

ALL AMERICAN CANAL MONITORING PROJECT

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ABSTRACT

Imperial Irrigation District (IID) will strategically place four independent sensor setups along the All American Canal (AAC) for better monitoring of flow in the canal. More accurate measurement is needed of flow into the Imperial Valley as well as for the diversions along the AAC upstream of Pilot Knob, and to Mexico at Pilot Knob. Increases in measurement accuracy will allow IID, which operates the AAC, to better account for supply and more efficiently distribute the water in order to manage the canal under the conditions of the Colorado River Quantification Settlement Agreement of 2003 (QSA). This monitoring project is expected to produce the result that three geographic areas (Mexico, Coachella Valley, and Imperial Valley) receive their proper amount of water for agricultural, municipal, and industrial uses; eliminating most delivery discrepancies and expensive overuse paybacks to the river.

ALL AMERICAN CANAL DIVERSIONS

Imperial Irrigation District (IID), which is the largest irrigation district in the United States and the sixth largest electrical utility in the State of California, is responsible for operation of the All American Canal (AAC). In recent years, but prior to the signing of the Colorado River Quantification Settlement Agreement of 2003 (QSA), around 4.8 million acre-feet (ac-ft) of Colorado River water have been diverted each year at Imperial Dam (Station 60) near Yuma, Arizona, into the 82-mile long earthen AAC.

In 2004, the first full year in which the QSA was in effect, this amount was reduced to 4.4 million ac-ft. In future years, the diversion will be reduced further in accordance with the QSA schedule of deliveries.²

Some of water transported in the AAC is supplied to users along the AAC upstream of Pilot Knob (Station 1117), while deliveries to Mexico for use in the Mexicali Valley are made through a channel downstream of IID's Pilot Knob hydroelectric plant. Historically around 300,000 ac-ft annually have been diverted into the Coachella Canal for delivery to the Coachella Valley Water District (CVWD) for use in the Coachella Valley. Under the QSA, this amount

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² For QSA documents, see <http://www.iid.com/water/transfer.html>

will increase by up to 424,000 ac-ft annually. IID obtains the benefit of running water that is delivered to CVWD and to Mexico through its Pilot Knob Power Plant before these deliveries are made.

The Imperial Valley's sole source of water is the Colorado River. Prior to the QSA, IID was transporting around 3.1 million ac-ft per year into the Imperial Valley where agriculture thrives and provides the nation with over \$1 billion worth of agricultural products. The water also serves the Imperial Valley's municipal and industrial needs for a population of over 160,000. In 2004, under the QSA, IID's delivery was reduced to less than 2.8 million ac-ft, and future years will see IID reduce its delivery by as much as 492,200 ac-ft per year.

IID FACILITIES

IID operates a number of large facilities, including Imperial Dam, the ACC, six regulating reservoirs, three lateral interceptor systems with four reservoirs, and six hydroelectric power plants. In addition, IID is responsible for an extensive drainage system that discharges around 1 million ac-ft per year of water into the New and Alamo rivers, and ultimately to the Salton Sea. General information about IID is provided in Table 1 below.

Table 1. IID Service Area - General Information.

Area Served	Acres
Gross acreage	1,061,637
Irrigated area	462,202
Water Use & Delivery	Acre-feet/year
Average Agricultural (varies per crop & soil type)	5.6 /acre
Water delivery via AAC (prior to QSA)	3,000,000/yr
Water delivery via AAC (by 2020, post QSA)	down to 2,645,300/yr
Canals & Drains	Miles
Main canals	230
Lateral canals	1,438
Concrete lined or pipelined	1,109
Drains	1,406
Irrigation Structures	
Delivery Gates	5,591
Lateral headings	493
Lateral checks	3,426

Source: <http://www.iid.com/aboutiid/iidbackground-facts.html>

IID diverts water from the AAC into three main canals in the Imperial Valley for distribution to nearly 500,000 acres of farmland. The AAC originates at the

Imperial Dam 20 miles north of Yuma, Arizona and completes its journey at the southwest corner of the Imperial Valley. As part of the QSA, a portion of AAC will be lined to conserve up to 67,700 ac-ft/year of seepage.

IID OPERATIONS

Each Wednesday, IID staff prepares a master water order for the upcoming week (Monday through Sunday) and submits the order to the Bureau of Reclamation. The master order is based on judgment, cropping patterns, and historical deliveries. The master order can be, and typically is modified according to trends in water orders, weather conditions and other factors. Master schedule modifications require four days of advance notice to the Bureau of Reclamation.

As a spot check, IID staff on the Colorado River at Imperial Dam conducts current metering on the AAC at Imperial Dam (Station 60) and below Pilot Knob (Station 1117), see Figure 1, twice a week. Metering is done on Sunday and Wednesday, which typically are the low-flow and high-flow day, respectively.

The purpose of metering at these sites is to check whether the flow is on-order; that is, to find out if the AAC flow is the amount IID requested on its master schedule order. If the flow is not on-order, Imperial Dam staff adjusts flow at Station 60 by changing the setting of roller gates at Imperial Dam. Subsequent settings for the days between each metering are based on that adjustment. The assumption is that the flow is on-order until it is measured again. Flow fluctuates between the meterings, and IID's Water Master conservatively estimates a discrepancy of approximately 100 cfs/day (approximately 200 ac-ft/day).

IID makes scheduled changes at Pilot Knob once a day. IID also measures the flow at AAC Drop 1, downstream of the Coachella Canal Heading. AAC Drop 1 (Drop 1) is where the operational requirement for IID's service area is set. When a flow increase is scheduled, water is pulled from the upstream reach of Drop 1 via the hydro- electric plant or by opening check gates in the AAC. An acoustic velocity meter (AVM) is located in the AAC below the check gates and power plant. In the event of AVM failure, reported flow through the check gates may vary by approximately 10% from what would be reported by the AVM. The existing AVM cannot take readings when AAC level is this low.

Overall, increased measurement accuracy is expected to result in approximately 37,500 ac-ft/yr. This accuracy will be used to increase IID's efficiency in distribution of delivered water. This is a matter of heightened importance, because flow at Station 60 is the amount for which IID and Coachella Valley Water District (CVWD) are charged against their allowable consumptive use according to the schedule of Quantification Settlement Agreement (QSA) of 2003.

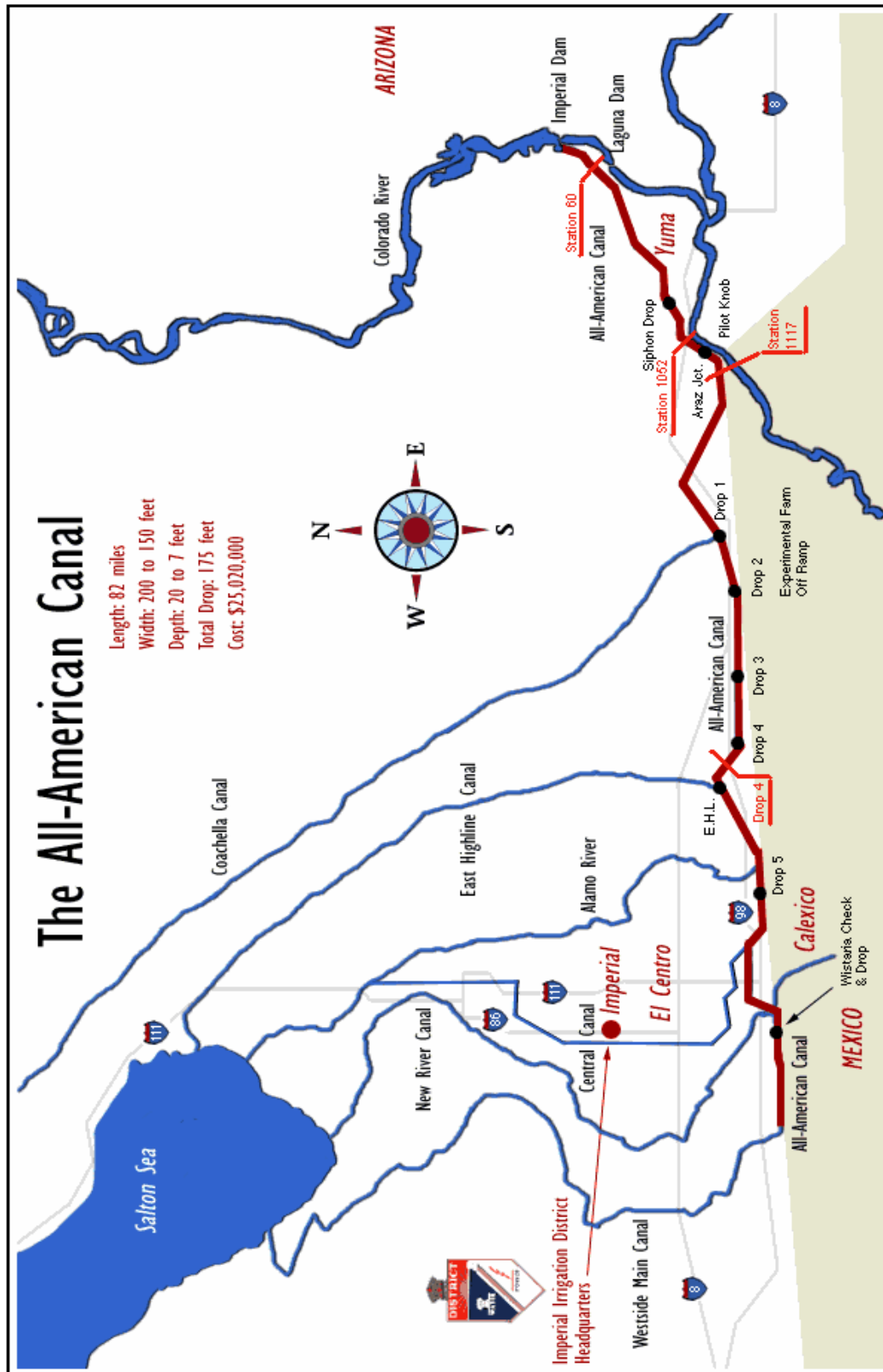


Figure 1. All American Canal, including proposed monitoring site.

IID DELIVERY

Prior to the QSA, IID received around of 3.1 million ac-ft of water each year from the Colorado River. Imperial Dam serves as a diversion structure for water deliveries throughout southeastern California, Arizona and Mexico. The operations of IID's River Division Office at Imperial Dam, as well as system wide water distribution, all fall under the direction of the Bureau of Reclamation, U.S. Department of the Interior.

Three main canals; the East Highline, Central Main and Westside Main receive water from the AAC and are used to deliver water through an extensive system of canals and laterals that serve growers in IID's service area in the Imperial Valley. IID zanjeros divert water directly from the laterals to farm delivery headgates for irrigation of approximately 479,000 acres of farmland within IID's boundaries.

IID delivers water to approximately 5,600 delivery gates for irrigation purposes. IID charges a water availability charge of \$3.80/acre/year, while the cost for delivery of water is \$16.00/ac-ft. IID operates and maintains more than 1,438 miles of lateral canals, 230 miles of main canals and the 82-mile-long All American Canal.

IID also provides raw water to the nine rapidly growing communities located in the Imperial Valley. These cities are responsible for treating the water and delivering it to their users. IID Energy Division and Water Department employ over 1,200 persons in the Imperial (water and power) and Coachella (power only) valleys.

Crops grown in the Imperial Valley fall into three categories – in 2004 there were around 90,000 acres of garden crops, 390,000 acres of field crops, and 20,000 acres of perennials. Within these categories the crops are many and varied, ranging from artichokes to zucchinis, alfalfa to wheat, and asparagus and citrus to pasture. In 2004, over 65,000 acres were multi- cropped (two or more short crops per year) with annuals, or the remainder was multi-year cropped with field crops and perennials. Irrigation methods are mainly flood and row, but include sprinkler for germination, drip for citrus and some other high-value crops, and some level basin.

PROJECT BACKGROUND

At the AAC Drop 1 site, flow is measured using a transit-time meter with four sensors, two located on each side of the AAC. They are placed across the channel in a diagonal and must be aimed directly towards each other for proper measurement. During low flow periods at least two of the sensors become exposed above the water level and skewed readings give false flow data. All

sensors are dependent upon each other to give correct readings. This system will be removed when the new RDI Channel Master 600 ADCP sensors are installed.

IID will install RDI Channel Master 600 ADCP sensors at Imperial Dam (Station 60), as well as at upstream of Pilot Knob (Station 1052) and at Station 1117. The new technology is needed at Station 1052, because water is delivered to a number of agencies between Station 60 and Pilot Knob. Accurate flow measurement upstream of Pilot Knob will allow staff to account for deliveries, seepage and evaporation, and to know how much water is available for diversion to IID, CVWD, and Mexico. A fourth station will be installed below AAC Drop 4 (Drop 4) to encourage IID's hydro plant operators to hold a steady flow and to allow IID Water Control Center (WCC) to determine the amount of water entering the IID service area.

Improvements in flow measurement have the potential of allowing IID to account for nearly all of the water in the AAC, however, it is likely that even with the improved system discrepancies will still exist. IID conservatively estimates that 50 percent of the current measurement discrepancy will be accounted for and that, as a result, IID will be charged for less water due to better accounting in the amount of about 37,500 ac-ft/yr. Thus overall increased measurement accuracy is expected to result in 37,500 ac-ft/yr of increase in efficiency in distributed water.

PERFORMANCE MANAGEMENT

AAC water distribution improvement will be monitored and transmitted to IID's Water Control Center at 15-minute intervals. The data will receive IID's standard quality control procedure and will be housed in IID's Water Information System (WIS). IID will analyze this data and use the resulting information to make adjustments at diversion sites to facilitate correct deliveries to all affected parties.

The proposed monitoring project allows placement of four independent sensor setups for monitoring AAC flow at two locations – before and after the diversion to Mexico and before and after the diversion to the Coachella Canal. This project will provide correct flow data for Imperial Valley as well as the other two entities, CVWD and Mexico.

INSTALLATION OF MONITORING EQUIPMENT

IID has chosen electronic sensing devices over a concrete structure. The reason for this is that the structure would cost approximately \$2 million, require more maintenance due to heavy silt load in the Colorado River water, and have to be removed by 2007 when the AAC lining project, which is part of the QSA, will go into effect in these areas. To verify accuracy and develop a calibration between the output of the Channel Master and the real discharge of the new flow meters, IID will obtain a 'RiverCat' instrument which will be used to make independent

discharge measurements. The RiverCat is an acoustic Doppler profiler that is deployed on a small catamaran and thereby used to make transects across the canal to measure the complete velocity profile and determine the discharge. The RiverCat will be operated from improved or newly constructed cableways at each site.

CONSTRUCTION METHOD

IID would like to accurately meter the flow in the All American Canal at four separate locations, at Imperial Dam (Station 60, upstream of Pilot Knob (Station 1117), downstream of Pilot Knob (Station 1052), and at the Drop 4 Station).

At each location there would be a sensor setup installed into the water approximately five feet from the bottom providing for the silt buildup and 15 feet from the surface 'low water' level mark formed during low draw on the river. There will be stairs built in the side of the canal down to a meter bridge that extends over the water thirty-five feet. This will ensure acceptable placement of the sensor. There will be a cableway and 'RiverCat' setup at each site for proofing, indexing, and quality control.

All of the sites would tie into the radio-based telemetry system that is in place for real-time display of canal operations data on existing computer screens in the Water Control building at the main headquarters of IID and at the River Division Offices located at Imperial Dam, 20 miles north of Yuma, AZ. Daily the data is compiled and stored in the Water Information System (WIS) at the Water Control Building at IID Headquarters in Imperial.

CONSTRUCTION SCHEDULE

Table 2 below summarizes the installation of the sensors, cableways, and meter bridges and associated timelines.

Table 2. Sensor, RiverCat, and Access Ramp Installation Schedule (work days).

Installation Schedule				
INSTALLATION RATE	AAC DROP 4	STA 1117	STA 1052	STA 60
Metering Bridge	4	4	4	4
Sensor	2	2	2	2
RTU	2	0	2	0
Cableway	3	0	2	0

The estimate for installation is less than the 24 month allotment. IID considers this of utmost importance and intends to have this project completed within this time period. IID staff has experience in both cableway installation and meter

bridge construction, so no excess time will be spent learning these aspects of the project.

WATER CONSERVATION MEASURES

Presently, IID uses ‘average’ flow for yearly delivery accounting purposes. The average is determined by IID staff on the Colorado River at Imperial Dam when they conduct current metering on the AAC at Imperial Dam (Station 60) and below Pilot Knob (Station 1117), twice a week. Metering is done on Sunday and Wednesday, which typically are the low-flow and high-flow day, respectively. This data is used to determine the average flow. Currently, IID does not have the capability to make more accurate flow measurements on the All American Canal. Accurate accountability (within reason) is critical to account for transfers to the San Diego County Water Authority and Metropolitan Water District, as well as deliveries to the Salton Sea. Accurate distribution of entitlements for the three entities, Imperial, Coachella, and the Mexicali Valley is a priority.

WATER SAVINGS

The proposed monitoring project would allow for accurate measurement of flow from the All American Canal to three entities. Past use of average flow measurement based on hand readings would be abandoned and accurate (real time) measurement of this valuable resource would replace it, eliminating serious discrepancies in actual delivery of entitlements, and helping to resolve difficult water issues facing IID.

USE OF MONITORED WATER

IID recognizes that mediocre accounting for water is not acceptable. The use of the new meters will ensure more accurate measurement of the amount of water delivered to three entities. With the West experiencing water shortages, IID must have the most accurate data available and past reliance on average spot check data is no longer considered accurate enough. Water that is measured more accurately is considered water conserved. IID is cognizant of the fact that good conservation begins at the system level, and delivery accuracy to all three entities is where this begins. IID anticipates that using more accurate measurement devices will reveal 37,500 ac-ft of water that has gone unaccounted for on an annual basis.

FUNDING PLAN

The estimated budget cost of the project is \$230,452.

CONSTRUCTION BUDGET

IID intends to have the sensors installed by IID staff. The IID Engineering Department intends to construct the meter bridges and install the cableways. IID SCADA personnel will maintain calibration with the RiverCat and complete all necessary operation and maintenance tasks.