Appendix C Existing Supplies

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DRAFT TECHNICAL MEMORANDUM

Date: July 14, 2009

To: Matt Zidar

From: Natural Resources Consulting Engineers, Inc.

RE: Technical Memorandum 2.1- Document Existing Colorado River Water Supplies for the Imperial Irrigation District

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This memorandum describes the Colorado River water supply available for use by Imperial Irrigation District (IID); it covers IID water rights, transfer agreements, and environmental compliance responsibilities.

In the mid-1990s, Arizona and Nevada, the other holders of Lower Colorado River water rights, began using their full allotment of Colorado River water. At the same time, a period of relatively high flow on the Colorado River was coming to an end. Consequently, California had to find a way to reduce its annual use from around 5.2 million acre-feet (MAF) to its allotment of 4.4 MAF.

In October 2003, a set of interrelated contracts called the Quantification Settlement Agreement and Related Agreements (referred to herein as QSA/Transfer Agreements), were signed by the U.S. Secretary of the Interior, various Indian tribes, IID, Coachella Valley Water District (CVWD), Metropolitan Water District of Southern California (MWD), and San Diego County Water Authority (SDCWA). Under the QSA/Transfer Agreements, IID's Quantified Priority 3a annual allocation of Colorado River water use is capped at 3.1 MAF, measured at Imperial Dam. With transfers and environmental obligations; the amount water available at Imperial Dam for IID net consumptive use is just under 2.8 MAF in 2010, leveling off at just over 2.6 MAF in 2027 and for the term of the QSA/Transfer Agreements[1],[2].

Under the QSA/Transfer Agreements, IID expects agricultural demands to decrease in an amount equivalent to the water conservation attributable to on-farm efficiency measures (setting aside outside factors such as annual rainfall, differences attributable to the intensity of farming with IID such as acreage in production, double cropping and market conditions, etc.), so while IID's total volume will decline, so too will its agricultural demands. Similarly, reductions attributable to system conservation efforts and the All-American Canal Lining Project are a result of the

[1] For details, see Colorado River Water Delivery Agreement: Federal QSA, Exhibit B, October 2003 http://www.usbr.gov/lc/region/g4000/crwda/crwda.pdf.

[2] Throughout this technical memo, net consumptive use is defined as per USBR Colorado River Accounting and Water Use (Decree Accounting) at Imperial Dam – not with any other accounting.

implementation of conservation measures, so there is no net decline in the water available for IID's water users as a result of water conservation and transfer projects, even though there are declining future consumptive use limits for IID.

This memorandum is divided into the following sections:

(1) IID Water Service Area, Facilities and Operations
(2) IID Colorado River Water Rights
(3) Environmental Compliance
(4) Colorado River Reliability
(5) Future Colorado River Water Supply
(6) IID Demand Variability
(7) Distribution and Priority of Deliveries within IID
(8) Summary

1 - IID Water Service Area, Facilities and Operations

IID delivers untreated water to farms, municipalities and industries in the Imperial Valley through an extensive conveyance and distribution system. Agricultural irrigation of nearly 500,000 acres uses about 97 percent of the water deliveries; while municipal, commercial and industrial (MCI) users receive the remaining 3 percent of the delivered water. Figure 1 provides a map showing IID's service area and water conveyance and distribution system.

Infrastructure
With more than 3,000 miles of canals and drains, the Imperial Irrigation District (IID) is the largest irrigation district in the nation. IID delivers untreated water to farms, municipalities, and industries in the Imperial Valley through an extensive conveyance and distribution system. IID's conveyance and distribution system begins at the point where Colorado River water is diverted at Imperial Dam. After desilting, the water is conveyed through the 80-mile-long All-American Canal. The All-American Canal discharges water to several turnouts before it reaches IID's Imperial Valley water service area, where it provides water to IID's three main canals: East Highline, Central Main, and Westside Main.

The East Highline Canal, an unlined 49-mile canal, serves the eastern and some of the central parts of the IID water service area. The canal follows the eastern boundary of the irrigated area of the Imperial Valley and conveys irrigation water to agricultural fields and other users via a series of east-to-west laterals. The Central Main Canal connects to the All-American Canal just north of the City of Calexico and serves most of the central part of the Imperial Valley. The Westside Main Canal joins the All-American Canal near the western edge of the Imperial Valley and serves the western part of the IID water service area. These three main canals serve as the main arteries of IID's water delivery system, which consists of approximately 1,667 miles[3] of canals and laterals that distribute irrigation water to individual farm fields and untreated water to other users within the IID water service area.

[3] 1,667 miles includes the AAC, EHL, CM and WSM, without them, the length is 1,438 miles.

Figure 1. IID Service Area and Water Conveyance and Distribution System.

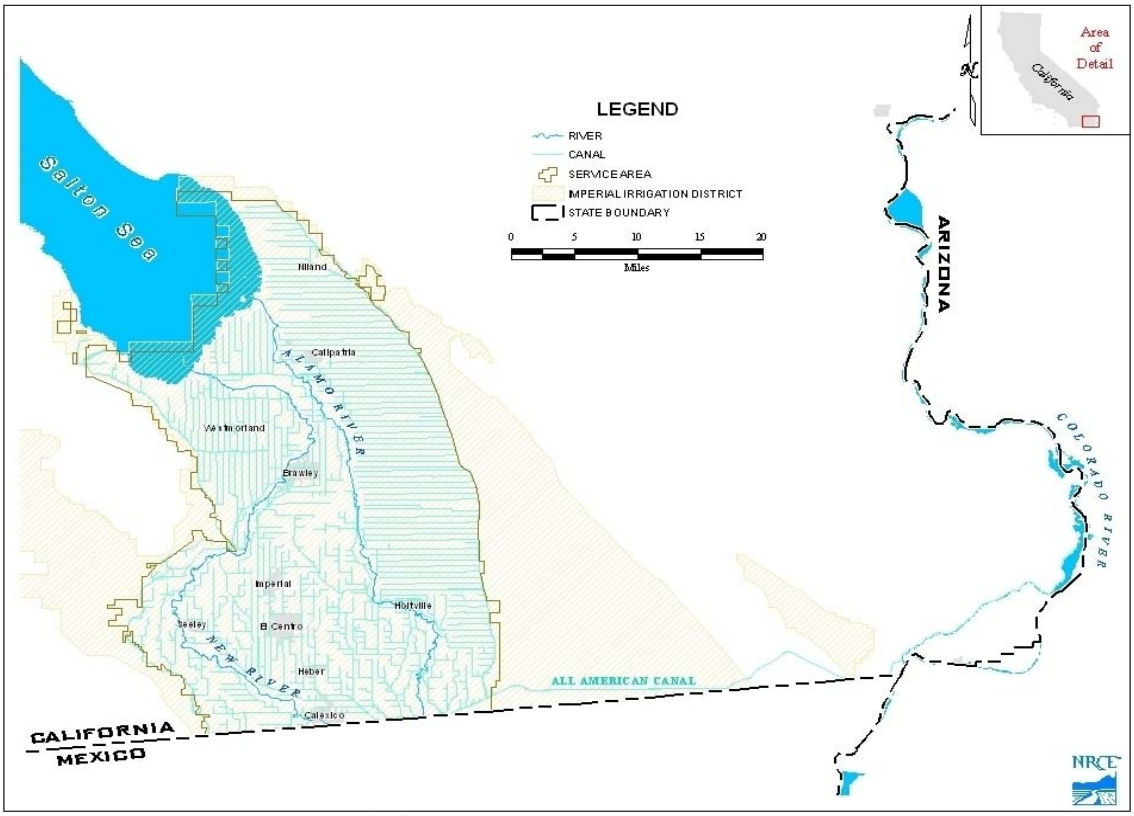

Figure 1: Imperial Irrigation District Water Distribution System March 2009

PRELIMINARY DRAFT

IID has constructed six reservoirs for the purposes of improving water supply management and conserving water. Under the 1988 IID/Metropolitan Water District of Southern California Water Conservation Agreement (IID/MWD Agreement), three interceptor systems serving 83,246 acres were constructed, including four additional reservoirs. IID growers also operate a number of water recovery systems.

Prior to the IID/MWD Program, IID had partially automated structures on the upper reaches of the main canals. Under the IID/MWD Program, automation was added to structures along the lower reaches of the East Highline and Westside Main canals, and existing partially automated structures along the main canals were modernized with radio communication equipment. Since these improvements, IID has also automated major checks and headings along the main canals. IID uses a Supervisory Control and Data Acquisition (SCADA) system that provides real-time measurements and telemetry to monitor and adjust flow at the automated sites. SCADA flow data for many of these operations, as well a conservation verification, lateral spill, direct to sea, and automated heading sites, among others, are stored in IID's Water Information System (WIS) in both raw and quality controlled format.[4]

IID drainage is comprised of subsurface tile drain, surface drain, and underground flow. Drainage water is collected and conveyed through a network of 1,456 miles of open and closed (pipeline)

[4] IID has historically used Stevens Chart Recorders and data loggers to monitor and record flow; all of these sites are now integrated into the IID SCADA system.

drains, 750 surface and subsurface drainage pumps, thousands of miles of subsurface farm drains (tile) and associated collection pipelines, which discharge via the New River, the Alamo River, and for a portion of the area served, directly to the Salton Sea. Surface drains normally run parallel to supply laterals and range from 6 feet to 10 feet deep to accommodate farm drain (tile) discharge. IID is responsible for constructing and maintaining the surface drainage system.

Operations

User demand drives IID's delivery of Colorado River water to farms and other users in the Imperial Valley. This demand varies throughout the year and from year to year in response to a combination of influences, including changes in climate and local rainfall, crop cycles, crop prices, and government crop programs. Typically, highest demands are April through August, which are the driest and hottest months of the year in the Imperial Valley.

IID operates and maintains a very complex, upstream-controlled distribution system that delivers an average of about 7,000 acre-feet (AF) of ordered water on a daily basis in a highly flexible manner. The complexity of the system is accentuated by the approximately four days of Colorado River water travel time from Lake Mead to Imperial Dam, the large number of daily water orders, and the long travel times required for the water to move from one point to another within IID's canal network. IID staff and canal operators have overcome formidable obstacles in achieving a highly efficient and flexible canal network, mostly by accurately predicting the weekly water demand, maneuvering the carry over of water orders (see below), and redistributing water between reservoirs and canals.

Manual measurements of lateral head gate settings are conducted by field personnel to ensure that the correct flow is being delivered. Field measurements at the lateral headgates are taken at least three times a day. Water Control Center (WCC) staff enter changes in lateral heading flow as well as some system flow records by hand on the Daily Water Record; these records are not entered into the WIS.

IID deliveries are based on daily water orders from its customers. Most water orders are filled the day after the order, with some orders being held for two or three days to accommodate mismatches between water supply, water orders, and system constraints. Water orders are submitted by the users to the District. Deliveries at the farm headgates are similarly measured by field staff and are checked periodically over the duration of the delivery, and for each water order, the user's individual gate account number, amount of flow, start date, and order duration are recorded into a water application form that is left at the gate for the grower's information. IID uses TruePoint Solutions (TPS), an integrated software system that allows the zanjeros and water clerks to take water orders, monitor consumption, and efficiently exchange data from the field back to the office for timely, accurate billing. Tracking is sufficient for users to manage their water use during years of declared supply/demand imbalance. If requested flows exceed the lateral canal capacity, certain orders can be delayed for up to three days. Delayed orders (carry-over orders) are prioritized based on the status of the order, type of order, and crop being irrigated. The carry-over orders and system storage are used to balance the flows in the system on a daily and weekly basis. The goal is to provide as much flexibility as possible to a grower without causing serious adverse effects on other growers.

On a weekly basis, IID places a master water order to meet its customers' anticipated daily water orders for the following week. The master order is placed with the U.S. Bureau of Reclamation (USBR) office in Boulder City, Nevada. Once the USBR releases water from Lake Mead, it cannot be held in lower reservoirs before being delivered into the All-American Canal at Imperial Dam for use by IID. Thus, from time-to-time, mismatches in water released from Lake Mead and the timing of IID orders can result in unintended deliveries to Mexico (if the order was too large) or shortages at Imperial Dam (if the order was too small). IID has built six regulating reservoirs to minimize the impact of such mismatches. In December 2008, construction of the Drop 2 Reservoir with a capacity of 8,000 AF began on the All-American Canal as a joint project that will benefit several users (but not IID) by reducing unintended flows to Mexico.

As a part of its operations, IID has instituted a vegetation management program, which includes drain and canal maintenance. The objectives are to 1) reduce soil erosion, 2) control sediment deposits, 3) decrease overgrowth of undesirable plant species within the canals and drains, 4) promote growth of beneficial plants, 5) reduce maintenance costs for the irrigation and drainage water distributions systems, 6) interact with growers agencies and other organizations, 7) improve essential levels of service, 8) maintain drain bank slope alignments, and 9) comply with Colorado Region Water Quality Control Board's TMDL levels for the IID [5].

2 - IID Colorado River Water Rights

A brief discussion is provided on the Colorado River water rights framework and the division of Colorado River water rights within California. A collection of agreements, generally known as the *Law of the River*, govern the interstate water rights as to the Colorado River[6]. This discussion is not meant to be exhaustive, but more of a brief overview focusing on pieces of Colorado River water law that effect IID. The discussion is organized chronologically.

California Water Right

IID's rights to appropriate Colorado River water are long-standing[7]. Beginning in 1885, a number of individuals, as well as the California Development company, made a series of appropriations of Colorado River water under California law for use in the Imperial Valley. Pursuant to then-existing California laws, these appropriates were initiated by the posting of public notice for approximately 7 million AFY at the point of diversion and recording such notices in the office of the county recorder. The individual appropriations were subsequently assigned to the California Development

[5] IID's Vegetation Management Plan is expected to be finalized in June 2009. Also see Section 4, Environmental Compliance.

[6] See USBR *Law of the River* - Consisting of Colorado River Compact, Boulder Canyon Project Act, California Seven Party Agreement, Mexican Water Treaty, Upper Colorado River Basin Compact, Colorado River Storage Project, *Arizona v. California* Supreme Court Decision (Supplemental Decree and Consolidated Decree), Colorado River Basin Project Act, Long Range Operating Criteria, Minute 242, and Colorado River Basin Salinity Control Act. http://www.usbr.gov/lc/region/pao/lawofrvr.html .

[7] IID holds legal title to all its water and water rights in trust for district purposes including delivery to landowners within the district. California Water Code §§20529 and 22437; Bryant v. Yellen, 447 U.S. 352, 371 (1980), fn.23.

> Company, whose entire assets, including its water rights were later bought by the Southern Pacific Company. The IID was formed in 1911. On June 22, 1916, the Southern Pacific Company conveyed all of its water rights to the IID[8].
>
> IID's predecessor right holders made reasonable progress in putting their pre-1914 appropriative water rights to beneficial use. By 1929, 424,145 acres of the Imperial Valley's approximately one million irrigable acres was (sic) under irrigation. By a decisive favorable vote at an election held on July 14, 1911, the people of the Valley organized the IID. The vote was made effective by resolution of the Board of Supervisors of Imperial County on July 24, 1911. The District, which was organized under the California Irrigation District Act for the purpose of acquiring the rights and properties of the CDC and its two Mexican companies, included 513,368 acres within its boundaries (Dowd, p 49).

Initial Colorado River Compact, Act, and Agreement

The 1922 Colorado River Compact guaranteed 7.5 MAF to the Lower Basin states in the Colorado River Basin. The allocation between Lower Basin states was provided in the 1928 Boulder Canyon Project Act[9], providing California with 4.4 MAF plus 50 percent of any declared surplus out of the Lower Basin supply. Within California, the Seven Party Agreement[10] of 1931 provided the water right priorities shown in Table 1.

Following the Seven Party Agreement, IID entered into a water delivery contract for permanent water delivery service with the USBR in 1932[11]. The contract required IID to pay construction and maintenance costs associated with its delivery facilities at Imperial Dam and with the All-American Canal. A conflict over deliveries to CVWD ensued. The conflict was resolved by a 1934 compromise agreement that provided CVWD with its own USBR water delivery contract and that stipulated that CVWD would subordinate its Seven Party Agreement water right priority to IID's. Thus, IID retains its full apportionment of the 3.85 MAF remainder after priorities 1 and 2, prior to CVWD diverting water.

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[8] Text taken from Petition for Approval of Long-term Conserved Water Transfer Agreement and Changes in Point of Diversion, Place of Use and Purpose of Use, Chapter III: IID Water Rights http://www.iid.com/Water_Index.php?pid=228 .

[9] HR 5773, An Act to provide for the construction of works for the protection and development of the Colorado River Basin, for the approval of the Colorado River compact, and for other purposes.

[10] Agreement under the Boulder Canyon Project, requesting apportionment of California's share of the waters for the Colorado River among the applicants in the state, August 18, 1931.

[11] From IID letter (2009): East Brawley Geothermal Development Project SB 610 Water Supply Assessment Review

Table 1: California Seven-Party Agreement Priorities

Priority	Water User	Annual Apportionment	Present Perfected Rights
1	**Palo Verde Irrigation District -** for use exclusively on 104,500 acres of Valley land in and adjoining district	3,850,000 AF	219,790 AF or consumptive use for 33,604 acres
2	**Yuma Project -** for use on California Division, not exceeding 25,000 acres of land		38,270 AF or consumptive use for 6,294 acres
3a	**Imperial Irrigation District -** for use on lands served by All-American Canal in Imperial and Coachella Valleys		2,600,000 AF or consumptive use for 424,145 acres
3b	**Palo Verde Irrigation District -** for use exclusively on additional 16,000 acres of mesa lands		
4	**MWD -** for use on the Southern California Coastal Plain	550,000 AF	
	Subtotal: California limit (not including surplus waters) of Colorado River water per Boulder Canyon Project Act and 1929 Limitation Act	**4,400,000 AF**	
5a	**MWD -** for use on the Southern California Coastal Plain	550,000 AF	
5b	**City and County of San Diego** - through MWD	112,000 AF	
6a	**Imperial Irrigation District -** lands served by AAC in Imperial and Coachella Valleys	300,000 AF	
6b	**PVID** - for use exclusively on 16,000 acres of mesa lands		
7	**California Agricultural Use -** Colorado River Basin lands in California	All remaining available water	
	Total:	5,362,000+ AF	

Note: (1) The Seven-Party Agreement 5.362 MAF annual allocation includes surplus water, as available. The likelihood of surplus being available has diminished with increased use and drought conditions on the river.

Source: *IID 2005 Annual Water Report*, p 22

Arizona v. California Case

The U.S. Supreme Court in *Arizona v. California* (1964-2006)[12] ruled that present perfected rights and Federal reserved water rights for Tribes must be included in the Colorado River allocations, and that these rights held higher priority than subsequent decreed rights. Pursuant to the terms of the Boulder Canyon Project Act, California's 4.4 MAF per year of mainstream water was to be used to satisfy "any rights which existed on December 21, 1928." These rights included present perfected rights within IID's pre-1914 state law appropriative rights.

Although the United States Supreme Court in *Arizona v. California* defined both "Perfected Right"[13] and "Present Perfected Rights"[14] in the 1964 Decree, IID's present perfected rights were not quantified until the Supreme Court issued a Supplemental Decree in 1979. That Supplemental

[12] Supreme Court Decision – 1964; Supplemental Decree – 1979; Consolidated Decree - 2006.

[13] A water right acquired in accordance with state law, which right has been exercised by the actual diversion of a specific quantity of water that has been applied to a defined area of land…

[14] Perfected rights, as defined above, existing as of June 25, 1929, the effective date of the Boulder Canyon Project Act.

Decree defined IID's present perfected rights as "a right to Colorado River water in annual quantities not to exceed: (i) 2.6 MAF of net consumptive use diversions from the mainstream, or (ii) the consumptive use required for irrigation of 424,145 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less," with a priority date of 1901.

IID's present perfected rights are significant, because Article II(B)(3) of the 1964 Supreme Court Decree provides that in any year in which there are less than 7.5 MAF of mainstream water available for release for consumptive use in Arizona, California and Nevada, the Secretary of the Interior shall first provide for the satisfaction of present perfected rights in the order of their priority dates without regard to state lines before imposing shortage cutbacks on other junior water right holders.

Quantification Settlement Agreement and Related Agreements

The Quantification Settlement Agreement and Related Agreements (QSA/Transfer Agreements) are a set of interrelated contracts that resolve certain disputes among the United States, the State of California, IID, MWD, CVWD and the SDCWA, for a period of 35 to 75 years, regarding the reasonable and beneficial use of Colorado River water; the ability to conserve, transfer and acquire conserved Colorado River water; the quantification and priority of Priorities 3 and 6 within California for the use of Colorado River water; and the obligation to implement and fund environmental impact mitigation related to the above[15].

Conserved water transfer agreements between IID and SDCWA, IID and CVWD, and IID and MWD are all part of the QSA/Transfer Agreements. These contracts identify the conserved water volumes and transfer schedules for IID along with the price and payment terms. As specified in the agreements, IID will transfer to MWD up to 110,000 AF[16], to SDCWA up to 200,000 AF and to CVWD and MWD combined up to 103,000 AF per year of water. The conserved water will come from delivery system improvements, on-farm efficiency improvements, and some fallowing, all in return for payments totaling billions of dollars. In addition, IID will transfer up to 67,700 AF per year of conserved water from the lining of the All-American Canal to SDCWA and certain San Luis Rey Indian Tribes in exchange for the payment of all lining project costs and a grant to IID of certain rights to use the conserved water. This last transfer is for a period of 55 to 110 years. It is the 3.1 MAF per year cap, not the conservation activities, that affects the supply. While conservation activities affect IID diversion; it is important to realize that there is an equivalent reduction in demand as a result of these conservation efforts.

After extensive public hearings the State Water Resources Control Board issued conditional approvals authorizing the transfer agreements. The QSA/Transfer Agreements have been approved by all appropriate parties; however, from their inception they have been challenged in judicial proceedings which are still ongoing.

The QSA/Transfer Agreements included a water balance for IID, as shown in Table 2.

[15] For QSA/Transfer Agreements documents related to IID, see IID, IID Water/ QSA link; for other QSA/Transfer Agreements see USBR Lower Colorado Region, Reports & Brochures link.

[16] Starting in 2007, by agreement between IID and MWD, this transfer was fixed at 105,000 AFY.

Table 2: IID Water Balance under the QSA/Transfer Agreements (Measured at Imperial Dam).

Item	**Annual Allocation (MAF)**
Priority 1-3 in Seven Party Agreement	3.8500
Estimated Palo Verde ID Priority 1 & Yuma Project Priority 2	- 0.4200
CVWD Priority 3a Quantified Amount	- 0.3300
IID Priority 3a Quantified Amount (balance of above)	3.1000
Miscellaneous and Indian Present Perfected Rights	*- 0.0115*
Conserved water made available to others	*- X*
Conserved water from lining AAC	*- Y*
Adjusted for IOPP	*- Z*
IID Available Water Supply (balance of above)	**3.1-(0.0115)-(X+Y+Z)**

Note: (1) IOPP – Inadvertent Overrun Payback Policy; policy for IID to repay diversions in excess of its rights[17]

Source: Colorado River Water Delivery Agreement: Federal QSA, Exhibit B, October 2003
http://www.usbr.gov/lc/region/g4000/crwda/crwda.pdf

In Summary

The reliability and certainty of IID's Colorado River water right is governed by a number of factors. In years with normal or average Colorado River flows and adequate reservoir storage in Lakes Powell and Mead, the IID allocation will remain at 3.1 MAF. In years with surplus flows (greater than 7.5 MAF in the Lower Basin and adequate reservoir storage), the Seven-Party Agreement and QSA/Transfer Agreements provide for allocations beyond 4.4 MAF within California. The likelihood of surplus flows in the Colorado River has been diminished by increased Colorado River water use by Nevada and Arizona, and by persistent drought conditions relative to historical flows.

Even in drought years with Lower Colorado River flows less than 7.5 MAF, the existing laws and agreements provide security that the IID should receive its Present Perfected Rights of 2.6 MAF and its overall water allocation remains at 3.1 MAF. This protection is based on the following:

- 1885 California water right, based on reasonable and beneficial use of approximately 7 MAF, conveyed to IID on June 22, 1916.

- 1922 Colorado River Compact requires the Upper Basin states to ensure the supply of 7.5 MAF at Lees Ferry for use by the Lower Basin states (actually stated as 75 MAF over 10 years). Thus, it is the responsibility of the Upper Basin states to provide the full Lower Basin allocation; even in drought years and even if the 10-year running average annual water supply of the river is less than 15.0 MAF.

- 1931 Seven-Party Agreement provides a schedule of apportionments and priorities, which the parties requested "The Division of Water Resource to, in all respects, recognize… and recommend to the Secretary of the Interior… for insertion in any and all contracts for

[17] Record of Decision Colorado River Water Delivery Agreement Implementation Agreement, Inadvertent Overrun and Payback Policy, and Related Federal Actions Final Environmental Impact Statement, October 2003, Secretary of Interior, Gale A Norton.

water made by him pursuant to the terms of the Boulder Canyon Project Act…Pursuant to the provisions . . . California was apportioned 4.4 million AF per year out of the lower basin allocation of 7.5 million AF per year, plus 50% of any available surplus water." [18]

- 1931 IID agreed to limit its California pre-1914 appropriate water rights in quantity and priority to the apportionments and priorities contained in the Seven-Party Agreement.[19]

- 1968 Colorado River Basin Project Act states that all deliveries to the Central Arizona Project (CAP) and all other post-1968 water deliveries are subordinate to pre-existing Colorado River water rights in the Lower Basin, regardless of each state's allocations under the 1928 Boulder Canyon Project Act. Therefore, all post-1968 rights in the Lower Basin, including the CAP's, are effectively junior in priority to California's Colorado River diversions under its 4.4 MAF rights. Post-1968 rights in the Lower Basin are estimated to be 1.8 MAF.

- 1979 Supplemental Decree in *Arizona v. California* retains IID's present perfected rights to use of the Colorado River water. If water supply shortages occur along the Colorado River, IID's present perfected rights must be satisfied prior to the satisfaction of any non-perfected rights, regardless of state lines and Federal agreements. IID has a present perfected right to 2.6 MAF.

- 2003 QSA/Transfer Agreements slightly modify the guaranteed senior water right of IID within California under the terms of the Seven Party Agreement (senior to CVWD, MWD and San Diego city and county), as follows: IID retains its priority 3(a) right to 3.1 MAF of net consumptive use at Imperial Dam; however, if IID does not use its full annual apportionment, then MWD can divert the balance up to California's 4.4 MAF per year allocation.

- 2007 USBR interim guidelines provide that shortages in Lake Mead storage, and decreasing water levels in the reservoir, will prompt reductions in the deliveries to Arizona and Nevada, but that California deliveries will remain at 4.4 MAF. If California deliveries remain to be 4.4 MAF, then IID deliveries should likewise remain at the agreed right of 3.1 MAF net consumptive use under the terms of the QSA/Transfer Agreements.

According the *Law of the River*, IID should retain a legal right to annual net consumptive use of 3.1 MAF from the Colorado River, even if severe water supply shortages occur. Under the terms of various agreements and laws, the annual Colorado River flows would have to be reduced to less than 5.0 MAF (one-third of historic average) before the water supply to IID would be impacted. Nevertheless, in the face of a large-scale water supply disruption in the western states, IID is

[18] "On November 5, 1930, the Secretary of the Interior requested the California Division of Water Resources to recommend a proper method of apportioning the water which California was entitled to receive under the 1922 Colorado River compact and the Bounder Canyon Project act. Thereafter, a number of users and prospective users of Colorado River water, including the IID and the MWD, entered into the Seven-Party Agreement." For source, see Footnote 6.

[19] Text from IID Water Rights, see Footnote 6 for source.

potentially subject to some water supply reduction. The following sections explain how IID's 3.1 MAF per year is apportioned consistent with the QSA and the other operating conditions on the Colorado River.

3 – QSA/Transfer Agreements and USBR Operating Policies

This section explains how the conserved water is to be made available to other agencies (entries X and Y in Table 2, above) through the QSA/Transfer Agreements. These agreements were important and necessary for preserving IID's senior water rights and for keeping California annual use within the 4.4 MAF apportioned to the State. IID has entered into several water transfer agreements. For the most part, these agreements involve implementation of water conservation efforts within the IID service area, with the conserved water being transferred to municipal water providers or other irrigation districts, or delivered to the Salton Sea. The water conservation measures include IID conveyance and distribution efficiency improvements and voluntary on-farm water conservation.

Since 2004, IID has prepared QSA/Transfer Agreement Annual Reports[20]. These reports, which contain information on water accounting, financial accounting, conservation and other topics, can be found on IID's website, click on IID Water/QSA/QSA Annual Report.

IID/MWD Agreement

The 1988 IID/MWD Water Conservation Agreement and 1989 Approval Agreement resulted in a water conservation and transfer effort between IID and Metropolitan Water District of Southern California, involving 17 water conservation projects as well as high-level program coordination and detailed conservation verification. The goal of the MWD-funded agreement is to conserve water within IID and to allow MWD to divert this conserved water through its Colorado River Aqueduct. Construction began in 1990 and was completed in 1998, at a total cost of $233 million (1998$)[21]. MWD continues to finance operations and maintenance activities associated with these projects. The IID/MWD water conservation projects involve both distribution system and on-farm improvements.

As projects were completed, the annual volume of conserved water increased, peaking in 2000 at 109,460 acre-feet. Given anticipated changes in IID operations as a result of QSA/Transfer Agreement activities, IID and MWD agreed that, starting in 2007 and for all subsequent years of the IID/MWD Agreement, water conservation transfer would be fixed to be 105,000 acre-feet per year. The revised agreement contains an added provision for MWD to undertake limited municipal conservation projects under specified circumstances. The IID/MWD Agreement will end December 31, 2041, or 270 days beyond the termination of the QSA/Transfer Agreements,

[20] Latest report: *2007 QSA IID Water Conservation & Transfer Agreement Annual Implementation Report, at* http://www.iid.com/Water/QSAAnnualReports.

[21] IID Water Resources Unit *Imperial Irrigation District and Metropolitan Water District of Southern California, Water Conservation Program, Final Program Construction Report*, April 2000.

whichever is later. Table 3 provides the water transfer schedule under the QSA/Transfer Agreements[22].

Table 3: IID/MWD Agreement Water Transfer Schedule

Year	IID/MWD Transfer (acre-feet/year)
2003	105,130
2004	101,900
2005	101,940
2006	101,160
2007-41	105,000
2042-47*	105,000
2048-77*	105,000

*Following consent to renewal terms

QSA/Transfer Agreements (2003)
The 2003 QSA/Transfer Agreements are a set of agreements among IID, Metropolitan Water District of Southern California (MWD), San Diego County Water Authority (SDCWA), and Coachella Valley Water District (CVWD), and the U.S. Secretary of the Interior, and other parties. One of the purposes of the QSA/Transfer Agreements is to reduce annual Colorado River water diversion by California, from a high of 5.2 MAF to California's annual net cumulative consumptive use apportionment of 4.4 MAF. QSA/Transfer Agreements water supply delivery details are contained in the Colorado River Water Delivery Agreement (CRWDA/Federal QSA)[23].

IID's original intent was to implement projects that would allow conserved water to be transferred from IID for use by water providers outside the Imperial Valley without reducing the cultivated acreage within the district. However, due to potential impacts on the Salton Sea, IID reluctantly agreed to include some fallowing in the CWRDA/Federal QSA.

Provisions in the QSA/Transfer Agreements that affect IID's conservation activities are: (1) 1988 IID/MWD Agreement, (2) IID/SDCWA Transfer, (3) IID/CVWD Intra-Priority 3 Transfer, and (4) All-American Canal Lining Project. The QSA/Transfer Agreements also provide for CVWD to line a portion of the Coachella Branch Canal for transfer of conserved water to SDCWA. The QSA/Transfer Agreements include a number of agreements that clarify operations and ensure that third party and environmental impacts are mitigated.

IID/San Diego County Water Authority Transfer Agreement (1998, 2003)
The IID/SDCWA Water Transfer Agreement provides that IID will implement efficiency improvements in its service area that will ramp up to 200,000 acre-feet per year of conserved water to be transferred to SDCWA. Water transferred in the early years (2003 – 2016) will come

[22] For actual conservation amounts, see IID's QSA Water Conservation & Transfer Agreement Annual Implementation reports.

[23] See Colorado River Water Delivery Agreement/Federal QSA, October 2003 http://www.usbr.gov/lc/region/g4000/crwda/crwda.pdf .

from fallowed fields in IID. Starting in 2013, on-farm and irrigation system efficiency improvements will begin to supply some of the transfer water. In 2017, water supplied by fallowed fields will be completely replaced by water conserved through efficiency improvements. The planned fallowing and efficiency improvement water transfer schedule is shown in Table 4. As indicated in Table 4, fallowing for a limited period provides time to implement efficiency improvements. However, the main purpose for fallowing is to provide water for the Salton Sea (see Section 4, below). It is IID's and the general consensus of Imperial Valley citizens that fallowing beyond 2017, the last year of Salton Sea deliveries, will not be part of the transfer agreements.

Table 4: IID/SDCWA Agreement Water Transfer Schedule

Year	**Fallowing (acre-feet/year)**	**Efficiency Improvements (acre-feet/year)**	**IID/SDCWA Transfer (acre-feet/year) (Col 2 + Col 3)**
2003	10,000	0	**10,000**
2004	20,000	0	**20,000**
2005	30,000	0	**30,000**
2006	40,000	0	**40,000**
2007	50,000	0	**50,000**
2008	50,000	0	**50,000**
2009	60,000	0	**60,000**
2010	70,000	0	**70,000**
2011	80,000	0	**80,000**
2012	90,000	0	**90,000**
2013	80,000	20,000	**100,000**
2014	60,000	40,000	**100,000**
2015	40,000	60,000	**100,000**
2016	20,000	80,000	**100,000**
2017	0	100,000	**100,000**
2018	0	130,000	**130,000**
2019	0	160,000	**160,000**
2020	0	190,000	**190,000**
2021	0	200,000	**200,000**
2022	0	200,000	**200,000**
2023	0	200,000	**200,000**
2024	0	200,000	**200,000**
2025	0	200,000	**200,000**
2026-47	0	200,000	**200,000**
2048-77*	0	200,000	**200,000**

*Following consent to renewal term

The initial term of the agreement with SDCWA is 45 years (ending in 2047), and a 30-year renewal can follow if both parties are agreeable. Water transferred to SDCWA by IID will remain in Lake Havasu behind Parker Dam from which MWD takes delivery from SDCWA as part of an exchange agreement. The Revised Fourth Amendment to the IID-SDCWA agreement includes the volume of water to be supplied by IID for mitigation of adverse effects to the Salton Sea from the reducing drain flows as a result of the transfer. Fallowing for this purpose continues through 2017. For Salton Sea Mitigation Schedule, see Table 6, below.

IID/Coachella Valley Water District Intra-Priority 3 Transfer Agreement (2003)
The IID/CVWD Intra-Priority 3 Transfer Agreement ramps up to a maximum of 103,000 AF per year of water conserved through efficiency improvements within IID to be transferred from IID to CVWD. The transfer is in collaboration among CVWD, IID and MWD; with MWD funding a portion of the IID efficiency improvements as per an agreement between CVWD and MWD. Table 5 provides the water transfer schedule under the agreement.

Table 5: IID/CVWD Agreement Transfer Schedule.

Year	IID/CVWD Intra-Priority 3 Transfer (acre-feet/year)
2008	4,000
2009	8,000
2010	12,000
2011	16,000
2012	21,000
2013	26,000
2014	31,000
2015	36,000
2016	41,000
2017	45,000
2018	63,000
2019	68,000
2020	73,000
2021	78,000
2022	83,000
2023	88,000
2024	93,000
2025	98,000
2026-47	103,000
2048-77*	100,000

*Following consent to renewal term

IID will leave the water to be transferred in Imperial Dam, from which CVWD is responsible for arranging its release and diversion to the All-American Canal for delivery to the Coachella Branch Canal. If CVWD and IID consent, there is a renewal term of 30 years immediately following the termination of the original agreement in 2047.

All-American Canal Lining Project (2003)
This section explains how conserved water from the lining of the All-American Canal (Item Y in Table 2 above) is accounted for in the QSA/Transfer Agreements. The $300 million All-American Canal Lining Project is funded by the State of California and SDCWA to transfer conserved water to SDCWA and the San Luis Rey Indian Tribes. The project consists of constructing 23 miles of concrete lined canal, beginning just west of Pilot Knob downstream to Drop 3, parallel to the existing canal such that water supply is not affected during construction. Lining the canal will prevent seepage and conserve an estimated 67,700 acre-feet of water annually.

The canal lining project was initially approved by the U.S. Congress in 1988, but water-right disagreements and legal arguments delayed construction. Construction on the canal began June 1997 and is expected to be complete by spring 2010. The agreement term is for 55 years from project completion, plus an optional 55-year renewal term. The All-American Canal is owned by USBR and is operated and maintained by IID as per contractual agreement between the two parties. IID will not have a water supply benefit from the canal lining project at present, because the conserved water will not be diverted into the All-American Canal.

Efficiency Conservation Definite Plan

The Efficiency Conservation Definite Plan[24] (Definite Plan) resulted form a process that was initiated by IID to provide a roadmap for the implementation of delivery system efficiency conservation projects and of on-farm efficiency conservation based on voluntary grower participation in the implementation of various on-farm measures. The Definite Plan identifies on-farm and delivery system efficiency improvement techniques. It also identifies economic incentives to attract voluntary involvement by growers and landowners in the on- farm conservation program.

The Definite Plan is the mechanism IID will use to identify specific conservation projects and their potential savings and costs. The goal of the Definite Plan is to identify projects and programs that will provide an additional 303,000 AF per year of efficiency conserved water for delivery to SDCWA and CVWD at a cost not to exceed revenue as per provisions of the QSA/Transfer Agreements. The results of the study can be summarized as follows:

(1) A blend of on-farm and delivery system savings results in the most cost-effective conservation;
(2) An on-farm incentive approach should be implemented to attract landowners and growers into voluntary participation in water conservation projects;
(3) Monitoring and management improvements should be implemented within the IID delivery system to conserve water;
(4) Water delivery measurements should be implemented to accurately account for water savings, so that compensation can be fair;
(5) Early (2008–2010) water transfer obligations should be met using canal seepage recovery to conserve water;
(6) Near-term actions should be completed to ensure IID has sufficient capacity to meet its water transfer obligations.

IID will monitor and verify the amount of water conserved by the projects and programs that are implemented.

[24] Prepared by IID Definite Plan Team, published May 2007 http://www.iid.com/Water/EfficiencyConservationProgram.

USBR Interim Guidelines
The 2007 USBR *Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead* [25] provide for the allocation of water during years with normal, surplus, and shortage Colorado River water supplies. As noted above, IID would seldom be impacted by any of these conditions due to the nature of its water right and the terms of the QSA/Transfer Agreements. The 2007 USBR interim guidelines provide that allocations to Nevada and Arizona will be cut back if the water surface elevation in Lake Mead drops to pre-determined levels, but that the allocation to California will remain at 4.4 MAF. If Lake Mead elevations drop to severely low levels (elevation 1,025 ft), then the guidelines recommend that the Lower Basin states consult regarding future water plans[26].

4 - Environmental Compliance

In February 2004, IID implemented a monitoring program in accordance with its Drain Water Quality Improvement Plan, Revised September 28, 2003 (Revised DWQIP). A Quality Assurance Project Plan (QAPP) was developed by the IID and approved by the Colorado River Basin Regional Water Quality Control Board (RWQCB) in January 2004. The Revised DWQIP and QAPP were developed in accordance with the current Water Quality Control Plan, Colorado River Basin – Region 7 (Basin Plan), which addresses the implementation section of the Alamo River Sedimentation/Siltation Total Maximum Daily Load (TMDL). The Revised DWQIP includes routine sampling of Imperial Valley's source water, IID's seven largest major drains, and eighteen additional drains that serve to represent all Imperial Valley drainsheds. Since 2004, IID has added 26 Total Maximum Daily Load (TMDL) sampling sites in compliance with its DWQIP. The IID also collects samples of its delivered water supplies at numerous sites including Imperial Dam, All American Canal Drop 1, and the East Highline, Central Main, and Westside Main Canals. Drain water is monitored at several sites on the Alamo and New Rivers.

Burrowing Owl Habitat Maintenance
It is believed that 70 percent of the endangered burrowing owl population in California resides in the Imperial Valley. These owls live in burrows in the ground, usually along drain or irrigation ditches. IID has a protocol to protect these owls that is followed by operations, maintenance and construction crews.

To comply with US Environmental Protection Agency (EPA) requirements and avoid termination of canal water service, residents in the IID service area who do not receive treated water service must obtain alternative water service for drinking and cooking from a state-approved provider. To avoid penalties that could exceed $25,000 a day, IID strictly enforces this rule. The section tracks nearly 4,000 raw water service accounts required by the California Department of Public Health (CDPH) to have alternate drinking water service. The section maintains a small-acreage pipe and drinking water database, and provides an annual compliance update to CDPH.

To comply with the various State and Federal environmental permitting requirements pertaining to the QSA/Transfer Agreements, IID has developed a Water Conservation and Transfer Project

[25] http://www.usbr.gov/lc/region/programs/strategies.html.

[26] Lake Mead is currently 52 percent full at 1100 ft (May 2009); at 1250 ft the reservoir is full.

Mitigation, Monitoring, and Reporting Program planning document[27]. Water committed to these environmental mitigation programs must be accounted for in IID's QSA water budget. All such water is accounted to IID's net consumptive use, as described below. Dedication of water to these purposes clearly limits this water availability for other beneficial uses. Water for Salton Sea mitigation comes from fallowing within IID through 2107. Water for a managed marsh and other projects will be supplied from IID's Colorado River allocation.

This technical memorandum attempts to consolidate the permit requirements that have been placed on IID as part of the Water Conservation and Transfer Project approval. These various requirements are found in:

(1) In-Valley Biological Opinion (IVBO) issued by the U.S. Fish and Wildlife Service[28]
(2) State Water Resources Control Board (SWRCB) water transfer permit conditions[29]
(3) Final EIS for the Water Transfer Project completed by IID (including the September 2003 addendum)[30]
4) State Legislation

The environmental compliance requirements in these documents overlap significantly.

IID continues to implement environmental mitigation projects, as required by State and Federal endangered species taking permits. A 959-acre managed marsh habitat is being planned (see 2008 Supplement to the Final EIS). IID is also continuing to develop the Habitat Conservation Plan (Federal) and Natural Community Conservation Plan (State) as part of its regulatory compliance and permitting process.

A long list of mitigation, monitoring, and reporting requirements are included in the State and Federal permit conditions. Most of these requirements involve additional studies to be completed, additional care to be taken during construction and maintenance activities, and additional monitoring of identified species. The following permit requirements were identified as having a possible effect on the water supply available for use by IID.

Salton Sea Impact Mitigation
With implementation of the IID/SDCWA Water Transfer, flows to the Salton Sea were expected to decrease relative to historic levels. To address this, the SWRCB permit for the IID/SDCWA Water Transfer stipulates that the inflow into the Salton Sea is not to be reduced during the first 15 years (2003-2017) of the program. This is restated in the In-Valley Biological Opinion.

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[27] IID Water Conservation and Transfer Project; Mitigation, Monitoring, and Reporting Program; September, 2003, includes all IID QSA/Transfer Agreements programs. For details, see Approval Documents for IID Transfer Project, IID Board Resolution 9-2003 http://www.iid.com/Water/ApprovalDocumentsforIIDTransferProject and IID Water Conservation and Transfer Project; Final EIR /EIS; Habitat Conservation Plan http://www.iid.com/Water/FinalEIREIS

[28] Final US Fish and Wildlife Service Biological Opinion on Reclamation's Proposed Section 7(a)(1) Conservation Measures for Listed Species in the IID/Salton Sea Areas

[29] SWRCB, Revised Order WRO 2002-0016, Permit 7643

[30] IID, Water Conservation and Transfer Project, Final Environmental Impact Report/Environmental Impact Statement, CH2MHill, 2002; And Supplement to the IID Water Conservation and Transfer project EIR/EIS for the Managed Marsh Complex, CH2MHill, 2008

To meet this obligation, IID adopted a mitigation strategy, which is detailed in its environmental compliance documents. The strategy is designed to mitigate impacts to the biological resources of the Salton Sea resulting from flow reduction to the sea caused by activities during the first 15 years of IID/SDCWA Water Conservation and Transfer Program (2003 – 2017). IID agreed to undertake fallowing in an effort to mitigate Salton Sea impacts during this period by conserving more water than needed to meet its transfer obligations. IID will deliver additional conserved water in a volume equal to the amount that would have flowed to the Salton Sea absent the transfer program[31].

This requirement will effectively reduce the water supply available for consumptive use by growers that participate in the IID Fallowing Program, through the year 2017. However, since the water for conservation is from consensual fallowing agreements with individual growers, the mitigation does not impact the water supply of users that do not participate in the fallowing program. Table 6 outlines the planned water supply reductions that IID will achieve through fallowing. For actual flows to the Salton Sea for 2003 – 2007, see *2007 QSA IID Water Conservation and Transfer Project Annual Implementation Report* (p 22). As previously stated it is IID's and the general consensus of the Imperial Valley citizens that fallowing beyond 2017 will not be part of the transfer agreements.

Table 6: Salton Sea Mitigation Water Requirements

Year	Salton Sea Mitigation (acre-feet/year)
2003	5,000
2004	10,000
2005	15,000
2006	20,000
2007	25,000
2008	25,000
2009	30,000
2010	35,000
2011	40,000
2012	45,000
2013	70,000
2014	90,000
2015	110,000
2016	130,000
2017	150,000

Construction of Managed Marsh Habitat

IID is in the first stage of constructing a managed marsh to mitigate potential habitat losses and/or habitat degradation that may result from projects and programs implemented to meet its QSA/Transfer Agreements obligations.

As IID system efficiency improvements decrease operational discharge and on-farm efficiencies improvements reduce tailwater, flow in IID drains will be reduced. The reduced drain flows are

[31] IID. *Final IID 2007 Water Conservation Plan*, p 57., see at http://www.iid.com/Water/WaterPlanning

expected to have a negative impact on the habitat established along the drainage system. To mitigate potential negative impacts due to QSA/Transfer Agreements efforts and due to normal operation and maintenance activities, IID will construct a 959-acre managed marsh that will receive water from IID's canal system. The marsh plan is based on a vegetation survey of IID drainage canals, and the consumptive use of the managed marsh complex is estimated to be approximately 5,760 acre-feet per year (6.0 ac-ft/acre), with an additional 4,416 AF per year (4.6 acre-feet/acre) draining from the complex, for a total delivery requirement of over 10,000 AF per year. The discharge and consumptive water use by the managed marsh complex have the effect of reducing the water supply available for other beneficial uses in the IID water service area. The first phase, approximately one-third of the marsh area is scheduled to be completed by the end of 2009.

Desert Pupfish Drain Habitat Maintenance and Refugium Pond
IID drains serve as habitat for the Desert Pupfish, and there is concern that reduced drain flows resulting from Transfer Project activities will negatively impact Pupfish habitat. The IVBO requires IID to maintain drain habitat for the Desert Pupfish by ensuring connectivity between drains and the Salton Sea and by constructing a refugium pond as breeding habitat. The water supply for these mitigation strategies may be counted against IID's water supply. For instance, if drain habitat is seen to degrade as a result of QSA/Transfer Agreement activities, then IID may be required to increase drain flows. Also, maintaining a refugium pond is a consumptive use of water, the quantity of which will depend on the size of the pond. At this time there are many uncertainties regarding the impact of the Desert Pupfish mitigation activities on IID's water supply, and no accounting is made for these activities in this document.

Yuma Clapper Rail and California Black Rail Habitat Creation
The Yuma Clapper Rail and California Black Rail require wetlands as habitat, and the extent and quality of drain and wetland habitat around IID are expected to decline with the implementation of Transfer Project programs. Salinity and selenium levels in IID drains and in the Salton Sea are expected to increase and have a negative effect on the quality of wetland habitat. To mitigate against the salinity and selenium impacts, the IVBO requires that 73 acres of managed marsh be constructed as new habitat for the Yuma Clapper Rail and California Black Rail. The 73 acres required for these species are included in the total 959 acres of managed marsh habitat that IID plans to construct within the district (see section, above).

Southwestern Willow Flycatcher Habitat Maintenance
The mitigated habitat for the Southwestern Willow Flycatcher is expected to consist of cottonwood and willow stands along riparian areas. The expected reduction in drain flows that will accompany the Transfer Project activities within IID may have a negative impact on the riparian tree habitat of the Southwestern Willow Flycatcher. The IVBO requires that Southwestern Willow Flycatcher habitat be evaluated and monitored throughout the duration of the QSA/Transfer Agreements. If the habitat is seen to degrade, then these impacts must be mitigated through the creation of new habitat or improvement of existing habitat. These mitigation requirements are not expected to impact the water supply available to IID unless suitable habitat cannot be created due to the reduced drain flows.

Cover Crop Requirement on Fallow Lands
To reduce impacts to air quality, all fallowed lands are required to implement dust abatement best management practices as recommended by the Natural Resources Conservation Service (NRCS).

In IID fallowing contracts with growers, allowable practices include: (1) leaving crop residue material on fields, (2) no tillage and reduced field traffic, (3) seeding with small grains, and (4) application of soil stabilization chemicals. If small grains are seeded, they must use residual water in the field and/or rely on available winter rainfall[32]. Based on the text of the fallowing agreement written by IID, water use by cover crops is not counted for water supply available to IID.

5 - Colorado River Reliability

Under the *Law of the River*, IID has significant historical legal protections in place to maintain its 3.1 MAF Priority 3a water right to consumptive use of Colorado River water even during lower Colorado River flow periods. See Section 2, above.

Historical Data on the Colorado River Water Supply
The Colorado River flow at Lees Ferry has been gauged since 1921. By removing reservoir and diversion effects, the USBR has created a "natural flow" record for this site. The long-term (1906-2004) average natural flow is estimated to be about 15.1 MAF based on the gage record. The annual natural flow records are shown in Figure 2. A few important points should be noted from the natural flow record:

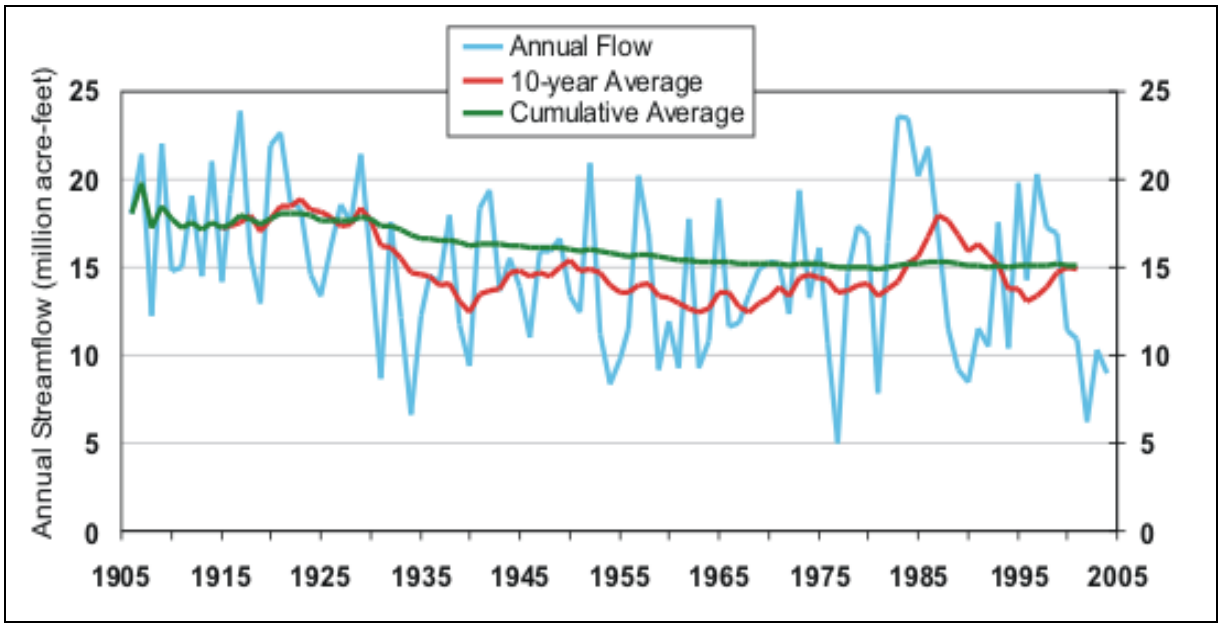
(1) The period 1906-1930 and prior was the available gauge record when many of the Colorado River compacts were drafted. This period had a 10-year running average flow of about 17.0 MAF, which is higher than almost any other period in the gage record.

(2) The 10-year running average from 1934 to 1984 was almost always less than 15 MAF, meaning that the 1922 Compact apportioning 7.5 MAF to the Upper and Lower Basins could not have been fully satisfied for most of this 50-year period.

(3) Allocations from the Colorado River total 16.5 MAF, divided as 7.5 MAF each to the Upper and Lower Basins, and 1.5 MAF to Mexico. The long-term average natural flows from the gauge record are less than these total allocations.

[32] This practice will not result in a crop that can be harvested; however, there is enough vegetation to hold the soli in place. This option is rarely used.

Figure 2: Annual Natural Flows of Colorado River at Lees Ferry, and Averages.

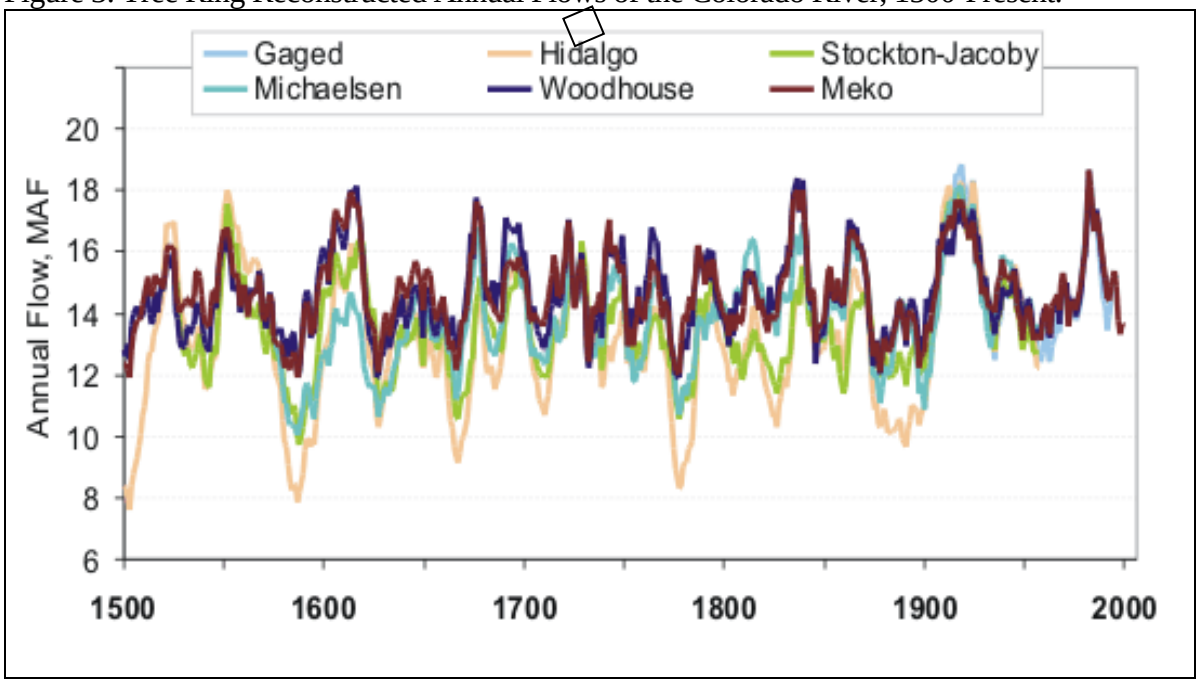


(Source: Western Water Assessment, Univ. of Colorado)

Reconstructed Climate Record Indications

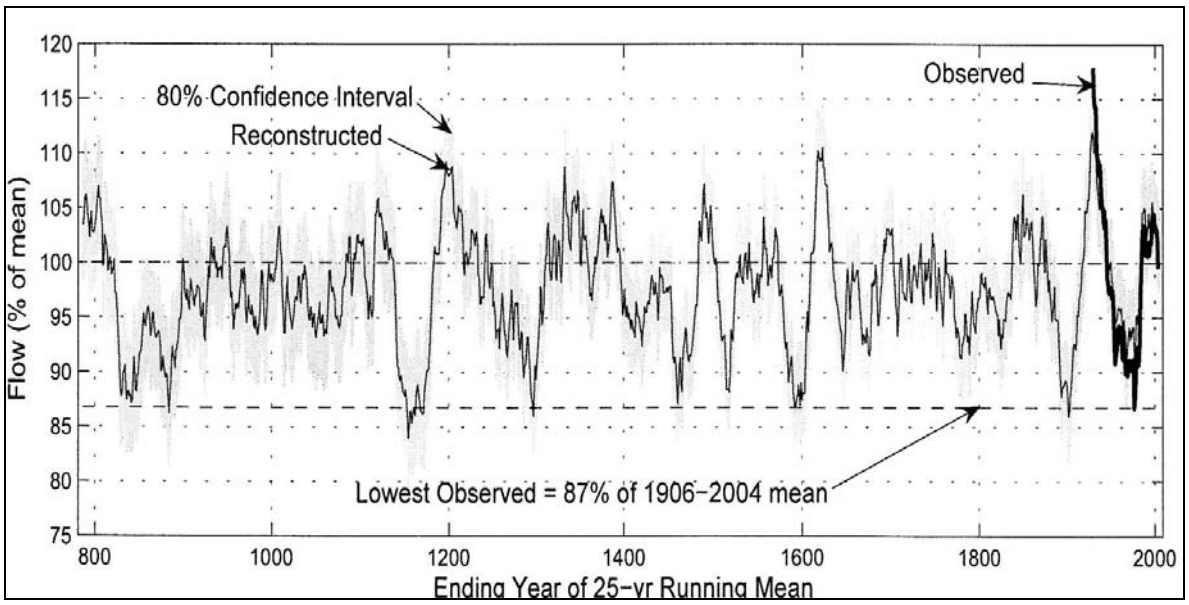
In the past few decades, information about the long-term climate (and hydrologic) conditions of the Colorado River Basin has been greatly expanded through analysis of tree ring data. These efforts have enabled researchers to reconstruct the annual flows of the Colorado River back to the 1500s and even back to the mid-700s. This new information allows water resource planners and mangers to see how the twentieth century gage flow record compares to the multi-century long-term average. Figures 3 and 4 are graphs of various reconstructions for 1500 to present, and from 800 to present. Table 7 summarizes the findings of the most relevant studies to date. The results of the various tree ring reconstruction studies indicate that the long-term (multi-century) average flow of the Colorado River is between 13 and 14 MAF, as shown in Table 7. An equally important observation of the tree ring reconstruction efforts has been the identification of prolonged drought periods where high flows are absent for over 50 years. Figures 3 and 4 are graphs of the various reconstructions from 1500 to present, and from 800 to present, respectively.

Figure 3: Tree Ring Reconstructed Annual Flows of the Colorado River, 1500-Present.



(Source: Western Water Assessment, Univ. of Colorado)

Figure 4: Tree Ring Reconstructed Annual Flows of the Colorado River, 800-Present.



(Source: USBR, 2007; from Meko, 2007)

Table 7: Tree Ring Reconstructions of Annual Colorado River Flow.

Study	Calibration Period	Gage Data Source	Chronology Type	Regression Approach	Variance Explained	Reconstruction Period	Long-Term Average Flow
Stockton and Jacoby, 1976	1899-1961	Hely, 1969	Standard	PCA with lagged predictors	0.75	1512-1961	14.2
	1914-1961	Hely, 1969			0.78	1512-1962	13.9
		UCRSFIG, 1971			0.87	1511-1961	13.0
		Avg of Above			--	1520-1961	13.4
Michaelson et al., 1990	1906-1962	Simulated flows	Residual	Best subsets	0.83	1568-1962	13.8
Hidalgo et al., 2000	1914-1962	USBR	Standard	Alt. PCA with lagged predictors	0.82	1493-1962	13.0
Woodhouse et al., 2006	1906-1995	USBR	Residual	Stepwise	0.81	1490-1997	14.7
			Standard	Stepwise	0.84		14.5
			Residual	PCA	0.72		14.6
			Standard	PCA	0.77		14.1
Meko et al., 2007	1906-2003	USBR	Residual	2-Step Regression with PCA	0.6	762-2003	14.7
	1906-2002				0.74	1182-2002	
	1906-2002				0.77	1365-2002	
	1906-2004				0.57	1473-2005	

(Source: USBR, 2007; Chronology Type: Standard chronologies contain low order autocorrelation related to biological persistence; residual chronologies have been prewhitened and contain no low order autocorrelation; Regression Approach: PCA is principle components regression. Best subset is multiple linear regression, using Mallow's Cp to select best subset. Alternative PCA used an algorithm find the best subset of predictors on which to perform PCA for regression. Stepwise is forward stepwise regression.

To understand historical water supply variations, natural flow records must be created that remove the effects of water user diversions and reservoir storage. The USBR has created a natural flow record for the Colorado River for flow forecasting. The long-term (1906-2005) estimated natural Colorado River flows at Lees Ferry average approximately 15.1 MAF. Annual natural flows at Lees Ferry are shown in Figure 5. The variation in these recent "natural" flows indicates the role and importance of storage on the Colorado River. Lake Mead reservoir elevations are also provided by the USBR, as shown in Figure 6 from 1939 to 2008.

Figure 5: Annual "Natural" Flows of Colorado River at Lees Ferry (MAF, 1906 – 2005)

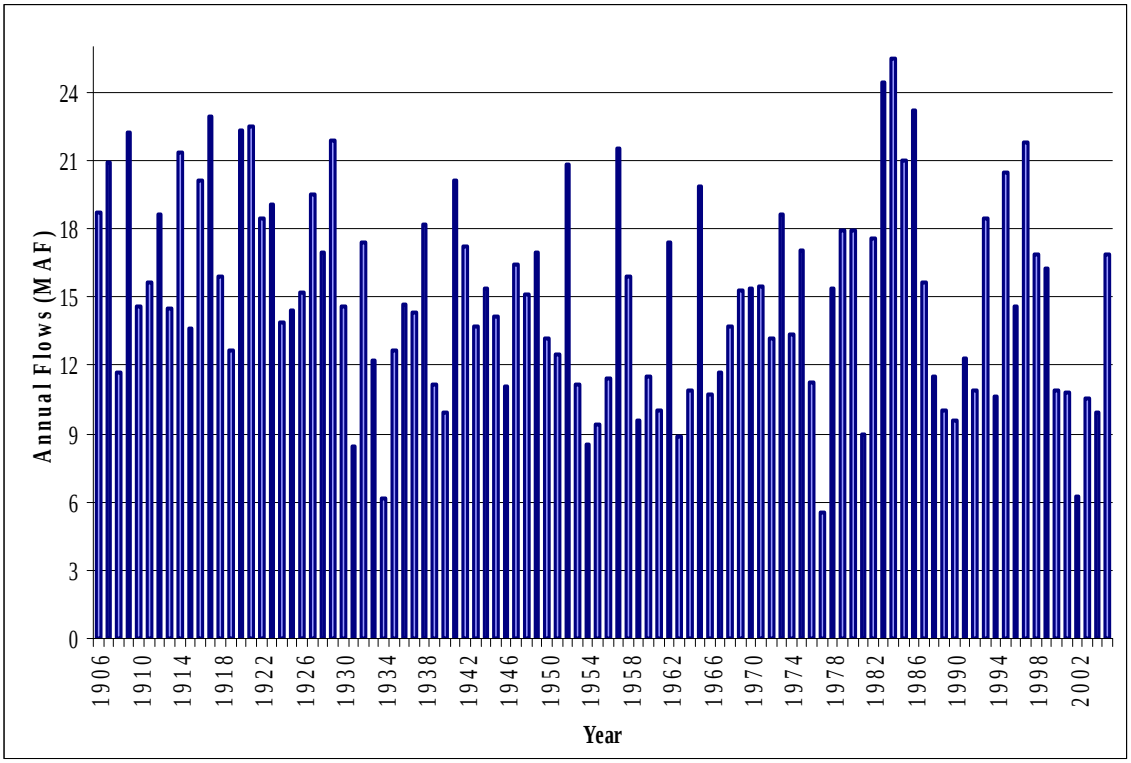
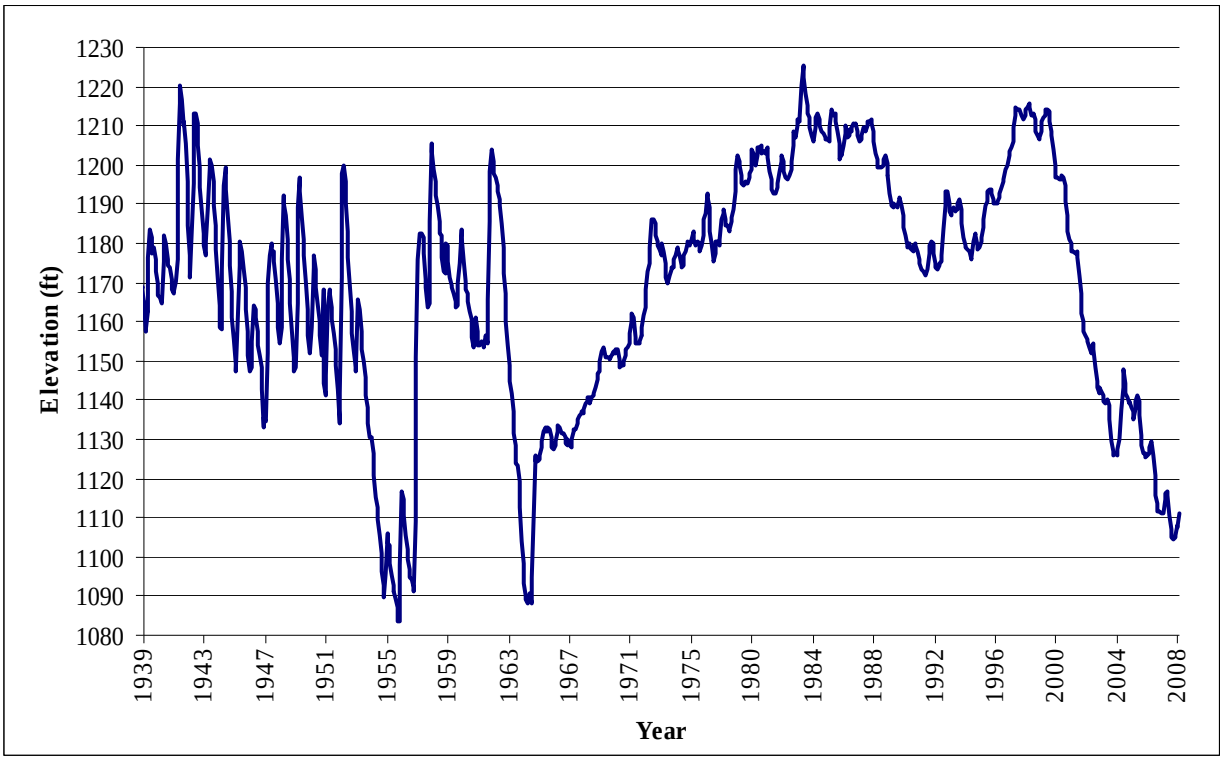


Figure 6: Lake Mead Reservoir Elevation (ft, 1939 – 2008)



6 – Future Colorado River Water Supply

Studies by scientists at the Scripps Institution of Oceanography at the University of California at San Diego indicate that average Colorado River flows may decrease by 10 to 30 percent by 2050, causing a decrease in Colorado River flow of about 400,000 AFY 40 percent of the time by 2025, and twice that by 2050. Under this scenario, the Colorado would be able to provide all of its allocated water only 10 to 40 percent of the time. The USBR, using a different set of calculations reached a similar prediction: that the Colorado could run short of water 58 to 73 percent of the time by 2050[33]. These findings are significant because decreased supplies on the Colorado River would affect millions of people and large areas of irrigated agriculture.

Several studies since 1979 have looked at potential impacts that changes in average temperature and precipitation might have on the flow of the Colorado River. Table 8 is a brief summary of some of the relevant studies that include hydrological models and statistical analyses. Over time, results of global climate models have improved, but they are not necessarily more accurate than scenario results from temperature and precipitation inputs into statistical hydrologic regression analyses. Similarly, hydrologic models can capture many of the processes that affect basin runoff, but their complexity harbors uncertainty and error. The general conclusion from the model results shown in Table 8 is that the average annual runoff (flow) of the Colorado River could decrease by 1 to 3 MAF in the next few decades as a result of changes in regional temperature and precipitation. From the perspective or water rights, this should not impact the IID right to net consumptive use of 3.1 MAFY of Colorado River water as measured at Imperial Dam.

[33] Text extracted from "Study: Shortages likely on Colorado River by 2050," By Mike Stark, Associated Press Writer, *The San Francisco Chronicle*, April 20, 2009.

Table 8: Studies of Climate Change Impacts on Colorado River Streamflow

Study	Climate Variable Source	Runoff Generation Technique	Results				
			Temperature Change	Precipitation Change	Runoff Change	Annual Runoff (MAF)	Notes
Stockton and Boggess, 1979	Scenario - 4 different scenarios on +/-2C temp change and +/-10% change in precipitation	Empirical, Langbein (1949) historical runoff-temperature-precipitation relationships	+2C	-10%	-33%	10	
			+2C	+10%	-33%	10	
			-2C	+10%	+50%	23	
			-2C	-10%	0%	15	
Revelle and Waggoner, 1983	Scenario, any combination of temperature and precipitation changes can be accommodated in the regression equation	Statistical Regression on Upper Basin historical temp and precip based on period 1931-1976	+2C	-10%	-40%	9	Regression explains 73% of variance gage flow record
			+2C	0%	-29%	11	
			0	-10%	-11%	13	
Nash and Gleick, 1991, 1993	10 Scenarios / GCM Simulations from 3 models	National Weather Service River Forecasting System (NWS-RFS) Hydrology Model	+2C	-10%	-20%	12	(52 results, range 33% to +19%)
			+2C	0%	4-12%	14	
Christensen et al., 2004	GCM simulations from PCM for 3 time periods, "Business as Usual" future emissions and a control run (no additional emissions)	Variable Infiltration Capacity (VIC) Hydrology Model	+0.5C	-1%	-10%	14	(Control)
			+1.0C	-3%	-14%	13	(2010-2039)
			+1.7C	-6%	-18%	12	(2040-2069)
			+2.4C	-3%	-17%	12	(2070-2098)
Hoerling and Eischeid, 2008	GCM results from IPCC Fourth Assessment Report, "Business as Usual" emissions	Statistical regression on Palmer Drought Severity Index (PDSI) using data from 1895-1989	+1.4C	0%	-33%	10	(2006-2030)
			+2.8C	0%	-45%	8	(2035-2060)
Christensen and Lettenmaier, 2008	GCM results from IPCC Fourth Assessment Report, emission scenarios A2 (high) and B1 (low), for 3 time periods	Variable Infiltration Capacity (VIC) Hydrology Model	+1.2C	-1%	0%	15	(A2, 2010-2039)
			+2.6C	-2%	-6%	14	(A2, 2040-2069)
			+4.4C	-2%	-11%	13	(A2, 2070-2099)
			+1.3C	+1%	0%	15	(B1, 2010-2039)
			+2.1C	-1%	-7%	14	(B1, 2040-2069)
			+2.7C	-1%	-8%	14	(B1, 2070-2099)

(Source: Udall, 2007)

7 – IID Demand Variability

Prior to the QSA, IID's water right was flexible and, in practice, was based on beneficial use for IID's irrigated acreage service area. Historically, agriculture demands within IID have tremendous variations from year to year. For example, IID's annual net consumptive use from the Colorado River for the period of 1970 to 2003 averaged 2.919 MAF with a standard deviation of 0.184 MAF. The variability in net consumptive use is a result of changes in irrigation demand, and the standard deviation of the net consumptive use is more than twice the demand non-agricultural uses in the IID water service area.

Crop economics, which influence the choice of crops planted and the extent of acreage planted, is probably the largest factor influencing the magnitude of agricultural water deliveries. A rise or fall in the market price of specific crops can cause large shifts in the cultivated acreage of those crops in the District, with a direct influence on the agricultural water demands. Precipitation also heavily influences agricultural water use, especially due to IID's flexible delivery scheduling allowing farmers to cancel water orders with short notice. Annual precipitation averages about 3 inches, with a typical range of between 1 and 5 inches. IID has estimated that each inch of rain can reduce agricultural water demands by 40,000 AFY.

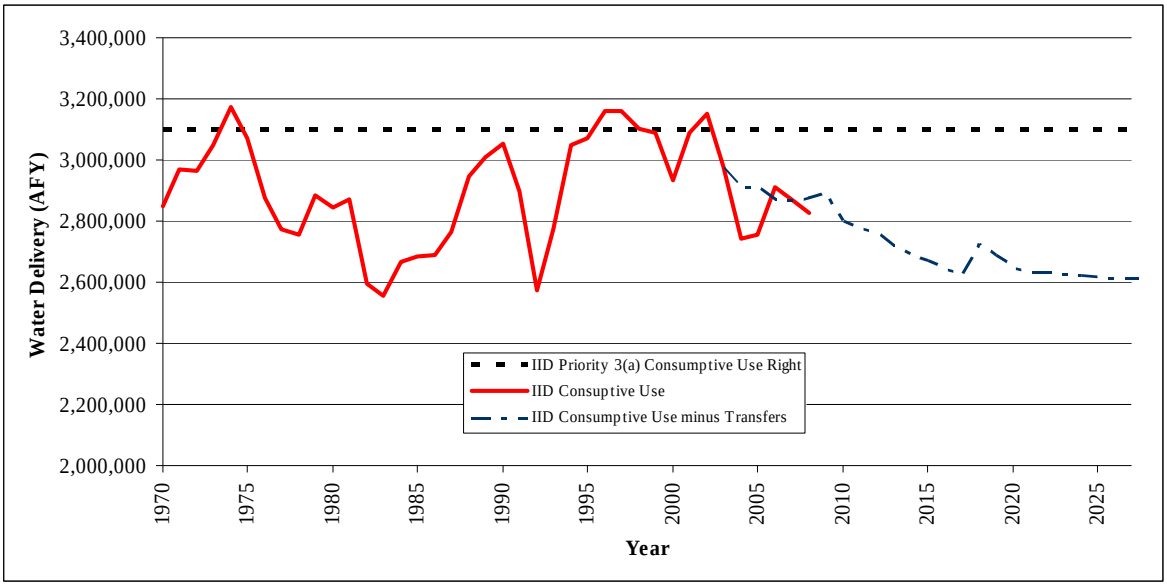
Quantification of IID's Priority 3a right at 3.1 MAF and the reduction of IID net consumptive use as measured at Imperial Dam as part of the QSA are part of an effort to reduce California's annual consumptive use of Colorado River water to match its right of 4.4 MAF (plus 50 percent of any declared surplus). However, quantification does not change the underlying conditions that result in high year-to-year fluctuation in irrigation demands. To deal with these fluctuations, IID implemented the Equitable Distribution Plan to help match IID net consumptive use to the allocated consumptive use in years when demand is expected to exceed supply. However, it is anticipated that IID diversions will, from time to time, still result in inadvertent overruns (diversion more than annual allocation) or under-runs (diversion less than the annual allocation). Overruns have to be paid back by reduced diversion in the future. Without off-river storage or groundwater banking, the under-run (unused allocation) goes to CVWD or MWD, the next priorities after IID within California's allocation.

Figure 7 shows IID net consumptive use of Colorado River water according to USBR records for 1970 through 2007, and the provisional USBR record for 2008. From 2003 through 2027, the QSA/Transfer Agreements projected net consumptive use by IID is also shown, adapted from Exhibit B in the 2003 Colorado River Water Delivery Agreement. The total annual reduced diversion from the water transfer agreements entered into by IID range from approximately 108,575 AFY in 2003 to with a long-term reduced diversion of approximately 487,200 AFY from the year 2026 for the remainder of the term of the QSA/Transfer Agreements.

The variability in IID's historical net consumptive use, which can be seen in Figure 7, is representative of the historic variability in agricultural deliveries, since IID's MCI deliveries are relatively small and fairly consistent. Historic variations in agricultural water demand actually exceed, but are similar in magnitude, to the 408,000 AF per year of transfers called for in the QSA/Transfer Agreements. For example, agricultural water demands for 1970-2003 varied from a low of 2.555 MAF per year to a high of 3.172 MAF per year – a variation of 617,000 AF. The

greatest variation for one year to the next was 326,000 AF, while several 2-year variations are in excess of 300,000 AF. Under the terms of the QSA/Transfer Agreements, IID has a variable demand and a fixed supply which can lead to the supply/ imbalances described above (overruns and under-runs); however, with implementation the Equitable Distribution Plan, these variations are expected to be much less.

Figure 7: IID Colorado River Net Consumptive Use (1970-2008) and Projected Net Colorado River Water Consumptive Use (2003-2027) based on USBR Colorado River Decree Accounting.



Prior to implementation of the QSA, water users receiving water from IID were part of a demand-based system. In any given year, each farmer made choices regarding what crop to plant and how much acreage to plant based on economics rather than water supply. Under the amended Equitable Distribution Plan that the District board adopted on December 18, 2007, the amount of water available to users is restricted in years for which the board declares a supply/demand imbalance. In such years a fixed volume per acre (AF/AC) is allocated for agricultural water along with various stipulations for other uses, see below. The Equitable Distribution Plan provides some flexibility for agricultural users to use more than the fixed allocation by using the District Water Exchange, which is described below. Even with the Equitable Distribution Plan in place, an overrun or under run can occur.

8 - Distribution and Priority of Deliveries within IID

IID has established an Equitable Distribution Plan and implementing regulations, together referred to as the Equitable Distribution Program, that are designed to provide for the distribution of water in any year when expected demand for water is likely to exceed expected supply.[34] Under the

[34] See IID website: Equitable Distribution http://www.iid.com/Water/EquitableDistribution

Equitable Distribution Program, when a supply/demand imbalance is declared, IID apportions the estimated supply among the various types of water users as follows:

a) Municipal and Commercial Users – Base amount of 2006 usage plus current District-wide average use per capita multiplied by the increase in population since 2006;
b) Industrial Users – For existing contracts, estimated based on past use, not to exceed contracted amount and contract terms. For new contracts, estimated based on anticipated use, not to exceed contract amount and contract terms, taking into consideration the Integrated Water Resources Management Plan.
c) Feed Lots and Dairies – Estimated based upon past use and consideration of future changes;
d) Environmental Resources Water – Estimated based upon the amount reasonably necessary to achieve the purposes of the District's commitments, taking past use into account; and
e) Agricultural Lands – Straight Line Apportionment. Subtract the estimated demand for categories a through d above from Available Water Supply, and then divide the remaining supply by the total number of Eligible Agricultural Acres. The amount of water apportioned to acreage that does not comply with Eligible Agricultural Acres will be placed in the District Water Exchange.

As part of the Equitable Distribution Plan, a District Water Exchange is established so that agricultural water users can sell and buy water. This provides flexibility for some agricultural water users to obtain water in addition to their straight line apportionment.

9 - Summary

Annual calculations of IID's net consumptive use water supply and of IID's and other transfer obligations are provided in Table 9, which is a modified version of CRWDA/Federal QSA Exhibit B (Data also shown in Figure 8). The net available water supply from the Colorado River at Imperial Dam for consumptive use by IID based on USBR Colorado River accounting, when factoring in commitments under the QSA/Transfer Agreements and environmental mitigations, is estimated to gradually be reduced from about 2.8 MAF in 2010 to about 2.6 MAF in 2026. All transfers are from water conservation. While conservation activities affect IID diversion; there is an equivalent reduction in demand as a result of water conservation.

Table 9: Summary of IID Consumptive Water Supply and Transfer Obligations, 2010-2047 (1,000 AF)[35]

Calendar Year	CO River Priority 3a Water Right	Misc. Present Perfected Rights	IID/MWD Agreement Transfer	SDCWA Transfer	CVWD Priority 3a Transfer	AAC Lining Project	Salton Sea Mitigation for QSA Transfers	Total Reductions	IID Net Consumptive Use after Reductions
2010	3,100.0	11.5	105.0	70.0	12.0	67.7	35.0	301.2	**2,798.8**
2011	3,100.0	11.5	105.0	80.0	16.0	67.7	40.0	320.2	**2,779.8**
2012	3,100.0	11.5	105.0	90.0	21.0	67.7	45.0	340.2	**2,759.8**
2013	3,100.0	11.5	105.0	100.0	26.0	67.7	70.0	380.2	**2,719.8**
2014	3,100.0	11.5	105.0	100.0	31.0	67.7	90.0	405.2	**2,694.8**
2015	3,100.0	11.5	105.0	100.0	36.0	67.7	110.0	430.2	**2,669.8**
2016	3,100.0	11.5	105.0	100.0	41.0	67.7	130.0	455.2	**2,644.8**
2017	3,100.0	11.5	105.0	100.0	45.0	67.7	150.0	479.2	**2,620.8**
2018	3,100.0	11.5	105.0	130.0	63.0	67.7	0.0	377.2	**2,722.8**
2019	3,100.0	11.5	105.0	160.0	68.0	67.7	0.0	412.2	**2,687.8**
2020	3,100.0	11.5	105.0	192.5	73.0	67.7	0.0	449.7	**2,650.3**
2021	3,100.0	11.5	105.0	205.0	78.0	67.7	0.0	467.2	**2,632.8**
2022	3,100.0	11.5	105.0	202.5	83.0	67.7	0.0	469.7	**2,630.3**
2023	3,100.0	11.5	105.0	200.0	88.0	67.7	0.0	472.2	**2,627.8**
2024	3,100.0	11.5	105.0	200.0	93.0	67.7	0.0	477.2	**2,622.8**
2025	3,100.0	11.5	105.0	200.0	98.0	67.7	0.0	482.2	**2,617.8**
2026	3,100.0	11.5	105.0	200.0	103.0	67.7	0.0	487.2	**2,612.8**
2027 - 2047	3,100.0	11.5	105.0	200.0	103.0	67.7	0.0	487.2	**2,612.8**

Note: After 2047, if SDCWA and IID mutually consent to a renewal term of 30 years, MWD will provide CVWD 50,000 AFY of the CVWD Transfer water (footnote 7 of Exhibit B – Quantifications and Transfers, Record of Decision).

[35] Adapted from Exhibit B – Quantifications and Transfers, Record of Decision - Colorado River Water Delivery Agreement – Implementation Agreement, Inadvertent Overrun and Payback Policy, and Related Federal Actions Final Environmental Impact Statement, October 10 2003, Gale A. Norton, Secretary of the Department of the Interior.

Figure 8: Projected Allocation of IID's 3,100,000 acre-feet per year from 2010 through 2047.