ATTACHMENT C

Dams and Reservoirs Along the Lower Colorado River

This attachment describes the dams and reservoirs on the mainstem of the Colorado River from Glen Canyon Dam in Arizona to Morelos Dam along the international boundary with Mexico. The role that each plays in the operation of the Colorado River system is also explained.

COLORADO RIVER DAMS AND RESERVOIRS
Lake Powell to the Southerly International Boundary

The following discussion summarizes the dams and reservoirs along the Colorado River from Lake Powell to the Southerly International Boundary (SIB) with Mexico and their specific roles in the operation of the Colorado River. Individual dams serve one or more specific purposes as designated in their federal construction authorizations. Such purposes are, water storage, flood control, river regulation, power generation, and water diversion to Arizona, California, Nevada and delivery to Mexico. The All-American Canal is included in this summary because it conveys some of the water delivered to Mexico and thereby contributes to the river system operation. The dams and reservoirs are listed in the order of their location along the river proceeding downstream from Lake Powell.

Glen Canyon Dam – Glen Canyon Dam, which formed Lake Powell, is a principal part of the Colorado River Storage Project. It is a concrete arch dam 710 feet high and 1,560 feet wide. The maximum generating discharge capacity is 33,200 cfs which may be augmented by an additional 15,000 cfs through the river outlet works. The active capacity of Lake Powell is 24,300,000 af. Lake Powell has no legislated flood control space. The required system flood control space is allocated among selected project reservoirs including Lake Powell, to augment the 1.5 maf required to be available in Lake Mead.

Hoover Dam – Hoover Dam was constructed in the Black Canyon of the Colorado River about 36 miles from Las Vegas, Nevada. Hoover Dam was constructed to provide storage for river regulation and flood control, storage of water for irrigation and domestic uses and generation of hydropower. Recreation also constitutes a major use of Lake Mead. The dam is 726 feet high and the water depth is approximately 590 feet. Lake Mead can store water to a maximum elevation of 1,221.4 feet above msl (maximum water surface). Hoover Dam spillway gates in the raised position would equal elevation 1229 feet. At that elevation Lake Mead has a nominal "live capacity" of 27,377,000 af and an active capacity of 17,353,000 af above elevation 1083 feet msl, the minimum elevation for power generation. However, sediment accumulation in the upper end of the reservoir is gradually decreasing the water storage capacity. The dam backs water upstream approximately 115 miles creating a surface area of about 163,000 acres at its maximum design water surface elevation of 1229 feet msl. Flood storage of 1.5 maf is located between elevation 1,219.6 and 1,229 msl.

Hoover Powerplant is a major source of hydropower in the Southwest. The powerplant generating capacity is rated at approximately 2,062,000 Kw with maximum release capacity of approximately 49,000 cfs. The spillways have a maximum release capacity of about 400,000 cfs at 1,232 msl with the drum gates in a closed position. This provides a total release capacity of 449,000 cfs.

Davis Dam – Davis Dam and Powerplant are 67 miles downstream from Hoover Dam, and approximately 2 miles upstream from Laughlin, Nevada, and Bullhead City, Arizona. The dam's primary purpose is to re-regulate Hoover Dam releases and aid in delivery of Mexico's annual apportionment of 1.5 maf, and meet downstream demand. Located on the Arizona side of the river, the Davis Dam Powerplant has five generating units, each rated at 50,000

Kw, whose combined hydraulic capacity is 31,000 cfs.

Lake Mohave lies behind Davis Dam and is bounded for most of its 67-mile length by the steep walls of Pyramid, Eldorado, and Black Canyons. The lake is relatively narrow, not more than 4 miles across at its widest point, but provides significant recreation opportunities and habitat for fish and wildlife. The lake also captures and delays flash flood discharge from the side washes below Hoover Dam. Typical flow time from Hoover Dam to Lake Mohave is 4 to 6 hours. The lake has a storage capacity of 1,818,000 af.

Parker Dam – Parker Dam spans the Colorado River between Arizona and California 17 miles northeast of the town of Parker, Arizona. Parker Dam's primary purpose is to provide reservoir storage from which water can be pumped into the Colorado River aqueduct and the CAP aqueduct. Lake Havasu, the reservoir behind Parker Dam, is about 45 miles long and covers 20,390 acres. It can store 648,000 af of water. Typical flow time from Davis Dam to Lake Havasu is 1 to 1.5 days.

Parker Powerplant is located on the California side of the Colorado River immediately below the dam. It houses four hydroelectric generating units, each of which can produce 30,000 Kw of hydroelectric power. Four 22-foot diameter penstocks carry up to 5,500 cfs each, to feed the generating units. Fifty percent of the plant's power output is reserved for MWD's use to pump water along the Colorado River aqueduct to the Pacific Coast. The remaining power is marketed by WAPA, a DOE agency. Under an agreement between Reclamation and MWD, the latter agency financed essentially the entire cost of constructing Parker Dam. MWD's Whitsett Pumping Plant, 2 miles upstream from the dam on Lake Havasu, lifts water from the reservoir into the Colorado River Aqueduct.

Headgate Rock Dam – Headgate Rock Dam is located on the river about 14 miles below Parker Dam about a mile northeast of the town of Parker. It was constructed as a diversion structure to provide irrigation water to the Colorado River Indian Reservation. A 3-unit, low-head powerplant is built into the dam structure. The water retained by the dam is named Lake Moovalya, which extends upstream approximately 10 miles and contributes a stable water surface to the recreational area referred to as the Parker strip. The dam raises the river water level approximately 15 feet but develops no useable storage. The water releases below Headgate Rock Dam mirror the releases from Parker Dam. The maximum powerplant discharge is 20,000 cfs. The maximum generating capacity of the powerplant is 19.5 MW. Typical flow time from Parker Dam to Headgate Rock Dam is 1 to 4 hours.

Palo Verde Diversion Dam – The Palo Verde Diversion Dam consists of a concrete, gated structure with an adjacent embankment, constructed as a permanent replacement for the old Palo Verde rock weir. The dam raises the water levels approximately 12 feet, which is sufficient for the gravity flow to provide the water supply to the Palo Verde Valley including the city of Blythe. The impoundment has no useable storage even though the backwater from the dam reflects approximately 15 miles upstream. The dam is operated and maintained by the PVID. Typical flow time from Headgate Rock Dam to Palo Verde Diversion Dam is about 1 day.

Senator Wash Pumping/Generating Plant and Regulating Reservoir – The Senator Wash

facility is a pumped offstream storage facility located approximately 2 miles upstream from Imperial Dam. It was constructed to supplement limited storage behind Imperial Dam and Laguna Dam responding to sudden changes in water delivery requirements at Imperial Dam; the water travel time from Davis Dam to Imperial Dam is 3 days or more. When sufficient storage is not available at Imperial and Laguna Dams, Senator Wash is used to regulate excess flows arriving at Imperial Dam to prevent over deliveries to Mexico, and to ensure demands can be met when flows arriving at Imperial Dam are less than water user demand. The reservoir elevation fluctuates according to water user demand and flows arriving at Imperial Dam.

The reservoir has a capacity of 13,836 af at elevation 251 feet msl. However, current reservoir restrictions prevent raising the reservoir to elevation 251 feet due to concerns with seepage and high hydraulic pressure under the toe of Senator Wash Dam and along Squaw Lake Dike.

Imperial Dam – Imperial Dam, approximately 18 miles northeast of Yuma, Arizona, was constructed to provide a diversion of Colorado River water to the Imperial and Coachella Valleys, to the Reservation Division and the City of Yuma through the first reach of the All-American Canal on the west side of the dam; and to the Gila Project and the Yuma Auxiliary Project through the Gila Gravity Main Canal on the east side of the dam. Imperial Dam, which raised the water surface above the original river 23 feet to elevation 181 feet msl, was designed to provide a maximum diversion of 15,155 cfs for the All-American Canal; 2,200 cfs for the Gila Gravity Main Canal; and was designed to pass a maximum flood of 180,000 cfs. Typical flow time from Palo Verde Diversion Dam to Imperial Dam is about 2 days.

Imperial Dam created a reservoir that originally had a capacity of 85,000 af but, as was anticipated, the reservoir quickly filled with sediment. Intermittent dredging and sluicing operations are required to maintain a small reservoir pool of about 1,000 af in capacity to ensure diversions can be made to the All-American Canal and Gila Gravity Main Canal. Desilting works were provided for both the All-American Canal and Gila Gravity Main Canal. Sediment accumulations are sluiced downstream to the Laguna Desilting Basin where the sediment is removed by dredging and disposed of adjacent to the desilting basin.

All-American Canal, Pilot Knob and Siphon Drop Powerplants – The All-American Canal is approximately 80 miles long and provides irrigation water to over 500,000 acres of land in the Imperial Valley, over 78,000 acres in the Coachella Valley, approximately 15,000 acres in the Reservation Division of the Yuma Project, and over 40,000 acres in the Valley Division of the Yuma Project. Situated along the All-American Canal are two turnouts through which water is released for use in Mexico and in the Reservation Division, after passing through a powerplant at each turnout.

A wasteway was constructed on the All-American Canal at Pilot Knob, to which a power generation facility was added. Both facilities are located upstream of Morelos Dam. The wasteway was constructed to protect the All-American Canal and provide a place to discharge excess water back to the Colorado River, in particular those deriving from side wash inflows or sudden water user cutbacks in Imperial Valley. Pilot Knob Powerplant was constructed to allow generation of power from water deliveries made in satisfaction of the 1944 Treaty with

Mexico. Pilot Knob has 55 feet of hydraulic head and can produce up to 33,000 Kw of electricity.

Siphon Drop Powerplant operates to develop power from Yuma Project deliveries and deliveries made to Mexico. Currently, if Mexico's order at the NIB, less drainage return flows and sediment control flows below Imperial Dam, is greater than 800 cfs, the water is routed through the Pilot Knob Powerplant to generate power, which then takes away water that would otherwise have been delivered either below Laguna Dam or through Siphon Drop Powerplant and the California wasteway near Yuma, Arizona.

If Mexico's order at the NIB, less drainage return flows and sediment control flows below Imperial Dam, is less than 800 cfs, the water is normally routed through the Siphon Drop Powerplant to generate power. Siphon Drop Powerplant requires a minimum flow of 350 cfs to operate and, to the extent possible, this flow is maintained through delivery requirements to Mexico and water ordered for the Valley Division of the Yuma Project.

The Yuma Main Canal wasteway, more commonly referred to as the California wasteway, was constructed to protect the Yuma Main Canal if excess flows are diverted into the canal or sudden cutbacks in water use in the Yuma Valley occur. The wasteway allows those excess flows to be diverted back into the Colorado River. Now a portion of the water delivery to Mexico is routed down the All-American Canal through Siphon Drop Powerplant and the Yuma Main Canal wasteway.

Laguna Dam – Laguna Dam was originally constructed (1905 - 1909) to serve as a diversion structure and desilting works for the Yuma Main Canal on the California side of the Colorado River and for the North Gila Canal on the Arizona side of the Colorado River. The dam raised the water level above the original stream bed approximately 13 feet. However, now these canals receive their water from the All-American Canal, diverted at Imperial Dam. And Laguna Dam serves as a regulating structure for sluicing flows that control sediment below Laguna Dam, and to help store excess flows that arrive at Imperial Dam to prevent over deliveries to Mexico. Water stored behind Laguna Dam can be used to make up part of Mexico's water order when a shortage of water relative to water user demand arrives at Imperial Dam. Laguna Dam also protects the downstream toe of Imperial Dam. Typical flow time from Imperial Dam to Laguna Dam is about 2 hours.

Total storage behind Laguna Dam is currently estimated to be 700 af. Prior to the 1983 Colorado River flood the capacity was approximately 1,500 af. Dredging was carried out behind Laguna Dam in the 1950s to the early 1970s, in order to maintain its relatively small storage capacity. Sediment removed from above Laguna Dam was placed directly downstream of the rockfill weir in the flood plain.

Morelos Dam – Morelos Dam is located along the limitrophe section of the Colorado River, approximately 9 miles southwest of Yuma, Arizona. Morelos Dam was constructed by Mexico to provide a diversion for the delivery of Colorado River water to the Mexicali Valley. Mexico is responsible for the operation and maintenance of Morelos Dam and associated expenses.

Under Minute 242 (Minutes are defined as decisions of IBWC and signed by the Mexican and United States commissioners of IBWC) of the Mexican Water Treaty of 1944, up to 140,000 af annually of agricultural drainage water can be delivered to Mexico at the SIB. The remaining 1,360,000 af of water is to be delivered to Mexico at the NIB annually and diverted at Morelos Dam to the Mexicali Valley of Mexico

Flows below Morelos Dam occur only when water in excess of Mexico's diversion requirements arrives at the dam, in which case the excess is normally passed through Morelos Dam into the original Colorado River Channel downstream. Water in excess of Mexico's water order occurs when surplus or flood releases are made from either the Colorado River system or the Gila River system. Excess water arriving at Mexico may also result from side wash inflows that occur above or below Imperial Dam; from a sudden drop in water user demand; or when insufficient storage is available in Senator Wash, Imperial or Laguna reservoirs.

Flows arriving at Morelos Dam normally range from about 900 cfs to over 3,000 cfs during the year. During 1983, flows in excess of 40,000 cfs arrived at the NIB due to flood control releases on the Colorado River, and in 1993 flows in excess of 25,000 cfs arrived at the NIB due to flooding on the Gila River. Typical flow time from Laguna Dam to Morelos Dam is about 6 hours.