

HABITAT WATER SUPPLY MANAGEMENT PLAN
FOR
THE ADJUDICATED AREA OF THE MOJAVE RIVER BASIN
SAN BERNARDINO COUNTY, CALIFORNIA

Prepared by
The California Department of Fish and Game

July 2004

California Department of Fish and Game

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1. BACKGROUND

The Riverside County Superior Court Judgment After Trial of January 10, 1996¹ (the Judgment) ordered certain parties in the litigation to undertake certain actions. The Judgment requires the Watermaster to establish a Biological Resources Trust Fund for the benefit of the riparian habitat areas and species identified in the Judgment. The Judgment refers to a habitat water supply management plan (Plan) to be prepared by the California Department of Fish and Game (Department) for the benefit of these riparian habitat areas and species identified in the Judgment. These riparian habitat areas and species are listed in Exhibit H of the Judgment.

- 1.A. The underlying goal of this Plan is to return certain locations within the areas designated in Exhibit H, that have been degraded or lost due to the over production of groundwater, to the natural resource values existing in the 1986 – 1990 time period that was evaluated in the Judgment. Elevating water levels provides a critical element in any effort to recover the degraded habitat, but alone will not reproduce the 1980's habitat condition. Corollary efforts such as non-native species control and removal; habitat manipulation and acquisition, water development and acquisition, and revegetation will be required. Investigations are required that include: determining non-native distributions, acquiring information pertinent to land and water acquisitions, developing plans for reconstruction and rehabilitation projects, determining species distributions and associated water requirements, and identifying specific habitat requirements and appropriate restoration activities. Ongoing investigations will also be necessary, such as monitoring of native and non-native species populations, groundwater and surface water levels, and habitat quantity and quality, is necessary for adaptive management which will be the mechanism to modify activities, if necessary, to meet this Plan's objectives.
- 1.B. The Department is the State agency that has the statutory authority and responsibilities with regard to fish and wildlife resources and habitats in California. California's fish and wildlife resources are held in trust for the people of the State by the Department (Fish & Game Code section 711.7). The Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitats necessary for biologically sustainable populations of those species (Fish & Game Code section 1802).

1 City of Barstow v. Mojave Water Agency, Riverside County Superior Court. Case No. 208568.

1.C. Broadly, two general types of habitats exist within the entire area of the Judgment. One is composed of xeric vegetation - an environment of scattered creosote-type desert plants dependent upon the slight soil moisture derived from rainfall, not groundwater, and which supports plants and animals adapted to dry conditions. The second is composed of phreatophytic vegetation - the riverine and seep-dependant plants whose roots can reach stream water or a shallow water table and which support a dense and highly diverse wildlife community. The Judgment limits the Habitat Water Supply Management Plan to the phreatophytic environment of the Mojave River floodplain. The areas to be covered in the Plan are shown in Exhibit H, Figure H-1, pages 1 through 5 (covered area). This environment, though now in some locales degraded from the 1986 condition, includes shallow pools and year-round flowing streams, cottonwood, willow, and mesquite forests, and an understory of willow, rushes, grasses, and reeds. Exhibit H identifies two reaches of riparian corridor as valued habitats to be protected under the terms of the Judgment. The southwestern reach is a 23-mile corridor running continuously from slightly south of Spring Valley Lakes in Victorville to a location two and one half miles northeast of the Silver Lakes development. The eastern 4-mile reach consists of the Camp Cady Wildlife Management Area in Newberry Springs, located fifteen miles northeast of Barstow. Only these two reaches of the Mojave River were designated in the Judgment. They were selected because they existed in reasonable condition in the 1986 - 1990 period when water rights were being quantified under the Judgment. By the time the stipulating parties went before the Court in 1995, water loss - related degradation had begun at some locations. The final selection of areas to be included was based upon the 1986 - 1990 existence and the possibility of restoring the habitat losses of recent years. Omitted are areas where loss had occurred many years prior to the 1986.

2. AUTHORITY, CONSTRAINTS, AND SCOPE

2.A The Judgment appoints the Mojave Water Agency (MWA) as Watermaster and gives the Watermaster the duty to collect a Biological Resource Assessment, create a Biological Resources Trust Fund and make the Biological Resources Trust Fund (Trust Fund) money available to the Department. Trust Fund money is derived from a levy of \$0.50 (in 1993 dollars) against each acre-foot of produced water (in the same manner as the Administrative Assessment) except that no Biological Resources Assessment shall be levied whenever the Trust Fund account balance exceeds \$1,000,000 (1993 dollars)². The following sections of this Plan respond to the requirements and constraints described in Exhibit H of the Judgment. Where possible, descriptions of Trust Fund usage are specific, but are also more generally described in categories as many changes in hydrologic conditions, adjacent land use, and legal actions have occurred since 1996 and are expected to do so in the future. At this time, major uncertainties remain regarding rampdown, nonstipulating parties water rights and other issues. The Department, therefore, may make modifications to this Plan in the future.

² Judgment Appendices Exhibit H, 3b. page H-3

- 2.B Figure H-1 of Exhibit H provides the geographic limits of the two locations to be served by the Biological Resources Trust Fund. Pages one through four cover the Victorville to Silver Lakes corridor. This corridor contains slightly more than five thousand acres of riparian habitat. About ten percent (six hundred and ten acres) of the forested area is owned by the Department. Most of the remaining lands are privately held in many small parcels. Based on hydrologic and cultural conditions, the Victorville-Silver Lakes corridor is broken into three reaches, the Upper (the southernmost) extending from the north of Bear Valley Road to the beginning of the Upper Narrows at the Highway 18 crossing; the Middle extending from the Upper Narrows to the National Trails Highway bridge crossing at the Lower Narrows (800 feet downstream of the USGS Lower Narrows stream flow gage); and the Lower (Transition Zone) reach extending from the Lower Narrows to about one mile north of the Helendale Fault near Silver Lakes. Excepting the one-mile reach north of the Helendale Fault, the entire 23-mile corridor lies within the Alto Subarea as defined in the Judgment. The northern one-mile reach lies within the Centro Subarea.
- 2.C The second region, the Camp Cady Wildlife Management Area, lies in the Baja Subarea at the northern edge of unincorporated Newberry Springs. The riparian corridor is four miles long and contains a little less than 1000 acres of cottonwood - willow and mesquite forest. This area is under the single ownership of the Department.
- 2.D In this Plan, descriptions of vegetation and wildlife are intentionally brief to provide focus on the water management hydrologic framework, including resource threats and remedial actions. Descriptions of past and current conditions and calculations of areas and distances are based on aerial photographs and field observations. The MWA photographic files extend back to 1969. MWA photos used in this plan are those from 1985 to 2002. Since 1996 MWA has taken aerial photos annually. The MWA photo flights are taken in June or July. By comparison with monthly well hydrographs and stream gages this time frame has been found to reasonably represent the drier conditions of the year. Also used were historic photographs of the Fairchild Collection of Whittier College, photo files of San Bernardino County, and photos taken by Department personnel and the Department's consultant, Thomas W. Bilhorn, using Department aircraft. The vegetation and surface water of the river was mapped two times for the Department- using 1993 and 1995 photographs of the MWA and those taken for the Department from the ground and air. The entire length of the river was traversed by ground during these mappings. Also utilized were aerial photographs by the Department's consultant of the peak stage of the 1993 record flood. Other data sources are as noted in the footnotes. Field investigations have occurred approximately monthly over the past ten years and are not otherwise noted herein. The MWA, as Watermaster under the Judgment, has assembled hydrologic and geologic data, particularly well hydrographs and pumping data. These data were greatly relied upon in addition to data from U. S. Geological Survey files and well measurements taken of sites installed by the Department's consultant.

3. HABITAT AREAS: CONDITION, THREATS, GOALS AND WATER MANAGEMENT STRATEGIES

Because the hydrologic framework controlling the Victorville-Apple Valley riparian corridor differs significantly along its length, it is divided into three reaches, Upper, Middle, and Lower (the Transition Zone).

3.A UPPER REACH OF THE VICTORVILLE TO SILVER LAKES CORRIDOR.

- 3.A.1 The Upper Reach of this corridor extends for four miles to the south of the Highway 18 bridge crossing of the Mojave River, reaching within one mile of Bear Valley Road, and has an area of 835 acres. The southern limit of this mature cottonwood-willow forest has withdrawn northward slowly from the 1986 to the present. A shallow flowing stream traverses the corridor. The linear extent of this stream has declined with time. In the 1986 - 87 interval its mid-summer length reached to the south edge of the Spring Valley Lakes development, 3.2 miles south of the Highway 18 bridge. Since that time the mid-summer length has been on the order of two miles, but is now made up of intermittent connecting ponds, wet soils and thread-like flows of 10 to 15 foot width.
- 3.A.2 Starting 0.6 mile south of the Highway 18 bridge and extending for one half mile northward, a 30-acre marsh area (called the Upper and Lower Sloughs) lies along the western edge of the mature forest. It is a long-term feature that initially was supported by a high water table and artesian flows, but now depends more upon erratically supplied water pumped from several upstream sources. It is the only long-lived perennial pond habitat area in the desert reach of the Mojave River. This area has not been affected by major floods and is therefore a highly valued habitat area for fishes and other wildlife dependant upon permanent pools and fringing emergent vegetation. Overall, the habitat types existing in the upper reach support species listed under the Federal Endangered Species Act or California Endangered Species Act as threatened or endangered.
- 3.A.3 Within the Upper Reach the Department owns 610 acres of riparian habitat (within the 1,009-acre Mojave Narrows Regional Park). The property is managed by San Bernardino County under the cooperative agreement of March 17, 1969 between the County and the Department. This agreement expires in 2018. The mature forest area functions as an active park with some paved walkways and horse trails. Two small lakes, Pelican and Horseshoe are stocked with fish and fed by interconnecting ditches carrying outflow from Spring Valley Lake. Spring Valley Lake, in turn, is fed by pumping wells within the lake, and flow from the discharge from the Department ' s Mojave River hatchery. The outflow from the hatchery is controlled to allow its flow to be divided between direct discharge to the riverbed and inland through a golf course pond and on to Spring Valley Lake and the Regional Park. Outflow from Pelican Lake helps to sustain the adjacent riparian forest. Outflow from Horseshoe Lake is conveyed through pipe and controlling valves, and is divided between a branch to the Kemper-Campbell ranch and a branch feeding the Upper and Lower Sloughs. The remainder of the park is intensely used for riding, camping and grazing. The Upper Reach is bounded on the east and most of the west sides by residential development. One mile of the western edge is pastureland, grazed by horses and cattle.

3.B MIDDLE REACH OF THE VICTORVILLE TO SILVER LAKES CORRIDOR.

- 3.B.1 The Middle Reach of the Victorville–Silver Lakes corridor is a mostly confined channel running from the Upper Narrows (at the crossing of Highway 18) to its discharge point at the National Trails highway bridge, 3.7 miles to the northwest. In the first mile it passes through the commercial area of the City of Victorville. Starting at the Oro Grande outlet (0.3 miles downstream of the Highway 18 bridge) the San Bernardino County Flood Control Department maintains a clear sand channel about 250 feet in width. Sand is graded onto the banks leaving only mature cottonwoods beyond. The channel control extends a short distance north of the Interstate 15 bridge. A band of mature cottonwood and willows 100 to 300 feet wide lines both channel edges. The river is additionally levied on the western side. The City of Victorville maintains a park on the western edge of the river that provides public access to the trees and river. The east side is privately held with the land in agriculture, excepting one residential trailer park. Until 2001 surface flow was a perennial shallow, but relatively wide stream. By 2004, only a very narrow stream flows intermittently through the reach.
- 3.B.2 From the Interstate 15 bridge northward, the Middle Reach broadens for one and a half miles through private lands. The eastern bank area is undisturbed and therefore valued as a wildlife habitat area. The western bank is partially buffered by trees, agricultural lands, and a cement company operation. The cement plant has fourteen wells within its property. With a total of 1,450 acre-feet of base annual production (produced in 1986), 2002 production was 2,168 acre-feet. The cement company 1986 production equaled slightly less than 7% of the gauged base flow from the Lower Narrows. With a base flow of only 4,500 acre-feet in 2002, the 2002 production of 2,168 acre-feet by this group of wells now equals nearly 50% of the base flow and therefore becomes an additional significant factor controlling the downstream surface water environment.
- 3.B.3 For the remaining one mile the reach again narrows to a channel of as little as 100 feet in width. Granitic banks rise sharply and limit the fringing vegetation to nearly a single tree in width. The east bank is open undeveloped land. The west bank is also undeveloped land with one small city park located 800 feet south of the Trails highway bridge and is the site of the U.S. Geological Survey 's Lower Narrows stream gaging station. Surface flow past the gage and the highway bridge continues to be perennial. Currently it is much reduced in volume, therefore scouring of the bed is slight and heavy emergent plant growth and some beaver dams now occupy the area. This undisturbed reach, if returned to a flowing channel, would be of high resource value because of the bordering open land. Other than the rare desert storm inflow at Oro Grande wash, the middle reach habitat corridor is supplied with water through the Upper Narrows.

3.C CAUSES OF LOSS IN THE UPPER AND MIDDLE REACHES.

- 3.C.1 The two forks of the Mojave River are joined behind the Corps of Engineers “Mojave River Dam” water control structure (a flood peak flow reducing structure, not a dam) at the

base of the San Bernardino Mountains. From this point river runoff flows steeply down an alluvial fan before reaching the granitic ridge forming the Upper Narrows. In this 14 mile distance the riverbed drops 450 feet. The river has cut a narrow and shallow opening through the ridge (200 feet wide, 45 foot bed depth³) and continues a northerly flow through four miles of a confined channel before exiting at the Lower Narrows. The combination of flow over porous sediments, the 450 foot drop, and the abrupt interception by barrier granitic rock has created a floodplain hydrologic system at the Upper Narrows of vertically stacked aquifers separated by partially to nearly impervious clay layers. Until the 1999 - 2004 interval, conditions provided sufficient pressure in deeper layers to cause artesian flow in wells near the Upper Narrows. These flows are now lost, however this pressure continues to allow some leakage from the deeper aquifers to the near surface at the Upper Narrows. This leakage, when mixed with bank flow from the adjacent regional aquifer system has historically been the source of surface water supplying the cottonwood - willow forest of the Upper Reach and the downstream flow through the Middle Reach. Upstream, the Regional and Floodplain aquifer systems are hydraulically interconnected as demonstrated by water level similarities and by observation of the migration of flood event spikes in well water elevations from the river eastward and westward.

3.C.2 In more recent years, the natural sources of surface water have been augmented in varying amounts by discharges from the Department 's fish hatchery, the Upper Narrows Regional Park, Jess Ranch fish ponds, and seepage from Spring Valley Lake. The fish hatchery pumps, and returns to the river, a substantial volume of water. The hatchery's base annual production right is 10,678 acre-feet per year (produced in 1988) and over the last nine years of record has produced between approximately 8,500 and 10,600 acre-feet per year. During the past four years annual flows have varied more narrowly – between 9,600 and 9,900 acre-feet. Jess Ranch recirculated water also contributes to the surface water of the Upper Narrows. This source, however, has been discontinuous and produced a smaller discharge – less than 1,000 acre-feet per year. Groundwater pumped to the surface from the Upper Narrows to south of Bear Valley Road likely simulates a zero sum game because the quantity released at the surface decreases the pressure head of the aquifer and thus the natural vertical leakage at the Upper Narrows. Although the fish hatchery and Jess Ranch flows have been recent, significant contributors, they are not the original source of surface water. More specific knowledge of the floodplain aquifer system in this locale is needed to make reliable numerical predictions of the impact of major changes in hatchery discharges. Flows now being recorded within the Spring Valley Lake area need more consistent data reporting and thorough analysis.

3.C.3 Aerial photographs, water level records, logs of geologic strata penetrated by wells, and gauged stream flow were utilized in the interpretation of the hydrologic system of the Upper Reach. For the purposes of understanding the dynamics of the hydrologic system of the Alto reach of the Mojave, the stream gage records of the gaging stations at Deep Creek,

³R. D. Catchings et al. 2000. Subsurface Structure and Seismic Velocities As Determined From High-Resolution Seismic Imaging in the Victorville, California area: Implications for Water Resources and Earthquake Hazards. USGS Open File Report 00-123.

the West Fork and the Lower Narrows are highly valuable. Rated as good ($\pm 10\%$) by the USGS, their accuracy is more than sufficient for such an examination. Also valuable are records of wells with readings starting in the 1980's, earlier if possible, and continuing until 2000 and later. U. S. Geological Survey Internet files list approximately 300 wells for the river corridor extending from Hesperia north to the Upper Narrows. About 40 of these records are sufficiently long. Within this time period two contrasting weather events have occurred - strong drought from the mid 1980's to the end of 1992 and a sequence of flood flows in 1993, 1995 and 1998. The 1993 flood has been measured at the Deep Creek and West Fork gages as the largest storm flow in the 63 years of record for the Mojave. Data sets of this 18-year interval and especially the recent five years of heavy river flows provide important information on past and present aquifer storage levels, trends and the amount of recharge.

3.C.4 Most significantly, these 18-year data sets indicate the current floodplain and regional aquifer elevations adjacent to the river are 20 to 30 feet lower than the pre-1985 levels - when surface water extent and downstream flow volumes were stable. Prior to the floods, water levels declined at a rate of approximately four feet per year in the south reach in the area of the Hesperia well field and on the order of one foot per year north of Bear Valley road. Both deep and shallow near-river aquifers responded rapidly to the extreme three flood-event years, rising as much as 40 feet. A more typical rise is 20 feet. After 1998, the levels declined more rapidly, as high as 10 to 20 feet per year - in part due to the spreading of the recharge dome laterally. However, drawdown of the floodplain and regional aquifer systems has been too great for the recharge resulting from the 1993, 1995, and 1998 floods to return aquifer water levels to 1985 conditions and reverse the trend of weakening bank flow to the river. Current observations of lowered base flow at the Lower Narrows gage (now only one fifth of the long term 21,000 acre foot annual flow) and the loss of surface water seen in photographs and field inspections are an expected result and are consistent with the aquifer overdraft demonstrated by these data. Fundamental to the maintenance of the habitat upstream of the Upper Narrows is the return of sufficient bank flow and pressure head at the Narrows.

3.D. UPPER AND MIDDLE REACH HABITAT WATER MANAGEMENT GOALS.

3.D.1 **The first and primary goal for the Upper and Middle Reaches is to stop any further water level declines.** This would maintain the vegetative corridor and the existing surface water flow as seen in 2003, but not return the 1986 conditions. As the Upper Narrows functions as a spillway, further water level declines will lead to continued reduction and stoppage of base flow from the Lower Narrows. **The second water management goal is to restore habitats to near 1986-1990 conditions.** This requires a rise on the order of 20 to 30 feet in the aquifer systems adjacent to the river.

3.D.2 Goals for these reaches include a corridor of full growth mature native trees, an understory of young trees, bushes, grasses, pond-edge reeds, with perennial pools and flowing streams which create a very diverse and productive desert riparian habitat. These habitats can provide the maximum diversity and density of vegetation and wildlife and, if of sufficient size, an area utilized by wildlife that also can support human recreational uses. Each of these elements still exists within portions of the Upper and Middle Reaches, but is

now diminished in extent and viability. Most obvious is the loss of surface water extent and flow volume. The continuation of year-round flow through the Middle Reach is an essential goal here, as well as for the downstream Transition Zone reach. A return to the flows passing through these two reaches approximating those seen in 1985 - 1989 period, 15,000 - 20,000 acre-feet per year base flow (as measured at the USGS Lower Narrows gage and reported by the Watermaster) , is the desired goal. Matching the seasonal flow pattern, the “hydroperiod” is also essential. Unrestricted passage of storm flows, required in the Judgment⁴, is also needed for channel clearing and initiation of seeding and repopulation of cottonwood trees and other elements of a mature native habitat.

3.E **UPPER AND MIDDLE REACH HABITAT WATER MANAGEMENT STRATEGIES**

3.E.1 To meet the goals described above, a plan for the entire Alto Subarea is required for water importation, location of specific recharge sites, and location of some new production facilities to the recharge site network. These sites should be located in both the floodplain and regional aquifer systems - within the forebays, the recharge areas, of major aquifers. To be of value to the habitat corridor, water must be constantly available - not just available on an interruptible basis. Imported water is most beneficial therefore, if it is placed where it will recharge aquifers, within both the Floodplain and adjacent Regional systems gradually increase the hydrostatic head rather than flowing on the surface on an intermittent delivery schedule. Most needed are recharge sites filling larger, continuous aquifers, capable of receiving excess or surplus water available as a result of northern California wet years or from other similar sources. The floodplain recharge location should be hydraulically up gradient; the present Rock Spring outlet area may be adequate. Additional useful locations may be further to the south.

3.E.2 The necessary detailed aquifer studies are expected to be undertaken by the MWA in accordance with the Regional Water Management Plan to be finalized in 2005. The construction and operation of the facilities that would be necessary would be the responsibility of the Mojave Water Agency.

3.F. **ACTIONS TO PROTECT HABITAT AREAS IN THE UPPER REACH AND MIDDLE REACH TO BE UNDERTAKEN BY THE DEPARTMENT OF FISH AND GAME PURSUANT TO THIS PLAN INCLUDE:**

3.F.1 The slough area north of Horseshoe Lake is currently erratic in size and depth, sometimes going nearly dry. Because it is one of only a few locations within the entire Mojave River length to provide a perennial impoundment and is not washed out by floods, priority will be given to restoring the slough area and the fishes, birds and wildlife associated with such a habitat area. To better control water flow and restore natural conditions in the sloughs, it may be necessary to make improvements to the Horseshoe Lake dam outlet and possibly the conveyance systems upstream of the Lake connecting to Spring Valley Lake.

⁴ Paragraph III,18, Judgment after trial. Page 23

- 3.F.2 Assess habitat and species in Horseshoe Lake, Pelican Lake, Spring Valley Lake, and the slough north of Horseshoe Lake to determine specific habitat requirements and appropriate restoration activities for the species present.
- 3.F.3 Investigate and identify aquatic exotic species in upstream source waters such as Horseshoe Lake, Pelican Lake, Spring Valley Lake, and golf course ponds to determine appropriate removal/control measures.
- 3.F.4 Establish a water release plan and agreement to maintain and enhance wetland and riparian habitats below Horseshoe Lake.
- 3.F.5 Conduct studies to determine water requirements to restore/maintain waterfowl, nesting, resting, and feeding habitats in the slough area north of Horseshoe Lake. Before any restoration of the slough area, conduct a full assessment of wildlife, including aquatic, should be conducted. Restoration may include provisions for removal of exotic species and possible re-introduction of native species.
- 3.F.5 Buy or lease water and/or lands within the covered area to promote the protection and restoration of riparian habitats and conduct any preliminary investigations necessary for such purchase or lease and any post-transaction monitoring.
- 3.F.6 Remove/control non-native species such as Saltcedar and Arundo throughout both reaches.
- 3.F.8 Purchase or lease supplemental water (State Water Project), FPA, or BAP production rights as needed to maintain and protect threatened habitat areas.
- 3.F.9 Install the observation well H1-2 east of Spring Valley Lake as required under Exhibit H.
- 3.G. **LOWER REACH OF THE VICTORVILLE TO SILVER LAKES CORRIDOR - "THE TRANSITION ZONE"**

3.G.1 The Transition Zone is so named by the Judgment because of the difference in location of the Alto-Centro Subarea boundary and the point of measurement of the inflow of the area – to - area makeup water obligation. The Subarea boundary is at a previously defined location, the Helendale fault⁵, but the inflow measurement point is at the USGS streamflow gage within the Lower Narrows. This discrepancy became necessary, as it was not practicable to measure flows at the Helendale fault location. The reach also remained within Alto because within it the Victor Valley Wastewater Reclamation Authority (VWVRA) plant discharges effluent that it collects from the upstream Victorville, Apple Valley, and Hesperia areas. The riparian corridor within this reach is 15.2 miles long and is slightly more than 3,800 acres in area. In its biological makeup, the Transition Zone riparian area is very similar to the Upper Reach. It contains a dense, mature cottonwood -

5 California Department of Water Resources, Bulletin 84. 1967

willow forest, an understory of dense willow brush and trees, and emergent vegetation (cattail, tule, bulrush) in areas of surface water. This vegetation and the surface water provide habitat for many of the species listed in Table H-1. However, since that table was prepared several state and federally listed threatened species have been found in the area. Included are the Least Bell's Vireo and the Southwest Willow Flycatcher. Both require surface water habitat. This corridor provides exceptional habitat because of the lack of extensive land development along much of its length - unlike the Upper and Middle reaches. Excepting the Silver Lakes development at the far northern end, the Palisades Ranch (a 2000 acre working ranch, but with small water use and 170 irrigated agricultural acres) and, the VVWRA plant, there is no significant development on the western edge. The eastern side development is limited to agriculture with the exception of some housing at Oro Grande. The eastern edge of the river valley (and the agricultural area) is bound by the Burlington Northern Santa Fe railroad tracks and the old two - laned Highway 66 now renamed the National Trails Highway.

3.G.2 From photographic evidence of the 1920's to the 1980's this corridor exhibited surface streamflow extending north from the Lower Narrows for a distance of approximately nine miles. The flow was perennial and within a channel several times wider than documented in recent years. Since the late 1980's the stream flow has become highly altered. Surface flow leaving the Lower Narrows now extends only one mile north of the highway bridge - a loss of 8 miles of natural flow. However, the VVWRA plant four miles to the north of the bridge began discharges to the river in 1982. These discharges have created a surface stream flowing northward from the plant for as much as four to six miles. Although VVWRA discharges have not declined, by mid 2003, stream flow has decreased and the clear flowing channel seen at Bryman Road has become cattail choked with intermittent pools of water. Two ponds a half mile north of the VVWRA plant, perennial through 2002 were dry by early summer in 2003. These changes have resulted in a net loss of surface water habitat of as much as six miles, some scattered loss of vegetation at the north end, and a loss of slightly more than 100 acres of forest at the south end.

3.G.3 Its high water table defines the Transition Zone hydrologically. The length of surface water, extent of fringing forest, and modest use of the adjacent lands has made it unique within the Mojave Desert - which has lost over 95% of this habitat type. The high water table is due to several factors. Its floodplain and channel is limited in width by granitic rocks on the east and poorly transmissive ancient clay and silt lakebeds on the west. Downstream the Helendale fault is an effective dam, impeding downstream flow in the deeper aquifers. Also, a portion of the reach has a water table aquifer perched on a clay layer. This reach is also referred to as the "Water Bridge". Historically, it has remained nearly water full and therefore conveyed undiminished storm flows downstream to the city of Barstow and others. Because of this function, the Judgment provides for maintenance of the high water level. In addition to those habitat protections of Exhibit H, other sections of the Judgment also provide "Water Bridge" protections. Specifically, if a replacement water obligation exists for the Alto Subarea, the assessment within the Transition Zone is to be used to deliver replacement water within the zone if it is not determined to be full⁶.

⁶ Judgment, Section V, paragraph 28 page 39

Further, The MWA is to establish observation wells within the Transition Zone and establish minimum water levels that will trigger the use of replacement water to maintain the levels⁷. Action is being undertaken by the MWA on locating and drilling the required observation wells. Exhibit H observation wells H1-1 in the Lower Narrows area and H2-1 at Bryman Road also have not yet been located and installed.

3.H CAUSES OF LOSS IN THE LOWER REACH

- 3.H.1 On the broadest scale, the principal impact of current high levels of groundwater pumping in the Victorville, Apple Valley, and Hesperia area to the Transition Zone is the large decrease in base flow through the Lower Narrows and has been described previously in the analysis of the Upper and Middle Reaches. Within the Transition Zone the north and south ends are areas with concentrated well fields. Each is the primary cause of the adjacent loss of habitat. The well fields at the south end, adjacent to the Lower Narrows and extending northward to Oro Grande pump nearly 8,000 acre-feet per year. The water is largely exported from the river, with no return flow. At the north end, the Silver Lakes development pumps approximately 2,000 acre-feet per year. Because of the high evaporation from the 278 acre lake, there is little return flow of the pumped water to the river area. Any increases in pumping in these areas will further adversely impact adjacent habitat.
- 3.H.2 The dependence of habitat on a continuous supply of water cannot be overemphasized. The infrequent storm flows of the Mojave River are needed for seed dispersal onto the floodplains and for area-wide aquifer recharge, but these erratic flows do not maintain trees, ponds and flowing streams. July 1985 Mojave Water Agency aerial photographs (false-color infrared) show surface water to be continuous from Spring Valley Lakes, south of the Upper Narrows, past the VVWRA wastewater plant. The July photographs are a fair indicator of perennial (year-round) flow as they are taken near the peak of a year's water demand. In 1985 gauged base flow was just over 21,000 acre-feet. Since 1986 base flow has been trending continuously downward to water-year 2002-2003's 3,648 acre-feet. 1987, 1989, and succeeding year's July photographs show surface flow to be broken from the area of the gage to the VVWRA plant. In the 2002-2003 water year, the combined Lower Narrow Gage base flow and the VVWRA annual flow has dropped to below 15,000 acre-feet.
- 3.H.3 A 15,000-acre foot minimum combined flow (seen for the past twelve years) is capable of sustaining a much more modest forest with running water from the VVWRA plant to north of Bryman Road. In 2003, the Department and VVWRA entered into a Memorandum of Understanding (MOU) that provides for that maintenance of the past twelve-year regime as a fair contribution of VVWRA towards protection of the Transition Zone. For VVWRA to attempt to provide a second point of discharge upstream closer to the Lower Narrows would require piping and lift pumps and is probably operationally unreliable in the long term. Provisions of the Judgment, particularly importation of water into the Victorville

⁷ Judgment Appendices Exhibit G, paragraph 2(b) pages G-2, G-3

area, are hoped to provide an increase in base flow, leading to the potential recovery of the lost stretch of surface water.

3.I LOWER REACH - TRANSITION ZONE HABITAT WATER MANAGEMENT GOALS

- 3.I.1 Within the Transition Zone the present day habitat system is degraded from its 1986 condition. Future production from the well field supplying Adelanto, the regional airport, the County, and Oro Grand is expected to increase. Production at the second major well field at Silver Lakes is also expected to increase because of a proposed new housing addition. With these limitations it is currently estimated that the riparian habitat believed to be maintainable is that of more recent years, 1990 – 2000. Presently, a study of locations of possible recharge sites is being conducted by the MWA. Two possible sites are (1) the Lower Narrows and (2) Silver Lakes. The Department recommends the Lower Narrows site, as it may help to better reduce the seasonal imbalance in wellfield drawdown now occurring there. As the water is an interruptible source and supplied locally, it does not reproduce the steady conditions needed for riparian habitat. The Silver Lakes area may similarly benefit from a recharge site in the future.
- 3.I.2 To be a better functioning ecosystem, the Transition Zone needs the restoration of base flows to the mid 1980's quantities - 15,000 to 20,000 acre-feet per year. To do this would require an active program of importation of water at a number of recharge sites in the Alto Subarea as described previously (section 3.E.1). In the interim, and if it proves not fully possible to reach the 1986 levels, it is critical for the VVWRA plant to continue discharge to the river. The MOU described in section 3.H.1 is considered the priority action. Although annual discharge values have been used in this Plan to simplify a more complex seasonal hydrologic regime, it is the continuous daily discharge that is most critical. Short stoppages of several days may not be harmful, but flowing stream habitat, valued for species and for habitat, is shallow in the Mojave River and highly sensitive to loss of inflow.
- 3.I.3 The eight years since implementation of the Judgment have demonstrated a varying, difficult to predict reaction to the conditions and options the Judgment provides. Transfer of Free Production Allowance (FPA), rampdown and the delay thereof, and the existence of a large FPA pool make it difficult to predict impacts to localized areas and the timing of many impacts. For those reasons and because of possible encroachment of forest areas by land development, key areas should be considered for purchase of water rights and land rights. Such areas exist within the Transition Zone and the other reaches of the Mojave River. Such actions may be a major use of the Trust Fund.
- 3.I.4 For the Transition Zone as well as the other reaches, enforcement of the provision in the Judgment of non-interference of storm flows is also an important protection. This must be carefully balanced with the construction of levees. Constriction of flow by poorly placed levees increases flow velocity and scouring and downcutting of the channel. Downcutting is the likely cause of the loss and damage to the forest in the vicinity of the VVWRA plant and levee placement is a possible factor in this downcutting event. The Department urges that channelization and levee work in these forest areas be carefully coordinated with the Department.

3.J **SPECIFIC ACTIONS TO BE TAKEN BY THE DEPARTMENT IN SUPPORT OF HABITAT PROTECTION WITHIN THE TRANSITION ZONE ARE:**

- 3.J.1 Conduct those investigations necessary for potential land or water acquisitions.
- 3.J.2 Purchase of land and/or water rights in protection of habitat and of riparian-dependant species including support of such purchases by other entities able to provide funding from sources other than the Trust Fund.
- 3.J.3 Remove invasive non-native plants such as saltcedar and Arundo in coordination and combination with other agencies.
- 3.J.4 Install the observation well required in Exhibit H in coordination with the wells planned by the Mojave Water Agency.

3.K **CAMP CADY WILDLIFE MANAGEMENT AREA**

- 3.K.1 From the time of the Department's purchase of Camp Cady in the late 1970's and continuing until the late 1980's, Camp Cady's four-mile long riparian corridor had the hydrologic environment required to produce a highly diverse floral and faunal assemblage. The most prominent hydrologic feature was a series of three ponds in the riverbed located roughly mid-way within the corridor. The ponds had an area of eighteen to twenty acres in the late 1970's, but by the late 1980's had been reduced to six acres. This reach is shown on Figure H-1 of Exhibit H as "Surface Water Habitat Area" and is the site for monitoring well H3-2. From the western end at Harvard Road (the location of H3-1, the second Camp Cady monitoring well) the corridor contained dense mesquite thickets throughout the four - mile length. The eastern end of the property is also the end of the riparian corridor of the Mojave River until Afton Canyon twelve miles to the northeast. The pond area was, and remains, surrounded by a mature cottonwood - willow forest with an extent of two miles. At the eastern downstream end of the property, shallow, seasonal flow once again emerged, becoming dry in the late 1980's. Currently some juveniles of both these plant species have become established - especially within the one-mile reach downstream of the Camp Cady ranch buildings where the depth to water in the sand channel has been measured at one to three feet as recently as 2004.
- 3.K.2 In the early 1990's the ponds gradually diminished; and then disappeared when breached and filled with sand by the 1993 flood. No perennial surface water now naturally exists in this area. Of the 1,000 acres of healthy vegetation existing in the late 1980's, less than two hundred acres now are healthy; the remainder is highly water stressed or dead. Two pump - fed ponds, totaling only one acre in size, have been constructed south of the channel to provide habitat for the Mohave tui chub, a federally and state listed endangered native fish. Within the Camp Cady reach of the Mojave River and within the floodplain, the cross - channel topography has considerable relief with several benches rising more than 5 feet above the bare sand channel. These benches are populated with some cottonwoods, but much more densely with mesquite. In the ranch building area, some of the mesquite

remains healthy and reproductive - in sharp contrast to the majority that have been lost upstream. Downstream, the distribution of healthy/stressed mesquite is erratic, reflecting the change in ground elevation and height above a gradually declining water table. The Camp Cady site provided habitat for neo-tropical migratory riparian birds as well as waterfowl and animals as large as bobcat and mountain lion. The site's current vegetative and hydrologic characteristics, although greatly depressed, still are sufficient to support several federal and state listed endangered or threatened bird species.

3.L CAUSES OF LOSS, CONTINUING THREATS

3.L.1 Examination of historic pumping records, well water levels, and aerial photographs have identified two causes for the lowered water table aquifer. The greatest impact has been from adjacent irrigation of alfalfa fields. One 120-acre field lay at the western edge of Harvard Road and has pumped between 800 and 1000 acre-feet of water a year from the riverbed water table and deeper floodplain aquifers. The field has been active since 1980. A group of circular alfalfa fields (pivots) at the northwest edge of Camp Cady have been in intermittent production, as has a single pivot at the southwest edge of Cady. They pump from deeper levels of the older regional, aquifer, which, depending on location, has generally poorer connection to the habitat-dependent riverbed water table aquifer. Comparison of pumping and water level hydrographs of the Harvard Road monitoring well (10N3E27J5, San Bernardino County)⁸ demonstrated the strong impact of the Harvard Road alfalfa production and fluctuations in the depth of the water table aquifer. The records also exhibit a ten foot rise after the 1993 flood that is lost during the next five years of production. Further, the well hydrograph shows that during a year of non-production and no flooding the water table aquifer will rise slightly. This indicates that some recharge is occurring by a combination of subsurface flow down the river channel and local bank inflow from the Regional Aquifer.

3.L.2 To reduce impacts from the Harvard Road pivot the Department initiated the state acquisition process for these lands. In early 2002 the California Wildlife Conservation Board completed acquisition of the river bottomlands and 907 acre-feet of Base Annual Production rights. The current water-related threats to the restoration and protection of the Camp Cady riparian corridor are the adjacent agricultural pivots, if overproduced, and upstream water production, particularly that lying between the Waterman and Calico - Newberry faults.

3.M CAMP CADY HABITAT WATER MANAGEMENT GOALS

3.M.1 At the Harvard Road end of Camp Cady, the current depth to the water table is greater than 40 feet⁹. At the middle reach, the area of the ranch buildings, it is only two to three feet. With expected gradual basin-wide correction and dependence on infrequent storm

⁸ A well cluster, J5 is the perforated interval from 35 to 45 feet and here measures the water table aquifer.

⁹ Measured in monitoring well 10N3E27J5, identified as H3-1 in Figure H-1

flows, preservation and enhancement of habitat in the middle reach is the near-term goal and the restoration of the water table at Harvard Road to riparian depths remains a long - term goal. Observation well H3-2 is located in this middle reach. The water level criterion for this site is plus one (1) foot above ground, about 1705 feet, mean sea level. It is derived from the typical water levels recorded by the lost monitoring well Number 5, a part of a study of the hydrology and vegetation of Camp Cady. This well was 500 feet upstream of a water-filled slough and located mid-channel, 330 feet east of the bunkhouse. The well was lost in the 1993 flood.

3.N CAMP CADY HABITAT WATER MANAGEMENT STRATEGIES

- 3.N.1 To promote the raising of the water table aquifer, particularly in the middle reach of Camp Cady where there is a surface water habitat area, reduction of adjacent heavy pumping is most critical. This reduction can be accomplished via rampdown by the Watermaster or by the purchase of water rights or land. Even with a gradual rise of the water table, restoration of the 20 acres of ponds is unlikely. The more immediate objective is to create a group of smaller, reliably perennial ponds and assure the maintenance of the cottonwood-willow forest. The specific and more immediate projects for Camp Cady include:
 - 3.N.2 Removal and control of invasive non-native vegetation such as Saltcedar, Arundo, and Russian thistle will be a continuing task. This activity will reduce water consumption and promote recovery and restoration of groundwater levels and native riparian vegetation.
 - 3.N.3 Develop food and nesting plots in areas of existing irrigation lines for resident and migratory bird species dependant upon lost appropriate cover.
 - 3.N.4 Develop old artesian wells. Install new windmill, or motor driven wells in appropriate locations in proximity to the river edge. These wells will supply the water needs of native game, migratory waterfowl, various native bird species, western pond turtles and other amphibious and aquatic species by restoring a number of ponds and enhancing riparian habitat. The initial efforts will be to emphasize the use of existing, abandoned wells on the north bank.
 - 3.N.5 As water table elevations are recovered and non-native species removed, restore and rehabilitate native species – including cottonwoods, willows, and mesquite. Atriplex, desert willow and other less water-dependant species will be planted where the water table remains deep to provide food and cover and reduce blowing sand problems. Temporary wells and irrigation may be installed to start the vegetation.
 - 3.N.6 Install the second monitoring well H3-2 as indicated in Exhibit H for Camp Cady.
 - 3.N.7 Renovate and re-configure the three existing artificial ponds on the south side of the river to improve habitat for the federally and state listed endangered Mohave tui chub and western pond turtle. Renovation will include removal of deleterious non-native species where they impose a threat to native populations. These actions are needed to support the required protection of the Mohave tui chub until populations can be re-introduced and

sustained in permanent habitats within their natural range.

- 3.N.8 Purchase or lease supplemental water (State Water Project), FPA, or BAP production rights as needed to maintain, improve and protect threatened habitat areas.

4. OTHER ACTIONS NECESSARY FOR HABITAT WATER MANAGEMENT

The foregoing has attempted to define specific regions and corrective actions. It has become increasingly evident that water management for habitat protection involves other, presently only generally definable efforts to accomplish the overall goals and provisions of Exhibit H.

- 4.1 Acquisition of water rights and or land to protect habitat from water loss or disturbance. At some locations the value and threat to habitat sufficiently support the need to acquire water or property. Property acquisition is an important action under Exhibit H. A step in such acquisitions is the preparation of Land Acquisition Evaluations and Conceptual Area Protection Plans. This work can be performed outside of the Department on a contract basis.
- 4.2 Data collection and Analyses to Solve Specific Problems. To solve specific area problems, collect and or collate necessary water use data including aquifer properties, other water use, water levels, inflows, pumping quantities, outflows, water chemistry, land use, species habitat needs and physiology, and related subjects as the basis for specific actions, designs and decisions. Studies may include economic analyses, biological surveys to determine habitat relationships, impacts, and resource assessments and monitoring to evaluate effectiveness of actions and to provide for adaptive management.
- 4.3 Construction and Rehabilitation Projects. As water levels are restored, exotic weeds removed, and otherwise damaged areas are recovered, restoration and rehabilitation projects will be undertaken. This work can include ground preparation, re-planting, and protection from intrusion such as berms and fences. It may become necessary to rely on construction of wells, connecting conveyances and discharge facilities to support valued habitat. Grading and similar construction may be used to restore seasonal and perennial surface water bodies in areas lost because of lowered water tables. Examples are ponds, channel runs, seeps, guzzlers and similar features.
- 4.4 Use of supplemental water (State Water Project), FPA, or Base Annual Production rights. It is possible at some locations that the overall goals of safe yield and protection are too long in achievement to maintain and protect exist habitat areas. The use of pumped or piped water may be a necessary interim remedy.

-----July, 2004-----