pursue other means to recover the lost water. Furthermore, the law authorizes specific southern California water districts to fund the project and authorizes the beneficial use of the conserved water within the service areas of the participating water districts. Conserved water would not be diverted by Imperial Irrigation District into the Canal, but would be left in storage in Lake Mead. It is likely that Metropolitan Water District would fund the project and use the conserved water by diverting it at Parker Dam into the Colorado River Aqueduct.

In a draft Environmental Impact Statement/Environmental Impact Report (DEIS) Reclamation and the participating water districts



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(Imperial Irrigation District, Coachella Valley Water District, and Metropolitan Water District, hereafter referred to as the sponsors) examined four action alternatives to recover the lost water as well as a no action alternative (Reclamation and Imperial Irrigation District 1990a). The Canal must remain in service continually, thus the range of alternatives was limited to lining the Canal under water (in-place lining), building a new parallel Canal, or constructing a well field to recover the Canal seepage. Construction of a new parallel Canal from Pilot Knob to Drop 3 was identified as the preferred alternative. The alternatives being studied are summarized here:

1. Parallel Canal. This preferred alternative involves construction a new parallel lined Canal from one mile west of Pilot Knob to Drop 3, a distance of 23 miles (Figure 1). The new Canal would be narrower and deeper than the existing canal (Table 1). The centerline of the new Canal would be offset from the centerline of the existing Canal by 300 to 600 feet depending upon terrain, ease of construction, and location of existing structures. The new Canal would lie north of the existing Canal from Pilot Knob to Drop 1, and south of the old Canal from Drop 1 to Drop 3. The new Canal would tie into the old Canal at existing drop structures and the two Interstate 8 bridges (10 tie-ins). Gates at each of the tie-in points would allow use of the old Canal in case of emergency, such as a major earthquake which may damage the lining. Construction of the Canal would require excavation of 25 million cubic yards of material which would be wind-rowed along the new Canal. The width of construction disturbance, including the Canal, wind-rows, and maintenance roads is estimated at 400 feet, except in the large dunes between Drop 1 and the eastern Interstate 8 crossing, where the width would be 600 feet. An estimated 5.5 years would be required to construct the new Canal. About 67,700 acre-feet of water would be conserved under this alternative. Dimensions of the new Canal are given in Table 2.

2. In-place lining to Drop 3. In this alternative the existing Canal would be lined in place and under water, while the Canal remains in service. The Canal would be lined from Pilot Knob to Drop 3, a distance of 24.6 miles. In-place lining would likely involve placement of a 30-mil polyvinylchloride liner in the Canal covered with 3 inches of concrete. A prototype lining machine was developed for the Coachella Canal. A similar device would be used to line the All-American Canal. The resulting Canal would be slightly wider with less-steep side slopes than the unlined Canal (Table 1). In the lining process, the Canal sides and bottom would be trimmed and the spoil material placed outside of the existing berms. About 6.5 years would be required

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Table 1. Dimensions and costs of alternatives to conserve seepage from the All American Canal.

	Existing Canal	Parallel Canal	In-place to Drop 3	In-place to Drop 4	Well Field
Length (miles)	29.9	23.0	24.6	29.9	15.0
Excavation volume (millions cubic yards)	-	25.0	0.8	1.0	-
Sand and gravel needed (millions cubic yards)	-	185,000	355,000	535,000	41,000
Top width (feet)	196	120	215	215	196
Water depth (feet)	16.6	23.1	15.5	15.5	16.6
Sideslopes	2:1	1.5:1	2.5:1	2.5:1	2:1
Water velocity at full flow (feet per second)	3.8	5.2	4.1	4.1	3.8
Construction cost (\$ millions)	-	85.5	105.4	137.6	20.8
Annual operations and maintenance cost (\$ thousands)	-	24.0	14.0	26.0	2,930

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for project construction. Dimensions of the in-place lined Canal are given in Table 2. The project would conserve 66,700 acre-feet of seepage water annually.

3. In-place lining to Drop 4. The same methods would be used to line the Canal as discussed in the previous alternative; however, the Canal would be lined from Pilot Knob to Drop 4, a distance of 29.9 miles. Construction would take about 8.5 years to complete. About 68,700 acre-feet of water would be conserved each year under this alternative.

4. Well Field between Pilot Knob and Drop 2. Twenty-five wells with a design pumping rate of 7 cubic feet per second each would be constructed south of the Canal between Pilot Knob and Drop 2 (Figure 2). The wells would be located in a single line and spaced from 0.25 to 0.75 miles apart. Pumped water would be conveyed to the Canal in steel, buried pipes. Graveled spur access roads to each well site would be constructed off of the existing access road which parallels the south bank of the Canal. Construction would take about 1.5 years to complete. This alternative would salvage 68,000 acre-feet of seepage per year.

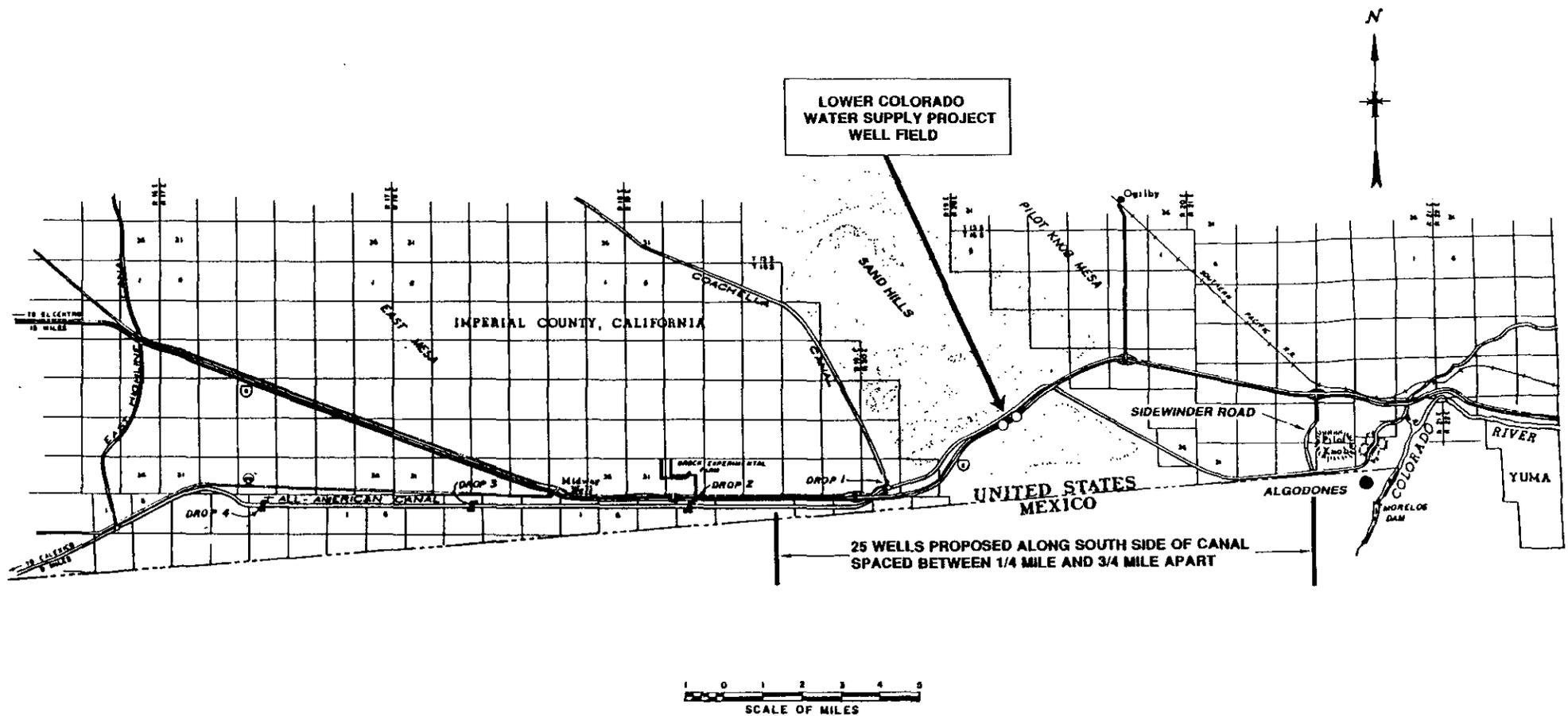
5. No Action. The Canal would likely remain unlined in the absence of a Reclamation project.

C. AQUATIC RESOURCES

1. Existing Conditions.

Fisheries. A sizeable freshwater fishery exists in the Canal and is thought to be primarily recruitment stock from the Colorado River. Engineering Science (1980a) speculated that some fish, particularly juveniles, may pass through the sedimentation structures at Imperial Dam. Another source of fish in the Canal exists from periodic stocking of fish by the California Department of Fish and Game.

Introductions of fish species by the California Department of Fish and Game have primarily been limited to channel catfish (*Ictalurus punctatus*). Prior to 1980 Imperial Irrigation District stocked tilapia (*Tilapia mossambica* and *T. zilli*) in the Canal to control aquatic weeds, but because of heavy predation and cool water temperatures in winter, these fish may not be established (Bureau of Reclamation and Imperial Irrigation District 1990b). Imperial Irrigation District has recently proposed stocking of triploid grass carp (*Ctenopharynogodon idella*) to prevent establishment of hydrilla (*Hydrilla verticillata*). Fish population levels are also undoubtedly



WELL FIELD ALTERNATIVE

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FIGURE 2

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maintained through reproduction of fish in the Canal where appropriate velocity, cover, and substrate conditions are found.

Fish sampling efforts in the Canal have been extremely limited. The first documented aquatic survey was conducted by Engineering Science (1980a) during the period of December 1978 through April 1979. Sampling of the Canal was difficult due to the physical configuration of the Canal and its associated high water velocities. The most severe limitation in the effort to collect fish was the inability of Engineering Science to launch an electroshocking boat in the Canal due to its extremely steep sides. As a result, fish collecting was limited to various netting techniques. Due to these difficulties Reclamation recommended, during feasibility planning, that an evaluation of the fishery resource of the lined and unlined sections of the Coachella Canal be made. This evaluation, it was argued, would be the best methodology available in predicting aquatic impacts associated with the proposed lining of the All American Canal. The Fish and Wildlife Service agreed with this approach, provided additional fish sampling was conducted in the All American Canal.

Substantial information is available to characterize the Coachella Canal fishery (Beaty et al. 1981, Beaty 1984, Minkley 1983, Mueller 1984a, Mueller 1989, Mueller and Liston 1991). Extrapolations from the Coachella Canal data sets to the All American Canal rely on the following assumptions:

1. Fish species found in both canals are very similar. The primary recruitment to the Coachella Canal is the All American and the Colorado River.
2. Fish population profiles can be considered in terms of canal habitat types, which are similar for both canals.
3. Data bases from the Coachella Canal are available that generally reflect fishery management practices similar to the All American Canal.

Limited data are available to test these assumptions. However, species lists for the two canals are similar (Table 2). The more extensive species list for the Coachella Canal probably reflects greater sampling effort. However, the presence of two species and a hybrid in the All American Canal which have not been recorded on the Coachella Canal may represent minor differences in fish communities. These species and hybrid, however, probably do not contribute significantly to the Canal fishery. Only one specimen of each has been observed or collected (Service 1988). The proximity of the All American Canal to the Colorado River may

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Table 2. Fishes in the All American and Coachella Canals¹

Species	All American Canal	Coachella Canal
Bluegill, <i>Lepomis macrochirus</i>	X	X
Redear sunfish, <i>Lepomis microlophus</i>	X	X
Warmouth, <i>Chaenobryttus gulosus</i>	X	X
Green sunfish, <i>Lepomis cyanellus</i>		X
Bluegill-green sunfish (hybrid), <i>Lepomis macrochirus</i> x <i>Chaenobryttus cyamellus</i>	X	
Largemouth bass, <i>Micropterus salmoides</i>	X	X
Smallmouth bass, <i>Micropterus dolomieu</i>	X	X
Black crappie, <i>Pomoxis nigromaculatus</i>		X
White crappie, <i>Pomoxis annularis</i>	X	
Red shiner, <i>Notropis lutrens</i>		X
Golden shiner, <i>Notemigonus crysoleucas</i>		X
Threadfin shad, <i>Dorosoma petense</i>		X
Goldfish, <i>Carassius auratus</i>		X
Bigmouth buffalo, <i>Ictiobus cyprinellus</i>		X
Yellow bullhead, <i>Ictalurus natalis</i>		X
Channel catfish, <i>Ictalurus punctatus</i>	X	X
Flathead catfish, <i>Pylodictis olivaris</i>	X	X
Triploid grass carp, <i>Ctenopharyngodon</i> <i>idella</i>		X
Carp, <i>Cyprinus carpio</i>	X	X
Mosquitofish, <i>Gambusia affinis</i>	X	X
Striped bass, <i>Roccus saxatilis</i>	X	

¹From California Department of Fish and Game (1974), Beaty et al. (1981), Minckley et al. (1983), Mueller et al. 1989, Engineering Science 1980a, and incidental sightings by Service biologists. Tilapia, *Tilapia zilli*, sailfin molly, *Poecilia latipinna*, and the Mexican molly, *Poecilia latipinna*, have also been collected by the Service at the recapture ditches south of the All American Canal between Drops 3 and 4.

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increase the chances of finding Colorado River fishes that do not occur upstream in the Coachella Canal. Based on fish stranded in a dewatered reach, the Coachella Canal supports a fishery dominated by channel catfish (51% of all fish) and threadfin shad (35%); but other species and species groups are well represented, including centrarchids (bluegill, warmouth, black crappie, largemouth bass, and redear sunfish) (6.6%), common carp (3%), and flathead catfish (1%). Although threadfin shad was second highest in total numbers collected, 99.7 percent of the individuals were collected in a reach of the Canal below Check Drop 5. Channel catfish, common carp, and flathead catfish represented approximately 42.4, 33.9, and 19.7%, respectively, of the total biomass (Minckley et al. 1983).

Fish abundance by species in the All American Canal cannot be estimated from available data without extrapolating from Coachella Canal data. By calculating fish densities in different habitat types on the Coachella Canal, then assuming that similar densities occur in All American Canal habitats, fish abundance on the All American Canal can be calculated from acreages of habitat. Species composition, biomass, and numbers of fish taken from the Coachella Canal were computed into units per surface area for three habitat types including shoreline, drop, and channel habitat (Table 3). Shoreline habitat was considered to extend a distance of 49 feet from the water's edge to the midline of the Canal and was characterized by reduced water velocities and emergent vegetation which provide feeding, resting, and shelter cover for fish. Channel habitat was in the center of the Canal where water velocities were higher and substrates consisted of shifting sands. Drop habitats were located below the three drop structures and were characterized by deep water, turbulence and possibly rocky substrates.

The surface areas of the three habitat types in the All American were calculated by Reclamation (1990b) (Table 3). If these surface areas are multiplied by the fish densities for similar habitat types found in the Coachella Canal, the resulting sums represent estimated total numbers of fish by species for the All American Canal (Table 4). Species composition and biomass can be similarly extrapolated (Table 4). Based upon this methodology, channel catfish are estimated to be the dominant fish species in the All American Canal, comprising 91.6 percent of all fish. Drop habitat supports the greatest densities of fishes but is the least abundant habitat type. Shoreline habitat supports moderate numbers of fish and is the most abundant habitat type. Channel habitat supports densities of channel catfish comparable to the other habitats, but few other fish use this habitat.

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Table 3. Aquatic habitat availability by alternative for the All American Canal between Pilot Knob and Drop 4

	<u>Surface Area (acres) of Habitat</u>			
	<u>Drop</u>	<u>Shoreline</u>	<u>Channel</u>	<u>Total</u>
No Action	6.33	350.98	306.68	663.98
Parallel Canal	6.33	82.44	398.13	486.90
In-place Lining to Drop 4	6.33	0	657.66	663.98
In-place Lining to Drop 3	6.33	63.36	594.30	663.98
Well Field	6.33	350.98	306.68	663.98

Reclamation (1985a) calculated that, averaged over all habitat types, the All American Canal would be expected to support approximately 2,335 fish per acre. The entire project area is expected to support approximately 285,000 fish. Fish biomass is estimated to average .0023 pounds/foot² or approximately 66,480 pounds fish in the project area (Reclamation 1990b). A detailed description of the methodology used to arrive at these estimates is presented in Service (1988) and Reclamation (1990b).

Macroinvertebrates. Macroinvertebrates are an important food resource in sustaining high levels of fish production in canals. Nineteen taxa of aquatic invertebrates are known to occur in the earthen portion of the canal. Mean densities were 15.6 and 400.9/ft² in mid-channel and bank habitats (Marsh 1983).

If Imperial Irrigation District introduces triploid grass carp, reduced densities of aquatic plants in shoreline habitats would likely result. Reduced vegetation cover would reduce the quality of these habitats for some species of fish.

2. Future Without the Project: No Action. In the absence of a Federal project, the Canal would remain unlined and its existing fishery and macroinvertebrate resources would be expected to remain similar to present day levels. This statement is based upon two major assumptions: (1) there will be no significant change in the quality or quantity of water which is transferred from the Colorado River; and (2) the Imperial Irrigation District does not construct additional hydropower facilities or other major structural features in the Canal. Changes in quantity and quality of water, or the addition of structural features, would

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Table 4. Estimated species composition and density by habitat type of the major fishes found in the All American Canal between Pilot Knob and Drop 4¹

Species	Drop Habitat		Shoreline Habitat		Channel habitat	
	Species Composition (%)	Density (fish/ac)	Species Composition (%)	Density (fish/ac)	Species Composition (%)	Density (fish/ac)
Threadfin shad	65.5	1472.9	0.2	1.0	1.2	3.4
Common carp	3.2	71.2	2.5	9.1	1.1	3.1
Channel catfish	21.6	485.5	91.6	434.8	96.3	335.7
Flathead catfish	0.3	6.1	1.3	5.5	0	0
Striped bass	0	0	trace	0.4	0	0
Sunfish	3.8	89.3	2.2	12.6	0	0
Largemouth bass	2.4	53.5	2.4	9.8	trace	trace

¹ Table from Bureau of Reclamation and Imperial Irrigation District 1990b.

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likely change the relative amounts of fishery habitat and thus alter fish species composition and abundance.

Imperial Irrigation District has proposed introducing grass carp in the Canal. Establishment of grass carp would reduce cover and shoreline habitat, thus causing a reduction in shoreline game fish.

3. Future With the Project: Parallel Canal.

Fisheries. The effects of this and other action alternatives on fisheries can be evaluated by multiplying estimated acreage of each habitat which would result under an alternative (Table 3) by the densities of fish by species in each of those habitat types (Table 4). The resulting sums, which are numbers of fish in the project area, can be compared with existing numbers of fish (Table 5).

The impacts to the fishery resulting from implementation of the Parallel Canal alternative are summarized in Table 5. The Parallel Canal would support approximately 34% fewer fish than the existing unlined canal. This represents a loss of 95,961 fish. Of that number, 7,493 would be shoreline game fish (i.e., flathead catfish, sunfish, and largemouth bass).

These impacts to shoreline game fishes, particularly the centrarchids, would result primarily from a major reduction in shoreline habitat. Lining of the Canal would eliminate emergent vegetation, an important component of shoreline habitat. Lining of the Canal would also eliminate cover for juvenile fishes and spawning substrate. Water velocities in the parallel Canal would increase by approximately 35% because it would be lined, narrower, and deeper. In the absence of cover, these higher velocities would almost completely eliminate available habitat for centrarchids which prefer sluggish to ponded waters.

Macroinvertebrates. Sixteen and 19 taxa of aquatic invertebrates have been collected in concrete-lined and unlined portions, respectively, of the Coachella Canal (Marsh 1983). While numbers of invertebrate taxa collected were similar, total abundance of benthic macroinvertebrates was about 4 times as great in the lined canal as compared with the unlined reaches. Mean densities in lined reaches in November, 1982 were 1,282 and 1,686/ft² in sidewall and bottom substrates, respectively, compared with 15.6 and 400.9/ft² in mid-channel and bank habitats in unlined reaches in November, 1980. These differences reflect large numbers of Chironomidae (midges), Oligochaeta (annelids), and Hydracarina (watermites) in the lined reaches. Chironomidae was the predominant macroinvertebrate taxon in the lined canal.

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Table 5. Comparison of existing fishery resources of the All American Canal with those predicted under the four action alternatives. Numbers in parantheses indicate losses.

Species and alternative	Number of fish	Percent of total	Change in number of fish	Percent change
Threadfin shad				
No Action	10,706	3.6	-	-
Parallel	10,742	6.0	36	0.3
Drop 4	11,572	4.8	866	8.1
Drop 3	11,416	4.6	710	6.6
Well Field	10,706	3.6	0	0
Common carp				
No Action	4,575	1.6	-	-
Parallel	2,249	1.2	(2,326)	(50.8)
Drop 4	2,473	1.0	(2,102)	(45.9)
Drop 3	2,852	1.2	(1,723)	(37.7)
Well Field	4,575	1.6	0	0
Channel catfish				
No Action	258,632	90.8	-	-
Parallel	172,570	91.2	(86,062)	(33.3)
Drop 4	223,850	93.7	(34,758)	(15.5)
Drop 3	230,129	93.1	(28,483)	(11.0)
Well Field	258,632	90.8	0	0
Flathead catfish				
No Action	1,969	0.7	-	-
Parallel	492	0.2	(1,477)	(75.0)
Drop 4	39	trace	(1,930)	(98.0)
Drop 3	387	0.2	(1,582)	(80.3)
Well Field	1,969	0.7	0	0
Striped bass				
No Action	142	trace	-	-
Parallel	26	trace	(116)	(81.7)
Drop 4	0	0	(142)	(100)
Drop 3	26	trace	(116)	(81.7)
Well Field	142	trace	0	0

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Sunfish

No Action	4,988	1.8	-	-
Parallel	1,604	0.8	(3,384)	(67.8)
Drop 4	565	0.2	(4,423)	(88.7)
Drop 3	1,364	0.6	(3,624)	(72.6)
Well Field	4,988	1.8	0	0

Largemouth bass

No Action	3,779	1.3	-	-
Parallel	1,147	0.6	(2,632)	(69.6)
Drop 4	339	0.2	(3,440)	(89.7)
Drop 3	960	0.4	(3,089)	(81.7)
Well Field	3,779	1.3	0	0

Totals - All Species

No Action	284,791		-	-
Parallel	188,830		(95,961)	(33.7)
Drop 4	238,838		(45,953)	(16.1)
Drop 3	247,134		(37,657)	(13.2)
Well Field	284,791		0	0

Totals - Shoreline Game Species

No Action	10,736	3.8	-	-
Parallel	3,243	1.7	(7,493)	(69.8)
Drop 4	943	0.4	(9,793)	(91.2)
Drop 3	2,711	1.1	(8,025)	(74.7)
Well Field	10,736	3.8	0	0

It accounted for nearly one-half (49 percent) of all individuals collected. Notably, most of the difference in invertebrate abundance between concrete and earthen canal reaches were a function of increased numbers of organisms associated with canal sidewalls.

Although abundance of benthic macroinvertebrates was greater in the lined canal when compared to the unlined canal, biomass of benthic invertebrates as measured in milligrams dry weight/meter² (mgDW/m²) was considerably greater in unlined reaches. Total benthic invertebrate biomass in the unlined canal was 2,000 to 7,500 mg DW/m² and 400 mg DW/m² in the lined reach. This was due to the large numbers of asiatic clams (*Corbicula fluminea*) in the unlined canal. Large asiatic clams (0.4-0.8 inch) constituted about 98 percent of the total biomass with other taxa contributing only minor percentages (Marsh 1983).

Concrete sidewalls add a habitat dimension not found in earthen canals. Sidewalls provide a stable attachment for micro and

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macro algae which in turn function as fine sieves which entrap fine particulate materials suspended in the water column (Marsh 1983). Certain benthic invertebrates, Chironomidae and Oligochaeta in particular, apparently find refuge within this epiconcretic matrix and use algae or entrained fine organic matter as food. In contrast the bottom of a concrete-lined canal, except in areas immediately adjacent to structures, is for the most part uniformly shifting sand material having low numbers of most aquatic invertebrates.

Assuming similar relationships on the All American Canal, diversity of macroinvertebrates in the Parallel Canal would be similar to existing conditions. Densities would be expected to increase by at least 300%, however, total biomass should decrease after lining by more than 80% as a result of much reduced populations of asiatic clams. Terrestrial invertebrates, which are often associated with shoreline vegetation, would be reduced in the Parallel Canal due to a reduction in shoreline habitat.

4. Future With the Project: In-place Lining to Drop 3.

Fisheries. From Table 5, this alternative would result in a loss of 37,657 fish, including 8,025 shoreline game fish. The effects of this alternative are similar to the Parallel Canal alternative in that all shoreline habitat between Pilot Knob and Drop 3 would be lost. However, with in-place lining the width of the Canal would be increased over existing conditions, resulting in more channel habitat than in the Parallel Canal alternative (Table 3). This channel habitat would support primarily channel catfish (Table 4).

In-place lining of the Canal could potentially affect water quality through an increase of pH in the canal waters downstream of construction. However, tests conducted by Reclamation showed little change in pH in laboratory tests and in the field during the Coachella Canal Prototype Lining Project (Reclamation 1990). Additionally, the Canal would be lined in four passes and it is larger than the Coachella Canal. Therefore, the effects of lining on water quality should be diluted beyond the small changes noted during prototype construction.

Macroinvertebrates. In-place lining to Drop 3 would result in similar habitats for macroinvertebrates as in the Parallel Canal alternative.

5. Future With the Project: In-place Lining to Drop 4.

Fisheries. Implementation of this alternative would result in a loss of 45,953 fish, including 9,858 shoreline game fish

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(Table 5). All shoreline habitat in the project area would be eliminated (Table 3). Of the four action alternatives, this plan would result in the greatest amount of channel habitat.

Macroinvertebrates. In-place lining to Drop 4 would result in similar habitats and effects to macroinvertebrates as in the Parallel Canal alternative. However, this alternative would affect a greater length of the Canal (29.9 versus 23.0 miles).

6. Future With the Project: Well Field between Pilot Knob and Drop 2.

Fisheries. Construction of a well field between Pilot Knob and Drop 2 would not affect the Canal fishery. Fish species composition and abundance would be the same as under the no action alternative.

Macroinvertebrates. No change from existing conditions would be expected under this alternative.

D. TERRESTRIAL RESOURCES

1. Existing Conditions

a. Vegetation - Desert Scrub. The project area lies within the lower Colorado River Valley subdivision of Sonoran desert scrub (Turner 1982). Within this community type, the desert scrub can be divided into sand dune associations and creosote scrub. Soils vary from packed sand to clay soils in the creosote scrub association and windblown sands in the dunes. Desert pavement occurs at the eastern end of the project area. A listing of plants in the project area is found in Service (1988) and McCalvin (1993). Off-road vehicle activity has degraded desert scrub communities in some areas, particularly in the 2 miles east of Drop 1. The Canal and locked gates across the Drop structures have minimized off-road vehicle activity south of the Canal and west of Drop 1.

The creosote scrub association is dominated by creosote (*Larrea tridentata*) and bursage (*Ambrosia dumosa*), but other perennial shrubs such as Emory's dalea (*Psoralea emoryi*), Mormon tea (*Ephedra trifurca*), and cheesebush (*Hymenoclea salsola*) are codominants in some areas. Blue palo verde (*Cercidium floridum*) and ironwood (*Olneya tesota*) occur east of the Algodones Dunes.

The plant community of the Algodones Dunes is quite different from the surrounding creosote scrub association and includes

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several species which are adapted to dunes and have limited distributions. Among these are several sensitive species, including Peirson's milkvetch (*Astragalus magdalanæ peirsonii*), sandfood (*Pholisma sonora*), and desert sunflower (*Helianthus niveus tephrodes*) (Table 6).

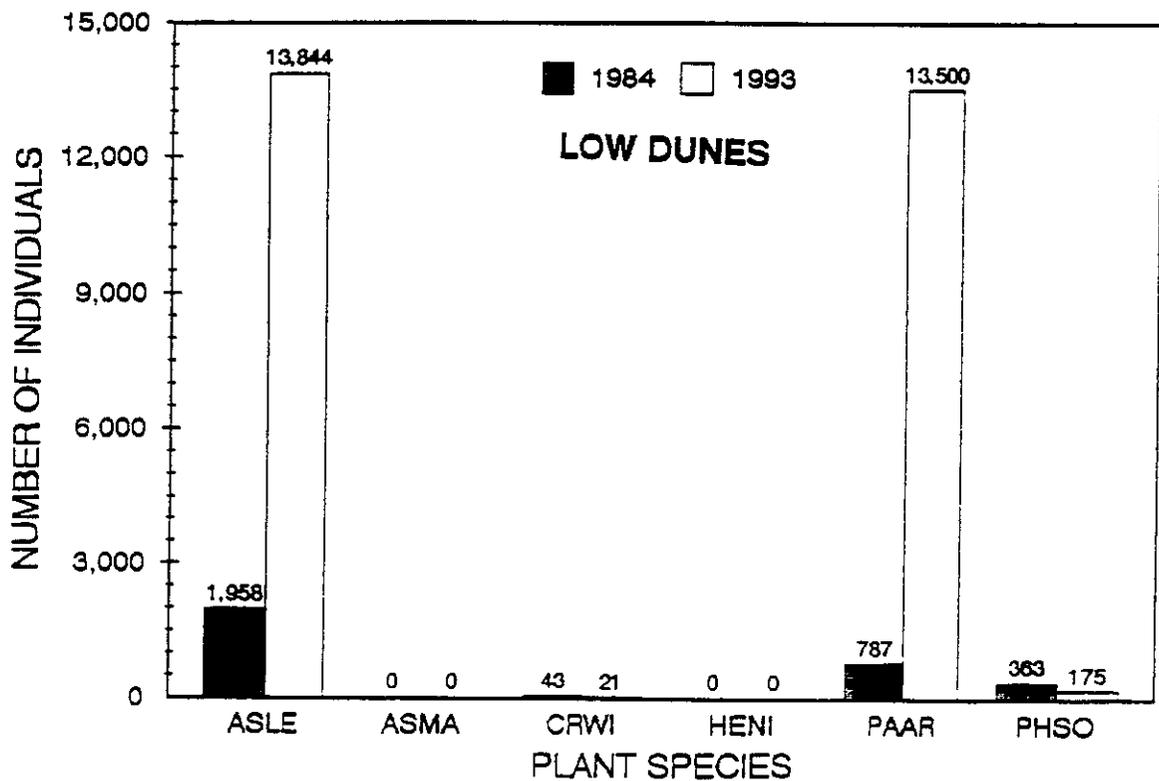
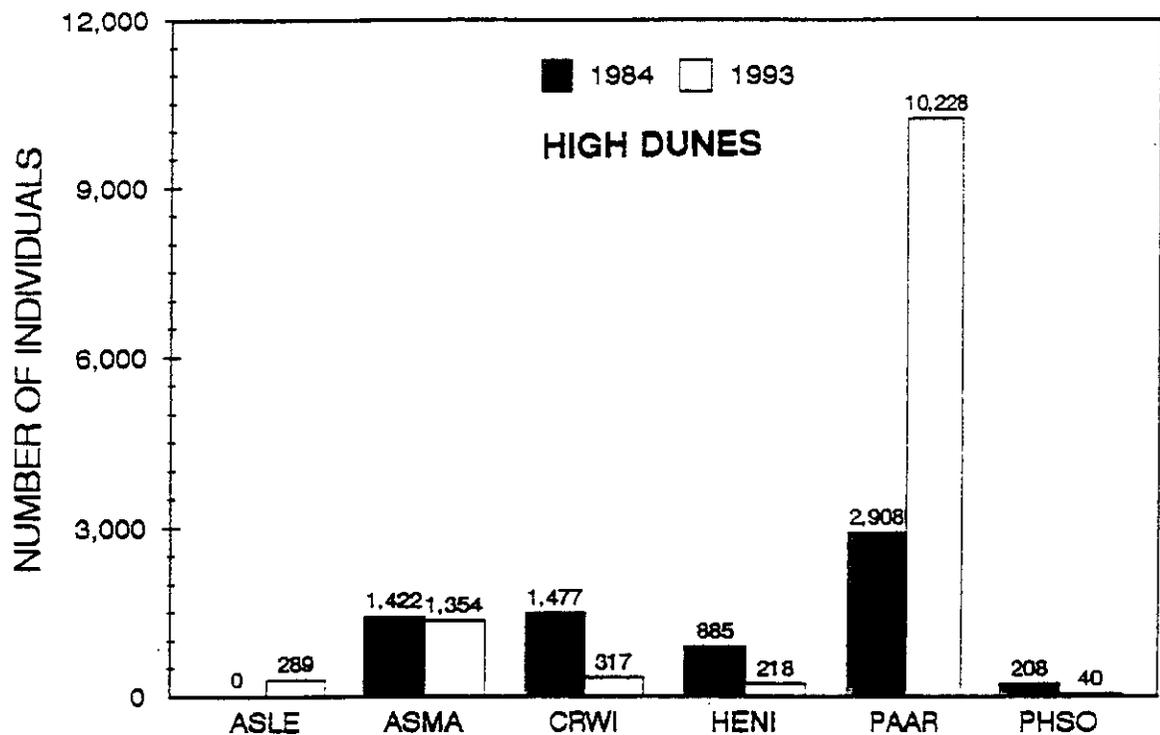
Service and Reclamation personnel surveyed a 600-foot wide corridor along the proposed realignment route for sensitive plant species on April 10 through 12, 1984 (Smith et al. 1984). The area was resurveyed by the Service in 1993 (McCalvin 1993). All candidate and proposed species listed in Table 6, plus the following species which are of limited distribution, were inventoried:

Borrogo dapple pod (*Astragalus lentiginosus* var. *borreganus*)
Wiggin's croton (*Croton wigginsii*)
Giant Spanish needles (*Palafoxia arida* var. *gigantea*)
Thurber's pilostyles (*Pilostyles thurberi*)

All species were observed except Thurber's pilostyles. Giant Spanish needles, Borrogo dapple pod, and Wiggin's croton were the most abundant species (Figure 3). The distribution of some species varied with terrain. For instance, Peirson's milkvetch, Wiggin's croton, and desert sunflower were found primarily in large dunes. East and south of the eastern Interstate 8 crossing of the Canal the dunes are low and rolling, and in places the terrain is nearly level. In this area Borrogo dapple pod and giant Spanish needles were most abundant. Sandfood was found throughout both the low and high dunes, but was also observed in the Canal right-of-way in sandy creosote scrub west of the dunes (McCalvin 1993). Giant Spanish needles and Borrogo dapple pod were more abundant in 1993 than in 1984, but fewer Wiggin's croton and sandfood were observed in 1993 (Figure 3).

b. Riparian and marsh vegetation. Marsh and riparian communities occupy 1,551.6 acres of the project area (Table 7). The largest wetland area is located south of the Canal between Drops 3 and 4 and extends south into Mexico. Cattails (*Typha domingensis*), Goodding willows (*Salix gooddingii*), Fremont cottonwoods (*Populus fremontii*), saltcedar (*Tamarix chinensis*), honey mesquite (*Prosopis glandulosa* var. *torreyana*), screwbean mesquite (*Prosopis pubescens*), and arrowweed (*Tessaria sericea*) comprise most of the wetland vegetation. An additional 98.5 acres of riparian and 0.9 acres of marsh habitats have been identified within the project area between Drops 1 and 3 (Table 7). The Canal bank supports a narrow band of carrizo (*Phragmites australis*) at the water's edge, except where concrete and rock have been used to stabilize the banks.

Figure 3. Comparison of 1984 and 1993 rare plant surveys for the high dunes (Drop 1 to eastern Interstate 8 crossing) and low dunes (eastern Interstate 8 crossing to Sidewinder Road). From McCalvin (1993). ASLE = *Astragalus lentiginosus* var. *borreaganus*, ASMA = *A. magdalenae* var. *peirsonii*, CRWI = *Croton wigginsii*, HENI = *Helianthus niveus* ssp. *tephrodes*, PAAR = *Palafoxia arida* var. *gigantea*, PHSO = *Pholisma sonorae*.



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Table 6. Listed, proposed, and candidate¹ species known to occur in the project area.

Species	Habitat	Status
Yuma clapper rail (<i>Rallus longirostris yumanensis</i>)	Marsh	Endangered
California black rail (<i>Laterallus jamaicensis coturniculus</i>)	Marsh	Category 1
Southwestern willow flycatcher ² (<i>Empidonax traillii extimus</i>)	Riparian	Proposed Endangered
Flat-tailed horned lizard (<i>Phrynosoma mcallii</i>)	Creosote/bursage Low dunes	Category 1
Colorado desert fringe-toed lizard (<i>Uma notata notata</i>)	Dunes	Category 2
Andrew's scarab beetle (<i>Pseudocotalpa andrewsi</i>)	Dunes	Category 2
Peirson's milkvetch (<i>Astragalus magdalenae</i> var. <i>peirsonii</i>)	High dunes	Proposed Endangered
Desert sunflower (<i>Helianthus niveus</i> var. <i>tephrodes</i>)	High dunes	Category 2
Sandfood (<i>Pholisma sonora</i>)	Dunes Sandy flats	Category 2

¹Category 1 candidates are species for which the Service has on file enough information to support proposals to list them. Category 2 candidates are species for which data are not currently available to support a listing proposal, but for which listing may be appropriate. In addition to the above species, giant Spanish needles occurs in the project area and has been recommended for category 2 status.

²Willow flycatchers were observed in May, 1984 at the wetland complex between Drops 3 and 4, however, it is unknown if these were of the subspecies *extimus* or another subspecies. Willow flycatchers are not known to breed on the lower Colorado River (Rosenberg et al. 1991).

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Table 7. Acres of riparian and marsh vegetation in the project area by community type and location

Community	Acres		
	Drop 1-3	Drop 3-4	Canal Bank
Cottonwood/willow IV ¹	0	39.1	0
Saltcedar V	28.7	754.5	0
Screwbean mesquite V	21.9	251.24	0
Honey mesquite IV	0.7	2.4	0
Honey mesquite/saltcedar IV	0	31.1	0
Arrowweed VI	47.2	233.1	0
Marsh Type 3	0	3.8	0
Marsh Type 4	0.9	40.3	0
Marsh Type 5	0	66.2	0
Marsh Type 6	0	0.5	30.0
Totals:	99.4	1422.2	30.0

¹Roman numerals indicate vertical structure. Structure type IV is typically characterized by trees of moderate stature (10 to 15 feet in height). Structure type V is typically shorter trees or shrubs (5 to 10 feet), while type VI is characterized by shrubs such as arrowweed or quailbush (*Atriplex lentiformis*) of short stature (2 to 10 feet) (Younker and Andersen 1986). The following descriptions of marsh types are taken from Younker and Andersen (1986):

Marsh Type 3: About 25 to 50% cattail/bulrush, some carrizo, open water, some trees and grass

Marsh Type 4: About 35 to 50% cattail/bulrush, many trees and grasses interspersed

Marsh Type 5: About 50 to 75% cattail/bulrush, few trees and grasses interspersed

Marsh Type 6: Nearly 100% carrizo, little open water

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A vegetation classification system developed on the lower Colorado River was used to map and classify marsh and riparian communities (Anderson and Ohmart 1984, Younker and Andersen 1986). The system classifies stands according to the dominant or most important species and vertical structure. Within the study area, six riparian species types and three structure types were identified. Four marsh types were also identified (Table 7).

c. Wildlife. Wildlife of the project area is characteristic of Sonoran desert scrub, riparian woodlands, and marsh communities (Turner 1982, Rosenberg et al. 1991, Anderson and Ohmart 1984).

Invertebrates. The invertebrates of the area have not been studied, however, Andrew's dune scarab beetle, a category 2 candidate for Federal listing, probably occurs in the Algodones Dunes in the project area. Adult beetles are active for approximately 6 weeks in April and May; host plants and activity patterns of larvae are unknown (Hardy and Andrews 1979). This species was not observed during field investigations by Reclamation, Service, or Engineering Science personnel; however, this is not surprising, given the brief daily activity period of the beetle and the unfamiliarity of the investigators with this species. Records are primarily along the eastern edge of the dunes, southeast of Glamis, but on at least one occasion, the Andrew's dune scarab beetle was located within one mile of the proposed realignment route (Hardy and Andrews 1979).

Reptiles and Amphibians. A large variety of reptiles and amphibians is known from the desert region of California (Stebbins 1985). Wetland habitats further increase the diversity of the project area's herpetofauna. Seven species of amphibians and 34 species of reptiles are known or suspected to occur within the project area (see Appendix 2 of Service 1988). Creosote scrub provides habitat for 36 species of reptiles and amphibians, more than any other community type in the project area.

Two candidate reptile species occur in the project area, including the Colorado desert fringe-toed lizard (*Uma notata notata*) (category 2) and the flat-tailed horned lizard (*Phrynosoma mcallii*) (category 1) (Table 7). A proposal to list the flat-tailed horned lizard has been prepared and at the time of this writing was pending publication in the Federal Register.

The flat-tailed horned lizard occurs in a variety of lowland, valley habitats typically characterized by open creosote scrub and sandy substrates (Turner and Medica 1982). Quantitative and qualitative loss of habitat threatens populations of this species

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throughout its range (Bolster and Nicholson 1989, Johnson and Spicer 1985).

Surveys for the flat-tailed horned lizard were conducted in May, 1984 and again in June, 1993 (Rorabaugh 1984, McCalvin 1993). Techniques followed those of Turner and Medica (1982) and Bureau of Land Management (1990) which determine presence and absence and possibly relative abundance based on counts of flat-tailed horned lizards and their scat. Results of the two surveys were similar. The only areas in which flat-tailed horned lizards were observed were between Drops 1 and 3; however, scat was also observed east of the eastern Interstate 8 crossing of the Algodones Dunes. Number of scat counted per hour was comparable to other studies. The greatest number of scat were counted between Drops 1 and 2, and within 2.8 miles southeast of the eastern Interstate 8 crossing (McCalvin 1993, Rorabaugh 1984). McCalvin (1993) surmised that the species is probably absent from the high dunes between Drop 1 to about the eastern Interstate 8 crossing, and in the eastern 4.2 miles of the project area. Although this species is well distributed along the Canal, this area has not been identified as a key area for the species (Turner and Medica 1982). Also, the area is isolated from other flat-tailed horned lizard habitat by the Canal, Interstate 8 on the north, and agricultural development in the Mexicali Valley to the south.

The Colorado desert fringe-toed lizard inhabits areas of windblown and shifting sand. This species exhibits a variety of morphological specializations for living in sandy environments (Stebbins 1985). Surveys for the Colorado desert fringe-toed lizard were conducted concurrently with sensitive plant surveys in April, 1993 (McCalvin 1993). As rare plants were surveyed, Colorado desert fringe-toed lizards were counted in the Canal right-of-way through the sand dunes from about 1.5 miles west of Pilot Knob to Drop 1. A total of 240 fringe-toed lizards was observed. The species was observed in 36 of 55 1,000-foot reaches and was well distributed through both the high and low dunes. The fringe-toed lizard probably occurs wherever dune habitats are present. Reaches where the species was not observed were likely surveyed too early or too late in the day when temperatures were not suitable for activity.

Birds. Two hundred, twenty-three species of birds have been reported from the project area (Engineering Science 1980b, Service 1984, see Appendix 3 of Service 1988 for species list). The marsh and riparian communities support 179 species, far more than any other community in the project area. The shallow, open water and dense vegetative cover and food offered by cattails, willows, cottonwoods, and mesquite offer a diverse and productive

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habitat for seasonal visitors and year-round residents. Cover and water provided by the wetlands make these areas very attractive to migrants that use the seeps as stopovers during spring and fall migrations. Reclamation biologists detected 58 species of birds in the seep wetland south of the Canal between Drops 3 and 4 during census work in April and May, 1984 (Reclamation and Imperial Irrigation District 1990b). The 3 most common species were common yellowthroat (*Geothlypis trichas*), mourning dove (*Zenaida macroura*), and Wilson's warbler (*Wilsonia pusilla*).

The aquatic habitat of the Canal supports the next highest number of bird species (88). The presence of water in an extremely arid environment draws many species to the Canal. Sand dune habitat, with its relative scarcity of plant cover, attracts only 29 species of birds, the lowest of any major community type in the project area.

The Yuma clapper rail is a State rare and federally listed endangered species. The Yuma clapper rail breeds primarily in freshwater marshes of the Colorado from Needles to the Gulf of California, along the Gila River in western Arizona, and in marshes near the Salton Sea (Eddlemann 1989). The largest numbers of Yuma clapper rails occur at the Wister Unit near Niland, California and at the Santa Clara Slough in Baja California Norte (Glen Gould, Reclamation, Boulder City, Nevada, pers. comm. 1993).

Service biologists detected 17 Yuma clapper rails in the seep wetland south of the Canal between Drops 3 and 4 on April 30 through May 1, 1981. On May 16, 1984, three clapper rails responded to taped vocalizations. The area was again surveyed during April and May, 1988 at which time three Yuma clapper rails were detected.

Pursuant to section 7 of the Endangered Species Act, Reclamation prepared a biological assessment dated March 15, 1985, which described potential project impacts to the Yuma clapper rail from implementation of a relocation alternative and a well field alternative. The Service's biological opinion, dated July 3, 1985, stated that the well field alternative and an alternative to construct a parallel canal from Pilot Knob to Drop 4 would not jeopardize the continued existence of the Yuma clapper rail. This biological opinion contained reasonable and prudent measures to minimize incidental take of rails, which formed the basis of our non-jeopardy opinion. In a memorandum to Reclamation dated February 25, 1991, the Service indicated that reinitiation on the current preferred alternative to construct a Parallel Canal to Drop 3 would not be necessary unless future monitoring detects a

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decreasing water table in the wetland between Drops 3 and 4 which may be a result of the project.

The California black rail is a category 1 candidate for Federal listing. On the lower Colorado River this species is found mainly in habitat dominated by three-square bulrush (*Scirpus americanus*) and California bulrush (*Scirpus californicus*) where water depths are very shallow (<2.5cm) and stable (Flores and Eddlemann 1991). In the seep wetlands between Drops 3 and 4, black rails were heard calling primarily from cattails, but also from areas containing willows, saltcedar, arrowweed, and pampas grass (*Cordaderia atacamensis*). Call count surveys in the marsh habitat between Drops 3 and 4 revealed the presence of two black rails in spring, 1979 (Engineering Science 1980b) and 10 on April 30 through May 1, 1981 (Service 1981). On April 10, 1984, 33 black rails responded on the south side of the Canal and five additional birds were heard on the north side. The area was surveyed again in April and May, 1988, at which time a minimum of three black rails were detected in marsh types 4 and 5 south of the Canal (Reclamation and Imperial Irrigation District 1990b).

Reclamation and Imperial Irrigation District (1990a) lists several other candidate bird species which, although they have not been recorded, may occur in the project area.

Mammals. The project area provides habitat for an estimated 52 species of mammals, including 22 rodents, 14 bats, and 11 carnivores (See Appendix 4 of Service 1988). Sonoran desert scrub, with the highest mammalian representation, supports 47 species; this diversity is probably a result of the large acreage of creosote and its proximity to other habitat types.

Burro deer (*Odocoileus hemionus eremicus*) inhabit washes and bajadas east of the Algodones Dunes and occur in the mountain ranges and riparian zones long the Colorado River. An estimated 900 to 2,000 individuals occur from the Algodones Dunes east to the Colorado River (Harvey and Stanley Associates undated). Burro deer occasionally migrate substantial distances. Therefore, the seep wetlands between Drops 3 and 4, the riparian woodland west of Drop 4, and the two large washes east of the Algodones Dunes may occasionally support deer (Jessie Garcia, California Department of Fish and Game, Niland, pers. comm. 1985); however, two helicopter overflights failed to detect any deer in the project area.

The Yuma puma (*Felis concolor browni*) is a category 2 candidate for Federal listing. The abundance of the puma is unknown, although it has never been considered to be common (Harvey and Stanley Associates undated). Little is known about its ecology,

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although riparian woodlands along the Colorado River appear to be an important habitat and burro deer its principal food. Sightings have occurred near Calexico and the Coachella Canal which indicate that the Yuma puma may occur the project area (Harvey and Stanley Associates undated).

Three category 2 candidate bat species, including the California leaf-nosed bat (*Macrotus californicus*), mastiff bat (*Eumops underwoodi*), and Townsend's big-eared bat (*Plecotus townsendii townsendii*) could conceivably occur in the study area. Roost sites for *Macrotus* and *Plecotus* occur in the Cargo Muchacho Mountains and both species have been recorded at Gold Rock Ranch to the north of the Canal (Pat Brown, Brownberry Biological Consulting, Ridgecrest California, pers. comm. 1993). Bats travelling from these areas may forage in the study area.

d. Wildlife value of riparian community types. The presence of the All American Canal in an otherwise extremely arid region has produced great benefits for fish and wildlife. In addition to providing an extensive aquatic environment and a year-round source of water, the canal seepage has produced an area, the seep wetlands between Drops 3 and 4, which contains very high wildlife values, as evidenced by the diversity and abundance of birds observed there.

Anderson and Ohmart (1984) quantified habitat value of the various riparian vegetation types on the Colorado River by summing the number of times each type ranked in the top three for 57 wildlife use categories. This resulted in a value per unit area for each vegetation community type ranging from one (arrowweed IV) to 26 (cottonwood-willow III)¹ (Table 8). Multiplying this value by the acreage of a given community type produces the value of that community type in the project area. Table 9 lists current riparian habitat values by community type and location in the project area. The value of marsh types was not quantified by Anderson and Ohmart (1984).

2. Future Conditions Without the Project: No Action. Environmental conditions would be anticipated to undergo no significant and rapid changes if a project was not built. Off-road vehicle use would probably continue to increase at a slow rate; however, barring construction of facilities permitting increased access (particularly bridges across the Coachella or All American Canals), the areas affected by this sort of recreation should not increase in the near future.

¹ Structure types range from tall, multi-layered forests (type I) to scrubby, short communities (type VI).

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Table 8. Per unit area values of riparian community types along the Canal. Values are based on wildlife use in lower Colorado River riparian communities (Anderson and Ohmart 1984).

Community Type	Per Unit Habitat Value
Saltcedar V	5
Honey mesquite/ saltcedar IV	8
Screwbean mesquite V	9
Honey mesquite IV	21
Cottonwood/willow IV	19
Arrowweed VI	1

Table 9. Existing riparian habitat values by community type and location in the project area.

Community Type	Drop 1-3		Drop 3-4	
	Acres	Value	Acres	Value
Saltcedar V	28.7	143.5	754.5	3772.5
Honey mesquite/ saltcedar IV	0	0	31.1	248.8
Screwbean mesquite V	21.9	197.1	251.2	2262.2
Honey mesquite IV	0.7	14.7	2.4	50.4
Cottonwood/ willow IV	0	0	39.1	742.9
Arrowweed VI	47.2	47.2	233.1	233.1
Totals:	99.4	402.5	1422.2	7077.8

Electroconductivity of soils in the riparian communities between Drops 3 and 4 is very high and may be inhibiting growth and reproduction of native plant species. Because of high temperatures, shallow water tables, and a corresponding high evaporation rate, soil salinity may be increasing in surface soils. These salts are unlikely to be leached because of infrequent precipitation. Thus, the vigor of these riparian communities may be declining due to salt accumulation. This decline would not be expected in areas of surface flow, such as marshes and in seepage collection ditches.

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3. Future Conditions With the Project: Parallel Canal.

Effects to Desert Scrub. Construction of a Parallel Canal would disturb a corridor adjacent to the existing Canal estimated at 600 feet in width through the large sand dunes north of Interstate 8, and 400 feet in width elsewhere in the right-of-way. Reclamation (1990a) calculated that 562 acres of creosote scrub and 916 acres of sand dune community would be destroyed by construction activities. About half this acreage would be required for the Canal prism, spoil berms, and access roads. Long-term, but possibly temporary impacts, would occur at staging areas, concrete batch plants, and access routes. These latter areas may recover, but reestablishment of a desert scrub community would likely take many decades, if not centuries (Vasek et al. 1975a and b).

The unlined Canal prism would be dewatered, but establishment of desert scrub there would be unlikely because the old Canal would be used for emergency conveyance of water, such as after earthquakes which might damage the Canal lining (Reclamation and Imperial Irrigation District 1990a). In addition, use of the old Canal by off-road vehicle enthusiasts, as has occurred on the old Coachella Canal, would inhibit establishment of vegetation.

Construction activities could result in the removal of palo verdes, ironwoods, and other desert wash trees east of the Algodones Dunes. Impacts are not quantifiable at this time, but loss of any trees in these washes would be significant because of their high wildlife values and scarcity within the project area.

Construction would destroy large numbers of candidate plants. Based on 1993 surveys, 1,354 Peirson's milkvetch, 218 desert sunflower, and 215 sandfood occur in the Canal right-of-way and would be destroyed by construction activities. Individuals of other sensitive plant species would also be lost (McCalvin 1993).

Effects to Riparian and Marsh Vegetation. Lining of the Canal would remove the source of water that currently supports riparian and marsh communities between Drops 1 and 3. Reclamation (1989b) has analyzed the decline of riparian species along lined portions of the Coachella Canal in an effort to predict the impacts of lining the All American Canal. Eight years after lining, saltcedar and honey mesquite remained mostly in good condition and approximately 47 percent of the screwbean mesquite originally found on-site remained alive. Reclamation estimated that similar, though somewhat more gradual, declines would occur at the All American Canal, with plants such as cattails, willows, and cottonwoods dying earliest. Because their extensive root systems are capable of using water from deep

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aquifers, honey mesquite, and to a lesser degree, saltcedar would persist much longer than other species.

Ground water levels would decline approximately 29 to 39 feet in the 52 years following the lining of the Canal (Reclamation and Imperial Irrigation District 1990b). A decline in ground water elevation of this magnitude would place the water table beyond the reach of all water-associated species except honey mesquite (Reclamation and Imperial Irrigation District 1990b). The honey mesquite community would also probably succumb in time because without moist soil conditions and a shallow water table, recruitment of young mesquite would probably not occur at a rate sufficient to replace mature trees as they become senescent.

Not constructing a lined Canal between Drops 3 and 4 avoids impacts to the majority of the area's riparian and marsh communities. However, all riparian and marsh communities between Drops 1 and 3 would be lost, including 98.5 acres of riparian vegetation, 0.9 acres of marsh type 4 between Drops 1 and 3, and an estimated 24 acres of marsh type 6 present on existing Canal banks (Table 10). Canal bank vegetation is not expected to develop on the concrete lining (Reclamation and Imperial Irrigation District 1990a).

As riparian and marsh communities desiccate, establishment of creosote scrub or other upland desert communities in their place would be unlikely because of high salinity in surface soils.

Effects to Wildlife. Desiccation and loss of 98.5 acres of riparian vegetation would result in a loss of 402.5 habitat units (Tables 10 and 11). Project implementation would also result in the loss of 24 acres of marsh type 6 and 0.9 acres of marsh type 4 which have high wildlife value (Tables 9 and 10).

As marsh and riparian communities desiccate, wildlife use of affected communities would decline. Water dependent species, such as amphibians, would be eliminated. With the death of trees and shrubs, the forage base for wildlife would be greatly reduced. Snags could, for a short time, provide enhanced habitat for woodpeckers and cavity nesters. However, over time nearly all current wildlife use of these areas would be lost. Desiccated riparian and marsh plants would be subject to fire and, because of high soil salinity, establishment of Sonoran desert scrub and its associated wildlife community would be unlikely. Yuma clapper rails and California black rails are not known to occur in the project area west of Drop 3, thus these special status species should not be affected.

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Table 10. Acreages of riparian and marsh community types for current and future scenarios.

Community Type	Existing, Well Field, and No Action	Parallel Canal	In-place to Drop 3	In-place to Drop 4
Cottonwood/willow IV	39.1	39.1	39.1	0
Saltcedar V	783.2	754.5	754.5	0
Screwbean mesquite V	273.1	251.2	251.2	0
Honey mesquite IV ¹	3.1	2.4	3.1	3.1
Honey mesquite/ saltcedar IV ¹	31.1	31.1	31.1	31.1
Arrowweed VI	280.3	233.1	233.1	0
Riparian Total:	1409.9	1311.4	1312.1	34.2
Loss of Acreage:	-	98.5	97.8	1375.7
Marsh Type 3	3.8	3.8	3.8	0
Marsh Type 4	41.2	40.3	40.3	0
Marsh Type 5	66.2	66.2	66.2	0
Marsh Type 6	30.5	6.5	6.5	0
Marsh Total:	141.7	116.8	116.8	0
Loss of Acreage:	-	24.9	24.9	141.7

¹Existing honey mesquite would survive loss of seepage through root elongation to stay in contact with the declining water table. However, honey mesquite communities would likely succumb over time due to poor seedling establishment and recruitment.

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Table 11. Wildlife values of riparian¹ community types for current and future scenarios.

Community Type	Existing, Well Field, and No Action	Parallel Canal	In-place to Drop 3	In-place to Drop 4
Cottonwood/willow IV	742.9	742.9	742.9	0
Saltcedar V	3916.0	3772.5	3772.5	0
Screwbean mesquite V	2457.9	2260.8	2260.8	0
Honey mesquite IV ²	65.1	50.4	65.1	65.1
Honey mesquite/ saltcedar IV ²	248.8	248.8	248.8	248.8
Arrowweed VI	280.3	233.1	233.1	0
Riparian Total:	7711	7308.5	7323.2	313.9
Loss of Value:	-	402.5	387.8	7397.1

¹Wildlife values of community types from Anderson and Ohmart (1984). Only riparian communities are assigned values in the Anderson/Ohmart system.

²Existing honey mesquite would survive loss of seepage through root elongation to stay in contact with the declining water table. However, honey mesquite communities would likely succumb over time due to poor seedling establishment and recruitment.

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Presently, the presence of carrizo and an earthen bank permits access to water for many vertebrate species. A steep, concrete-lined bank would prevent wildlife from having relatively easy access to drinking water and would result in drownings of some vertebrates. The long-term reduction in available water would probably result in an overall decrease in wildlife numbers.

Of primary concern would be the potential drowning losses of burro deer. Deer loss in canal systems of the western United States is a significant problem (Büsch et al. 1984). A minimum of 29 deer drowned during construction of the Coachella Canal in 1980. In 1981 and 1982, after the construction was complete, an additional 18 deer were reported drowned. All deer drownings occurred in the summer. Burro deer are not known to occur in the project area, but have been recorded nearby to the north and east and could use the Canal as a water source, on occasion. The eastern end of the project area is closest to extant populations of burro deer and is the most likely portion of the Canal to experience drownings.

The loss of 562 acres of creosote scrub and 916 acres of sand dunes would be accompanied by reductions in wildlife use. Based on an evaluation of suitable habitat presented by McCalvin (1993), habitat for the flat-tailed horned lizard in the project area would be reduced by an estimated 1,203 acres. The Colorado desert fringe-toed lizard probably inhabits all 916 acres of sand dune habitat which would be affected.

Water savings due to Canal lining and reduced seepage is estimated at 67,700 acre feet per year. This water savings would reduce the need to divert water to the Canal from the Colorado River. Saved water would be diverted by Metropolitan Water District at Parker Dam, rather than the headworks of the All American Canal at Imperial Dam. Thus, flows in the Colorado River between Parker Dam and Imperial Dam, a distance of 143.1 miles, would be reduced by 67,700 acre feet per year.

Reclamation evaluated the cumulative impacts of 10 possible water savings and water transfer projects, including the lining of the Canal, on flows between Parker and Imperial Dams. These 10 projects would reduce flows by 480,000 acre feet per year, reduce average surface water elevation by 4 inches, and result in a loss of no more than 30 acres of water surface area (Reclamation 1991). The lining of the Canal would cause about 14% of these impacts, or a reduction in average surface water elevation by 0.6 inches and a reduction in surface water area by no more than 4.2 acres. This loss would occur in shallow water areas, such as backwaters, marshes, and shorelines, which are characterized by high wildlife and fisheries value.

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4. Future Conditions With the Project: In-place Lining to Drop 3.

Effects to Desert Scrub. In comparison to the Parallel Canal alternative, in-place lining would result in much reduced impacts to desert scrub habitats. Impacts would be primarily associated with expansion of the spoil berm into adjacent habitat and construction of access roads, staging areas, and a batch plant. An estimated 50-foot strip on both sides of the canal would be disturbed. This disturbance would result in the loss of 153 acres of sand dune habitat and 109 acres of creosote scrub.

Numbers of candidate plants which would be destroyed cannot be estimated precisely. However, assuming similar densities to that found in the Parallel Canal right-of-way, 230 Peirson's milkvetch, 37 desert sunflower, and 37 sandfood would be lost.

Effects to Marsh and Riparian Vegetation. Marsh and riparian habitat loss under this alternative would be similar to the Parallel Canal alternative (Table 10). Loss of seepage would result in desiccation and loss of 97.8 acres of riparian vegetation, 0.9 acres of marsh between Drops 1 and 3, and 24 acres of marsh type 6 on the banks of the Canal (Tables 9 and 10).

Effects to Wildlife. Loss of riparian habitat would reduce riparian habitat values by 387.8 units (Table 11). Twenty-four acres of marsh type 6 on the banks of the Canal and 0.9 acres of marsh type IV between Drop 1 to Drop 3 would also be lost. California black rails and Yuma clapper rails are not known to occur in the project area except in the wetlands between Drops 3 and 4, thus these special status species would not be affected.

All 153 acres of sand dunes which would be lost are probably habitat for the Colorado desert fringe-toed lizard. An estimated 200 acres of flat-tailed horned lizard habitat would also be lost.

The effects on flows in the Colorado River between Parker and Imperial Dams would be the same as in the Parallel Canal alternative.

5. Future Conditions With the Project: In-place Lining to Drop 4.

Effects to Desert Scrub. Because this alternative includes lining between Drops 3 and 4, acres of desert scrub affected would be somewhat greater than in the In-place Lining to Drop 3 alternative. Sand dune acreage lost would remain the same as in the Drop 3 alternative, but 183 acres of creosote scrub would be

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lost. Numbers of candidate plants affected by construction would be the same as for the Drop 3 alternative.

Effects to Marsh and Riparian Vegetation. Lining of the Canal between Drops 3 and 4 would dramatically increase loss of riparian and marsh habitat relative to the other alternatives (Table 10). Only 34.2 acres of honey mesquite of an original area of 1,409.9 acres of riparian and 141.7 acres of marsh habitat are anticipated to survive the loss of seepage. As noted earlier, seedling establishment in these remnant mesquite stands would probably not be adequate to replace mature trees that die.

Effects on Wildlife. Loss of the marsh and riparian habitat would eliminate numerous breeding bird species and substantially reduce the densities of other species. Seventeen of the 58 species (29 percent) detected by Reclamation personnel during the spring, 1984, census are assumed to use the wetland areas as breeding habitat. These species, including the federally endangered Yuma clapper rail and the category 1 candidate California black rail, would be lost as breeding species. Assuming all marsh habitat between Drops 3 and 4 is suitable habitat for Yuma clapper rails, then 111.7 acres of habitat for this species would be lost. Between 3 and 17 Yuma clapper rails and as many as 38 California black rails would be displaced or lost if this alternative is implemented. Additionally, the loss of this mesic habitat with its open waters would result in a decrease in the production of insects. It is very likely that a concomitant decrease in insectivorous vertebrate species would occur with this decline in the food base.

Sand dune habitat for the Colorado desert fringe-toed lizard in the amount of 153 acres would be destroyed under this alternative. Habitat for the flat-tailed horned lizard in the project area would be reduced by 274 acres.

The effect of this alternative on flows in the Colorado River would be similar to the Parallel Canal alternative.

6. Future Conditions With the Project: Well Field between Pilot Knob and Drop 2.

Effects to Desert Scrub. Disturbance to desert scrub under the Well Field alternative would be limited to grading and construction well pads, and construction of access roads, pipelines from the wells to the Canal, and powerlines. An estimated six acres of desert scrub would be destroyed. About two of those six acres would be creosote scrub; the remaining four acres would be in the sand dunes.

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Impacts to candidate plant species would be minimal. Areas which would be disturbed by the well field were not surveyed for candidate plants. However, if similar densities of plants as in the Parallel Canal right-of-way are assumed, then about six Peirson's milkvetch, one desert sunflower, and one sandfood would be lost.

Effects to Marsh and Riparian Vegetation. Wells and associated project features would be constructed outside of marsh and riparian areas, thus no direct impacts would occur to these communities. However, pumping of 68,000 acre feet of ground water per year has the potential to lower ground water elevations and make seepage less available to marsh and riparian plants. The results of a ground water modeling study suggest that no decline in ground water levels would occur within the seep wetlands if pumping occurred east of Drop 1 (Loeltz and Leake 1979). Construction of wells as far as 2.5 miles west of Drop 1 is proposed under this alternative, but Reclamation maintains no decline in ground water elevation would occur in existing seep wetlands (Reclamation and Imperial Irrigation District 1990a).

Effects to Wildlife. Minimal impacts to wildlife would occur under this alternative. About four acres of Colorado desert fringe-toed lizard habitat, and about two acres of flat-tailed horned lizard habitat would be lost.

E. MITIGATION PLAN

The Service has adopted a mitigation policy that covers impacts to fish and wildlife populations, their habitat, and human uses thereof, and addresses loss of habitat value resulting from project implementation. The Service categorizes habitats into four resource categories based on the values of the project area to evaluation species, the uniqueness of the habitat types on a national or regional basis, and the ability to replace habitat values that may be lost. This categorization of habitat values is then used to develop mitigation plans for the subject action (Federal Register 1981 46(15):7657).

Based on evaluations of the habitat types present in the study area, the Service concludes that only two categories of habitat occur on-site. These categories are those that require mitigation goals of no net loss of in-kind habitat value (category 2) and no net loss of habitat value while minimizing the loss of in-kind habitat value (category 3).

The goal of no net loss of in-kind habitat value is sought when habitat is of high value to evaluation species and is scarce or becoming scarce on a national or ecoregional basis. Using

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existing scientific and engineering skills, the values exhibited by these habitats could be replaced in-kind by creation of new habitat or enhancement of existing values. Within the project area, the Service has determined that the marsh communities (exclusive of canal bank vegetation) and riparian vegetation, sand dune communities, and the palo verde/ironwood woodlands characteristic of drainages east of the Algodones Dunes, meet the definition for this goal (category 2). Wetlands are particularly rare in the desert and support a great diversity of wildlife, including in this case, the endangered Yuma clapper rail. Palo verde/ironwood woodlands also occupy a very small percentage of the desert's land area in California while supporting a large density and diversity of species, including migratory birds. The sand dunes represent a unique habitat which supports many species of limited distribution, including Peirson's milkvetch, which is proposed for listing as endangered.

The remaining habitat types found in the study area (the Canal's aquatic habitat, creosote scrub, and canal bank vegetation) exhibit characteristics which facilitate achieving a mitigation goal of no net loss of habitat value while minimizing the loss of in-kind habitat value (category 3). The creosote scrub community is habitat for the flat-tailed horned lizard, a category 1 candidate for listing, but this habitat is not currently recognized as a key area for the species and is isolated from other habitat by the Canal, Interstate 8, and agricultural lands. A considerable fishery resource exists in the Canal, but Reclamation studies have demonstrated these impacts can be mitigated. For this reason, in-kind replacement of habitat values is sought for these habitats.

More than half of the study area's riparian vegetation is comprised of saltcedar associations. The relatively low wildlife values of saltcedar are well documented and reflected by its low habitat rating (Table 8). The Work Group determined that an appropriate means of replacing lost riparian habitat values would be to create a smaller acreage of habitat of greater wildlife value per unit area than that lost. Replacement of lost saltcedar values could be achieved more efficiently, in terms of water consumption and lands required for mitigation, if these habitats were replaced by higher value honey mesquite and cottonwood-willow woodlands.

We emphasize that all of the mitigation measures and recommendations in this Report are presented as general planning guidelines and represent concepts that have been developed by the Service, Bureau of Land Management, Reclamation, California Department of Fish and Game, and other participants in the Work Group. Should the lining of the Canal proceed in any fashion,

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the mitigation concepts presented in this Report will be further developed into specific plans by the Work Group. In addition, if project area habitats change appreciably due to development, habitat management, or other actions, before the impacts of the project become evident, this mitigation plan should be revised to reflect these changing conditions.

1. *Parallel Canal Alternative.*

a. Aquatic Resources. The mitigation goal for the loss of fishery resources in the Coachella Canal is no net loss of habitat value while minimizing the loss of in-kind habitat value. Construction of a Parallel Canal would reduce the number of fish in the project area by about 95,961. Largemouth bass, sunfish, and flathead catfish, which are primarily associated with shoreline habitat, would account for 7,493 of these fish (Table 5).

The consensus of the Work Group was to mitigate the loss of shoreline game fish by constructing artificial reefs in the Canal. These reefs would mimic shoreline habitat by reducing water velocity locally and providing resting, feeding, and cover sites for fish. Reefs would be made of used automobile tires bound into mats chained to the Canal side slopes.

Mueller and Liston (1991) compared fish densities in cellular (tires laid vertically) and flat (tires laid flat) artificial reefs in the Coachella Canal. These reefs were smaller than those proposed for mitigating lining impacts: the areas of the flat and cellular reefs were 165 and 97 ft², respectively (mean of 131). Mean fish densities per reef in flat and cellular reefs were 9.0 and 10.0, respectively. The shoreline game fish accounted for 62% of all fish and 38% of fish biomass in the tire reefs. Channel catfish accounted for an additional 20% of all fish and 57% of fish biomass (Mueller and Liston 1991). Mean shoreline game fish per cellular and flat reef were 6.0 and 5.9, respectively. Mean shoreline game fish per square foot of tire reef (cellular and flat) was 0.048.

The 16 by 50 foot tire reefs would have an area of 800 ft². Assuming fish usage per unit area of these large reefs would be similar to flat and cellular reefs, then an estimated 38 shoreline game fish would use each large reef. To fully mitigate the loss of 7,493 shoreline game fish, 197 reefs should be placed in the Canal. If equally spaced along the length of the project, reefs would be spaced about every 0.12 miles.

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Table 12. Recommended mitigation features by action alternative.

Mitigation Feature	Parallel Canal	In-place to Drop 3	In-place to Drop 4	Well Field
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AQUATIC RESOURCES

1. Construct and place the following number of tire reefs in the Canal:

	197	211	258	0
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TERRESTRIAL RESOURCES

Desert Scrub Mitigation:

1. Avoid and/or minimize impacts to creosote scrub and sand dune habitat, particularly localities of candidate and proposed plant and lizard species (all alternatives).

2. Collection of morphological data on candidate and proposed plant species to be destroyed (all alternatives).

3. No new access permitted across the Coachella or All American Canals for the life of the project (all alternatives).

4. 1:1 compensation for loss of candidate/ proposed sand dune species habitat.

Acreages requiring compensation:

	188	41	41	4
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Table 12 (continued)

Mitigation Feature	Parallel Canal	In-place to Drop 3	In-place to Drop 4	Well Field
5. 1:1 compensation for loss of flat-tailed horned lizard habitat. Acreages requiring compensation ¹ :	1,203	200	274	2
Riparian Mitigation:				
1. Riparian revegetation with cottonwood, willow, and/or honey mesquite. Acreages of revegetation required:	19	18	346	0
Marsh Mitigation:				
1. Create cattail/bulrush marsh. Acreage of marsh required:	0.9	0.9	111.7	0

¹Lands for which flat-tailed horned lizard compensation fees have been paid do not require further compensation for sand dune species. Loss of flat-tailed horned lizard habitat in the Well Field alternative may be avoidable.

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Table 12 (continued)

Mitigation Feature	Parallel Canal	In-place to Drop 3	In-place to Drop 4	Well Field
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Canal Bank Mitigation:

1. Riparian revegetation with cottonwood, willow, and/or honey mesquite.

Acreages of revegetation required:	24	24	30	0
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Colorado River Mitigation:

1. Enhance backwaters on the lower Colorado River between Imperial Dam and Parker Dam (all alternatives).

Large Mammal Escape:

1. Construct large mammal escape ridges the length of the project (all alternatives).

MONITORING

1. Monitor success of marsh and riparian mitigation areas through year 25 after construction (Parallel Canal and In-place Lining alternatives)
2. Monitor ground water elevation in the wetland between Drops 3 and 4. Develop and implement remedial actions, as needed (Parallel Canal, In-place lining to Drop 3, and Well Field alternatives).

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b. Terrestrial Resources

Desert Scrub. Reclamation and the sponsors should carefully evaluate the habitat quality of the areas being considered as staging areas, batch plants, and access routes. Those areas which have been previously disturbed and in which candidate and proposed species are rare or absent should be used to the maximum possible extent. The sponsors should also fully consider the use of construction practices in the vicinity of the Algodones Dunes which will not allow increased access to portions of the dunes not currently heavily used by off-road vehicles. The existing Canal and the Coachella Canal provide impediments to off-road vehicle use of the area north of the Canal. To protect sand dune habitat from off-road vehicles, the Service recommends no new access be created across either the Coachella or All American canals for the life of the project, unless gated to prevent access by the public. Reclamation and the project sponsors should also consider closing to public access the bridge across the Coachella Canal just north of Drop 1. Vehicles accessing the dunes across this bridge have caused considerable damage to creosote scrub near Drop 1 and candidate and proposed plants in the Algodones Dunes.

Whenever possible, clearing of vegetation and disturbance of surface soils should be avoided. If shrubs can be crushed by construction equipment rather than cleared with a grader or other equipment, many will base sprout and recover. When clearing is unavoidable, topsoil should be stripped prior to disturbance and stockpiled. After completion of construction activities on a Canal reach, batch plant sites, staging areas, and other areas with temporary impacts should be recontoured to approximate original topography and the surface soil materials replaced over the ground surface. Surface soils bladed from the Canal right-of-way should be placed over spoil berms. Stockpiling and replacement of surface soils is necessary to reestablish a seed source and facilitate natural revegetation.

Loss of the palo verdes, ironwoods, smoke trees, and honey mesquites in washes east of the Algodones Dunes should be mitigated through avoidance, whenever possible, with unavoidable impacts being compensated through revegetation at a ratio of two trees replanted for each tree destroyed. The Service recommends this ratio because of the uncertainty associated with desert revegetation efforts and the temporal loss of structural diversity that would occur until young trees mature. Where disturbance to desert washes is unavoidable, the ground surface should be recontoured to approximate the preconstruction topography. Desert wash trees should be planted along drainages east of the Algodones Dunes and upslope of the Canal where runoff

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accumulates. Planting trees adjacent to the wetland between Drops 3 and 4 where these species could make use of Canal seepage may also be appropriate. Drip irrigation will likely be needed to establish trees, and plantings will need to be protected from herbivores.

Compensation, pursuant to the Bureau of Land Management compensation formula, is recommended to mitigate loss of flat-tailed horned lizard habitat. The compensation ratio is 1:1 (Jim Watkins, Bureau of Land Management, El Centro, pers. comm. 1993); thus funds necessary to acquire 1,203 acres of flat-tailed horned lizard habitat should be transferred to the Bureau for use in habitat acquisition, enhancement, and studies (Bureau of Land Management 1990).

Abundance and habitat use information should be collected for Peirson's milkvetch, desert sunflower, and sandfood affected by the project. Pre-construction collections of plants and morphological data, such as rooting characteristics and host plants of sandfood, should be made for a representative sample of plants (10 of each species). Such data should be summarized in a report delivered to the Service's Ventura Field Office no later than 90 days after completion of pre-construction activities. This information would help Service biologists in the preparation of recovery plans, should these species become listed, and mitigation strategies for future projects.

One to one compensation should be provided for loss of habitat of candidate and proposed plant species and habitat of the Colorado desert fringe-toed lizard. All 916 acres of sand dune habitat affected by the project support one or more of the candidate species. However, an estimated 728 of these acres support flat-tailed horned lizards, thus mitigation for these acres would be in accordance with flat-tailed horned lizard compensation, as described above. To mitigate loss of the remaining 188 acres of sand dunes, Reclamation or the project sponsors should acquire and transfer to the Bureau of Land Management 188 acres of sand dune habitat in the Algodones Dunes which support Peirson's milkvetch, desert sunflower, sandfood, and the Colorado desert fringe-toed lizard. Lands acquired should be in the North Algodones Dunes Wilderness Study Area or in other areas which the Bureau of Land Management will manage for the benefit of these species.

If sand dune habitat of sufficient acreage to achieve 1:1 compensation is not available, mitigation for sensitive sand dune species could be accomplished by developing a multi-species conservation plan that would review the biology of each target species, identify factors which threaten habitat and the

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continued existence of the target species, and outline actions needed to protect target species from threats. The project sponsors should also implement a portion of the plan if funding allows. The Service suggests that implementation funding be equal to the estimated cost of 1:1 sand dune habitat compensation minus the cost of developing the multi-species plan.

Riparian vegetation. Mitigation of riparian habitat lost as a result of this project would require creation of 402.5 riparian habitat units (Table 11). Because the value of cottonwood/willow and honey mesquite communities are relatively high, a revegetation project using these species could be smaller than the acreage of riparian vegetation lost. These revegetation sites would have the greatest value if they were in a single block and contiguous with adjacent naturally occurring riparian woodlands (Shafer 1990). As a result, the Service recommends these habitats be created in or on the edge of the riparian woodlands between Drops 3 and 4.

The Service recommends crediting habitat values for revegetation based on the expected habitat value of mature revegetated stands. For example, if a honey mesquite IV community is expected, the value of this community would be 21 habitat units per acre (Table 4). Although several years will likely be necessary for revegetated stands to achieve their full stature and value, additional mitigation to offset temporal loss of habitat value is not needed because the deterioration of existing riparian stands will also be a slow process as ground water declines or disappears (Rorabaugh 1989). Assuming a revegetation site with an expected value of 21 units per acre, a 19-acre revegetation project would be required to mitigate loss of riparian values. Trees should be planted at a density of 100 per acre, or if existing desirable trees occur on site, the density of planted and existing trees should be about 100 per acre. In total, 1,900 trees (100 trees per acre X 19 acres) should be planted.

The precise locations of revegetation sites and determination of site suitability for revegetation should be based on a thorough analysis of ground water elevation and quality; soil salinity; competition from undesirable species, such as saltcedar and arrowweed (Anderson and Miller 1992, Anderson and Ohmart 1982); and future groundwater declines resulting from the project. Site preparation may include removal of saltcedar and arrowweed, but other native species should be left in place. Auguring and backfilling to till planting sites, and protection of plantings with chicken wire baskets will likely be necessary to ensure a successful project. Water of sufficient quality and quantity will need to be provided to the seedlings by drip irrigation or other means until the trees become established. Specific

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implementation plans for the establishment of mitigation areas for riparian vegetation should be prepared by the project sponsor(s) and approved by the Work Group prior to the commencement of project construction. Revegetation should be accomplished concurrently with Canal construction.

Because revegetation in desert riparian ecosystems is often unsuccessful (Carothers et al. 1990), the Service strongly recommends initiating a number of pilot revegetation projects to test methodologies. A small number of honey mesquite was planted at the wetland between Drops 3 and 4 during 1990. These plantings should be evaluated and perhaps further pilot plantings initiated to identify potential revegetation sites. Pilot projects should consist of small numbers of trees planted at a site and monitored for a year. If a pilot project is successful on a particular site, then that site should be fully planted using the same methods. If the pilot project fails, different species better suited to the site conditions should be considered or new sites should be investigated. This would result in a phasing of the planting effort, but testing of methods with pilot projects would improve the likelihood of a successful revegetation effort.

Marsh. The Parallel Canal alternative would result in a loss of 0.9 acres of marsh type 4 between Drops 1 and 3. The Service recommends acre-for-acre, in-kind mitigation for this loss by construction of 0.9 acres of marsh habitat adjacent to existing marsh between Drops 3 and 4. The created marsh should exhibit vegetation composition and densities, and percentages of open water similar to that lost. The exact location and design of the mitigation marsh should be based on a site analysis and should be determined by Reclamation and the project sponsors in coordination with the Work Group. The created marsh should be constructed concurrently with the Parallel Canal.

An option with regard to creation of an additional marsh would be to enhance some areas of the existing marsh that are currently occupied by pampas grass, an invasive exotic species. The value trade-offs involved in this mitigation effort would likely involve a 1:1 replacement of pampas grass with native marsh vegetation. We base this on the relative lack of wildlife value associated with this species.

An estimated 24 acres of marsh type 6 which occurs as a narrow band on the canal bank would also be lost under this alternative (Table 10). This vegetation is valuable as cover for shoreline game fish, but this impact would be mitigated with tire reefs. This vegetation is also important cover for a variety of terrestrial species which water at the Canal. The Service

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recommends mitigation of this loss by creating 24 acres of cottonwood-willow, and/or honey mesquite riparian vegetation. This revegetation effort should be a part of the revegetation project described under "riparian vegetation" above. Site selection, trees per acre, valuation of the revegetation site, and other considerations would be the same as described in the above section.

An estimated maximum of 4.2 acres of water surface area would be lost on the Colorado River between Parker and Imperial Dams. This loss of watered area would occur in areas of shallow water, probably in backwaters, marshes, and shorelines. Reclamation proposes \$100,000 of backwater restoration, creation, or enhancement to mitigate this impact. The precise location and design of the project would be determined by the Work Group and the Colorado River Backwaters Committee, an interagency team which includes the Service's Phoenix Field Office.

Large mammal escape. After a 49-mile reach of the Coachella Canal was concrete-lined in 1980, large numbers of burro deer drowned as they attempted to drink from the new canal. Animals slipped on the concrete lining and once in the canal were not able to escape. Reclamation responded by installing 19 windmill watering devices along the canal to provide an alternate and safe water source. The water sources were successful in drawing deer away from the canal and minimizing deer drownings. However, they have been costly to maintain and occasional drownings still occur (Rorabaugh and Garcia 1983).

Instead of watering devices, Reclamation proposes shallow ledges on the Canal sides, 1.5 inches deep and 18 inches apart, from top to bottom to provide footing for ungulates and humans that have fallen into the Canal. To test construction methods, ledges were constructed on a 1.5-mile prototype Coachella Canal reach which was lined in place. It was believed that the combination of the ledges, lower water velocities than in the first 49 lined miles, and flatter side slopes of the prototype reach would enable deer to escape the canal. In the summer of 1989, the ledges were tested by using a tame mule deer provided by the California Department of Fish and Game. During a brief test, the deer entered and left the Canal unassisted (Reclamation 1989). Other animals and humans which become entrapped would also be more likely to escape if the ledges are installed. Additionally, the ledges would allow continued access for all wildlife species using the Canal as a water source.

Construction of a Parallel Canal would result in a steeper side slope (1-1/2:1) than either the existing canal (2:1) or in-place lining (2-1/2:1). As a result, although deer can successfully

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escape an in-place lined reach, they may not be able to escape the steeper slopes of a Parallel Canal. Tests are underway in canals in Colorado to test the efficacy of ledges as ungulate escape devices in steep, high velocity canals (Larry White, Reclamation, Denver, pers. comm. 1993). If tests on steep-sided (1.5:1 slope) canals in Colorado show that escape ridges are effective in reducing deer drownings, then large mammal escape ridges should be incorporated into the project design and should run continuously for the entire length of the lining project. Deflector systems, such as cables with visible buoys, should be installed and maintained on the upstream side of all siphons to direct large mammals to escape steps.

If the escape ridges do not prove effective in allowing escape of deer from steep-sided canals, then Reclamation has proposed construction of escape ramps [see Rautenstrauch and Krauseman (1986) for a general description of deer escape ramps]. Escape ramps should be constructed on both sides of the Canal at intervals of no more than one mile and just upstream of all siphons. Deflector systems should be constructed at all escape ramp locations.

2. In-place Lining to Drop 3.

a. Aquatic Resources. The In-place Lined Canal would provide habitat for 37,657 fewer fish, including 8,025 shoreline game fish, than existing conditions (Table 5). Impacts to fish would be reduced relative to the Parallel Canal alternative because in-place lining would result in a greater acreage of channel habitat which would reduce impacts to channel catfish. Mitigation for losses of shoreline game fish could be provided by installing 211 tire reefs in the Canal. These reefs would be measure 16 by 50 feet and be evenly spaced on either side of the Canal, as in the Parallel Canal alternative.

b. Terrestrial Resources.

Desert Scrub. Adverse effects to desert scrub under this alternative would be much reduced relative to the Parallel Canal alternative. Mitigation would be the same, except that compensation for loss of habitat would be reduced. Replacement of palo verdes, ironwoods, smoke trees, and honey mesquites in washes east of the Algodones Dunes would also be less due to a narrower disturbance width.

Reclamation or the project sponsors should, in accordance with Bureau of Land Management (1990), provide 1:1 compensation for loss of 200 acres of flat-tailed horned lizard habitat. One to one compensation, as described for the Parallel Canal

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alternative, should also be provided for loss of sand dune habitat supporting candidate and proposed plants and Colorado desert fringe-toed lizards. Of the 153 acres of sand dunes which this alternative would affect, an estimated 41 acres are not habitat for the flat-tailed horned lizard. Thus, Reclamation or the project sponsors should acquire and transfer title to the Bureau of Land Management 41 acres of sand dune habitat supporting the candidate and proposed species. If sufficient acquisition lands are not available, a multi-species conservation plan should be developed and a portion of that plan implemented, as described under the Parallel Canal alternative.

Riparian vegetation. Mitigation for loss of riparian vegetation would be similar to the Parallel Canal alternative. Replacement of the lost 387.8 habitat units could be accomplished by revegetating 18 acres of cottonwood-willow, and/or honey mesquite woodland with a mature value of 21 units per acre. Location, planning, pilot projects, and design should be the same as described for the Parallel Canal alternative.

Marsh. In-place Lining to Drop 3 would result in a loss of 0.9 acres of marsh type 5 between Drops 1 and 3. Mitigation would be identical to that described for the Parallel Canal alternative: Reclamation or the project sponsors should create 0.9 acres of marsh adjacent to extant marsh communities between Drops 3 and 4.

An estimated 24 acres of marsh type 6 on the banks of the Canal would also be lost. This vegetation is not expected to reestablish on the concrete lining. As with the Parallel Canal alternative, the Service recommends that Reclamation or the project sponsors revegetate 24 acres of cottonwood-willow, and/or honey mesquite as mitigation for this impact. Location, planning, pilot projects, and design would be the same as described above.

Large mammal escape. To prevent drownings of burro deer and other wildlife in the lined Canal, the escape ridges described above for the Parallel Canal should be constructed the length of the project. Because of the flatter side slopes of the in-place lined Canal as compared to the Parallel Canal, further testing of the escape ridges would be unnecessary.

3. In-place Lining to Drop 4.

a. Aquatic Resources. In-place Lining to Drop 4 would provide habitat for 45,953 fewer fish, including 9,793 shoreline game fish, than existing conditions (Table 5). As with the Drop 3 alternative, impacts to fish per mile of lining would be reduced relative to the Parallel Canal alternative because a

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greater acreage of channel habitat would result with in-place lining. However, the Drop 4 alternative would line 29.9 miles of canal versus 24.6 and 23.0 miles in the Drop 3 and Parallel Canal alternatives. Mitigation for losses of shoreline game fish could be provided by installing 258 tire reefs in the Canal. Reefs would measure 16 by 50 feet and would be evenly spaced on either side of the Canal, as in the Parallel Canal alternative.

b. Terrestrial Resources

Desert scrub. Adverse effects to desert scrub under this alternative would be slightly greater than in the In-place Lining to Drop 3 alternative. Mitigation would be the same, except that compensation for loss of habitat would be increased. Numbers of palo verdes, ironwoods, smoke trees, and honey mesquites in washes east of the Algodones Dunes to be replaced at the 2:1 ratio would be the same as the Drop 3 alternative.

Reclamation or the project sponsors should, in accordance with Bureau of Land Management (1990), provide 1:1 compensation for loss of 274 acres of flat-tailed horned lizard habitat. One to one compensation, as described for the Parallel Canal alternative, should also be provided for loss of sand dune habitat supporting candidate and proposed plants and Colorado desert fringe-toed lizards. Of the 153 acres of sand dunes which this alternative would affect, an estimated 41 acres are not habitat for the flat-tailed horned lizard. Thus, Reclamation or the project sponsors should acquire and transfer title to the Bureau of Land Management 41 acres of sand dune habitat supporting the candidate and proposed species. If sufficient acquisition lands are not available, a multi-species conservation plan should be developed and a portion of that plan implemented, as described under the Parallel Canal alternative.

Riparian vegetation. Lining of the Canal to Drop 4 would eliminate most riparian vegetation between Drops 3 and 4, as well as the scattered riparian acreage between Drops 1 and 3. Because of the high value of these riparian habitats (as well as marsh habitats which would be lost) the Service strongly recommends that this alternative be rejected. If, however, the canal is lined to Drop 4, Reclamation or the project sponsors would need to replace the 7,397.1 habitat units destroyed under this alternative. This could be accomplished by revegetating 346 acres of cottonwood-willow, and/or honey mesquite with a mature value of 21 units per acre.

Three potential sites have been identified by the Work Group for this revegetation effort:

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1. Between Drops 3 and 4. The mitigation site would be placed within or adjacent to the existing riparian and marsh communities. Sufficient quality and quantity of water to maintain the plantings in perpetuity would have to be delivered to the site from the Canal. Revegetation at this site may afford an opportunity to maintain some of the existing vegetation in place, instead of replacing it. This is the Service's preferred site, because revegetation here would represent in-place mitigation. However, if site suitability or other factors would result in poor survival or growth of plantings, the following sites would be preferable.
2. East Highline Site. Located about 2 miles northwest of Drop 4, this site supports patches of riparian vegetation. Ground water is relatively shallow and may provide a water source for the plantings. Alternatively, water of sufficient quality and quantity would be supplied from the Canal to support the revegetation project in perpetuity.
3. Drop 3 Site. This site is located immediately south of Drop 3 and would require a water delivery system and water from the Canal in perpetuity to maintain riparian plantings.

Before selecting a site, suitability of the site for planting the target species, pilot projects, and other planning and design considerations would need to be evaluated, as described for the Parallel Canal alternative. The revegetation project should be initiated concurrently with the lining of the Canal.

Marsh. In-place Lining to Drop 4 would result in a loss of 111.7 acres of marsh between Drops 1 and 4. An additional 30 acres of marsh type 6 would be lost on the banks of the Canal. Mitigation for the 111.7 acres between Drops 1 and 4 could be accomplished by creation of 111.7 acres of marsh adjacent to the riparian revegetation effort. Water of sufficient quality and quantity to maintain the marsh would need to be delivered to the site in perpetuity. The mitigation marsh should be in place before the effects of Canal lining become apparent.

Loss of the 30 acres of Canal bank vegetation could be accomplished by revegetating 24 acres of cottonwood-willow and/or honey mesquite. This revegetation project would be a part of the larger effort described above.

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Because the endangered Yuma clapper rail would be affected by this alternative, the formal section 7 consultation would need to be reinitiated or amended to address this action. A prior biological opinion for the relocation alternative of this project, dated July 3, 1985, established reasonable and prudent measures to eliminate incidental take. The reasonable and prudent measures are expected to be similar for this in-place lining alternative because both relocation and lining in-place would have similar effects on the rails.

A management plan would need to be written and a management entity identified and funded to maintain marsh and riparian mitigation sites.

Large mammal escape. To prevent drownings of burro deer and other wildlife in the lined Canal, the escape ridges described above for the Parallel Canal should be constructed the length of the project. Because of the flatter side slopes of the in-place lined Canal as compared to the Parallel Canal, further testing of the escape ridges would be unnecessary.

4. Well Field between Pilot Knob and Drop 2.

a. Aquatic Resources. No effects to the Canal fishery are anticipated under this alternative, thus no mitigation is needed.

b. Terrestrial Resources.

Desert scrub. Adverse effects to desert scrub under this alternative would be much reduced relative to the other three alternatives. Four acres of sand dunes and two acres of desert scrub would be lost if this alternative is implemented. Because this alternative would disturb a relatively small acreage and the location of the wells, pipelines, and access roads are somewhat flexible, the project sponsors could mitigate most if not all impacts to candidate and proposed plants, the Colorado desert fringe-toed lizard, desert wash trees (palo verdes, ironwoods, smoke trees, and honey mesquites), and the flat-tailed horned lizard by constructing project features at disturbed sites or other areas where these species are absent. To reduce mortality and injury, construction should, if possible, occur when candidate lizard species are active.

Wash trees that cannot be avoided should be replaced at a ratio of two planted for every one tree removed as described under the Parallel Canal alternative, above. Where impacts to flat-tailed horned lizard habitat cannot be avoided, Reclamation or the project sponsors should provide 1:1 compensation for loss of such habitat, in accordance with Bureau of Land Management (1990).

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One to one compensation, as described for the Parallel Canal alternative, should also be provided for loss of sand dune habitat supporting candidate/proposed plants and Colorado desert fringe-toed lizards (minus acreage supporting flat-tailed horned lizards).

Riparian and marsh vegetation. No riparian or marsh vegetation would be directly affected by this alternative. If monitoring reveals that pumping of ground water is causing ground water depth in riparian and marsh areas to increase, then corrective action may need to be implemented (see monitoring plan, below).

Large mammal escape. The Well Field alternative would not affect use of the Canal by vertebrates, thus no mitigation would be required.

5. No Action

If no action is taken, there would be no need to consider fish and wildlife mitigation measures. Should any entity attempt to implement this action without Reclamation's participation, the Service would review the environmental impacts under the authorities mandated to it by the Federal Water Pollution Control Act (Clean Water Act) (33 U.S.C. 1251-1376) and the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended. Our mitigation and compensation goals in that situation would closely resemble those recommended here.

6. Mitigation costs

Mitigation features recommended by the Service are listed in Table 12. A cost estimate for this mitigation package is currently being developed by Reclamation; however, the Service estimates total mitigation costs for the Parallel Canal alternative at 1.4 million dollars. Estimated mitigation costs for the In-place Lining to Drop 3, In-place Lining to Drop 4, and Well Field alternatives are 1.0, 3.6, and 0.1 million dollars, respectively.

F. MONITORING PLAN

Reclamation or a management entity funded by the project sponsor(s) should be responsible for monitoring the impacts of the proposed action and the success of the mitigation efforts.

1. Marsh and Riparian Habitats. A monitoring program to document the project's effects on marsh and riparian habitats as well as the non-project related evolution of the vegetation

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should be developed and implemented. Monitoring of non-project related vegetation changes would provide a control to which restored riparian and marsh communities could be compared.

The recommended riparian revegetation sites and marsh mitigation areas should be monitored monthly during the first and second year growing seasons, twice during the growing seasons in years three through five, and annually for years six through 10. The sites should then be monitored in post-planting years 15, 20, and 25. The monitoring plan should be reviewed upon the completion of each survey year to determine if modifications to the plan or corrective actions would be required.

The monitoring program should also include an assessment of the success of the marsh and riparian mitigation areas. Evaluation criteria should be established that will address both physical (e.g., water quality, soil chemistry) and biological (e.g., vegetation growth and vigor) parameters. Mitigation goals of complete replacement or maintenance of wildlife and habitat values should be reflected in the evaluation criteria.

Evaluation criteria should, at a minimum, consider the survivorship and vigor of riparian plantations. To ensure full value of riparian revegetation sites, if, on any 10-acre site mortality of trees or shrubs exceeds 20% over and above mortality on adjacent, similar native riparian stands within 25 years after planting, reasonable corrective action should be taken, including replacing dead plants, or other actions as agreed to by the Work Group. Comparing planted areas with natural areas would allow a fair assessment of the success of the mitigation in light of other changes that may be occurring in the project area, such as negative effects of salt accumulation in surface soils. Criteria to evaluate whether or not growth of planted trees and shrubs is adequate to ensure mitigation should also be developed by the Work Group.

2. Ground Water Elevation. Of the action alternatives, only the In-place Lining to Drop 4 alternative is expected to cause a lowering of the water table under the marsh and riparian communities between Drops 3 and 4. No wetlands in the project area should be affected by implementation of the Well Field alternative. However, to test these assertions, ground water elevation should be monitored at all wetland communities between Drops 1 and 4 for the Well Field alternative, and at the wetland between Drops 3 and 4 for the Parallel Canal and In-place Lining to Drop 3 alternatives. If depths to ground water increase as a result of the project, Reclamation and the project sponsors should, in coordination with the Work Group, develop and implement appropriate action to prevent loss of wildlife value.

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Special attention should be given to maintenance of the Yuma clapper rail and black rail habitat between Drops 3 and 4.

3. Water Quality. To ensure that water delivered to the Canal from the Well Field does not adversely affect the Canal fishery, Reclamation or the project sponsors should conduct periodic water quality tests of well water. If the water quality of the wells deteriorates to a level detrimental to the fishery, pumping should be suspended until the water quality problem is corrected.

F. RECOMMENDATIONS

The Well Field alternative would have the least impact on the fish and wildlife resources of the Canal and vicinity. Therefore, it is the Service's preferred alternative among the action alternatives. In-place Lining from Pilot Knob to Drop 3 would result in less disturbance of the fish and wildlife resources of the project area than construction of a Parallel Canal. Therefore, it is the Service's preferred action among the lining alternatives. Construction of a Parallel Canal would result in greater disturbance of terrestrial resources than either the Well Field or In-place Lining to Drop 3 alternatives. In-place Lining to Drop 4 is the Service's least preferred alternative due to adverse effects to the wetland between Drops 3 and 4.

The direct effects to terrestrial habitats in any of the alternatives can be reduced through careful site selection of work areas. Impacts to fishery resources could be mitigated through enhancement of the in-Canal fishery.

1. Parallel Canal

a. For the loss of shoreline game fish, 197 reefs, consisting of discarded automobile tires, shall be constructed and placed in the Canal. The reefs shall be evenly distributed over the 23-mile project area from Pilot Knob to Drop 3 and shall be alternately placed on both sides of the Canal.

b. For the loss of 24 acres of common reed along the existing Canal banks, Reclamation shall plant 24 acres of cottonwood-willow and/or honey mesquite woodland with a mature habitat value of 21 points per acre adjacent to or within the wetland between Drops 3 and 4.

c. For the loss of the 98.5 acres of riparian vegetation east of Drop 3, Reclamation shall plant 19 acres of

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cottonwood-willow and/or honey mesquite woodland with a mature habitat value of 21 points per acre adjacent to or within the existing wetland between Drops 3 and 4.

d. Specific implementation plans for riparian revegetation shall be prepared by Reclamation following determination of specific site characteristics. Ratios of cottonwood, willow, and honey mesquite planted shall correspond to the suitability of potential revegetation sites for these species. The planting of honey mesquite/quailbush associations may be appropriate in areas of high soil salinity. These plans shall be approved by the Work Group prior to the commencement of project construction. Clearing of existing vegetation to plant seedlings shall be minimized and limited to saltcedar and arrowweed. Seedlings shall be planted at a density of 100 per acre and irrigated with water of sufficient quality and quantity to allow establishment.

e. For the loss of the 0.9 acre marsh located east of Drop 3, Reclamation shall recreate an 0.9 acre of marsh adjacent to the existing marsh between Drops 3 and 4, or remove pampas grass from 0.9 acre of existing wetland between Drops 3 and 4 and replace it with native marsh vegetation.

f. Reclamation shall fund backwater restoration, development, and/or enhancement on the Colorado River between Parker Dam and Imperial Dam in the amount of \$100,000. The location, purposes, and design of the project shall be coordinated through the Work Group and the Colorado River Backwaters Committee.

g. To the extent possible, construction activities, including access roads, staging areas, and batch plants, shall avoid flat-tailed horned lizard, Colorado desert fringe-toed lizard, and candidate and proposed plant habitat and shall be located within previously disturbed areas. Construction zones shall be flagged and all activities shall be confined to these designated work areas. After construction is completed, Reclamation shall conduct an evaluation and quantification of the disturbance which occurred in creosote scrub and the Algodones Dunes.

h. Prior to construction, abundance and habitat characterization shall be quantified for *Astragalus magdalena* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, and *Pholisma sonora* to be destroyed by the project. Collections of plants and morphological data, including measurements and rooting characteristics, shall be made for

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a representative sample of plants (10 of each species). The host plant of any collected *Pholisma sonora* shall be identified. Data collected on these species shall be delivered to the Service within 90 days of completion of pre-construction activities.

i. No new access to the dunes across either the All American Canal or the Coachella Canal, unless gated to prevent public use, shall be created for the life of the project.

j. Reclamation or the project sponsors shall acquire and transfer to the Bureau of Land Management 188 acres of sand dune habitat. Acquired lands must support, at a minimum, the following species: *Astragalus magdalenae* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, *Pholisma sonora*, and Colorado desert fringe-toed lizard. If sand dune habitat of sufficient acreage to achieve 1:1 compensation is not available for acquisition, Reclamation or the project sponsors shall implement the following actions in addition to acquiring available habitat for the above species:

1. Reclamation or the project sponsors shall fund a Multi-Species Conservation Plan for the sand dune species. This plan would address habitat conservation and recovery of *Astragalus magdalenae* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, *Pholisma sonora*, the Colorado Desert fringed-toed lizard, and Andrew's scarab beetle. The plan would include the following sections:

- a. a review of the biological literature for each species including a listing of all known localities,
- b. a discussion of all factors which threaten the continued existence of populations of species,
- c. and the development of actions needed to protect the species from these threats.

② Reclamation or the project sponsors shall, in coordination with the Service and the Bureau of Land Management, implement a portion of the Conservation Plan. Implementation funding shall be equal to the estimated cost of acquiring 188 acres of sand dune habitat minus the cost of developing the Conservation Plan and the cost of lands actually acquired and transferred to the Bureau of Land Management.

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k. In areas disturbed by construction, vegetation shall be crushed rather than bladed, whenever possible. In vegetated areas requiring blading, topsoil shall be stripped prior to disturbance and stockpiled. Prior to abandonment, construction sites shall be recontoured to approximate original topography and the surface soil materials replaced over the ground surface to facilitate natural revegetation.

l. Compensation, pursuant to the Bureau of Land Management compensation formula, shall be provided by Reclamation or the project sponsors to the Bureau of Land Management for the permanent or long-term loss of 1,203 acres of flat-tailed horned lizard habitat.

m. To prevent the drowning of burro deer and other wildlife and to permit the Canal to continue to function as a source of water, Reclamation or the project sponsors shall construct the escape ledges described in section E.1.b of this Report along the entire length of the project. If further testing of the ledges in steep-sided canals shows they are not effective at allowing escape of deer, then escape ramps shall be constructed on both sides of the Canal at intervals of no more than one mile and just upstream of all siphons.

n. Deflector systems, such as cables with visible buoys, shall be installed and maintained on the upstream side of all siphons to direct large mammals to escape ridges. If escape ramps are constructed instead of escape ridges, deflector systems shall be constructed just upstream of all escape ramps.

o. Reclamation or a management entity shall develop and implement a monitoring program to document the development of the riparian and marsh mitigation areas. Evaluation criteria shall be established by the Work Group that will address both physical (e.g., water quality, soil chemistry) and biological (e.g., vegetation growth and vigor) parameters. Riparian revegetation sites and marsh mitigation areas shall be monitored monthly during the first and second year growing seasons, twice during the growing seasons of years three through five, and annually for years six through 10. The sites shall then be monitored in post-planting years 15, 20, and 25. The monitoring plan shall be reviewed by the Work Group prior to the first monitoring efforts and upon the completion of each survey year to determine if modifications to the plan or corrective actions would be required.

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p. If, on any 10-acre site, mortality of planted riparian trees or shrubs exceeds 20% over and above natural mortality in adjacent and similar native riparian stands within 25 years after planting, reasonable corrective action shall be taken, including replacing dead plants, or other actions as agreed to by the Work Group.

q. Groundwater elevation shall be monitored within the wetland between Drops 3 and 4. If groundwater elevation decreases as a result of the project, Reclamation or the project sponsors shall initiate discussions with the sponsors and the Work Group to identify and implement reasonable measures to ensure maintenance of existing values within the wetland. Special attention shall be given to maintenance of Yuma clapper rail and black rail habitat.

r. All fish and wildlife mitigation recommendations specified herein shall be implemented by Reclamation or the sponsors concurrently with project construction.

s. All operations and maintenance activities and fees associated with these fish and wildlife mitigation recommendations shall be the responsibility of Reclamation or the project sponsors.

2. In-place Lining to Drop 3

Implementation of this alternative would affect biological resources in a manner similar to that of the Parallel Canal alternative, except in the extent of terrestrial impacts and adverse effects to the Canal fishery. The adverse effects on the Canal fishery would be increased slightly. In-place Lining to Drop 3 would result in reduced impacts to the creosote scrub and sand dune communities and their associated rare plants and animals. As a result, compensation acreages and/or funds transferred to the Bureau of Land Management would be reduced under this alternative.

To account for slightly decreased adverse effects to the Canal fishery, recommendation a. from the Parallel Canal alternative should be modified as follows:

a. For the loss of shoreline game fish, 211 reefs, consisting of discarded automobile tires, shall be constructed and placed in the Canal. The reefs shall be evenly distributed over the 24.6-mile project area from Pilot Knob to Drop 4.

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To account for decreased adverse effects to habitat of the flat-tailed horned lizard, candidate and proposed plants, and the Colorado desert fringe-toed lizard, recommendations j. and l. from the Parallel Canal alternative shall be modified as follows:

j. Reclamation or the project sponsors shall acquire and transfer to the Bureau of Land Management 41 acres of sand dune habitat. Acquired lands must support, at a minimum, the following species: *Astragalus magdalenae* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, *Pholisma sonorae*, and Colorado desert fringe-toed lizard. If sand dune habitat of sufficient acreage to achieve 1:1 compensation is not available for acquisition, Reclamation or the project sponsors shall implement the following actions in addition to acquiring available habitat for the above species:

1. Reclamation or the project sponsors shall fund a Multi-Species Conservation Plan for the sand dune species. This plan would address habitat conservation and recovery of *Astragalus magdalenae* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, *Pholisma sonorae*, the Colorado Desert fringed-toed lizard, and Andrew's scarab beetle. The plan would include the following sections:

- a. a review of the biological literature for each species including a listing of all known localities,
- b. a discussion of all factors which threaten the continued existence of populations of species,
- c. and the development of actions needed to protect the species from these threats.

2. Reclamation or the project sponsors shall, in coordination with the Service and the Bureau of Land Management, implement a portion of the Conservation Plan. Implementation funding shall be equal to the estimated cost of acquiring 41 acres of sand dune habitat minus the cost of developing the Conservation Plan and the cost of lands actually acquired and transferred to the Bureau of Land Management.

l. Compensation, pursuant to the Bureau of Land Management compensation formula, shall be provided by Reclamation to the Bureau of Land Management for the permanent or long-term loss of 200 acres of flat-tailed horned lizard habitat.

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3. *In-place Lining to Drop 4*

Recommendations for this alternative would be the same as under the In-place Lining to Drop 3 alternative, except that modifications are needed to account for greater adverse effects to the Canal fishery, much greater adverse effects to marsh and riparian communities, and slightly greater adverse effects to flat-tailed horned lizard habitat.

Recommendation a., b., c., d., e., and l. would be modified as follows:

a. For the loss of shoreline game fish, 258 reefs, consisting of discarded automobile tires, shall be constructed and placed in the Canal. The reefs shall be evenly distributed over the 29.9-mile project area from Pilot Knob to Drop 4 and shall be alternately placed on both sides of the Canal.

b. For the loss of 30 acres of common reed along the existing Canal banks, Reclamation or the project sponsors shall plant 30 acres of cottonwood-willow and/or honey mesquite adjacent to or within the wetland between Drops 3 and 4.

c. For the loss of 1,376 acres of riparian vegetation, Reclamation shall plant 359 acres of cottonwood-willow and honey mesquite woodland with a mature habitat value of 21 units per acre. The plantation shall be located at the existing wetland site between Drops 3 and 4. If site conditions or other factors preclude locating the revegetation site between Drops 3 and 4, the revegetation shall be accomplished at one of the following locations after evaluating their suitability for revegetation:

1. East Highline Site - This site is about two miles west of Drop 4 in an area of high groundwater where the Canal would not be lined.

2. Drop 3 Site - Located immediately south of Drop 3, this area consists of fallow agricultural lands.

d. Specific implementation plans for riparian revegetation shall be prepared by Reclamation following determination of specific site characteristics. Ratios of cottonwood, willow, and honey mesquite planted shall correspond to the suitability of potential revegetation sites for these species. Planting of honey mesquite/quailbush associations may be appropriate in areas of high soil salinity. These

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plans shall be approved by the Work Group prior to the commencement of project construction. Clearing of existing vegetation to plant seedlings shall be minimized and limited to saltcedar and arrowweed. Tree seedlings shall be planted at a density of 100 per acre and irrigated with water of sufficient quality and quantity to allow establishment.

e. For the loss of 112 acres of marsh, Reclamation or the project sponsors shall create 112 acres of marsh adjacent to the riparian revegetation site. Specific marsh types shall be replaced in-kind to the degree possible; however, less desirable marsh types could be replaced with higher value types.

1. Compensation, pursuant to the Bureau of Land Management compensation formula, shall be provided by Reclamation or the project sponsors to the Bureau of Land Management for the permanent or long-term loss of 274 acres of flat-tailed horned lizard habitat.

To ensure the long-term maintenance of the riparian and marsh mitigation areas, the following additional recommendations would be added:

1. A water distribution system shall be constructed as needed to maintain the marsh and riparian mitigation areas in perpetuity. This distribution system shall be designed to allow flexibility in the amount and location of delivered water. Sufficient water, currently estimated at 4,000 acre feet of water per year, shall be delivered from the Canal through the distribution system to maintain the mitigation areas in perpetuity.

2. All marsh and riparian mitigation areas shall be managed by a management entity(s) to be identified by the Work Group. Reclamation or the project sponsors shall provide sufficient funds to the management entity(s) for long-term management of these areas.

4. Well Field between Pilot Knob and Drop 2

The effects of the Well Field alternative would be fundamentally different from the other alternatives. The Canal fishery would not be affected and terrestrial impacts would be greatly reduced relative.

a. In areas disturbed by construction, vegetation shall be crushed rather than bladed, whenever possible. In vegetated areas requiring blading, topsoil shall be stripped prior to

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disturbance and stockpiled. Prior to abandonment, construction sites shall be recontoured to approximate original topography and the surface soil materials replaced over the ground surface to facilitate natural revegetation.

b. Sites for wells, access roads, and ancillary facilities shall be selected to minimize adverse effects to sensitive plant species, the Colorado desert fringe-toed lizard, and the flat-tailed horned lizard. Preconstruction surveys of potential construction sites shall be conducted by qualified biologists to identify important habitats for sensitive species. Construction of drill pads at the well sites should occur during times of the year when candidate lizards are active and able to move from the path of construction activities.

c. Compensation, pursuant to the Bureau of Land Management formula, shall be provided by Reclamation or the project sponsors for any permanent or long-term loss of flat-tailed horned lizard habitat.

d. No new access to the dunes across either the All American Canal or the Coachella Canal, unless gated to prevent public use, shall be created for the life of the project.

e. Prior to construction, abundance and habitat characterization shall be quantified for *Astragalus magdalenae* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, and *Pholisma sonora* to be destroyed by the project. Collections and morphological data, including measurements and rooting characteristics, shall be made for a representative sample of plants. The host plant of any collected *Pholisma sonora* shall be identified. Data collected on these species shall be delivered to the Service within 90 days of construction completion.

f. Reclamation or the project sponsors shall acquire and transfer to the Bureau of Land Management an acreage of sand dune habitat equal to the acreage of candidate and proposed plant and Colorado desert fringe-toed lizard habitat lost as a result of the project (1:1 compensation). Acquired lands should support, at a minimum, the following species: *Astragalus magdalenae* var. *peirsonii*, *Helianthus niveus* ssp. *tephrodes*, *Pholisma sonora*, and Colorado desert fringe-toed lizard.

g. Reclamation or the project sponsors shall conduct periodic water quality tests to ensure that the well field

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water remains of such chemical composition that the aquatic resources of the Canal will not be adversely affected. If the water quality of the wells deteriorates to a level detrimental to the Canal's aquatic life, pumping shall be suspended until the water quality problem is corrected.

h. Groundwater elevation shall be monitored in marsh and riparian areas between Drops 1 and 4. If groundwater elevation decreases as a result of the project, Reclamation shall initiate discussions with the sponsors and the Work Group to identify and implement reasonable corrective measures to ensure the maintenance of existing values within the wetlands. Special attention shall be given to maintenance of existing Yuma clapper rail and black rail habitat.

i. Reclamation or the project sponsors shall fund backwater restoration, development, and/or enhancement on the Colorado River between Parker Dam and Imperial Dam in the amount of \$100,000. The location, purposes, and design of the project shall be coordinated through the Work Group and the Colorado River Backwaters Committee.

j. All operational and maintenance activities and fees associated with the fish and wildlife mitigation recommendations (a through i) shall be the responsibility of Reclamation or the project sponsors.

k. All fish and wildlife mitigation recommendations specified above shall be implemented by Reclamation or the project sponsors concurrently with project construction.

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