Immediate Options for Augmenting Water Flows to the Colorado River Delta in Mexico

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Jo Clark, Clark Consulting, Inc., Boulder, Colorado
Michael Clinton, Michael Clinton Engineering, Las Vegas, Nevada
Paul Cunningham, Clark Consulting, Inc., Boulder, Colorado
David H. Getches, University of Colorado School of Law, Boulder, Colorado
Jose Luis Lopezgamez, Imperial Irrigation District, El Centro, California
Malissa Hathaway McKeith, Loeb & Loeb, Los Angeles, California
Lic. Luis Octavio Martinez Morales & Lic. Beatrice Bogada, Mexico City, D.F.
Jaime Palafox, Skadden, Arps, Slate, Meagher & Flom LLP. Washington, D.C.
Carlos Valdes-Casillas, CECARENA, Guaymas, Sonora

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I. EXECUTIVE SUMMARY

The Colorado River Delta in Mexico was a world-class ecological resource until the river's flows were harnessed and depleted by a vast network of water facilities constructed to serve water and power needs in the United States and in Mexico. Historically, the Delta included wetlands and riparian vegetation along approximately 100 miles of the Colorado River corridor in Mexico and the inter-tidal area where the Colorado River meets the Gulf of California. Increased water demands on the Colorado River by the United States and Mexico, however, have deprived the Delta of water, causing loss of fish, wildlife, and plants whose habitats depend on the Delta's ecosystems.[1]

Since 1983, additional waters, beyond Mexico's 1944 Treaty allotment, have occasionally flowed to the Delta. These additional flows have helped to re-establish some of the habitat that once flourished, and have rescued some areas and species from possible extinction. Such improvements illustrate the potential for recovering the ecosystems of the Colorado River Delta, and they provide opportunities to determine the effects of providing water to the Delta's ecosystems and to set realistic goals for sustaining and restoration.

Under U.S. and Mexican laws governing the Colorado River, no explicit requirements exist to provide water to sustain ecosystems in Mexico; in addition, obligations under the various national environmental laws have not yet been determined. Until recently, the importance of the Delta to Mexico and to the United States was not well recognized and neither government assumed any responsibility for the management of its ecological resources. That is now changing.

During the last five years, water demands of the lower basin states have increased from the "normal" year supply of 7,500,000 acre-feet per year (AFY) to more than 8,200,000 AFY. California's 4,400,000 AFY apportionment has been exceeded for decades by at least 800,000 AFY and, under contracts with the United States, California may be legally required to reduce its water uses by this amount in 2002. Regulations of the U.S. Department of the Interior, known as Interim Surplus Criteria (ISC), were issued in January 2001 to allow California more time to reduce its dependence on excess Colorado River water. The ISC allows greater and more frequent releases for use by the Lower Basin States than what previously occurred when Army Corps flood releases were the primary basis for surplus releases. When combined with current below-normal runoff conditions, the ISC has the potential to reduce the likelihood of surplus flows reaching Mexico. These events have caused a heightened level of concern about the Delta on the part of scientists, non-governmental organizations and the governments of both countries.

Recognizing the seriousness of these Delta ecological concerns, on December 12, 2000, the governments of the United States and Mexico executed Minute 306 to the 1944 Mexican Water Treaty. The two countries, among other measures, set up a technical task force that will pursue studies of Delta restoration and cooperative projects concerning the Delta "to ensure use of water for ecological purposes." The Minute 306 process, however, is intended to pursue long-term solutions and it is not likely to resolve the more immediate needs of the Delta.

This report explores options for securing immediate sources of water for the Delta. It concludes that a variety of constructive actions should be taken by both governmental and non-governmental entities to provide an interim water supply for the Delta while needed research continues.

This report proposes two sources of water that could be secured in the short-run for furnishing a sustainable, annual supply of water to some of the ecosystems in the Delta. One source involves the purchase of marginal agricultural land with water rights in Mexico, and the dedication of those water rights for establishing specific areas of cottonwood and willow habitat in the river corridor below Morelos Dam. Appropriate parcels have been identified for this purpose, and the acquired water could amount to as much as 15,000 AFY. Legal research conducted for this report confirms that water rights in the Mexicali and San Luis Río Colorado Valleys can be purchased and transferred for ecological purposes with the concurrence of local and federal Mexican officials.

The second proposed source of water is agricultural runoff from farmland near Yuma, Arizona. This runoff is unrelated to the 125,000 AFY of brackish water already by-passed from Wellton-Mohawk to Mexico. Currently, the Yuma agricultural drainage water is returned to the Colorado River at the Northerly International Boundary and to the Southerly International Boundary where it is counted as part of Mexico's 1.5 million AFY annual treaty entitlement. As much as 75,000 acre-feet of Yuma irrigation runoff is available for diversion. This report proposes that facilities be constructed to divert an appropriate amount of Yuma brackish flows directly into targeted ecological areas in Mexico and, in particular, the agricultural land purchased and retired as part of this proposal. The Yuma brackish water would not be counted against Mexico's 1.5 million AFY entitlement, and thus Mexico would receive deliveries of an equivalent amount of higher quality substitute Minute 242 Well Field groundwater or mainstream Colorado River water released from Lake Mead.

The options proposed in this report are bilateral measures that can be implemented without significant delay if the responsible parties are amenable to solving the problem. Based on the research and interviews conducted for this report, these options are likely to encounter the fewest practical, political, and financial challenges and arouse less controversy than many other options. Nevertheless, implementation of the options will require coordinated action and funding from public and private sources and should have the concurrence of the two nations through a Minute to the 1944 Treaty. A comprehensive, long-term solution, on the other hand, will require considerable research as well as negotiations among multiple stakeholders.

The actions proposed in this report could constitute important first steps in addressing the ecological needs of the Delta. Moreover, implementation of the proposals could help to sustain and to restore important habitat in the short-term while the scientific and diplomatic processes seek a comprehensive, long-term Delta management strategy. The actions proposed in this report are, therefore, intended to complement and build upon the ongoing work of government agencies, non-government organizations and universities to better understand the Delta ecosystems and promote their restoration.[2] Implementing these proposals in the short-term will result in benefits to both countries and, most importantly, the ecology of the Delta.

II. OVERVIEW OF THE COLORADO RIVER DELTA

For purposes of this report, the "Delta" is defined as the area including: approximately 100 miles of the Colorado River corridor in Mexico upstream of its confluence with the Río Hardy; the Río Hardy drainage; the Ciénaga de Santa Clara; the Laguna Salada; and the river's inter-tidal zone and tidal flats leading to the Gulf of California. Figure 1 is a Landsat photo of the irrigated and Delta area in Mexico.[3]

The value of the historic Delta for ecological purposes cannot be overstated. Even today, the ecological resources of the Delta are impressive. Because the Delta supports more than 160,000 shorebirds, 60,000 waterfowl, and a dozen threatened or endangered species of animals, fish, and plants, the Delta was registered in 1996 as a Ramsar site. The Ramsar Convention recognizes wetlands that meet criteria for international importance. The Delta also has been part of the Western Shorebird Reserve Network since 1992. The Delta's survival is important for many purposes beyond just ecological conservation. Since earliest times, it sustained fisheries on which indigenous peoples depended. And for many years, the Delta was a destination for hunting and fishing, making it economically important for tourism.

Realistically, the Delta cannot be restored to the conditions before the Colorado River waters were harnessed in the 1930s. It is realistic, however, to expect that a sustainable supply of water allocated to the Delta could maintain the quality of habitat restored during the 1980s and 1990s, when the Delta benefited from larger than normal Colorado River flows. There currently exists an opportunity to develop a common vision of what is meant by "restoring the Delta." Through the Minute 306 process and through dialog among interested parties and organizations, it is hoped that the geographic scope and detail of scientific study, minimal ecosystem management requirements, restoration objectives and operational strategies can be agreed upon.

This report seeks to identify immediately available sources of water that could be used for this purpose. It also proposes to improve the existing habitat through better management of the water. These measures are neither intended to nor do they answer the overall Delta water problems. Once an overall Delta management program is identified, the interim water supplies and management strategies identified herein could be withdrawn, depending upon the overall needs and commitments of the parties.

A. Changes in River Flows

Historically, the Colorado River was an active river that continually changed channels in the Delta as its large loads of sediments were deposited, creating natural berms and dikes. The energy and extent of its nutrient-carrying floods created extensive floodplains with rich and abundant wetlands. The wetlands served as a nursery for fish, a home for numerous mammals, and as habitat for both resident and migratory birds using the Pacific Flyway. Where the river reaches the Gulf of California, it historically combined forces with a large tidal zone, resulting in one of the most productive and diverse estuarine ecosystems in the world, supporting both wildlife and indigenous communities dependent upon fishing for their subsistence life style. Moreover, until the 1970s, the Delta was a key destination for US and Mexican hunters due to its large bird population.

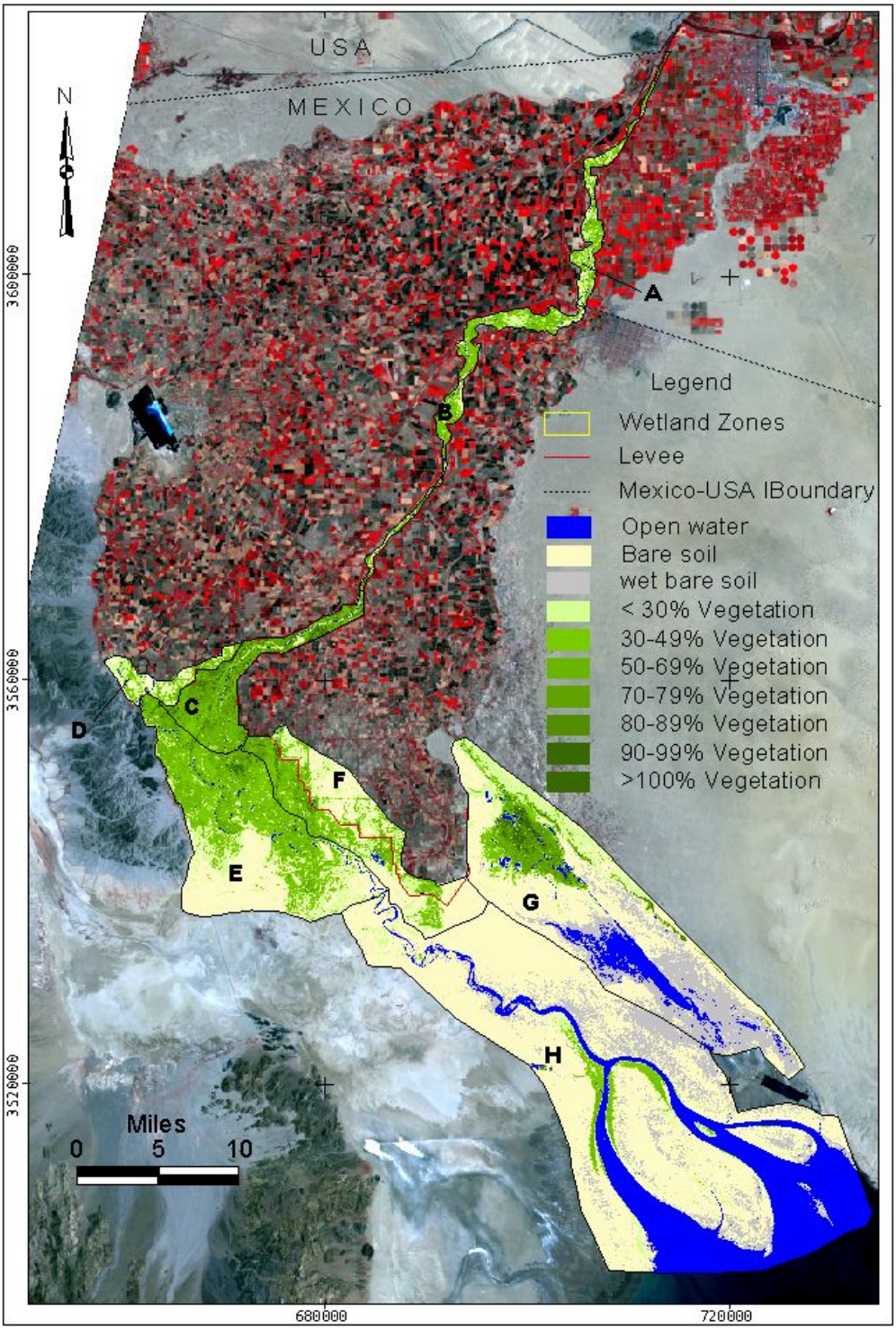

Figure 1

Irrigated and Delta Areas in Mexico

(Wetland Zones Based on Vegetation Response, proposed by Zamora et al, In Press.)

Today, nearly all of the Colorado River water entering Mexico passes through dams and reservoirs in the United States. The last such facility before the river enters Mexico is Imperial Dam located about 20 miles upstream from the United States-Mexico border. Water released from Imperial Dam is delivered to Mexico at the Northerly International Boundary and then is diverted at Morelos Dam (constructed in 1950) into the Mexicali Valley for agricultural, municipal, and industrial uses. Water that is not diverted at Morelos Dam flows southwest into the river corridor in Mexico. When large flows pass Morelos Dam, they reach the river's confluence with the Río Hardy, eventually crossing miles of mud flats in the inter-tidal zone before they reach the Gulf of California ("Gulf"). The entire corridor constitutes a rich biotic resource. The southernmost portion of the river, together with the upper Gulf and Ciénaga de Santa Clara, are included in an International Biosphere Reserve.

Today, Mexico's 1.5 million acre-feet per year treaty allocation from the Colorado River ordinarily does not reach most portions of the Delta or the Gulf. For many years in the past decade, however, natural runoff exceeded consumptive uses and storage capacity in the United States so that Mexico received significantly larger releases of water. In 1995, for example, Mexico received 61,000 acre-feet of excess water; in 1997, 634,000 acre-feet; in 1998, 2.4 million acre-feet; in 1999, 900,000 acre-feet; and in 2000, 337,000 acre-feet. While the 1997-99 excess flows were caused by flood control releases, the excess flows in 2000 were from operational over-deliveries. Some of these excess deliveries have not reached the Delta, but have been diverted and used in Mexico for agricultural and municipal purposes.

B. Ecosystems of the Delta

The additional waters available to the Delta in recent years significantly improved the quality of the habitat in some areas. Wetland and riparian areas connected to the river have gained in size and diversity. Two large wetland lakes exist in the Delta. The Laguna Salada is located to the west of the river and varies in depth, size, and salinity depending on rainfall runoff, farm runoff, river flows that occasionally back up into the area, and the length of time that the water remains in the area before completely evaporating. The ephemeral nature of the Laguna Salada, its incompletely defined ecological resources and the limited technical understanding of its operation suggest that its potential for management be assessed separately from the overall Delta protection and restoration activities.

The Ciénaga de Santa Clara is on the east side of the river, and owes its current size primarily to brackish flows of agricultural drainage water coming down the Bypass Drain from the Wellton-Mohawk District in Arizona. The Ciénaga encompasses an area of 50,000 acres, of which 11,000 acres are vegetated.[4]

As the ecological health of the Delta greatly improved in the 1990s, universities, environmental NGOs, local communities, and Ducks Unlimited began to identify and prioritize opportunities for Delta restoration.[5] These efforts assessed the ecological conditions of the riparian corridor from Morelos Dam to the Gulf as well as opportunities for restoration.

Researchers have divided the Delta into seven zones based on vegetation structure and landscape conditions (Figure 2).[6]

Zone 1 includes the stretch of the river that is also the International Boundary between the US and Mexico, from Morelos Dam to the Southerly International Boundary (SIB), just above the San Luis Río Colorado Bridge. This area retains its relatively natural ecological conditions. The Cocopah Tribe, the US indigenous people that traditionally subsisted on Delta resources, maintains its reservation in this zone. This area is the first to receive excess flows in wet years. On both sides of the river, the two intensively irrigated farming areas sustain groundwater at levels that help maintain good stands of cottonwoods and willows.

The riparian corridor just below the Southerly International Boundary south to the San Felipito Dip (above the railroad crossing) is defined in Figure 2 as **Zone 2** and part of **Zone 3**. It includes areas dominated by large stands of cottonwoods and willows[7]. The lower portion of Zone 3 is a narrow stretch of the river corridor where the two levees are the closest. Built to contain floods, the levees extend for most of the length of the river in Mexico. The zone extends southwest from the San Felipito Dip to just above the confluence of the Colorado River and the Río Hardy. This area of the Colorado River corridor has been identified as a priority for landscape design and management (Valdés et al 2000). It is an area that contains major stands of cottonwoods and willows, as well as a system of ponds and old-river meanders. It is the beginning of an ecological transition zone where areas maintained by agricultural runoff interacts with areas influenced by high tide.

Zone 4, the Río Hardy area, is used for human activities -- outdoor recreation, aquatic activities, aquaculture, ecotourism, hunting, and recreational and commercial fishing. This area requires continuous water quality monitoring and improvement. The Río Hardy area has great potential for community-based ecological management. Recreation activities such as aquaculture and aquatic recreation can coexist with the establishment of various habitats for wildlife, including cattails, open water ponds, and riparian vegetation.

Zone 5, the Cucapá Complex, is the zone that offers the greatest potential for sustainable hunting and fishing, if the water supply can be stabilized. This area includes the main activity area for the Cucapá community, and is also influenced by the estuarine tides. This zone requires a detailed study for engineering design, to create and maintain optimal conditions for hunting, fishing, waterfowl wintering and feeding.

Zone 6 includes the tidal flats and areas covered by endemic salt grasses, which are very important to shorebirds and to stabilize the estuarine conditions at the mouth of the Colorado River.

Zone 7 includes the Ciénaga de Santa Clara, a large cattail marsh. The Ciénaga's habitat supports 60 percent of the total population of the Yuma clapper rail as well as the desert pupfish – both endangered species.

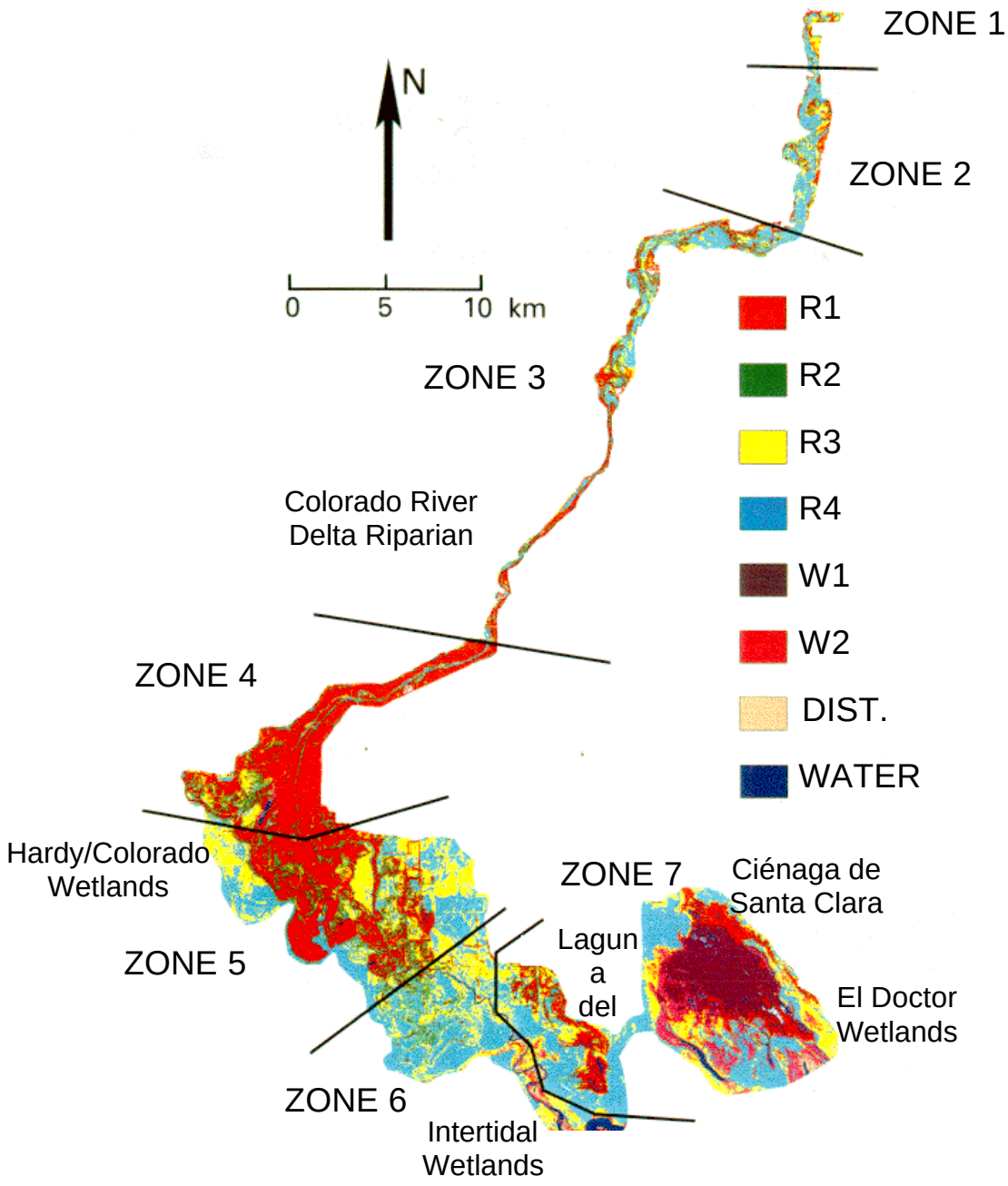

Figure 2

Vegetation Zones of the Colorado River Delta

Source:

Valdés-Casillas, C.; E.P. Glenn, O. Hinojosa-Huerta, Y. Carrillo-Guerrero, J. García-Hernández, F. Zamora-Arroyo, M. Muñoz-Viveros, M. Briggs, C. Lee, E. Chavarría-Correa, J. Riley, D. Baumgartner, and C. Condon. 1998. Wetland Management and Restoration in the Colorado River Delta: The First Steps. Special publication of CECARENA-ITESM Campus Guaymas and NAWCC. Mexico. 32 pp.

Although maintained by independent sources of water (artesian springs at the edge of the Gran Desierto de Altar) the Pozos del Doctor (Doctor wetlands) also are ecologically critical areas in the Delta. Zones 6 and 7 are within the Biosphere Reserve of the Upper Gulf and Colorado River Delta (a protected area with international recognition).[8] In fact, a good portion of Zones 6 and 7 are within the Core Zone -- the area provided with the highest protection from the Mexican federal government.

Environmental water requirements for sustaining the remnant riparian and wetland ecosystems of the Delta appear to be surprisingly modest. A group of researchers from the Environmental Research Lab at the University of Arizona, the Center for Conservation and Use of Natural Resources (CECARENA) at the Monterrey Tec University in Guaymas, the Sonoran Institute, Pronatura Sonora, and Environmental Defense have provided estimates of Delta water requirements. For the river corridor below Morelos Dam and upstream from the San Felipito Bridge, they suggested that an annual flow of as little as 32,000 acre-feet per year could suffice. They further suggested that such an annual water supply be supplemented by pulse releases of flood flows once every four to five years. Those researchers believe that such a flow regime could have significant benefits in maintaining and restoring that area.

Zone 5, containing much of the Cucapá Complex, offers the potential for wetland improvement, increasing the number of small ponds and the variety of vegetation. Mesquite forests also could be reestablished, offering opportunities for quail and dove hunting. Further, improvements to habitat will enhance sustainable ecotourism opportunities for the Cucapá. With further training and support, the Cucapá could expand their ability to serve as guides for bird watching and as outfitters for hunting and fishing. Wetland enhancement will improve fishing and hunting for both Mexican and US residents.

III. MANAGEMENT OF THE COLORADO RIVER IN THE UNITED STATES AND ITS RELATIONSHIP TO MEXICO

A. The Law of the River

Distribution of Colorado River water within the United States is accomplished through a complex system of physical facilities. This system is operated to comply with legal obligations under statutes, interstate compacts, court decrees, regulations and contracts, known collectively as "the law of the river."

In 1922, the Colorado River Compact divided water between the Upper basin states (Colorado, Utah, Wyoming and New Mexico) and lower basin states (California, Arizona and Nevada). The upper basin states agreed to deliver, on the average, 7.5 million acre-feet of water per year to the lower basin states. Later, the Colorado River Basin Project Act empowered the Secretary of Interior to operate facilities to deliver more or less than 7.5 million acre-feet to the lower basin states in years when he determines that there will be a surplus or shortage of water in the river. A 1944 treaty with Mexico promised that the United States would deliver 1.5 million acre-feet of water each year to Mexico, except in surplus or shortage years[9]. Under the compact, the responsibility for delivering that water, if there is a shortage, comes equally out of the Upper and Lower Basin apportionments of water.

In 1928, the Boulder Canyon Project Act divided the lower basin's first 7.5 million acre-feet per year of mainstream water among California (4.4 million acre-feet per year), Arizona (2.8 million acre-feet per year), and Nevada (300,000 acre-feet per year). In its 1963 Opinion in *Arizona v. California*, the United States Supreme Court upheld the division of the 1928 Act. The Court's decree also provided that California would receive 50% of any surplus water, Arizona, 46%, and Nevada, 4%. The upper basin's share – up to 7.5 million acre-feet after Mexico and the lower basin get their guaranteed deliveries – was divided in a compact allocating Colorado 51.75%, Utah 23%, Wyoming 14%, New Mexico 11.25%, and Arizona 50,000 acre-feet per year.

As one of the most "controlled" rivers in the world, the Colorado today is radically different than it was a century ago. At the beginning of the last century, a national vision evolved that embodied "taming" the river to meet human needs for flood control, water, power and the irrigation of desert farmland. That vision resulted in the construction of the great Hoover and Glen Canyon Dams and other facilities to divert the river's waters and generate electricity for cities and farms. Today, the river maintains a society and an economy that far surpasses the vision of those who began managing the river a century ago.

Most river management infrastructure was financed, built, and is operated by the US Bureau of Reclamation, an agency of the US Department of the Interior. The cost of much of this infrastructure has been or is being reimbursed by the sale of water and power to the many project beneficiaries. Some water projects have been planned and constructed by the private sector and by local governments. Examples include the irrigation works that serve the Imperial and Palo Verde Valleys as well as the locally financed facilities of the Metropolitan Water District that convey Colorado River water to Southern California.

The U. S. Congress designated the Secretary of the Interior to operate Colorado River dams and reservoirs. In that role, the Secretary has become, in essence, the "water master" of the river, conducting day-to-day operations through the Bureau of Reclamation. Reclamation contracts with water users to allocate water within the wide discretion allowed the Secretary under federal law. Under this authority, the Bureau of Reclamation ("Reclamation") prepares and implements annual operating plans and sets other criteria for operating facilities. Reclamation operates the River and delivers water in accordance with water use contracts developed pursuant to Section 5 of the Boulder Canyon Project Act. The underlying premise of this system is a "trickle down" theory that allows water not used by one contractor to be used by junior priority contractors.

The Secretary also has authority to make rules and regulations governing the operation of federal dams and reservoirs. For example, in 1974, the Secretary promulgated water conservation management procedures that are contained in the Code of Federal Regulations (C.F.R. 43-417). Also, the Secretary adopts both long-term and annual operating criteria. He recently promulgated the Interim Surplus Criteria that were approved by a Record of Decision requiring review under the National Environmental Policy Act. When new rules or operations are considered, the Secretary must consult with the governors of the seven Colorado River Basin states and other parties. Reclamation generally seeks input from water-users within each state to determine the quantities of water that they expect to use under existing laws and contracts. Reclamation also consults with the U. S. Section of the International Boundary and Water Commission (IBWC), which has the responsibility for coordinating delivery of water to Mexico under the 1944 United States-Mexico Treaty. The communications received from the governors of the basin states, federal agencies, IBWC, the various water-using entities, and the public are considered by Reclamation in making recommendations to the Secretary on proposed river management decisions.

Any transfer to Mexico of United States water will need to comply with the Law of the River. For example, one possible solution to bring water to the Delta is to purchase water from a specific Lower Basin contractor. However, for such a transfer to occur, all contract holders and the three lower Basin states would need to waive their rights to use the purchased water.

The 1963 Opinion and the 1964 Decree of the US Supreme Court in *Arizona v. California* also limits the discretion of the Secretary regarding deliveries of water. Specifically, Article II (A) of the Decree enjoins the Secretary from releasing water except for uses that satisfy particular purposes in the U.S. It exempts from these priorities any releases by the United States to Mexico unless "in satisfaction of its obligation to the United States of Mexico under the Treaty dated February 3, 1944…."

Although some have read the decree as precluding the delivery of water to Mexico in excess of 1.5 million acre-feet per year, changes in delivery strategies beyond the Treaty have been agreed upon through agreements (Minutes) between the Mexico and US Sections of the International Boundary Commission. Minute 242, for example, provided for the construction of the Yuma Desalting Plant and the bypass of Wellton-Mohawk return flows without charge against Mexico's 1.5 million acre-feet per year treaty delivery entitlement. A similar mechanism is available to transfer water to the Delta if the two Nations agree.

Due to the intricate legal framework used on the Colorado River, reaching a long-term management strategy for the Delta will be time-consuming and may take many years. In the interim, the Delta habitat may suffer. Therefore, this report attempts to identify mechanisms for bringing

water to the Delta that are immediate and consistent with the Law of the River. Because these steps are interim, both the United States and Mexico would have more flexibility in fashioning a short-term solution while the longer-term technical studies and negotiations take place.

B. Impacts of Colorado River Management on Mexico

(1) Imperial Dam Releases and Operational Over-Deliveries

Imperial Dam, about 20 miles north of Yuma, Arizona, is the last major Colorado River diversion point in the United States. Under Annual Operating Plans approved by the Secretary, about 6 million acre-feet of water per year is scheduled to be released from upstream reservoirs to arrive at Imperial Dam on a monthly, daily and hourly basis. The water is then diverted to California's Imperial and Coachella Valleys and to the farms and communities in the area of Yuma, Arizona, and to Mexico under the 1944 Treaty. Often there is a mismatch between water needs and the actual flows arriving at Imperial Dam. Colorado River water released from storage in Lake Mead takes about three days to reach Imperial Dam. Because travel time from Imperial Dam to some distant irrigated areas in the Imperial and Coachella Valleys is three to four days, water released from Lake Mead is ordered as much as a week before it is actually used. This delayed delivery period, vagaries of weather, channel gains and losses, and changing water needs combine to make the scheduling of releases from Lake Mead somewhat imprecise. This is particularly the case when storms reduce the need for irrigation water that has been previously ordered.

To accommodate some of this variability, Senator Wash Dam and Reservoir was constructed in the 1960s, two miles upstream of Imperial Dam. When excess water arrives at Imperial Dam, it is stored in Senator Wash Reservoir and later released to meet scheduled water deliveries. Excess flows greater than the storage capability of Senator Wash Reservoir are delivered to Mexico even though they exceed the scheduled Treaty delivery requirements. Such additional deliveries to Mexico are known as "operational over-deliveries."

Years of very high runoff have resulted in millions of acre-feet of operational over-deliveries to Mexico. This occurred in the 1980s and again during the period from 1995 to 1999. In 2000, Senator Wash Dam was being repaired and did not operate, allowing about 360,000 acre-feet of operational over-deliveries to reach Mexico. Senator Wash Dam and Reservoir were placed back into operation at the end of 2000 and historical experience suggests that future operational over-deliveries will average about 30,000 acre-feet per year. Plans are underway to build additional re-regulating reservoirs as a part of the program to line the All American Canal to reduce or eliminate such operational over-deliveries.

Operational over-deliveries that reach Mexico benefit the area in many ways. When possible, the Mexican water agency, Comisíon Nacional de Aguas, (CNA) delivers the majority of that water to farms in the Mexicali and San Luis Río Colorado Valleys; however, these flows also recharge groundwater aquifers and have restored some of the Delta vegetation that exists in the river corridor below Morelos Dam. During periods of large or sustained operational over-deliveries, flows reach the Gulf of California and back-flows reach the Laguna Salada.

(2) Salinity Concerns

The high levels of salinity in the water delivered to Mexico began causing serious problems between the United States and Mexico in the 1960s. When the concentration of salts in the water delivered to Mexico increased radically, crop production -- particularly vegetable production -- diminished and the irrigated land in the Mexicali Valley became significantly more saline. This led to protests by Mexico and a series of interim agreements to control the salinity of Colorado River water delivered to Mexico under the Treaty.

In 1965, Minute 218 (effectively an amendment) to the United States Mexico Treaty) was approved. It required the United States to bypass around Morelos Dam part of the extremely saline (6,000 mg/l TDS) agricultural drainage from the Wellton-Mohawk district in Arizona. Negotiations for a permanent resolution of the salinity issue continued between 1965 and 1972. In 1973, an agreement was reached restricting the allowable increase in salinity between Imperial Dam and the Northerly International Boundary to 115 ppm $\pm$ 30 ppm. The agreement was embodied in Minute 242 to the Treaty. To achieve the standards of Minute 242, all of the agricultural drainage from the Wellton-Mohawk area would have to be desalted or else bypassed around Morelos Dam without being credited against the Treaty delivery obligation.

Bypassing flows without charge against the 1.5 million acre-feet per year Treaty delivery obligation resulted in additional water being released from Hoover Dam to meet the increased total delivery to Mexico. This additional Hoover Dam release could decrease the amount of water available to US water users in a serious drought.

(3) Yuma Desalting Plant

The Yuma Desalting Plant was constructed to enable the United States to comply with Minute 242. The plant was completed in 1992 and operated during most of 1993. However, because surplus river flows allowed enough good quality water to reach Mexico and because of the high cost of operation, the plant was shut down in the early 1990s and remains idle. A decision to operate the plant could be made by the Secretary of the Interior as a part of the Annual Operating Plan after consultation with interested and affected parties. That decision also would be subject to congressional appropriation of operating funds. The Colorado River Basin states (particularly the State of Arizona, which has the lowest priority for river water) continue to urge the Secretary to operate the plant and thereby reduce the likelihood of future water shortages in the United States.

(4) The Bypass Drain and the Ciénaga

The Bypass Drain was constructed pursuant to Minute 242 to carry any untreated and bypassed Wellton-Mohawk drainage water and the salt-water waste stream from the Yuma Desalting Plant to an acceptable terminal location. It has a conveyance capacity of 300 cubic feet per second (210,000 acre-feet per year). When the Bypass Drain was originally designed, its terminus at the Ciénaga was largely a sand and mud flat area that was occasionally washed with seawater during high tides. Flows were expected to reach the Gulf, but in fact were blocked by a rise in the land that created a self-contained basin. The Bypass Drain began operating in 1977, and has carried the untreated brackish agricultural drainage water since then. This delivery of brackish agricultural drain waters to the Ciénaga supports many species of birds and fish, including the endangered Yuma clapper rail, desert pupfish, and a variety of ducks and other birds.

The Bypass Drain now carries about 120,000 acre-feet per year of brackish water. The salinity of the water in the Bypass Drain has decreased from 6,000 mg/l in the 1960's to 2,400 mg/l today because the saltiest Wellton-Mohawk ground water has been flushed from the aquifer by deep percolation of better quality irrigation return flows. If the Yuma Desalting Plant becomes operational using the currently installed technology, the flow in the Bypass Drain would be about 28,000 acre-feet per year of 7,500-mg/l water. Operation of the Plant is not anticipated in the foreseeable future unless a serious drought develops. Therefore that contingency is not considered in this report; however, those parties evaluating longer-term solutions for the Delta must consider its impact on the Delta.

(5) The Interim Surplus Criteria

During the last five years, the availability of surplus water from high natural run-off has allowed deliveries of water to the lower basin states to increase from the "normal year" supply of 7,500,000 acre-feet per year to more than 8,300,000 acre-feet per year. The excess has been delivered primarily to California to meet its demands. With "normal" runoff conditions such as those expected in 2001, California would be legally required to reduce its water uses immediately to the maximum allowed to it under the law of the river. This would require reductions amounting to as much as 800,000 acre-feet per year.

In January 2001, the US Secretary of the Interior approved Interim Surplus Criteria (ISC) allowing water users in the United States to exceed their normal year apportionment for a period of 15 years while conservation measures are implemented. This is to be accomplished through the Secretary defining and declaring a "surplus" condition, even though a flood control release is not necessary or imminent.

Traditionally, the Colorado River system has been kept at maximum storage levels with releases strictly limited to downstream water delivery needs and flood control releases. The new ISC will allow for greater drawdown of Lakes Mead and Powell so that California can continue using water in excess of its normal apportionment until 2016. According to Reclamation's projections of demand and predicted weather conditions, the average amount of water stored in Lake Mead in 2016 will be 1.18 million acre-feet less than would be expected without the ISC.

Under the Treaty, Mexico is entitled to an additional 200,000 acre-feet per year when water is available "…in excess of the amount necessary to supply uses in the United States…"[10] In the past, however, Mexico has received and used additional water for agricultural, municipal, and industrial purposes when flood control releases occurred. Furthermore, surplus deliveries to Mexico improve water quality through dilution. The ISC do not provide Mexico any surplus deliveries when an ISC surplus year is declared in the United States. Also, California's continued consumption in excess of its normal year apportionment, allowed under the ISC, combined with the below normal runoff of 2000 (and likely 2001), reduces the likelihood of surplus water being delivered to Mexico in the next few years[11]. With the ISC, in all but very high flow years those benefits will be lost.

The Foreign Ministry of Mexico filed a formal diplomatic note on January 16, 2001, requesting that the State Department of the United States eliminate adverse impacts resulting from the ISC. Recent comments by Victor Lichtinger, Mexico's Minister of Environment, have emphasized the influence of serious border water issues on overall US/Mexico relations.[12] The Delta issue is now being discussed at the highest levels of the two governments. At this point,

however, Mexico has not yet pressed for a formal legal interpretation of the surplus provision in the treaty.

C. Other US Demands on the River

At the same time that California is being asked to reduce its water uses, scientists, hunters and other citizens with support of environmental groups are demanding that the Colorado River be managed for ecological purposes. The Endangered Species Act has forced the consideration of strategies in the US to protect the critical habitat of native fishes and other species through a Multi-Species Conservation Plan (MSCP). Further, *Defenders of Wildlife* in 1999 filed suit against the Secretary of the Interior and the Secretary of Commerce seeking consultation between the agencies in those Departments to determine whether changes in the operation of the River in the United States would place endangered habitat in Mexico in jeopardy. This pending lawsuit has played an important role in focusing the attention of the federal and state governments on solving the Delta issues.

In addition to environmental demands, Indian tribes with rights to Colorado River water are seeking to quantify, protect, and use their water rights. The water uses of the tribes are counted against the apportionments of the state where the reservation is located. Some of the tribes, through court decrees and settlements, have quantified the water rights of their reservations, but others do not have quantified water rights. Only a few tribes are presently using substantial portions of their water rights. This may change in the future as tribes gain the financial capacity to develop their water for beneficial uses. Increasingly, the tribes and their trustee, the United States, are taking steps to protect tribal water rights and achieve tribal self-sufficiency. Additional tribal water uses will add to existing demands on the river.

IV. MANAGEMENT OF COLORADO RIVER WATER IN MEXICO

Irrigation in the Mexicali Valley began in the 1880s, through the use of canals constructed by the California Development Company. Those canals provided water to both the Mexicali and Imperial Valleys, with the *Canal Independencia* (previously named the Alamo Canal) serving both valleys. When the Canal Independencia headworks at the Colorado River west of Yuma failed in 1905, floodwaters destroyed thousands of acres of Mexicali Valley farmland. After the headworks were repaired in 1907, the core irrigation system that exists today in the northern Mexicali Valley was constructed and began operation. Because the Canal Independencia served farmland in both Mexico and the United States, many disputes arose over the methods of operating, maintaining and funding related activities. The unreliable flow of the Colorado River and its huge sediment loads caused serious operational difficulties.

By the late 1930s, about 50,000 hectares (125,000 acres) were being farmed in Mexicali and San Luis Río Colorado Valleys using about 750,000 acre-feet of water per year. Much of this water, particularly during low flow periods, was brackish agricultural return flow from the farms in the US. With the completion of Hoover Dam in 1935 the Colorado River flow stabilized, and the All American Canal was constructed just north of the Mexican border so that it was no longer necessary to convey water to the Imperial Valley through Mexico.

Seeing increasing water use in the United States, Mexico sought to secure its rights to Colorado River water. The ratification of the 1944 Mexican Water Treaty by both nations secured for Mexico the right to about twice the water it was then using, 1.5 million acre-feet per year. Following ratification of the Treaty, Mexican land cultivation and water use steadily increased. By the 1960s and continuing to the present time, about 186,000 hectares (460,000 acres) of land in the Mexicali and San Luis Río Colorado Valleys are farmed using about 1.42 million acre-feet of water per year. Today, water is delivered at two points, the Northerly International Boundary, immediately upstream from Morelos Dam (about 1,360,000 acre-feet per year) and at the Southerly International Boundary near San Luis, Arizona, and San Luis Río Colorado, Sonora (about 140,000 acre-feet per year).

To supplement the Colorado River water delivered under the Treaty, wells have been installed and now produce about 730,000 acre-feet annually. Figure 3 shows the canals and drains of the Mexicali and San Luis Rio Colorado Valleys.

A. Interaction between CNA and the Modules

Mexico's National Water Law provides for institutional and strategic management for all waters that belong to the nation. Under this law, the Comisíon Nacional de Aguas (CNA) is the federal agency that defines water policies and administers the implementation of those policies. A branch office of CNA is located in each state, including Baja California. Most day-to-day management and administration activities are delegated to the state office.

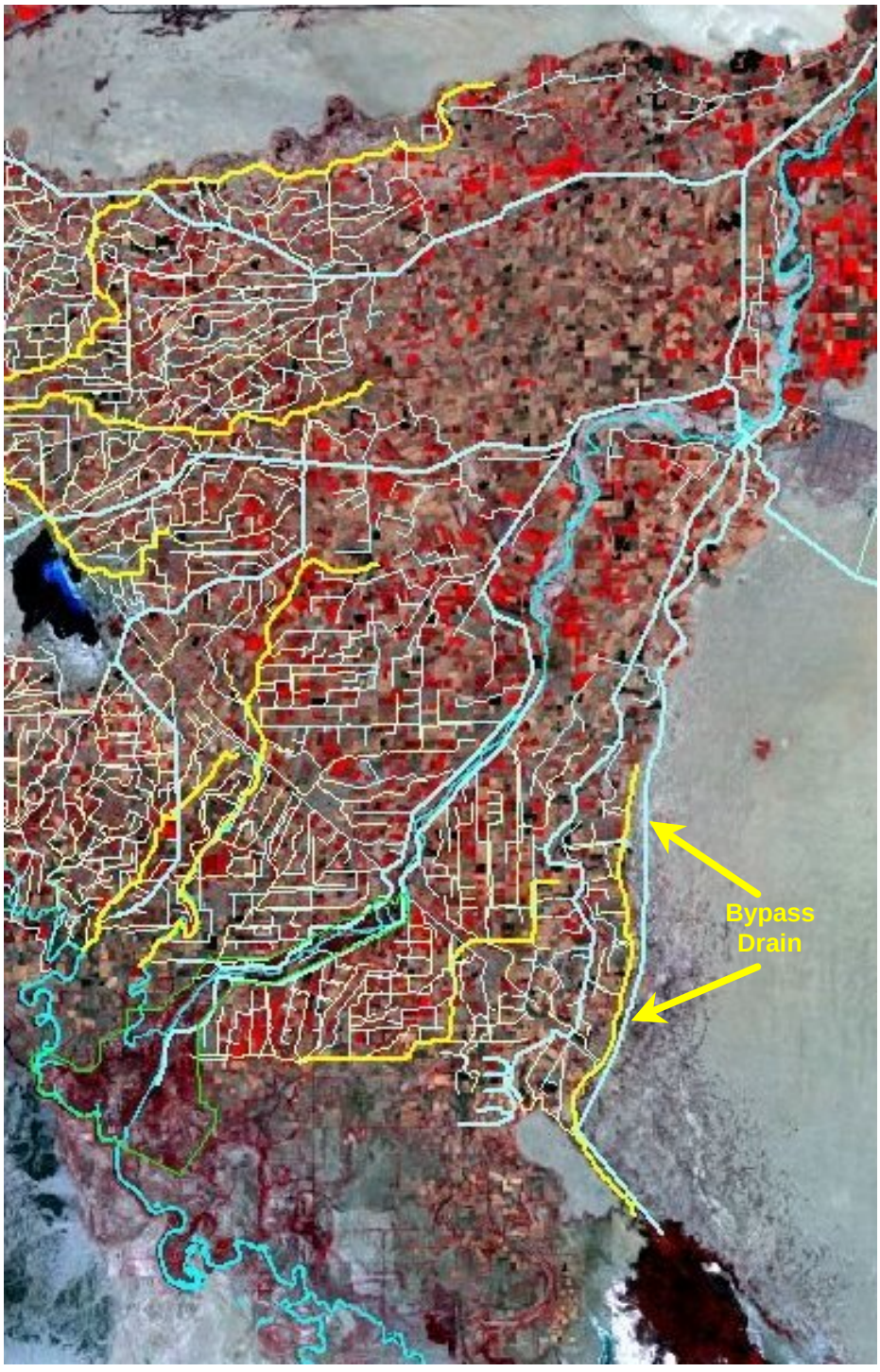

Figure 3

Irrigation Canals (in blue) and Drains (in Yellow) in District 014

Throughout Mexico, CNA has designated individual water management areas as "Districts." District 014 encompasses the irrigated area in the Mexicali and San Luis Río Colorado Valleys. The irrigated lands are divided into modules, which are defined geographic areas. Although District 014 includes some ejido properties, no water rights are attached to those ejido properties. The modules each have local governing responsibility for water management and operate and maintain the distribution canals that are located within the module. Figure 4 is a CNA map showing the boundaries of the modules.

CNA operates and maintains the main delivery canals and drainage systems as well as the levees and related flood control works that protect the area. CNA receives water orders from each module that are aggregations of the water orders from individual parcels within the module. CNA then delivers the ordered quantity of water to the external boundary of each module and the zanjeros (ditch riders) employed by the module make the water deliveries to the various parcels. The zanjeros are responsive to the local political leadership within their individual modules. As such, political, social, and peer pressure operate to assure that water is delivered in a timely manner to the individual parcels that have placed orders for water. The integrity of this system of combined federal and local management has resulted in a set of checks and balances that are quite successful in preventing illegal water use. If the CNA canal system and delivery ditches within the modules are to be used to deliver water to the Delta ecosystem, it is imperative that an advocate for delivery of the Delta water be an active participant in governance of the participating module or modules. Furthermore, a new Minute would help to ensure that water dedicated for use in the Delta ecosystem is managed effectively for that purpose.

B. The "Compaction Zone"

Historically, some parcels of land distant from the CNA main canals were irrigated and obtained water rights. This is particularly prevalent at the southern edge of the San Luis Río Colorado and Mexicali Valleys. In recent years, CNA has operated a program to consolidate the irrigated land base into a more compact area known as the "Compaction Zone."

The Compaction Zone in District 014 was created in 1976, to consolidate the irrigated areas by establishing an elevation 7.5-m asl (about elevation 25 feet, mean sea level); all land below this elevation was determined to be out of the Compaction Zone (approximately 10,000 hectares). As part of the consolidation of District 014, 8,000 hectares of land with water rights were condemned and water users were relocated into and given lands within the Compaction Zone.

Additional land remains outside the Compaction Zone south of modules 21 and 22, however, and the owners have the right to receive water. The area outside of the Compaction Zone faces several problems. Generally the land is of poor soil quality and productivity. Because of the lack of drainage, a pumping system is operated to control the groundwater elevation.

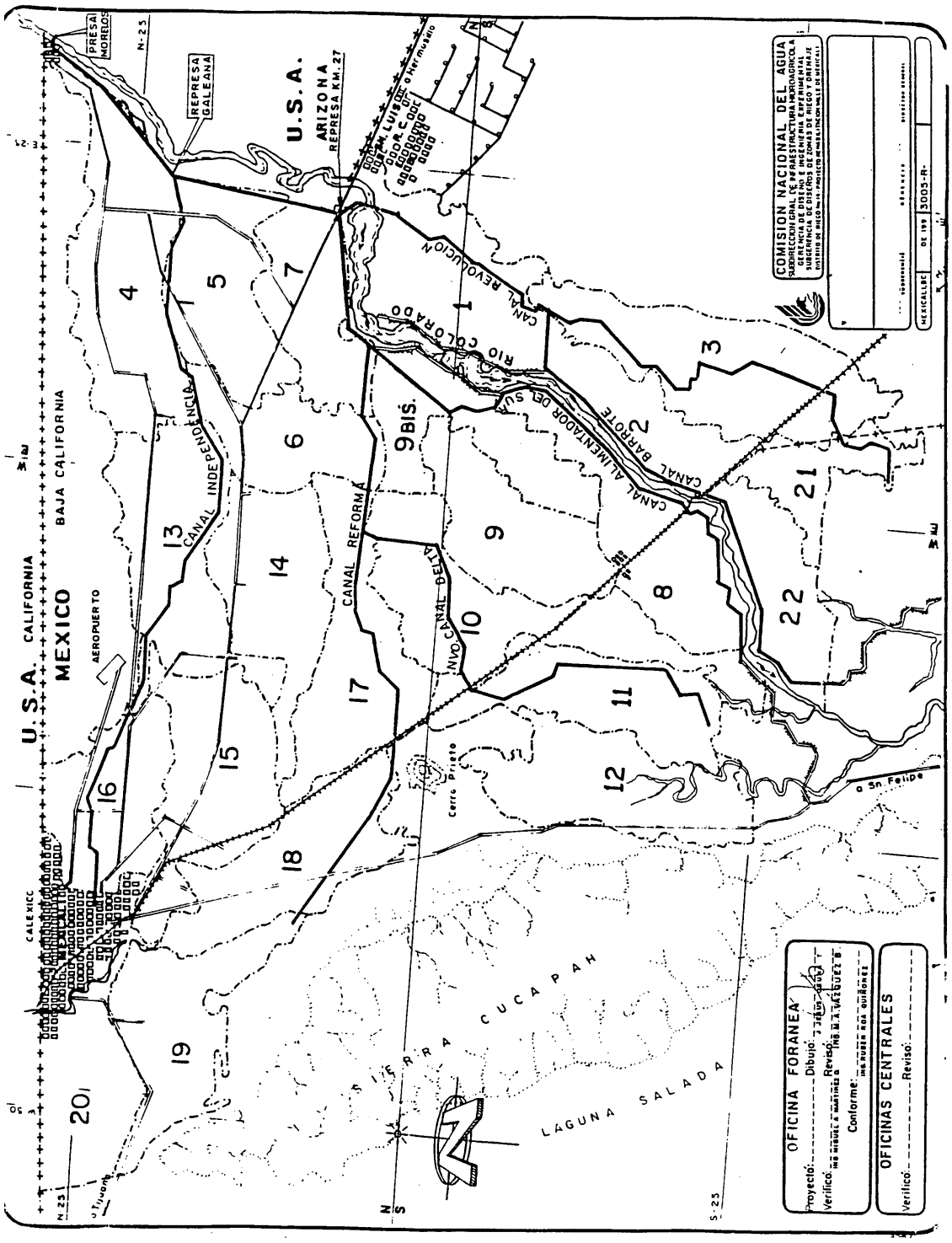

Figure 4

CNA Map Showing Boundaries of the Modules

Further, the water losses in the old dirt ditches are extremely high. Perhaps most important, CNA has discontinued maintenance of the canal system.

The current method being used to consolidate the remaining irrigated area within the Compaction Zone is to encourage the sale and transfer of water rights from parcels outside the zone to parcels within the zone. There is, however, a shortage of good quality land within the Compaction Zone to accomplish additional water right transfers and relocations. This situation provides a unique opportunity for implementing the recommendations in this report. Many isolated parcels outside the Compaction Zone continue to have water rights. Several of these parcels were identified as part of this report and are being considered for acquisition.

C. Determination of Water Duties

Historically, CNA allocated water rights in District 014 by assigning cropping patterns throughout the area. Based upon national crop production priorities, and subject to the available water supplies, an overall cropping pattern was established for District 014. The owners of croplands were then given a cropping pattern for their individual parcels. This process continued through the year 2000.

For better management of water right exchanges and transfers, CNA is now proposing to assign a uniform water duty to each parcel. The available duty for each parcel of water right land would be 1.0 meter, about 3.1 acre-feet per acre after conveyance losses.[13] The regulations needed to make that change are now in the approval process.

Using the above described water duties, the overall supply and allocation of water in District 014 is as follows:

Water Supplies and Allocations
in District 014

Source/Use	Quantity (AY/Yr.)
Supplies	
Treaty	1,500,000
Ground Water	730,000
Conveyance Losses	645,085
Net Avail. Supply	1,584,915
Allocations	
Irrigation	1,424,964
Mexicali Municipal & Industrial (M&I)	66,478
Tecate M&I	2,675
Tijuana M&I	64,857
Ensenada M&I	7,297
San Luis Rio Colorado M&I	18,646
Total Allocations	1,584,915

D. Other Concerns of Mexico

Today, the agricultural base in the Mexicali and San Luis Río Colorado Valleys is generally stable. However, salinity remains a problem, particularly in the San Luis Río Colorado Valley where the water supply is predominantly agricultural drainage water from the Yuma Valley. Also, groundwater users in Mexico are increasingly concerned about the stability of groundwater supplies that may be diminished by canal lining programs in the United States. Groundwater quality in District 014 is also a concern since the salinity of the groundwater aquifers continues to increase because they are recharged by brackish agricultural deep percolation.

In addition, awareness of the need to protect the ecosystems of the Colorado River Delta is growing in Baja and in Mexico City. Mexican state, federal, and NGO interests express a desire to see a shared, bilateral commitment to providing the water needed for protection and restoration of the Delta. They look to the US and Mexican Sections of the IBWC to pursue an ongoing dialogue seeking resolution of these problems.

V. OPTIONS FOR MEETING DELTA WATER NEEDS

A wide variety of possible sources of water to augment flows needed to sustain the Delta's ecosystems have been identified. Some of them include:

- Purchase and transfer of agricultural water rights with or without retiring agricultural lands from irrigation districts, tribes, or other water rights holders in the United States;

- Purchase and transfer of agricultural water rights from water rights holders within Mexico;

- Dedication and delivery to the wetlands in Mexico of US operational over-deliveries of Colorado River water that exceed Treaty delivery requirements. These flows are not guaranteed but are the results of unscheduled operational events;

- Scheduling of larger releases of water from US dams to the Delta for perennial and periodic flows; larger flows to re-establish areas of native vegetation and to flush salts and other constituents into the Gulf of California;

- Fallowing of the least productive irrigated lands in Mexico or the US and dedication of the water to the Delta;

- Allocating to Delta ecological uses a specific portion of any surpluses declared by the US;

- Allocating to Delta use a part of the current flow in the Bypass Drain now delivered to the Ciénaga;

- Encouraging the conservation of water through projects that create increased irrigation efficiency in Mexico and dedication of conserved water to the Delta;

- Diversion and transport to the Delta of water from the New River;

- Diversion and transport to the Delta of treated wastewater from the planned Mexicali II Wastewater Treatment Plant or other wastewater treatment projects in Mexico;

- Pumping and delivery to the Delta of brackish groundwater;

- Pumping and delivery to the Delta of groundwater in the area of the Limitrophe Section;

- Collection and delivery to the Delta of wastewater from the Community of San Luis Río Colorado;

- Collection and delivery to the Delta of agricultural drainage water from Mexico; and,

- Collection and delivery to the Delta of agricultural drainage water from the United States.

The above list of possible sources of water for the Delta and is not exhaustive. In addition, some combinations of the identified sources may be appropriate. However, physical, legal, economic, institutional, social and environmental problems exist with each of the options. For example:

- Diversion of water from the New River or the planned Mexicali II Wastewater Treatment Plant would require major investments in infrastructure and would have adverse impacts on the elevation and salinity of the Salton Sea, and therefore this option may take years to accomplish;

- Although there is brackish groundwater in the Delta area, initial analyses suggest that the geologic characteristics of the aquifers are not expected to allow development of significant sustainable groundwater supplies for the Delta;

- Redirecting current Bypass Drain flows from the Ciénaga to other Delta areas would sacrifice existing habitat resources.

- Purchase and retirement of agricultural water rights in Mexico or in the United States can raise problems of social equity unless some countervailing benefit or compensation is provided to offset the community impacts of reducing the agricultural economic base;

- Collection and delivery of Mexicali Valley agricultural drainage would require major investments in tile drainage for fields and for construction of delivery infrastructure to transport the water to the Delta area;

- Installation of agricultural efficiency improvements require capital investment and engineering to demonstrate the quantities of water that would be available without adversely impacting current groundwater recharge or compromising the interests of agricultural water users;

- Purchase and transport of water rights from within the United States, especially if it requires moving the water across state lines or the International Boundary, implicates complex legal structures including contractual arrangements among US water users allocating unused apportionments;

- Agricultural drainage from the Yuma area could be collected and transported to the wetlands with modest infrastructure investments; however, those supplies are now delivered to Mexico as a part of the treaty delivery requirements and would require a new minute and consultation with United States water users to accomplish;

- Periodic releases of larger volumes of water to the Delta for flushing purposes would increase the risk of shortages in the United States unless the reservoirs were subsequently refilled with high runoff; and,

- Delivery of operational over-deliveries of Colorado River water to Mexico in excess of the Treaty delivery requirements to the Delta wetlands is limited by needs of agricultural water users in Mexico and canal capacity. Also, as a part of the program to line the All American Canal, plans are being developed to build additional regulating reservoirs, that could reduce the magnitude and frequency of such operational over-deliveries of water to Mexico and to the Delta.

While recognizing that all potential sources of Delta water supplies are problematic, the report does not dismiss or endorse any of them as a water supply for long-term Delta management. Ultimately, the solution to the ecological problems of the Delta will require considerable technical inquiry that could take years. Agreement on the goals and the design of a truly comprehensive approach for protection of the Delta's ecosystems will require the collaboration and best efforts of all interested parties. This report merely attempts to identify and test alternatives that appear to have the least political, legal, and financial complications and that could be implemented in a relatively short time.

Two combinations of supplies were selected that the authors of this report believe could provide a sustainable near-term supply of water for protection and enhancement of Delta ecological resources. These options are not entirely free of physical, economic, institutional, social, and environmental problems; however, they appear to offer a feasible means of providing important near-term ecological benefits. The two options are:

A. Fresh Water Sources

This alternative involves the purchase and retirement from willing Mexican landowners of about 2,000 hectares (5,000 acres) of marginal, privately-owned agricultural land west of Mexicali or south of the Compaction Zone. This would provide approximately 15,000 acre-feet of water per year that could be designated to restoring Delta habitat. The 2,000-hectare objective was developed with the assistance of local CNA staff and represents an estimate of the marginal agricultural land that could be retired from an operational perspective with minimal impact on established agricultural uses. As a comprehensive Delta management program is developed, the opportunity to expand such purchases can be explored.

The United States now provides operational over-deliveries of Colorado River water, when available. These waters are expected to average about 30,000 acre-feet per year. When they occur, the flow volumes often exceed the water delivery needs of water users in District 014 under current operation strategies. Operational over-deliveries that exceed demands flow into the river corridor below Morelos Dam.

Together, these two sources would provide an average of 45,000 acre-feet per year of fresh water to the Delta. CNA would be requested to use its infrastructure to deliver the 15,000 acre-feet per year of purchased water rights and to divert and wheel unused operational over-deliveries to identified tracts of land within the river corridor between Morelos Dam and the confluence with the

Rio Hardy. The fresh water would be used, primarily during winter and spring, to establish new stands of riparian vegetation on an ongoing annual basis.

The following issues must be addressed:

- Additional due diligence and the execution of various agreements would be required before these alternatives can be implemented, including CNA's commitment to maintain control over the purchased water.

- Assessing the economic and social implications of purchasing and retiring agricultural land.[14]

- Addressing the competing uses for this water. It should be recognized that the communities of Mexicali, San Luis Rio Colorado, Tijuana, Tecate and Rosarito need additional water for their growing communities. Also, drainage return flows to the Delta could be marginally impacted through a land retirement program.

- Securing the ecological use of parcels of land within the riparian river corridor through long-term leases.

- Addressing the implications of possible US reservoirs associated with lining the All American Canal that could diminish the volume and frequency of operational over-deliveries of Colorado River water to Mexico.

- Identification of a bi-national institutional framework that will have an advisory and support role for implementation and operation of the project.

B. Brackish Water Sources

This alternative would involve transportation, at least during the term of the ISC, of brackish agricultural drain water from the Yuma area to an area in Mexico lying south of the Compaction Zone, west of the Ciénaga de Santa Clara and east of the confluence of the Colorado River and the Rio Hardy. This area is currently targeted by CNA for elimination of irrigation activities. Once irrigation is no longer being practiced, the CNA drainage wells that now lower groundwater in the area would no longer be operated. Without the drainage wells operating, the area is expected to become swamp like. The brackish water from the Yuma area is of such a salinity that it can be used to establish open water areas and support other marsh species that are already established in the area.

The brackish water would be transported from the Yuma area to this area by the Bypass Drain and would be in addition to the 125,000 acre-feet per year of agricultural drain water from the Wellton-Mohawk area that now is delivered to the Ciénaga. The limitation on the quantity of additional brackish water that can come from the Yuma area is the total unused conveyance capacity in the Bypass Drain. The Bypass Drain can carry a maximum of about 200,000 acre-feet per year. The brackish drainage water would be transported through the existing Bypass Drain to a newly constructed 4-mile long connector canal. The connector canal would take water from the Bypass Drain to the Plan Ayala Drain at a location about 10 miles south of Colonia Esperanza. Figure 5

shows the location of the proposed restoration area and the facilities that would be used to convey the brackish water to that area.

There are five sources of Yuma area brackish water that could easily be diverted into the Bypass Drain. These waters are now delivered to Mexico as a part of its Treaty entitlement of 1.5 million acre-feet per year. The sources include the flow from the Yuma Valley Main Drain and four Drainage Pump Outlet Channels in the South Gila Valley.

Because of Bypass Drain capacity limitations the range of possible deliveries could be as high as 75,000 acre-feet per year. For purposes of this analysis, it is assumed that 8,000 acre-feet per year from the Yuma Valley Main Drain and 30,000 acre-feet per year from the South Gila Drainage Pump Outlet Channels would be delivered to the Delta area rather than being mixed in with and included in the Treaty water delivered at the Northerly and Southerly International Boundaries. It is further assumed that the 8,000 acre-feet per year of water from the Yuma Valley Main Drain would be replaced by additional water pumped from the 242 Well Field and that the 30,000 acre-feet per year of water from the South Gila Drainage Pump Outlet Channels would be replaced by additional releases from Lake Mead storage.

The legal and institutional precedent for delivering brackish water to Mexico through the Bypass Drain without charge against Mexico's Treaty entitlement, can be found in Minute 242. The two nations would need to determine jointly that such a program is in their best interest, and it must be recognized that users in the US would forgo opportunities to put the water to use.

Reclamation and CNA would be requested to design, construct, and operate the necessary physical facilities, although most of the facilities are already in place or are being designed. A Minute would be added to the Treaty to coordinate facility construction and operation and to guarantee the deliveries of brackish water to the Delta wetlands. Should such a program be implemented, the Minute could provide that the allowable salinity differential between Imperial Dam and the Northerly International Boundary would be reduced accordingly.

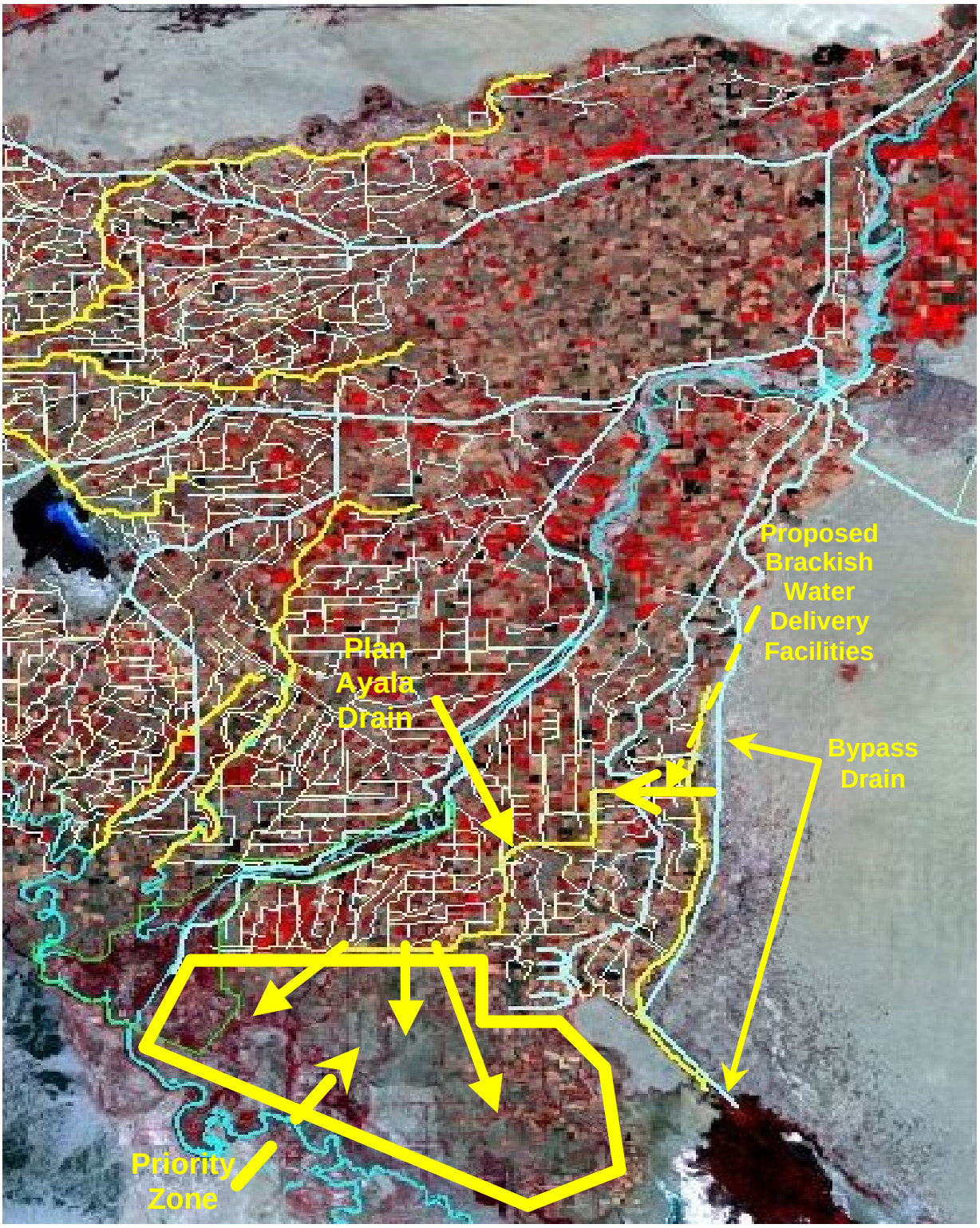

Figure 5

Location of Brackish Water Delivery System and Priority Zone (Yellow)

From time to time, the entire flow of the Bypass Drain could alternate between the Colorado River wetlands and the Ciénaga, mimicking the pulse-flow extremes seen in nature. Such a management strategy would not take water from the Ciénaga but would allow the water now entering that area to be delivered in surges.

The unresolved issues with such an approach are:

- The potential for increased shortages in the United States and allocating responsibility for mitigating those shortages, should they occur.

- The ability of the two governments to reach agreement on a Minute to the Treaty.

- A determination whether the benefits of reduction in salinity of water used by all farmers in the Mexicali and San Luis Río Colorado Valley areas would offset the local economic and social implications of purchasing and retiring agricultural land.

- Confirmation that the brackish water will be of sufficient quality to sustain the stands of riparian vegetation (cottonwoods and willows) as well as the patches of cattails in the pond systems in the area south of the Compaction Zone. Recent research by Zamora-Arroya, et al.,[15] has demonstrated that brackish water can provide a valuable water supply source for many species of vegetation in the Colorado River Delta, although careful management is needed.

C. Implications for Water Users in the United States

The proposed release during the term of the ISC of additional water into the Bypass Drain without credit against Treaty delivery requirements would marginally increase the potential for future shortages to US water users. To put the magnitude of that additional risk in perspective, a comparison of alternative Hoover Dam releases is provided in the table at the top of the following page.

As can be seen, the ISC will allow California to continue using more than its 4.4 million acre-feet per year normal apportionment. However, the continued excess use by California in the meantime will cause additional releases from Lake Mead and thus increase the likelihood that shortages would occur. The additional releases for the proposed Delta water supply measures constitute a very small additional demand on the River compared to that of the ISC.

Consumption from and Releases from Hoover Dam
(1,000 Acre-feet per year)

	Type of Year as Determined by Secretary			
Water Use	Flood Control Surplus	ISC Surplus	ISC Plus Delta Deliveries	Normal
Arizona	3,200	2,800	2,800	2,800
California	5,300	5,300	5,300	4,400
Nevada	400	300	300	300
Subtotal	8,900	8,400	8,400	7,500
Mexico	1,700	1,500	1,500	1,500
River Losses	500	500	500	500
Bypass Drain	120	120	158	120
Total Release	11,220	10,520	10,558	9,630

Under ordinary circumstances, Arizona would assume the shortages associated with the ISC. Because California water users are the primary beneficiaries of the ISC, the ISC contain a "reparation" provision whereby California (i.e., The Metropolitan Water District of Southern California) will accept additional Arizona shortages that are caused through operation of the ISC. A similar approach might be appropriate for the Delta.

D. Implications for Water Users in Mexico

Since the water right purchaser will continue to pay associated water delivery fees, other water users will not bear any additional CNA costs resulting from the purchase. There may be a minor reduction in the overall CNA operating costs since drainage pumping in areas outside the Compaction Zone may be reduced or eliminated.

This proposed delivery of 38,000 acre-feet per year of Yuma area brackish water to the Delta should result in reducing the salinity of water delivered at the Southerly International Boundary by 26 mg/l, and the potential for water quality spikes at that site would also be reduced. This option also would allow the Minute 242 salinity differential between Imperial Dam and the Northerly International Boundary to be reduced from 115 ppm + 30 ppm to 89 ppm + 30 ppm. (See Appendix A for detailed estimates of the changes in salinity that would be expected through implementation of the proposed diversion of Yuma area irrigation return flows.)

The purchase and retirement of 2,000 hectares of farmland in District 014 could adversely impact the local agricultural economy. Nevertheless, it is anticipated that the reduction in the salinity of water delivered under the Treaty will improve the productivity of remaining farms throughout District 014. Quantification of the value of these impacts and benefits is beyond the scope of this report, but will be assessed if the recommendations proceed.

VI. PURCHASING AND TRANSFERRING WATER RIGHTS IN MEXICO

The following section discusses the ownership and transfer of water rights in District 014. It concludes that, subject to additional due diligence in connection with certain targeted parcels, property with water rights can be purchased and the water rights transferred for ecological purposes. Pending regulations that would clarify and strengthen this transfer process are expected to be adopted by the time recommendations in this report are implemented.

Substantially all of the water available in District 014 is under the jurisdiction of CNA and defined as national waters.[16] The Mexican government has been allocating rights for the use of national waters in District 014 since 1938. Under existing laws, a private party may acquire and transfer the right to use national waters. However, since a new law was enacted in 1992, there have been two parallel water right management systems. The rights to use national waters in District 014 can be held by private parties under either (1) concession titles or (2) irrigation rights ("*derechos de riego*"). Both types of water rights are managed by the district and CNA charges user fees for any water distributed in the district, in accordance with a fee schedule set by the Federal Law of Fees. The rules for transferring water rights in District 014 vary depending on whether a water right is held as an irrigation right or under a concession title and the co-existence of both systems complicates but actually creates an integrated mechanism that allows the purchase of water rights in District 014.

Under the older Irrigation Rights System created in 1938,[17] the federal government granted irrigation rights to farmers in District 014. These irrigation rights are linked to land and allocated based on the size of a particular parcel, according to criteria established by CNA. Most parcels receive the water required to irrigate a twenty-hectare parcel. As discussed below, this system remains in place today but its management rules are in flux.

The second water right management system currently in place in District 014 was created in 1992, with the enactment of the National Water Law ("NWL"). Under this law, a so-called Concession System was created to allocate national waters to private parties.[18] The NWL promulgates rules under which water concessions are granted and transferred. Although the new Concession System recognizes the existence of irrigation districts, it does not clearly define the way in which irrigation rights will be managed under a concession system. Currently, a concession title is the only way a private party can acquire a newly issued right to use national waters.[19]

A. Ownership and Transfer of Irrigation Rights

CNA is in the process of bringing the older Irrigation Rights System into conformity with the new concession system in Irrigation District 014. Most of the water rights in this area continue to be held as irrigation rights and not concession titles. As such, this report focuses primarily on the steps required to transfer Irrigation Rights from irrigation to ecological purposes. It concludes that the irrigation right should first be converted to a concession and then transferred.

Irrigation rights are registered in the Public Registry of Water Rights ("REPDA") created by the NWL.[20] Although the REPDA only functions as a registry, the NWL recognizes the registration of water rights in the REPDA as a means of proving the existence and status of such rights.[21] For

example, as parcels of land or the associated water rights are sold or leased, CNA registers those changes in the REPDA and adjusts water deliveries to the individual modules accordingly.

Irrigation rights are tied to parcels of land. Under CNA's current practice, such rights are allocated within the district, based on a formula that assigns a specific volume of water based on the size of a parcel. An assigned water right is registered in the REPDA with a reference to the size of a parcel and not by a specific volume of water.[22] The calculation of the volume of water granted to every parcel holding an irrigation right can vary from year to year, depending on availability, as determined by CNA. However, this is not an issue in District 014 because of the stable water supply from the Colorado River assured under the Treaty, as well as reliable supplies of groundwater.

Under the water allocation rules applicable in Irrigation District 014, urban, industrial, and domestic water uses take priority over agricultural uses.[23] As discussed below, the new draft rules of operation will distribute quantities of water among users, in proportion to the volumes of water previously assigned to each user without regard to the type of use.[24]

The duration of an irrigation right is uncertain in light of the pending rules. Irrigation rights issued prior to 1992 and registered in the REPDA are valid for at least ten years from December 1, 1992 – the date of entry into force of the NWL.[25] Thus, any such rights will be valid at least until 2002. However, holders of irrigation rights are also made subject to all limitations applicable to concession holders, and the law specifies that concessions have a term of up to 50 years. Although it is not clear whether the sunset provision on pre-1992 irrigation rights will be enforced by CNA, it seems unlikely that it will, given CNA's delay in bringing the Irrigation Rights System into conformity with the concession system.

Most of the water rights available for purchase in District 014 are irrigation rights. Such rights may be changed from an agricultural use to other uses, as long as there is a prior authorization from the Irrigation District (CNA), and the new use is in accord with the NWL.[26] CNA officials in Mexicali have confirmed that approval is generally granted. A concession title – not an irrigation right – is issued to the transferee. In this way, the change in water use is used as a way of converting old irrigation rights into the new concession titles, and merging the two water management systems into the new concession system.

The transfer of irrigation rights is still governed by the rules of operation[27] enacted by Irrigation District 014 in 1964, prior to the adoption of resource conservation principles in most laws in Mexico. Although the 1964 rules are not very detailed in their description of the requirements for transferring irrigation rights, a transfer is allowed, as long as a water right is sold jointly with the parcel to which it attaches as registered in the REPDA.[28] Draft rules of operation to replace the 1964 rules for District 014 are pending approval by CNA headquarters in Mexico City.[29] The draft rules are more flexible in allowing the transfer and change of use of irrigation rights. For purposes of this report, we assume that the proposed rules will be adopted.

Under Articles 56 and 59 of the draft rules of operation for the district, the transfer of irrigation rights for use other than irrigation also will require the prior approval of the General Assembly of Users within each irrigation unit, or module (*modulo*). According to CNA, however, such approval would only be necessary if the transferee planned to use the irrigation unit's distribution infrastructure.

In the water transfer envisioned by this report, the distribution infrastructure of the module in which parcels were purchased would not be used and therefore permission may not be needed; however, the infrastructure of the module to which the water is being transferred would be needed. Even though the approval of the receiving module appears not to be legally required, local support for the transfer and distribution of the water is necessary and therefore this approval is strongly recommended.

B. Purchase and Transfer of Water Rights Issued under Concession Title

Concession titles are issued by CNA in accordance with the provisions of Article 21 of the NWL. To obtain a new concession title, a petition containing the following information must be filed with the local CNA Office. Also, an administrative directive from the Ministry of Environment and Natural Resources ("SEMARNAT") requires that specific environmental and physical information be included in a petition. CNA is required to respond within 90 working days after the petition is filed. The issuance of a new concession title will be subject to the availability of water, as defined annually in CNA's hydraulic programming, and will take into account existing water use rights included in the REPDA, as well as any existing legal reserves. Because CNA has not identified any water available for the issuance of new concession titles in District 014 it is likely that any concessions issued in the district will be based on existing irrigation rights.

A concession can be granted for a period of 5 to 50 years. This term can be extended for a term equal to the initial duration of the concession title. A concession title must be registered in the REPDA. Concession holders have specific rights specified in law and regulation.

A concession title may be transferred to another individual or legal entity, without transferring title to the associated land. When a transfer involves a simple change of the concession holder, and the terms of the concession title are not modified, the transfer can occur by registering a notice in the REPDA. In cases where the transfer may affect rights of third parties, hydrological or ecological conditions of basins and aquifers may be altered, or whenever any changes in water use are requested, prior CNA authorization is required. The Commission may authorize, deny or establish terms and conditions under which authorization is granted.

The NWL allows changes in water use for water rights issued under the concession system with the prior approval of CNA. Similar changes are allowed but not clearly defined under the Irrigation Rights System.[30] Generally, water rights granted in concession titles may be granted for any of the following uses: (1) urban; (2) agricultural, including water rights administered by irrigation districts; (3) power generation; and (4) "other productive activities," including industrial activities, aquaculture, tourism, and certain other uses. In addition, the NWL regulations define this catchall category as covering two water use categories: (1) multiple use, and (2) ecological conservation use.[31] Although changes in water use have generally been approved for urban and industrial uses, according to various CNA officials, no prior experience exists for approving changes in water use to an ecological conservation use either in Mexicali or nationally. Although District 014 has regularly authorized changes of water rights classified as agricultural use to other uses, CNA confirmed that it has not been requested to approve changing agricultural water use to ecological conservation use. Officials state, however, that they would issue such an authorization, if provided with sufficient data to support the change.

C. Unilateral Termination

The water rights held under either the concession or the Irrigation Rights System may be subject to unilateral termination by CNA, when:

(1) The term of a concession ends;

(2) The volume of water used exceeds the permitted allocation;

(3) User fees are not timely paid;

(4) Title to water is transferred in violation of any legal requirements;

(5) Any water rights expire due to lack of use;

(6) The federal government exercises its eminent domain powers, subject to indemnification; or

(7) By judicial decree.[32]

In order to avoid any unilateral termination actions by CNA, prior to purchasing water rights, the buyer should verify that such rights are properly registered in the REPDA and obtain written confirmation from CNA that the water rights are in good standing.

Once the water rights are purchased, under Mexican law the purchaser has several ways of addressing a governmental taking of any water purchased under a concession title. First, any CNA proceeding to revoke a concession for cause is subject to constitutional due process rules. Under the NWL, a concession holder whose right is considered for revocation will be provided with a hearing, and any resolution revoking a concession may be appealed for lack of a substantive basis. Once an appellate decision on the revocation is issued, a concession holder may still seek redress from a federal district court under a constitutional-rights proceeding ("amparo"). Under such a proceeding, the court may enjoin the taking of any water rights until such time as the court can resolve whether due process protection was granted. A CNA official's refusal to observe a federal court's injunction would potentially subject the official to penalties, including imprisonment.

If the revocation of a water right is related to an eminent domain proceeding, the concession holder has a right to be indemnified for the monetary damages caused by such a taking. A court will determine the damages, after hearing from the concession holder. Under Mexican law, there have not been any decisions issued regarding whether a operational action constitutes a taking redress able with payment of monetary damages.[33]

Finally, it should be noted, that under both the concession and the Irrigation Rights System, CNA might restrict water availability in the district in cases of severe drought or water scarcity. In such cases, irrigation rights would be inferior to urban, domestic, and industrial uses, and would be allocated accordingly. The allocation criteria for concession titles have not been clearly defined, but if the pending rules are approved as currently drafted, water will be allocated in cases of drought among all registered users.

VII. SUMMARY OF SUGGESTED FUTURE ACTIONS

A. Concerns

There is a risk of potential loss of Delta habitat as operational over-deliveries diminish when surplus flow conditions on the river no longer exist, as occurred in 2000 and is occurring in 2001. A drought, particularly a sustained drought, has the potential to eliminate flows to the Delta, and adversely impact the existing habitat.

To address these concerns, this report suggests acquiring 15,000 acre-feet per year of water per year from marginal agricultural lands in Mexico and re-directing brackish agricultural drain water from the Yuma area. These waters would be dedicated, respectively, for the continued establishment of native riparian habitat in the river corridor and for the restoration of the habitat in the area south of the Compaction Zone. US water users want assurances that a more comprehensive Delta plan does not require additional water from the United States. Therefore, these measures should be continued only through the term of the ISC or until a more comprehensive Delta plan is adopted, whichever comes sooner.[34]

B. Water Supply Acquisition and Management

Implementation of the recommendations in this report will require a collaborative effort amongst a wide-range of stakeholders including government agencies, NGOs, universities, and traditional water users. For example, additional scientific studies are needed concerning the hydraulics and biology of the Delta area including the management of additional fresh and brackish water supplies to best address the needs of the habitat. Furthermore, the involvement of local communities and NGOs is essential to the management and restoration of the wetland areas and to maximize the use of the targeted waters. Funding for this activity would come from NGOs, foundations and government sources in the US and Mexico.

C. Facility design, Construction, and Operation

The physical facilities needed to deliver the proposed water sources to the Delta are largely in place. In the United States, most facilities to divert the brackish water into the Bypass Drain are already operational. Reclamation is now designing the facilities necessary to divert water from the Yuma Valley Main Drain to the Bypass Drain and those facilities are expected to be completed in early 2002.

In Mexico, the 14-mile connector from the Bypass Drain to the Plan Ayala Drain would need to be constructed on an expedited basis under a new Minute. It is also assumed that the delivery facilities would be operated by Reclamation and CNA in accordance with that new Minute. Funding from both countries would be needed to implement this option.

D. Wetland Management Solicitation

A sustainable water supply for the Colorado River corridor and the target restoration area south of the Compaction Zone needs to be managed to maximize the ecological values of those areas. Design and implementation of such a management program requires input from a broad

range of professional disciplines. Ultimately managing the water to maximize its ecological value also will be a priority.

To develop the needed management program, a professional design competition solicitation could be circulated among university, environmental and engineering organizations with an emphasis on local community involvement. The winning design group would be awarded a contract to implement the wetlands and water management plan. Funding for the design competition and concept implementation would come from NGOs and foundations in the US and Mexico.

E. Development of Scientific Basis for Management Decisions

The immediate water supply, delivery and management actions described above are intended to maintain and improve the currently established wetlands in the river corridor below Morelos Dam and in the Cucapá Complex. However, the Delta ecosystem lacks a comprehensive scientific basis for long-term future management decisions. Work under Minute 306 and the various IBWC management groups have begun the process of broadening the base of scientific knowledge. However, a comprehensive approach to these investigations is needed with scientific-based oversight rather than advocacy based initiatives. It is suggested that a process similar to the Salton Sea Science Committee be used for this purpose. Funding for such a program would be through government agencies in the US and Mexico, although university funding, where available, also would be utilized.

F. Coordination Activities

Implementation of the recommended actions described in this report will require continued coordination. An important aspect includes the development of governmental and non-government coalitions to provide the financial resources needed for program implementation. It is anticipated that such continuing coordination and advocacy would be sponsored by NGOs and foundations in the US and Mexico.

Appendix A

Estimated Changes in Salinity
from Proposed Action

This report proposes changes in the sources of water that are delivered to Mexico in satisfaction of the 1944 Mexican Water Treaty. This Appendix contains the estimates of changes in salinity of affected water supplies that would result if those changes are implemented.

The flow and water quality data for each source are based upon data contained in either published USGS flow records or data contained in the report entitled "GROUND WATER STATUS REPORT, 1994, YUMA AREA, ARIZONA & CALIFORNIA," Prepared by US Bureau of Reclamation, Lower Colorado Region, Yuma Area Office, April 1996.

Northerly International Boundary

The diversion into the Bypass Drain of 30,000 acre-feet per year of brackish water from the South Gila Valley and replacement with water from Imperial Dam would reduce the salinity of water delivered at the Northerly International Boundary by about 26 parts per million each year. The computation of that change is shown in the following table:

Northerly International Boundary

Station	Flow (A.F./yr.)	Tons of Salt (Tons/yr.)	Salinity ppm
Historical NIB	1,360,000	1,691,140	915
So. Gila DPOC # 1	-18,000	-40,722	1,665
So. Gila DPOC # 3	-9,000	-28,968	2,368
So. Gila DPOC # 4	-3,000	-11,645	2,871
Imperial Dam Replacement	30,000	32,616	800
Proposed NIB	1,360,000	1,642,421	889
Salinity Reduction			26

Southerly International Boundary

The diversion into the Bypass Drain of 8,000 acre-feet per year of brackish water from the Yuma Valley Main Drain and replacement with water from the 242 Well Field would reduce the salinity of water delivered at the Southerly International Boundary by about 21 parts per million each year. The computation of that change is as follows:

Southerly International Boundary

Station	Flow (A.F./yr.)	Tons of Salt (Tons/yr.)	Salinity ppm
Historical NIB	140,000	214,233	1,126
Yuma Valley Main Drain	-8,000	-15,874	1,460
242 Well Replacement	8,000	11,959	1,100
Proposed SIB	140,000	210,318	1,105
Salinity Reduction			21

Bypass Drain

The diversion into the Bypass Drain of 8,000 acre-feet per year of brackish water from the Yuma Valley Main Drain and 30,000 acre-feet per year of brackish water from the South Gila Valley would reduce the salinity of in the Bypass Drain by about 126 parts per million each year. The computation of that change is as follows:

Bypass Drain

Station	Flow (A.F./yr.)	Tons of Salt (Tons/yr.)	Salinity ppm
Historical Bypass Drain	120,000	392,371	2,406
So. Gila DPOC # 1	18,000	40,722	1,665
So. Gila DPOC # 3	9,000	28,968	2,368
So. Gila DPOC # 4	3,000	11,645	2,871
Yuma Valley Main Drain	8,000	15,874	1,460
Proposed Bypass Drain	158,000	489,580	2,280
Salinity Reduction			126

Appendix B

Report Contributors

Malissa Hathaway McKeith, Lead Investigator – Ms. McKeith is a land use and resources attorney with extensive experience in Colorado River matters within the US where she is one of two Public Members appointed by the Governor to the Colorado River Board of California. Previously, she was a partner at Baker & MacKenzie, a large international law firm, where she specialized in the development of environmental law and resource management in Mexico and South America. She currently is a partner at Loeb & Loeb where she specializes in land use, energy and environmental law.

Michael Clinton, Lead Hydrologist and Executive Management – Mr. Clinton is a professional engineer registered to practice in all seven Colorado River Basin States. He was a US technical advisor during the 1973 negotiations of Minute 242, headed the Colorado River Salinity Control Program in the early 1980's. From 1985 to 1987, he served as Special Assistant to the Under Secretary of the Department of the Interior where he managed many environmental and Indian water rights settlements. While General Manager of the Imperial Irrigation District, he negotiated the water transfer agreement between Imperial and the San Diego County Water Authority.

David H. Getches, Legal Advisor – Mr. Getches is the Raphael J. Moses Professor of Natural Resources Law at the University of Colorado School of Law. He specializes in water law and Indian law and has written books and articles on those subjects, including several on the law of the Colorado River. He served in the 1980s as Executive Director of the State of Colorado Department of Natural Resources, and he was the Founding Director of the Native American Rights Fund. Professor Getches has been a consultant to federal agencies, states, Indian tribes, and Latin American countries. He is also on the boards of several environmental organizations.

Jaime Palafox, Legal Advisor – Mr. Palafox is a native of Baja California, Mexico and is an attorney with the Washington D.C. law firm of Skadden, Arps, Slate, Meagher & Flom LLP. Mr. Palafox works in the Environmental Practice Group on matters related to Latin American transactions. His professional emphasis is on acquisitions of Mexican facilities by foreign investors, environmental due diligence of manufacturing and maquiladora operations in Mexico, and review of environmental impact issues pertaining to the siting of new facilities, including energy-related projects. Previously, Mr. Palafox was the First Secretary, Office of Representation, Secretariat of Environment, Natural Resources and Fisheries, Embassy of Mexico, Washington, DC. In that capacity, he provided legal and policy advice on environmental and legislative issues. Represented the Environment Ministry at meetings of entities created under the North American Free Trade Agreement, including the Commission on Environmental Cooperation, the North American Development Bank and the Border Environmental Cooperation Commission.

Lic. Luis Octavio Martínez Morales, Legal Advisor – Mr. Martínez is a private attorney in Mexico City, who specializes in environmental, water and institutional law as well as the amparo remedy. He is a former fellowship holder of a "MacArthur Foundation" grant, with which he developed a project for the proper access to justice of individuals and NGO's interested in the defense of environmental

matters. He currently works at "International Legal Consulting" a Law firm managed by Ambassador Alberto Székely.

Beatrice Bogada, Legal Advisor – Ms. Bogada received her J.D. degree from the National Autonomous University of Mexico and her LL.M. degree from Harvard Law School. She also earned a master's degree from the Spanish Agency of Development Cooperation and is a member of the Leadership on Environment and Development Program of the Rockefeller Foundation. She currently teaches courses in International Environmental Law and Mexican Environmental Law at Iberoamericana University and is an independent legal consultant.

Jose Luis Lopezgamez, Mexico Government Liaison[35] – Mr. Lopezgamez is a native of Mexicali and a professional engineer licensed to practice in Mexico. As a member of the Trans Border Technical Working Group, he has represented the Imperial Irrigation District in seeking solutions to the water pollution concerns associated with managing wastewater from Mexicali that flows through the New River into the United States

Carlos Valdes-Casillas, Environmental Specialist – Mr. Valdes-Casillas is a professor at the Conservation Center for the Utilization of Natural Resources (CECARENA) at the Monterey Institute of Technology and Advanced Studies, Guaymas Campus, Mexico, since 1992. He has served as the organization's director for the past three years. He is currently doing research in the delta of the Colorado River, focus on the development of a wetland restoration plan. Dr. Valdés has worked throughout Mexico on design of protected natural areas, coastal marine resource management, geographic information systems, and regional resource evaluation and planning. He received his doctorate in natural resource planning from Oregon State University. He will be responsible of the Bioinformatics Program at the Commission of Environmental Cooperation of North America. *Paul Cunningham, Environmental Specialist* – Mr. Cunningham has worked on water policy in all the water basins in the West, as a gubernatorial assistant and as Executive Director of the Western Governors' Association. While Manager of External Affairs for the Imperial Irrigation District, Mr. Cunningham became involved in the Colorado River Delta. Currently, Mr. Cunningham is engaged in the restoration work underway at the Salton Sea.

Jo Clark, Research Manager – Ms. Clark has been instrumental in programs to create regional water market systems and to manage watersheds to optimize their diverse ecological resources. As President of Clark Consulting, Inc., she specializes in community involvement and public outreach for complex natural resource challenges. She is currently head of a team working with the Salton Sea Restoration Project. Prior to forming her own firm, she managed land and water programs for the Western Governors' Association, including Colorado River Basin issues.

End Notes

[1] A recent, well-documented report explains the history and nature of the problem. See Environmental Defense Fund, *A Delta Once More,* Leucke, et al.; June 1999. (Environmental Defense Fund has recently changed its name to Environmental Defense)

[2] See Luecke, et al, June 1999 bibliography.

[3]For detailed information on the Biosphere Reserve, see http://www.ine.gob.mx/ucanp/data/consultaFicha.php3?anp=1

[4] Luecke, et. al., p. 16.

[5] Payne, J. M., F. A. Reid, and E. Carrera-Gonzales. Feasibility Study for the possible enhancement of the Colorado delta wetlands, Baja California Norte, Mexico. Ducks Unlimited, Inc. Sacramento, California.

[6] See Luecke et al. and Valdés-Casillas, C.; E.P. Glenn, O. Hinojosa-Huerta, Y. Carrillo-Guerrero, J. García-Hernández, F. Zamora-Arroyo, M. Muñoz-Viveros, M. Briggs, C. Lee, E. Chavarría-Correa, J. Riley, D. Baumgartner, and C. Condon. 1998. Wetland Management and Restoration in the Colorado River Delta: The First Steps. Special publication of CECARENA-ITESM Campus Guaymas and NAWCC. Mexico. 32 pp.

[7] Leucke, et. al., p. 26

[8] In 1993, the Mexican Federal Government established by Presidential decree the Biosphere reserve of the Upper Gulf of California and Colorado River Delta (Reserva de la Biosfera del Alto Golfo de California y Delta del Río Colorado). A biosphere reserve is a worldwide category of protected areas, established by the UNESCO Program of Man and the Biosphere, which emphasizes that humans are part of the biosphere to be considered within the protected area concept.

The Upper Gulf Biosphere Reserve contains more than 900,000 hectares of marine and land areas. They contain the Ciénaga de Santa Clara, a large cattail marsh which provides habitat for the endangered Yuma clapper rail and desert pupfish; the estuarine area at the mouth of the river, a critical habitat for many aquatic, vegetative, and avian species; and extensive mudflats – essential habitat for shorebirds. Remnant clam populations have recently been discovered in the flats that had been thought extinct.

The Biosphere Reserve includes two management zones. A core zone provides more restricted protection for ecologically sensitive areas. It includes habitat that supports endangered species such as the Vaquita porpoise and totoaba fish in the marine portion, and the clapper rail and pupfish in the Ciénaga. A buffer zone allows human use, promoting sustainable activities such as fishing, ecotourism, hunting, and agriculture. For more information contact Jose Campoy at (6) 536-3757 or www.semarnat.gob.mx.

[9] In surplus years Mexico will receive 1.7maf; in shortage years, Mexico receives the same percentage reduction in water as the US.

[10] See Article 10 (b) of 1944 Treaty.

[11] Studies by the Bureau of Reclamation suggest that the ISC will reduce the probability of surplus deliveries of water to Mexico during the next 15 years from a likelihood of 26 percent to a likelihood of 23 percent of those 15 years. (FEIS Interim Surplus Criteria, USBR< Volume 11, Page 2-25, Table 2-7)

[12] El Norte, 23 February 2001.

[13] The agricultural water duty for lands served by the CNA delivery system is derived as follows:

Total Registered Agricultural Area:

Colorado River	137,602.84 Ha
Wells	48,442.57 Ha
Total	186,045.41 Ha => 459,666 ac.

Lands Using Groundwater:

Connected to Canals	19,377 Ha
Isolated	29,065 Ha
Total	48,442 Ha => 119,700 ac.

Overall Water Duty:

Irrigation Allocation	1,424,964 AF/yr.
Acres Served	459,666 ac.

Water Duty

1,424,964 AF/yr. / 459,666 ac. = 3.1 AF/ac.

[14] "Californians United for Reasonable Expansion ("CURE"), Inc., has commissioned a study of the impacts of land fallowing for the targeted area in this report to determine both adverse and positive impacts to the local community.

[15] See Zamora-Arroyo, F. O. Hinojosa, E. Glenn and M. Briggs, In Press, Vegetation Trends in Response to Instream Flows in the Colorado River Delta, Mexico, Journal of Arid Environments

[16] Unless otherwise noted, all water rights referred to in this memorandum are water rights for the use of national waters in District 014. Under Article 27 of the Mexican Constitution, national waters are federal property and the Federal Government regulates their use.

[17] Agreement on the Control and Organization of the Irrigation District for the Colorado River, in Baja California, dated December 5, 1938; and the regulations for the Irrigation District of the Colorado River, published in Mexico's Federal Register on July 24, 1964 (1964 Rules).

[18] A concession may also be granted for the private operation of water distribution systems. These systems operate in District 014 and are known as Irrigation Units or *Modulos*. These usually charge a fee for the usage of its distribution system. There are 23 such units in Irrigation District 014.

[19] Art. 20, NWL.

[20] Art. 52, NWL.

[21] *Id*. *Note however*, that according to a Mexican Supreme Court decision issued in 1991 (prior to the enactment of the NWL), the only means for a private party to prove standing to defend its right to use national waters is by showing proof that such party holds a concession title or permit issued by the Federal government. *See* SEMANARIO JUDICIAL DE LA FEDERACION, OCTAVA EPOCA, TOMO VIII, MEXICO, JULIO DE 1991, P. 123.

[22] According to the 1964 rules of operation for the district, generally, the amount of water allocated to a parcel was the volume required to irrigate twenty hectares of agricultural land.

[23] Art. 24, 1964 Rules of Operation for Irrigation District 014.

[24] *See* Art. 42 (I). Draft Rules of Operation for Irrigation District 014 (November 2000). *Note also* that according to CNA, the possibility of further water reductions due to increased urban consumption is less likely. The water allocated by CNA for use by the cities of Ensenada, Mexicali, Tecate, and Tijuana (the major cities in the State of Baja California), and San Luis Rio Colorado, in the State of Sonora, is provided by an aquifer located in the vicinity of San Luis Rio Colorado and not from the Colorado River. Water rights held by the municipal water systems in these cities have been assigned by CNA and registered in the REPDA. Any future increments in water required by these cities will have to be

purchased from holders of irrigation rights or concession titles. *See* Art. 42 (VI). Draft Rules of Operation for Irrigation District 014 (November 2000).

[25] NWL, Implementation Article (*Articulos Transitorios*) 7.

[26] Art. 117 (XIX) 1964 Rules. The rules do not discuss this issue at length, however, they state that a water user may not "...without prior approval from the head of the Irrigation District... change the use of the [national] waters... in accordance with the Law of National Waters..." (This law has been through different changes and has now become the NWL.).

[27] Art. 51, NWL.

[28] Art. 19, 1964 Regulation for the Irrigation District of the Colorado River, in Baja California (1964 Rules).

[29] These draft rules were proposed by the Hydraulic Committee of Irrigation District 014, and must be approved by CNA headquarters prior to their enactment. As part of this approval process, CNA has been internally discussing the change in use of irrigation rights in the district. *See* Art. 99, National Water Law Regulations ("NWLR").

[30] The draft rules of operation for Irrigation District 014, also allow for changes in water use to usage other than for irrigation purposes.

[31] Art. 2 (XIX), (XXII), (XXV), NWLR.

[32] Art. 28, 68, NWL.

[33] Any unilateral termination without fault to the owner of a water right, would entitle the owner to indemnification in accordance with Mexican law. It should be noted that there is a difference in the calculation of damages and the basis for payment of such damages between the rights of some US and Canadian investors, and Mexican entities.

[34] As part of this report, the authors canvassed the various Colorado River stakeholders in both Mexico and the United States to test various options. Although no firm commitments were made, the two options identified in this report received the least opposition and were perceived as the most fiscally and practically achievable on the short-term.

[35] The role of Mr. Lopezgamez was confined to analyses of the water management and delivery systems in Mexico. He took no part in developing or evaluating sources of water supply from within the US.

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