WATER MANAGEMENT PLAN UPDATE

FOR

ALTA IRRIGATION DISTRICT

For Submission to

California Department of Water Resources

Regarding compliance with SB x7-7

Volume 3 of 3

December 2012

ALTA IRRIGATION DISTRICT

BOARD OF DIRECTORS

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GENERAL MANAGER/ SECRETARY

IRMA PANTOJA FARIA
CONTROLLER/TREASURER

December 14, 2012

California Department of Water Resources
Water Use and Efficiency Branch
Division of Statewide Water Management
901 P Street
Sacramento, CA 95814

Attn: Agricultural Water Use Efficiency

(Electronic Copy Emailed to ague@water.ca.gov)

Alta Irrigation District is herewith submitting (electric and hard copy) it's AB 3616 Agricultural Water Management Plan (1999), AB 3616 Agricultural Water Plan Update (2003), and updated plan elements in conformance with SB x7-7. The updated plan elements (SB x7-7) include items completed or contemplated subsequent to (i) the 1999 plan adoption or 2003 plan update, (ii) items that were not previously required under the 2012 Agricultural Water Management Plan, and (iii) additional reference documents to support updated plan elements. If there are additional information or questions regarding this submittal please contact Chris Kapheim at cmk@altaid.org.

Sincerely,

Chris M. Kapheim,
General Manager

289 NORTH L STREET • P.O. BOX 715 • DINUBA, CA 93618 • (559) 591-0800 • FAX (559) 591-5190 • altaid.org

REVISED AGRICULTURAL WATER MANAGEMENT PLAN OUTLINE

1. NOTICE REQUIREMENTS AND BOARD ADOPTION

2. UPDATED PLAN ELEMENTS

A. Operating Rules and Regulations

B. Water Delivery Measurements and Calculations

C. Water Rate Schedules and Billing

D. Groundwater Supply

E. Groundwater Recharge

F. Water Supply and Reliability

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I. Water Use Efficiency Information Required Pursuant to Change in Plan

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C. Description of Water Measurement Best Management Practices

D. Documentation of Water Measurement Conversion to Volume

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4. REFERENCE ATTACHMENTS

A. Private Lateral Headgate Turnout List, (2012)

B. Inadequate Means of Measurement Private Lateral Headgate Turnout List, (2012)

C. Methods and Devices, (2008)

D. SB 1938 Groundwater Management Plan, (2010)

E. Water Banking Annual Report, (2011)

F. Water Supply Study Cutler-Orosi Area (Draft), (2007)

G. Engineering Report Supplement, (2009)

H. Dinuba Pond Operating, Maintenance and Capital Replacement Agreement, (2011)

I. Integrated Regional Water Management Plan, Section 17 Climate Change, (2012)

J. Engineer's Report Proposition 218 Procedures, (2005)

K. Map Depicting Ponding Basins, (2012)

L. Map of IRTC Flap Gates, Automatic Control Gates, Doppler-type flow meters, variable frequency drive pump, and magnetic flow meter & SCADA controlled facilities, (2012)

M. SBX7 Flow Rate Measurement Compliance for Agricultural Irrigation Districts, ITRC, Cal Poly State University, (2012)

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CHAPTER 1

ALTA IRRIGATION DISTRICT

PUBLIC NOTICE

Intent to adopt a 2012 Agricultural Water Management Plan to be in compliance with SB x7-7. A draft 2012 Ag Water Management Plan can be reviewed at the Alta Irrigation District's Main Office, located at 289 North L Street, Dinuba, CA, on Friday, November 30, 2012 and thereafter. Office Hours: (8:00am - 5:00pm) (Closed for lunch 12:00 pm - 1:00pm) Monday - Friday

Subject to public notice provision under Government Code 6066, a public hearing will be held at 9:30 a.m. on December 13, 2012 at 289 North L Street, Dinuba CA, to review the draft 2012 Agricultural Water Management Plan. Subsequent to the public hearing, the Alta Irrigation District Board of Directors at a public meeting will take the following action: adopt the plan as presented, amend the plan or not take action on the plan.

Published: Dinuba Sentinel, November 29, 2012 and December 6, 2012

R2012-12-01

RESOLUTION OF THE BOARD OF DIRECTORS OF THE ALTA IRRIGATION DISTRICT TO APPROVE AN UPDATED WATER MANAGEMENT PLAN DEVELOPED UNDER AUTHORITY OF SB X7-7

WHEREAS, Alta Irrigation District is located in portions of Tulare, Fresno and Kings Counties; and

WHEREAS, Alta Irrigation District did notice counties and cities within Alta Irrigation District's boundaries of its intent to review, hold a public hearing and adopt an Updated Alta Irrigation District Water Management Plan complementary to its current AB 3616 Water Management Plan adopted in 1999 and updated in 2003; and

WHEREAS, Alta Irrigation District did notice under Government Code 6066 its intent for the public to review the Updated Alta Irrigation Water Management Plan, hold a public hearing to consider all comments and adopt an Updated Alta Irrigation District's Water Management Plan complementary to its current AB 3616 Water Management Plan adopted in 1999 and updated in 2003; and

WHEREAS, the Updated Alta Irrigation District Water Management Plan includes significant changes that are being contemplated in the near future or have been implemented since the 1999 3616 Water Management Plan and 2003 Updated Plan were adopted, as per the following examples: implementation of water banking facilities, strategies for mitigating climate change, water measurement at the turnout and volumetric pricing.

NOW, THEREFORE, BE IT RESOLVED, at a regularly scheduled board meeting held on December 13, 2012, Alta Irrigation District did consider all comments and adopted the Updated Alta Irrigation District Water Management Plan developed under the authority of SB x7-7. By taking this action, it is Alta Irrigation District's intent to demonstrate its long-term commitment to water management and conservation.

NOW, THEREFORE, BE IT FURTHER RESOLVED, that Alta Irrigation District did adopt the Updated Alta Irrigation District Water Management Plan on December 13, 2012, as submitted, by the following vote:

Ayes:	**Norman Waldner, Tom Marshall, Jerry Halford, John Krahn, Jack Brandt, Dan Astiasuain, and John Kalendar**
Nays:	**None**
Abstain:	**None**
Absent:	**None**

I, **Chris M. Kapheim,** Secretary to the Board of Directors of **Alta Irrigation District,** hereby certify that the foregoing resolution was duly passed and adopted by said Board at a regular meeting thereof duly called and held on December 13, 2012.

CERTIFIED:

Chris M. Kapheim

Chris M. Kapheim, Secretary

CHAPTER 2

A

RULES & REGULATIONS
GOVERNING DISTRIBUTION OF WATER AND MAINTENANCE OF DISTRIBUTION SYSTEM OF THE ALTA IRRIGATION DISTRICT

(Revised 12/13/2012)

*(California Water Code **§10826(a)(5)**)*

Section 22257 of the California Water Code provides in part as follows:

"Each District shall establish equitable rules for the distribution and use of water, which shall be printed in convenient form for distribution in the District".

These rules and regulations cancel and supersede any and all previous rules and regulations adopted and/or printed by the District.

OWNERSHIP AND CONTROL OF SYSTEM

Rule 1: All diversion works, canals, ditches, conduits, pipelines, headgates, and other structures owned by the District are dedicated to public use and are under the exclusive control and management of the Board of Directors. No person other than the authorized agents and employees of the District shall have any right to interfere with any of said diversion works, canals, ditches, conduits, pipelines, headgates or other structures of the District.

RIGHTS OF WAY ARE PART OF SYSTEM

Rule 2: Rights-of-way and easements for canals, ditches, and conduits owned by the District include, in addition to the land actually occupied by the canal, ditch, or conduit, such land on both sides thereof as is reasonably necessary for the maintenance, repair, cleaning and operation of such canals, ditches, and conduits. Obstruction of or interference with this secondary easement is prohibited by Section 22438 of the California Water Code. Widths of easements vary with the size of the canal, ditch, or conduit and other factors. Questions regarding the specification and location of various easements may be addressed to the District's administration office.

ACCESS TO LANDS IN DISTRICT

Rule 3: The authorized agents or employees of the District shall have free access at all times to all lands within the District in which the District has an interest for the purpose of constructing, replacing, maintaining, operating, inspecting or examining the canals, ditches, conduits, pipelines, headgates, and other structures owned or operated by the District and the flow of water therein, and for the purpose of ascertaining the acreage of crops on lands irrigated or to be irrigated with water furnished by the District. If the District owns a right of way or easement across privately owned land for the operation and maintenance of a canal, ditch or other facility, the law provides that the District shall have certain secondary rights and easements, such as the right to enter upon the property on which the right of way or easement is located to make repairs and do such things as may be reasonably necessary for the full exercise of the easement rights.

WELL MEASUREMENTS

Rule 4: If requested, by District, landowners may allow District employees to enter upon their property and measure the depth of water in their private wells for the purpose of determining the conditions and the average depth of the groundwater within the District.

EMPLOYMENT AND DUTIES OF DITCHTENDERS

Rule 5: The General Manager of the District shall employ such Ditchtenders and other assistants as may be necessary for the proper operation of the District's distribution system and for the distribution of water furnished by the District. Ditchtenders shall have the responsibility of enforcing District rules and directives. Ditchtenders shall be responsible for, and in charge of operational areas of the District allocated to them. All Ditchtenders shall be responsible to the Superintendent. Any decision made by the Ditchtender may be appealed by a landowner to the General Manager. A landowner may appeal any decision of the General Manager to the Board of Directors.

APPORTIONMENT OF WATER SUPPLY

Rule 6: The water supply available to the District will be apportioned to each distributing section of the District by the Superintendent, and will be apportioned to the landowners within the District in accordance with the provisions of Section 22250 of the California Water Code.

SUPERVISION OF SYSTEM

Rule 7: All matters relating to the distribution of water and the maintenance of District canals, ditches, pipelines, conduits, ponds, and other District structures or facilities shall be under the general supervision of the General Manager, who shall act under the authority of, and with the approval of, the Board of Directors.

DISTRIBUTION SCHEDULES

Rule 8: In general, water shall be distributed among the landowners in accordance with equitable water use formula based upon the delivery of one cubic foot per second of water for four (4) consecutive days to irrigate each 20 acres in the District having a 100% water entitlement. The Board of Directors shall establish the water use formula for that water season and may adjust the formula during that season. Landowners using and taking delivery of District water shall be informed of the date on which the water run shall begin, the date on which delivery requests will be received and accepted by the District, and the percentage of water entitlement per parcel in the District. The District shall also inform landowners of the initial water rotation cycle and any subsequent cycles.

MEASUREMENT OF WATER

Rule 9: Water shall be measured by the Ditchtender at least once per day. All water delivered through facilities owned or controlled by District shall be measured by means of a flow meter, submerged orifice measurement device, or other means of measurement approved by District. District may deny or refuse to deliver water to a turnout or headgate that is equipped with an inadequate means of measurement, as determined by District.

(1) "Inadequate means of measurement" is any of the following:

(a) New water delivery location without a District-approved means of measurement;

(b) Existing delivery location with respect to which District has given to landowner(s) adequate notice and/or opportunity either to install a measurement device or structure approved by District, to the satisfaction of District to meet its minimum compliance requirements.

(2) Meter calibration and measurement device maintenance: Every eight (8) years, or sooner if District and landowner so agree; District shall facilitate calibration and maintenance, as necessary to all meters in order to meet District’s standards. A consent agreement will be used to validate meter calibration, maintenance, repair and replacement by District or landowner for flow meters installed by landowner(s) on landowner owned facilities, i.e., booster pumps.

(3) The headgates of District that divert water to and into private lateral pipelines or open ditches and the type of measurement devices used at those headgates are depicted on Attachment "A", attached hereto and incorporated herein by this reference.

(4) To meet the initial requirement of SB x7-7, District shall install acceptable means of measurement on the headgates delivering water to and diverting water into the private lateral pipelines or ditches listed on Attachment "B", attached hereto and incorporated herein by this reference.

(5) District shall use proceeds of its volumetric surcharge to pay the cost of calibrating and maintaining the meters and installing flow meters and submerged orifice devices that are used or are to be used to measure the flow and volume of water delivered to and diverted into private lateral canals and pipelines, as stated in section (4).

(6) Active submerged orifice measurement devices and flow meters shall be reviewed daily in conjunction with water measurements and inspected monthly, during Water Run, and repairs to be made as required.

(7) District shall pay from its general fund the cost of maintenance, inspection, repair and replacement of existing and future submerged orifice devices used to measure the flow and volume of water delivered to District owned turnouts and headgates, except as stated in section (4).

CONTINUOUS USE OF WATER

Rule 10: Water deliveries shall be made on the basis of continuous and steady use of water during a twenty-four (24)-hour period, including weekends and holidays. No additional delivery time shall be allowed to landowners who fail, neglect or refuse to use water continuously, when available, during the allotted delivery cycle. Landowners who fail, neglect or refuse to use water during the cycle when water has been scheduled shall not have any right to use said water during any other subsequent cycle. If such failure to use water, however, is due to circumstances beyond the control of the landowner, particularly if caused by the unavailability of water, the District shall endeavor to make up the lost delivery time in so far as it can be done without unreasonably interfering with the scheduled delivery of water to other landowners. However, there is an exception for low-volume irrigation deliveries where the Ditchtender may allow periodic use, especially at night. Daytime water deliveries for low-volume irrigation use lasting less than twenty-four (24) hours may be allowed for water deliveries of less than one (1) cubic foot per second (cfs) per occurrence.

REQUESTS FOR DELIVERIES

Rule 11: At least two (2) days in advance, landowners shall make requests of Ditchtenders to turn on, increase, or decrease water deliveries, or allow low-volume use for less than twenty-four (24) hours. Turning off water requires at least twenty-four (24) hours prior notice. If a landowner gives the Ditchtender a request to turn off water deliveries less than twenty-four (24) hours in advance, District will calculate the volume of water delivered to that landowner as though the delivery continued until midnight of the day on which such a request is made.

DURATION OF DELIVERIES

Rule 12: After water service has started, District shall deliver water continuously for the duration of the scheduled delivery, or as otherwise requested by landowner, if approved by Ditchtender. The twenty-four (24)-hour notice for stopping water service may be waived in case of an emergency or when the Ditchtender and landowner agree to delivery for low-volume irrigation lasting less than twenty-four (24) hours.

TIME OF COMPLIANCE WITH REQUESTS

Rule 13: When a request for starting or stopping water service is acted upon, the Ditchtender shall start or stop the water delivery as requested when he passes the point of delivery on his regular run for that day. Requests to start or stop water service on a certain hour shall not be accepted, but the Ditchtender shall cooperate with the landowner to the extent that he can maintain efficient operation of the system.

TRANSFERS IN POINTS OF DELIVERY

Rule 14: A transfer of water from one delivery point to another delivery point may be made only with a notice of transfer signed by the transferor, the transferee and the District. Water transfers may be permitted only if they do not create an operational problem or unreasonably interfere with the regular distribution schedule, and will not exceed the safe operating capacity of any canal, ditch, pond, pipeline, conduit or other District structure or facility and will not appreciably increase the amount of spill or transportation losses to serve the transferee as determined by the General Manager or his designated representatives.

MAINTENANCE OF UNIFORM FLOWS

Rule 15: A diligent effort shall be made by the Ditchtenders to maintain a reasonably uniform flow in accordance with the distribution schedules that are under their immediate charge and supervision. Changes in water use, however, due to temperature variation, improper coordination by upstream users during water changes, local runoff from precipitation, spill water from other lateral systems, canal breaks, and other emergencies may cause unavoidable fluctuations and interruptions in flow. A landowner shall notify the Superintendent or his designated representatives if water is not available at the time his rotation period begins or if the flow is interfered with during the period. Proper allowances will be made in the schedules for such emergencies, and immediate notice shall be given to all landowners affected by any such change.

SERVICE TO PRIVATE LATERALS

Rule 16: The District shall not be liable for damages of any kind that result directly or indirectly from the operation of any private canal, pipeline, ditch or other conduit or from water flowing therein. Except where the District and landowners have agreed in writing to specific responsibilities in a consent agreement for private turnouts, the responsibility of the District shall cease and terminate when water is delivered into the private canal, pipeline, ditch or other conduit, including without limitation, a headgate, in accordance with these Rules and Regulations. Cleaning, maintaining, and replacement of private canals, pipelines, ditches and conduits are the responsibility of landowners who own or use those privately-owned facilities.

The District will not knowingly, and a Ditchtender is not authorized to, deliver water to a private canal, pipeline, ditch or other conduit that is not reasonably clean, free of leaks or obstructions, or that does not have sufficient capacity to carry the flow of water. The District will control water deliveries through the headgate of private laterals. It shall be incumbent on the landowners to control the actions of persons taking water from private canals, pipelines, ditches or conduits.

INTERFERENCE PROHIBITED

Rule 17: No person other than an authorized agent or employee of the District shall undertake to operate any of the facilities constituting any part of the distribution system of the District. Tampering with or changing the adjustment of any headgate, valve, pump or other structure or facility is strictly prohibited. Any interference with the facilities under the control of the District, except as is otherwise provided in Rule 18, is a penal offense.

LIABILITY FOR INTERFERENCE

Rule 18: Landowners who, by opening, closing, or otherwise interfering with regulating gates or devices, cause any fluctuations in the flow of water in the District's distribution system or cause any overflows, breaks or damage of any kind, shall be responsible to the District for the expense and damage caused thereby. In case of an emergency when immediate adjustment or other corrective action will prevent overflows, breaks, crop loss, or other property damage, or when instructed by an authorized District representative to make adjustments or to take corrective actions, the person making the adjustments or taking corrective actions will not be in violation of this Rule; provided that such emergency action or adjustment is reported immediately to the Ditchtender or Superintendent.

WASTE OF WATER

Rule 19: Landowners are responsible for the efficient use of water received. Those Landowners who waste water through carelessness, defective, or inadequate privately owned facilities, or because of inadequate land preparation, may be refused further water service until such conditions are remedied. Any waste, pollution, contamination, or other improper use of water shall be reported to the Superintendent.

Landowners shall be responsible for all water after it leaves any canal, ditch, conduit or other structure owned by the District. The District shall not be responsible or liable for any damage caused by negligence or careless use of water by any Landowner or by any Landowner's failure to maintain any canal, ditch, pipeline, or other facility for which he is wholly or in part responsible. It is incumbent on all Landowners to prevent hazardous conditions, mosquito nuisances, or damage to the property of others.

INSTALLATIONS PROHIBITED WITHOUT APPROVAL

Rule 20: No delivery gate, pipe, siphon or any other structure or device shall be installed or placed in any canal, ditch or conduit owned or operated by the District without express written consent of the Board of Directors or General Manager. Any installation must be installed in strict compliance with plans and specifications approved in writing by the Board of Directors or their designated representatives. Any such structure or device installed on a District canal, ditch or conduit without such express written consent may be removed by the District at the expense of the owner.

DAMAGING OF SYSTEM PROHIBITED

Rule 21: No person shall damage any gates or cut any locks or chains belonging to the District. No person shall make an opening, cut, plow or disc down or otherwise damage or weaken any District canal, ditch, conduit, or other structure or facility without express written consent of the Board of Directors or their designated representatives. Any such consent to open, cut, plow, or disc down or otherwise disturb any District canal, ditch, conduit or other structure or facility shall contain requirements for the restoration of such canal, ditch, conduit, or other structure or facility to its original condition or better. The District reserves the right to seek restoration and monetary damages as provided by law for any unauthorized damage caused to its system.

ENTRIES ON DISTRICT PROPERTY

Rule 22: Any person entering District property or District right of way does so at his own risk and assumes all risks associated with such entrance and by such action accepts responsibility for any damage to himself, the District, or private property resulting there from.

TRASH OR DEBRIS

Rule 23: No tires, trash, debris, litter, garbage, pruning's, brush, grass, dairy waste, dead animals, herbicides, pesticides or any other material that is offensive to the senses or injurious to health, or that pollutes or degrades the quality of water or which obstructs the flow of water, shall be placed, emptied, discharged, thrown, or be allowed to slide, flow, wash or be blown into any canal, ditch, conduit, pond, or other structure or facility belonging to the District. All District employees shall promptly report any violations of this rule to the Superintendent. The District reserves the right to take appropriate legal action and seek restitution in incidents of this nature.

ENCROACHMENTS

Rule 24: No trees, vines, shrubs, corals, utility poles and /installations, fences, pipelines, culverts, buildings, bridges or any other type of encroachment shall be planted or placed in, on, over, or across any District canal, ditch, conduit, drain, or the right of way therefore except by written authority of the Board of Directors or General Manager. Any approved encroachment is subject to the express condition precedent that adequate passageways for tractors and other District equipment shall be provided and that fences or other approved obstructions shall be removed whenever requested by the General Manager. Any unauthorized encroachment may be removed by the District at the expense of the encroaching party. If in the sole opinion of District, existing encroachments become

damaged, structurally deficient or unsafe, such encroachment may be removed at the direction of either the Board of Directors or General Manager.

DISCHARGE INTO SYSTEM

Rule 25: No person, company, corporation, firm, or agency shall be permitted to pump, siphon, or drain storm water, waste water, surplus irrigation water, or any other water, including but not limited to well water, into any District canal, ditch, conduit, or pond without express written consent from the Board of Directors. Any such written authorization shall include the manner, method, limitations, and terms and provisions for the District's control and regulation of the approved discharge.

LIABILITY FOR DAMAGE TO SYSTEM

Rule 26: Every user of District water shall be responsible for and liable to the District for all damages of any kind caused to the distribution system by willful or careless acts. Any person, who fails to repair damages of any kind to District facilities after adequate notification by the Ditchtender, shall be responsible for and liable to the District for the expenses incurred to repair District facilities.

WATER ON PUBLIC HIGHWAYS

Rule 27: Any person draining water upon or permitting water to drain upon any neighboring property or public highway shall be liable for damages of any kind caused thereby and shall be subject to criminal prosecution.

PENALTY FOR VIOLATIONS

Rule 28: Failure or refusal to comply with the requirements of or transgression of the stated "Rules and Regulations", or any interference with the discharge of the duties of any official of the District, may result in sanctions, including but not limited to denial of water service, being imposed by the District until full compliance has been made.

CERTIFICATION

I, Chris M. Kapheim, Secretary of the Board of Directors of Alta Irrigation District, hereby certify that the foregoing Rules and Regulations were adopted at its regular meeting held December 13, 2012.

Chris M. Kapheim
General Manager and Secretary of the Board

B

WATER DELIVERY MEASUREMENT AND CALCULATIONS

*(California Water Code **§10826(a)(6)**)*

All surface water is measured and recorded once a day. The principle methods of measuring water are by the submerged orifice or cumulative flow meters. To measure a submerged orifice, a Ditchtender measures the depth of water using an engineering tape prior to the calibrated opening and after the calibrated opening (see Methods and Devices 2008, Attachment C). The most common types of calibrated openings used by the District are a one foot and, two foot opening that can be adjusted at three inch increments by means of a metal slide. Using the rating tables for such openings, the instantaneous flow rate can be measured in cubic feet per second. Multiplying the instantaneous by the time of water use per twenty-four hour period, the acre-feet per day can be determined.

Currently the Ditchtender utilizes a smart phone (Apple IPhone®) that takes a picture of a bar graph installed at each turnout. This allows the Ditchtender access to review the history for the turnout and to record the correct information for the respective turnout. To minimize errors in transcribing measurement data, no writing of data is required. The smart phone sends the daily measurement data to a report that is reviewed the following day by the Ditchtender, Supervisor and office staff. Once the information is tripled checked, the measurement data is transcribed by a water program (STORM©) into a billing format. The day after water measurements are taken, the data is ready for billing. Each landowner can view the billing information with a private password on the District's website the day after the measurement is taken. The intent is to ensure that there is a check by the landowner prior to being billed in November.

Furthermore the District performs a blind check each year by taking two independent measurements within four hours of the Ditchtender measurements and then check for compatibility between the different measurements. If there is a significant variance, an internal audit and review is performed.

All water use is recorded by using a 24 hour timing cycle ending at midnight. Landowners are required to give a minimum of 24 hour notice for turning water on or off. Notwithstanding low volume irrigation facilities, all water deliveries are to be scheduled for a minimum time period of 24 hours. Low volume irrigation can be used for less than 24 hours with flexible time schedules coordinated between Landowner and the Ditchtender. If a landowner turns off without a 24 hour notice to Ditchtender, said Landowner will be charged until midnight, the end of the daily time cycle.

The intent is for all water to be measured at the turnout for each landowner. However, to facilitate the administration of entitlement calculations for landowners who have more than one parcel on the same lateral, the entitlement per each parcel is calculated as a cumulative entitlement amount. The STORM© water accounting program then prorates the water use to the parcels in question.

C

WATER RATE SCHEDULES AND BILLING

*(California Water Code **§10826(a)(7)**)*

The District currently has a volumetric surcharge based on measured water used and a per acre General and Administrative charge for costs other than those attributed to water distribution costs. In 2005, the District differentiated those items used to substantiate the volumetric surcharge and all other costs have categorized as General and Administrative (see Table 1 and Table 2, Engineer's Report Proposition 218 Procedures, December 2005).

TABLE 6

DISTRICT OPERATIONAL HISTORICAL REVENUES AND COSTS

Volumetric Water Surcharge	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$1.71**	**$1.71**	**$1.71**	**$3.20**
Fiscal Year	**96/97**	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**
Water Run Revenues								
Water Surcharge *	$ -	$ -	$ -	$ 178,894	$ 130,446	$ 132,351	$ 262,594	$ 234,406
Water Surcharge Penalty	-	-	-	1,043	412	465	1,503	1,756
Pine Flat Power Income 50%	169,282	134,076	117,644	91,298	78,999	64,778	55,515	67,796
Total Water Run Revenues	$ 169,282	$ 134,076	$ 117,644	$ 271,234	$ 209,856	$ 197,595	$ 319,611	$ 303,957
Water Run Costs								
Maintenance Ditchtender Trucks	$ -	$ -	$ 5,559	$ 4,348	$ 3,301	$ 3,716	$ 8,224	$ 4,462
Fuel - Ditchtender trucks	22,792	24,097	14,910	21,307	14,979	12,831	15,244	18,016
Cell Phone - Ditchtenders	-	-	7,918	10,050	8,062	6,037	3,919	3,803
Answering Service	-	-	149	223	185	206	170	282
Car Hire	41,513	34,985	-	-	-	-	-	-
Algicide	-	-	-	-	9,416	8,258	8,180	6,036
Operational Payroll	203,869	240,671	209,916	248,492	159,654	182,124	183,459	166,232
Payroll Tax/Benefits	65,694	77,553	67,643	80,073	51,446	58,687	59,117	53,566
Drop Boards	8,708	5,452	5,782	4,776	4,394	3,858	3,818	4,426
Total Water Run Costs	$ 342,576	$ 382,758	$ 311,877	$ 369,269	$ 251,437	$ 275,717	$ 282,131	$ 256,823
Net Operational Cash Flow	$ (173,295)	$ (248,682)	$ (194,233)	$ (98,035)	$ (41,581)	$ (78,122)	$ 37,480	$ 47,134

* Water Revenues Are Shown In The Year Generated For Budget Purposes.
These Revenues Are Actually Received In The Following Year.

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Table 1, Engineer's Report Proposition 218 Procedures, December 2005

TABLE 7

DISTRICT MAINTENANACE & GENERAL HISTORICAL REVENUES AND COSTS

Fiscal Year	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04
Maint & General Revenues								
Assessment Revenues	$ 1,503,970	$ 1,505,871	$ 1,504,005	$ 1,501,432	$ 1,498,439	$ 1,505,096	$ 1,502,142	$ 1,561,387
Pine Flat Power 50%	169,282	134,076	117,644	91,298	78,999	64,778	55,515	67,796
PGE Evaporation	-	-	-	-	12,982	10,467	28,058	10,958
Interest Income	116,656	180,638	146,954	160,590	152,824	79,781	50,942	44,536
Penalties and Cost	8,902	9,899	9,408	9,525	12,634	4,347	9,841	9,815
Equipment Lease/Rents	5,550	6,542	6,000	6,180	6,430	6,410	10,030	7,320
Administrative Fee	-	-	9,052	377	640	1,590	26,173	2,597
London Pond Soil Sales	3,530	10,700	3,600	6,350	-	-	-	-
Misc Income	52,036	65,687	134,463	51,011	3,428	9,096	6,990	13,036
Gain/(Loss) Sale of Equipment	2,007	(42,457)	(15,928)	292	9,077	390,000	-	-
Total Maint & General Revenues	**$ 1,861,933**	**$ 1,870,956**	**$ 1,915,198**	**$ 1,827,055**	**$ 1,775,453**	**$ 2,071,565**	**$ 1,689,691**	**$ 1,717,445**
Maint & General Costs								
Pine Flat Dam M&O	$ 45,228	$ 46,039	$ 95,000	$ 65,000	$ 67,569	$ 70,116	$ 66,623	$ 61,411
KRWA M&O / Water Fees	62,192	71,513	72,849	88,092	77,854	109,666	86,486	93,278
Maintenance (+ Maint payroll)	532,549	538,040	438,494	451,530	480,340	432,247	502,164	585,169
General	1,079,773	1,027,848	970,614	938,550	1,004,531	920,914	1,023,138	1,047,205
Interest Expense			20,056	17,512	33,768	38,339	30,526	25,149
Total Maint & General Costs	**$ 1,719,742**	**$ 1,683,440**	**$ 1,597,013**	**$ 1,560,684**	**$ 1,664,062**	**$ 1,571,282**	**$ 1,708,937**	**$ 1,812,212**
Maint & Admin General Costs								
BUDGET Maint - Capital	$ 93,700	$ 15,183	$ 22,564	$ 13,863	$ 86,506	$ 7,042	$ 60,149	$ 26,118
BUDGET Office - Capital	-	36,000	6,955	37,275	1,858	2,950	5,600	30,450
BUDGET Finance Packages *(principal only)*	-	-	-	61,675	99,440	138,597	99,587	71,969
BUDGET Pine Flat Repayment	35,500	35,500	35,500	35,500	35,500	35,395	35,395	-
Ditchtender Trucks - finance package	-	-	27,982	45,828	45,828	45,828	19,095	-
Capital purchases and financial packages	**$ 129,200**	**$ 86,683**	**$ 93,001**	**$ 194,141**	**$ 269,132**	**$ 229,812**	**$ 219,826**	**$ 128,537**
Total Maint & General Costs	$ 1,848,942	$ 1,770,123	$ 1,690,014	$ 1,754,825	$ 1,933,194	$ 1,801,094	$ 1,928,763	$ 1,940,749
Net Maint & General Cash Flow	**$ 12,991**	**$ 100,833**	**$ 225,184**	**$ 72,230**	**$ (157,741)**	**$ 270,471**	**$ (239,072)**	**$ (223,304)**

III-12

Table 2, Engineer's Report Proposition 218 Procedures, December 2005

In addition, the District has entitlement categories that are as follows:

1. 100% Entitlement
2. 75% Entitlement
3. 50% Entitlement
4. 25% Entitlement
5. Groundwater Only
6. Fifty Cent Land

Notwithstanding the Fifty Cent Category or parcels less than 5 acres, all of the remaining categories are applied to the following formula:

(Groundwater Charge) plus (Acres times Entitlement Category Percentage) plus (Volumetric Surcharge) = Water Rate

Except for parcels less than five acres that are bill through Fresno and Tulare Counties every other year, surface water costs are billed annually with bill statements mailed to each landowner the end of October, due and payable on November 20 and delinquent on December 20th of each year.

D

GROUNDWATER SUPPLY

*(California Water Code **§10826(b)(2)**)*

The amount of water recharged by the District has been enhanced with water banking projects that the District has participated in. The Traver and Harder Pond Projects are owned and operated by the District. Annually, the District compiles an annual report depicting the depth to groundwater, and the amount of water recharged and extracted on a cumulative basis, trends and conclusions (see 2011 Water Banking Annual Report, Attachment E). As a result, the District is able to utilize unreliable surface water supplies and make them reliable groundwater supplies.

The District's current Groundwater Management Plan limits the extraction amount by the District to eighty-five (85%) percent of the recharged water (see 2010 SB 1938 Groundwater Management Plan, Attachment D). The Water Banking Annual Report clearly defines and reports the non-extracted recharged water (see 2011 Water Banking Annual Report, Attachment E). The amount of water pumped from the banking project minus the required recharge is the amount of water that is available and accounted for as a usable commodity (the "Available Recharge"). The Available Recharge modified by the conserved water percentage (50%) to comprise the usable water from the project (the "Project Yield"). The Project Yield has been designated as a drinking water supply for the easterly portion of the District.

In February 2007, Orosi Public Utility District, Cutler Public Utility District and Alta Irrigation District initiated a study, Water Supply Study, for the Cutler-Orosi Area to evaluate and determine long-term sustainable drinking water solution (see Water Supply Study, Attachment F). Currently, groundwater quality in the area for drinking water purposes in the easterly portion of

the District is deteriorating to the point that operating community groundwater wells are being turned off to meet drinking water standards (see Engineering Report Supplement dated February 2009, Attachment G). As a result, the District continues to develop a surface water supply to service the proposed surface water treatment plant for the Cutler-Orosi area. The treatment plant will provide a partial drinking water supply to allow disadvantaged communities in the area to meet current and future drinking water standards.

The Dinuba Pond, (see 2011 Water Banking Annual Report, Attachment E) is a recharge and extraction project that is jointly administered by City of Dinuba and the District. The District maintains an accounting of the recharge water and it will be shown in future Water Banking Annual Reports. The City of Dinuba's groundwater wells adjacent to the project benefit from the recharged water thru a reduction in the pumping lift and corresponding savings in electrical use (see Dinuba Pond Project Operations, Maintenance and Capital Replacement Agreement, Attachment H).

E

GROUNDWATER RECHARGE

*(California Water Code **§10826(b)(5)(E)**)*

Since 1999, the most notable change impacting groundwater recharge is the ability of the District to recharge water in its banking facilities, i.e., Traver, Harder and Dinuba Ponds, and then extract a portion of such recharged water (see 2011 Water Banking Annual Report Attachment E). The District has concentrated its water banking facilities in areas of declining groundwater tables or near concentrated urban pumping (see map of Water Banking Facilities, Attachment K).

F

WATER SUPPLY AND RELIABILITY

*(California Water Code **§10826(b)(8)**)*

Historically, the District has operated a gravity water delivery system. In 2003, Alta Irrigation District was successful in securing Proposition 13, Groundwater Storage Construction Grant for their Harder Pond Project (the "Harder Project"). In 2008, water recharge was initiated at the Harder Project, with water extractions beginning in 2009. The Harder Project has allowed the District to reduce its surface water deliveries from Pine Flat that required delivering water 38 miles from the Kings River to the lower reaches of the District. To balance operational flows, the District can utilize~~s~~ up to eighty-five percent (85%) of the recharged water using groundwater pumps to supplement existing surface water supplies; at the lower end of the District; surplus water can be recharged at the Harder Project and utilized when needed. As a result, the District has adapted a more efficient and flexible system to accommodate landowner's demands for water thus reducing landowner's reliance on groundwater pumping from individual landowner wells and accruing the conserved water for meeting water quality objectives for disadvantaged communities. In 2012, Alta Irrigation District, Cutler PUD, Orosi PUD, Sultana CSD, East Orosi CSD and the County of Tulare representing numerous unorganized areas, i.e., Monson, Yettem and Seville, signed a Water Supply Safe Drinking Water Program Feasibility Study Memorandum of Understanding. The intent is to develop a regional surface water treatment facility to blend surface water with local groundwater supplies for multiple disadvantaged communities to achieve long-term drinking water sustainability.

In 2008 to further the concept of regional water management, the District applied under Proposition 50, Chapter 8 Integrated Regional Water Management Grant Application, Round 2, Step 2 (the "Traver Project"). The intent of the Traver Project is to develop an additional surface water supply for the Cutler-Orosi Area. In addition, the Traver Project will provide a level of flood protection to the community of Traver, enhance coordination of surface water deliveries, and increase groundwater recharge.

To document the results of the Harder and Traver Projects, the District compiles an Annual Water Banking Report that summarizes from each of the banking projects the amount of water recharged per year, amount of water extracted, amount of water conserved and any transferred water (see 2011 Water Banking Annual Report, Attachment E).

G

CLIMATE CHANGE

*(California Water Code **§10826(c)**)*

There are no definitive studies or conclusions to support the impact of climate change on the Alta Irrigation District.

Effective Precipitation & Snowpack Summary (IN)						
	2006-07	2007-08	2008-09	2009-10	2010-11	Average
*SNOWPACK APRIL 1st	45%	115%	80%	120%	185%	109%
**RAIN FALL Month						
July	0.00	0.00	0.00	0.00	0.00	**0.00**
August	0.08	0.00	0.00	0.00	0.00	**0.02**
September	0.09	0.00	0.00	0.00	0.00	**0.02**
October	0.21	0.08	1.37	0.65	0.24	**0.51**
November	0.06	1.17	0.45	2.06	0.53	**0.85**
December	1.74	1.79	13.64	7.89	0.00	**5.01**
January	2.88	1.51	2.32	1.66	0.68	**1.81**
February	2.51	2.64	2.69	1.51	0.65	**2.00**
March	0.00	0.32	1.66	4.17	2.12	**1.65**
April	0.00	0.22	2.90	0.62	2.93	**1.33**
May	0.47	0.69	0.19	0.62	0.00	**0.39**
June	0.00	0.40	0.00	1.60	0.00	**0.40**
Total	**8.04**	**8.82**	**25.22**	**20.78**	**7.15**	**14.00**

Snowpack measurements are based on historical reference location, Monitored by KRWA

***** Precipitation based on a local reference location, Monitored by District Corporate Yard. 8951 Ave 432, Dinuba CA.***

Table 3, Effective Precipitation & Snowpack Summary (IN)

The Kings Basin Water Authority, an integrated planning process for the Kings Sub-Basin, did address climate change (see Kings Basin IRWMP, Chapter 17 Climate Change, 2012, Attachment I). However, upon review of such data, it is prudent to access areas of vulnerability, adaptive measures or options to address potential scenarios, and monitoring of impacts that

document climate change over time. Climate change does have the potential, according to some studies, to result in less snow pack with greater amounts of precipitation. This could result in more arid climate conditions. Impacts from climate change could result in "greater risk of reduced water supplies, greater groundwater overdraft, urban water shortages, higher water costs, and lower agricultural output."

The high elevations of the Sierra Nevada Mountain Range Watershed that correlates to Alta Irrigation District's entitlement schedule off the Kings River Watershed could help alleviate some of the impacts of climate change, but an adaptive strategy to address other potential impacts of climate change is warranted as part of an overall water management planning policy. Listed below are goals and objectives for Alta Irrigation District to address climate change:

1. Increase water banking facilities: Water banking facilities will increase the local water supply that will allow the District to increase its water supply and optimize timing of water deliveries.

2. Increase water efficiency in utilizing existing water supplies: If a reduced snowpack becomes apparent, it would result in higher cost of surface water that would require efforts to increase efficiency of surface water deliveries and more accountability of measured water use at the turnout.

3. Increase efforts to utilize all potential water supplies, i.e., storm water and spill water: If snowpack yield is reduced, it will be necessary to utilize storm water and agricultural spill water to recharge the groundwater.

4. Provide greater flexibility using banked water to meet urban water needs: Urban areas are currently totally dependent on local groundwater supplies for drinking water and may need to diversify their drinking water supply thru the utilization of water banking programs to support long-term sustainability with declining the use of groundwater resources.

H

DESCRIPTION OF PREVIOUS WATER MANAGEMENT ACTIVITIES

*(California Water Code **§10826(d)**)*

Prior to year 2000, the District charged for water only on a per acre basis. In 1999, a 3616 Water Management Plan was adopted by the District. One of the substantive findings of the Plan was the development of a process for charging for water based on volumetric measurements at the turnout. In 2000, the District implemented volumetric pricing based on daily measurements of meter readings. Initially, the District charged $1.71 per acre-foot for water used and a standby charge per acre $15.00 per acre. In 2005, the District had a Proposition 218 election to increase both volumetric charges and standby charges (see 2005 Engineer's Report, Attachment J). The primary results from implementing volumetric pricing based on measurements at the turnout have been a reduction in spill water and a lower flow requirement demand per unit of time. As a result, by using less water on a daily basis, the District is able to run longer and offers greater opportunities to utilize surface water especially for low volume irrigation.

In years 2003 and 2008, in areas with adequate groundwater recharge, the District implemented a water banking program (see 2011 Water Banking Annual Report, Attachment E). The intent of developing the water banking program, a program to measure groundwater recharge and extract and deliver measured water supplies to landowners, is to improve agricultural water deliveries and develop a new water supply to mitigate contaminated groundwater currently being used for drinking water in the easterly region of the District.

Previously, there were issues in serving the lower reaches of the District. By improving water delivery reliability, landowners have greater opportunity to use surface water thus reducing

groundwater pumping. The greatest opportunity to recharge groundwater is to reduce groundwater pumping by landowners. The District has addressed improvements to manage its water deliveries by installing the Button Pond Project and London Pond Project to re-regulate water in surface water regulation facilities to maximize water reliability (see District Map, Attachment K) along with previously discussed water banking projects (Harder and Traver Projects).

I

WATER USE EFFICIENCY INFORMATION
REQUIRED PURSUANT TO CHANGES IN PLAN

*(California Water Code **§10826(e) & §10608.48**)*

The primary water use efficiency issues discussed in the 1999 Water Management Plan under the Agricultural Water Management Council and the 2003 Plan Update and subsequently implemented by the district in accordance with said plan are as follows:

1. Water measurement at the turnout: In 2000, the District implemented daily measurements at the turnout.

2. Volumetric pricing based on water measured at the turnout: In 2000, the District implemented volumetric pricing of $1.71 based on measured water. Currently the volumetric surcharge is $4.10 per acre-foot (see 2005 Engineer's Report, Attachment J).

3. Technology and automation of control devices, gates and structures (see map depicting Technology and automation of control devices, gates and structures, Attachment L):

    A. Several automatic control gates have been planned, with one constructed in 2012, at strategic locations within the District.

    B. Doppler type meters at banking inlets and recharge facilities (Doppler meters at Harder Pond and Traver Pond, and Dinuba Pond facilities).

C. Variable frequency drive pumps and magnetic flow meter measurement at the Sandridge Pump facility to allow for variances and flexibility in flow requirements.

D. SCADA implementation and control facilities located in strategic locations within the District.

E. ITRC Flap Gates have been installed in critical areas to control the elevation of the upstream head above a check structure.

CHAPTER 3

A

LEGAL CERTIFICATION AND APPORTIONMENT

FOR WATER MEASUREMENT

(California Code of Regulation ***§597.3(b)(1)(A)****)*

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CERTIFICATION MEMORANDUM

TO: Alta Irrigation District
Board of Directors

FROM: Douglas B. Jensen
Lauren D. Layne
BAKER MANOCK & JENSEN, PC

DATE: November 29, 2012

RE: Alta Irrigation District Water Management Plan
re: District Access to Private Pipelines

Alta Irrigation District (the "District") currently maintains approximately 2,000 irrigation water turnouts on property owned by the District or over which the District holds an easement. Therefore, the District is able to measure water flow at these locations. However, there are also many privately-owned lateral pipelines within the District that were paid for by private property owners and are maintained by the property owners on private property. The District does not have access to or the right to enter on the private property where these laterals are located and, instead, measures water deliveries at the District's turnouts that deliver water to those private pipelines, which may serve several farmers.

Qualification

This memorandum is to be submitted with the District's water management plan to confirm the District does not now have legal access to the delivery points on private property of individual customers or groups of customers needed to install, measure, maintain, operate, or monitor a measurement device. This memorandum is not meant to be used by anyone other than the District or for any other purpose.

We are informed by the District, and therefore assume that the District does not own the pipeline infrastructure or the property on which these private laterals are located. The District will request from the landowners access to these private laterals and access onto the landowners' private properties. Subject to these landowners' consenting to allow District employees to enter onto their properties and agreeing to the District's policies, the District does not have legal access to the private laterals on the private property of those customers.

Legal Analysis

As a general rule, landowners have a right to exclude other persons from private property and to prevent them from trespassing thereon. The right to exclude other persons is a fundamental aspect of private property ownership. (*Church of Christ in Hollywood v. Superior Court* (2002) 99 Cal.App.4th 1244.) The District does not now have permission to enter onto these private properties to install, measure, maintain, operate, or monitor a measurement device. The existing laterals were constructed with private funding by the landowners (or their predecessors in interest) and are not owned or operated by the District. The District delivers irrigation water into these private laterals through turnouts that are owned by the District and are located on District property or property over which the District has an easement.

In order to regulate these private lateral pipelines, the District would need to integrate them into the District's system, which may require an eminent domain action. A taking occurs when the government encroaches upon or occupies private land for its own proposed use. (*U.S. Const. Amend. 5*; *Palazzolo v. Rhode Island* (2001) 533 U.S. 606.) Although the District has the power of eminent domain to take private property for public use, such an action would require the District pay compensation to each landowner for the right to enter onto that landowner's property for measuring, maintenance, operation or monitoring of a device that is not owned by the District. That action would not be a complete taking, but merely a taking to acquire a right of access. However, this expensive action is unnecessary because the District already measures water deliveries into those private pipelines through legal means that meet the requirements of SB x7-7.

By entering onto private property without permission, the District also risks the threat of an inverse condemnation action by the landowner for damage to property and temporary invasions. Furthermore, the District cannot require the landowner to allow it onto the property and install these new metering devices because, while property may be regulated to a certain extent, if a regulation goes too far it will be recognized as a taking. Governmental action in the form of regulation can be so onerous as to constitute a taking, which constitutionally requires compensation. (*Pinheiro v. County of Marin* (1976) 60 Cal.App.3d 323.) The District should not be put into this position.

In addition to inverse condemnation, the District could be sued for civil trespass for entering onto private property without permission. California courts have declared broadly that every wrongful entry upon land in the occupation or possession of another constitutes trespass. (*Triscony v. Brandenstein* (1885) 66 Cal. 514.) Liability for trespass, however, is imposed when the act constituting the trespass was committed intentionally, or was the result of negligence, recklessness, or extrahazardous activity. (*Wilson v. Interlake Steel Co.* (1982) 32 Cal.3d 229.) Lack of consent is an element of the tort of trespass. (*Civic Western Corp. v. Zila Industries, Inc.* (1977) 66 Cal.App.3d 1.) The District should not take this risk.

Conclusion

We believe that without specific permission, the District does not have legal access to the water delivery points located on private property of individual customers or groups

of customers needed to install, measure, maintain, operate, or monitor a measurement device installed on conveyance facilities by those customers.

B

ACCURACY CERTIFICATION

(California Code of Regulation ***§597.3(a)****)*

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CONSULTING CIVIL ENGINEER, INC.

JAMES H. WEGLEY
CONSULTING CIVIL ENGINEER, INC.

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MEMORANDUM

REGISTERED PROFESSIONAL ENGINEER
JAMES H. WEGLEY
No. 24383
Exp. 12-31-13
CIVIL ENGINEER
STATE OF CALIFORNIA

Date: 11/30/2012

To: Alta Irrigation District - Water Management Plan

From: James H. Wegley

Subject: METER ACCURACY EVALUATION

The Alta Irrigation District utilizes some propeller meters within the District for measuring water deliveries to individual turnouts. The accuracy of these meters is typically 5±% or better. Their accuracy has been confirmed through testing conducted by the meter manufacturer and third party testing laboratories. The primary measurement device used within the District for individual turnouts is a submerged orifice plate. This is a standard water measurement device that has been used for over 50 years in irrigation districts throughout the west.

Engineering Review

The United States Department of Interior, Bureau of Reclamation (Bureau) has conducted tests on the orifice type of measuring device at their hydraulic laboratory (see SECTION D of the WATER MANAGEMENT PLAN). In accordance with the testing conducted at the Bureau's hydraulic laboratory, the coefficient of discharge for the orifice type of measurement has been determined. The actual volume of water measured is a function of the area of the submerged orifice, the orifice discharge coefficient, the head on the orifice and the length of time for the water run. The area of the orifice is determined by the District and remains fixed for the specific gate opening. The District determines the length of time that each water user is allowed to run with the District's ditchtender turning each turnout on and off. According to studies conducted by ITRC, Cal Poly State University (See SECTION D of the WATER MANAGEMENT PLAN), a fluctuating water level impacts the volume measurement by less than 0.2%. These studies further state that the overall Volumetric accuracy will be in the range of 93±%.

Based on these studies and the continued implementation of the Best Management Practices as defined in SECTION D of the ALTA IRRIGATION DISTRICT'S WATER MANAGEMENT PLAN, the submerged orifice plates will provide flow accuracy well within the requested 12%.

In conclusion, the flow measurement for individual turnout within the District provides an equitable distribution of the District's water supply and the orifice plates can be maintained in the future to provide flow measurement as stated in the following excerpt from SECTION D of the WATER MANAGEMENT PLAN: "*With the District's proposed maintenance plan, verification procedures, ditch tender training, best management practices, additional water level monitoring along with testing on the coefficient of discharge for their orifice plate VO by ITRC, the accuracy of their water measurements should be maintained.*"

C

SUPPORTING DOCUMENTATION
SECTION C

DESCRIPTION OF WATER MEASUREMENT: BEST PROFESSIONAL PRACTICES

*(California Code of Regulation **§597.4(e)(2)**)*

The Alta Irrigation District measures the water delivered to each farmer turnout from their distribution system. The distribution system consists of 250 miles of open canals and 75 miles of pipelines. The water deliveries are measured through a propeller meter or an orifice plate. There are 41 propeller meters and 1,383 orifice plates located within the District. The orifice plates are located in prefabricated concrete structures built by the District. These structures include a rectangular orifice opening in the front of the structure and a slide that is used for flow measurement. On the back of the structure is a canal gate that can be used to isolate the structure from the irrigation canal. This gate can also be utilized to control the flow delivery with the slide gate only being used to determine the flow rate. This structure is called a submerged orifice measurement device and pictures of typical submerged orifice measurement device turnouts are attached. These structures are precast by the District and installed in the canal. To maintain uniformity throughout the District the precast structures are built exactly the same, except for the three different sizes to accommodate the different flow rates required to serve individual farm properties.

Approximately fifteen (15) years ago the District embarked on a major upgrade to their turnout measuring devices. On new pipelines, the submerged orifice measurement device type of measurement box is not appropriate and propeller meters have been installed. Many of the submerged orifice measurement devices were in disrepair and required a

significant investment by the District to upgrade them to achieve adequate measuring capability. Existing concrete boxes were broken, unleveled or out of plumb. These boxes were reinstalled or replaced. The slides on many of the submerged orifice measurement devices were rusted, inoperable or not adequately attached to the structure. These gates were taken in and repaired and painted or replaced as necessary. In addition, the District invested in a computer system with handheld monitors and a bar code to record the field data. These improvements reduced errors in recording the field data and the integration into a billing format to the landowner. The District has now instituted a maintenance program to insure that these facilities do not return to the previous state. Completion of these upgrades were required prior to instituting an acre-foot charge for water delivered to each turnout. The volumetric billing is in addition to the per acre charge. After instituting the acre-foot charge, the District landowners became more aware of their water use and expressed additional interest on the deliveries being made through their farm turnout.

The Ditchtenders are trained in the correct techniques to be utilized in taking the measurements in the field. By adjusting the slide on the orifice plate, the flow rate in each turnout can be varied. The District has developed tables for determining the flow rate in cubic feet per second for the various sized orifices. The table for a 1 foot slide width is attached (see Table III Methods and Devices 2008, Attachment C). Each Ditchtender receives a copy of this manual and is instructed on the techniques utilized to perform the necessary measurements to accurately determine flows to each parcel of land.

Each farmer turnout has a bar code located at the metering device, whether propeller meter or orifice plate. The District's Ditchtenders scan the bar code and enter the readings taken at the turnout. Each propeller meter and orifice plate has readings taken every day, using a handheld unit. All readings are uploaded to the District's server in real time. Based on the readings taken in the field, the daily quantity of water applied in acre feet is determined. At the end of the year, the landowners are billed for the total quantity of water that passes through their individual turnout. Some landowners may have only one turnout serving their property, whereas others may have multiple turnouts or multiple properties with individual turnouts.

Initially the District installed plastic bar codes on the meter devices. Those have now been replaced with metal bar codes that last longer. Within the files for each bar code, information is maintained on the land being served by the turnout. This information includes the turnout number, landowner name, address, acreage, date and time of measurements, flow rate and historical water use for that turnout. The District is now converting from dedicated handheld scanners to Apple IPhones® for use in reading the bar codes and inputting the data.

For quality control purposes, when the field data is entered into the dedicated scanner, an alarm signal is activated if the flow rate is out of the normal range for that turnout. The normal range is determined by the District and input into the scanners. This alerts the ditchtender to the possibility of an error and allows him to verify the input data before leaving the site. This information is always uploaded and checked for any

inconsistencies. Any apparent errors in the measurements for an individual turnout are given to the ditchtender for rechecking. As a further quality control measure, the supervisors for the District check 20 percent of the individual measurements on their own to verify the accuracy. The Ditchtenders are not aware of which readings are being field-verified.

The District proposes to begin conducting prescribed maintenance on 12.5 percent of the propeller meters and orifice plates each year, checked daily and maintained as needed. On the propeller meters, this will include removal of the meter and transporting to a testing laboratory. A complete check and evaluation of the meter will be done. This will include a calibration test and replacement of bearings, propeller, cable, register, etc., as required. The daily maintenance on the orifice plates will include inspection to insure the concrete box is plumb and level. The slides will be removed and repainted, as necessary. The concrete box will be inspected and replaced if broken. In addition, each year, maintenance of each site is undertaken to remove any weeds and accumulated sand that would interfere with the readings taken at the orifice plate VO. Cleaning of the sand in front of and inside of the concrete structure used for the orifice plate turnout is a critical item. Any maintenance that is conducted on the propeller meter and orifice plate turnout is recorded on the maintenance form prepared for each individual farmer turnout (see Maintenance Report Form). Of course, any known problems with the propeller meters or orifice plate turnouts are corrected in a timely manner regardless of the program maintenance cycle.

The extensive best professional practices employed by the District are costly and time consuming. The continuation of these practices provides the necessary checks and balances required to deliver and verify the irrigation flows delivered to each parcel. The continued implementation of these practices is recommended. Additional best management practices are not currently anticipated. During the three year update of the District's Agricultural Water Management Plan, these practices will be revisited and additional practices recommended as appropriate.

DRAFT

TURNOUT NO.

MAINTENANCE REPORT

INSPECTION DATE	INITIALS	STATUS/INSPECTION/MAINTENANCE/RECOMMENDATION	COMPLETION DATE	INITIALS

D

SUPPORTING DOCUMENTATION

SECTION D

DOCUMENTATION OF WATER MEASUREMENT CONVERSION TO VOLUME

*(California Code of Regulation **§597.4(b)(2)(e)**)*

The District uses both propeller meters and submerged orifice measurement devices for measuring water deliveries to each farmer turnout. The propeller meters are factory built and installed according to the manufacturer's requirements. The submerged orifice measurement devices are built by the District according to standards developed by the United States Department of Interior Bureau of Reclamation.

Propeller Meters: The propeller meters have a register that indicates the instantaneous flow rate and a totalizer that integrates the flow rate over time and records the quantity of water delivered. This quantity can be shown in gallons or acre-feet. The manufacturer's testing has shown the meters to be 95+ percent accurate. The published literature has placed the accuracy of most propeller meters from 2± to 5± percent of the actual flow. [1]

Submerge orifice measurement device: The submerge orifice measurement device is a standard measuring device with a long history. The submerged orifice measurement device is used to measure the velocity through a standard plate of known dimension. The velocity will vary depending on the differential head across the orifice. This calculated flow rate is adjusted based on a coefficient of discharge. Significant laboratory testing has been done over the years to establish accurate values to be utilized for this coefficient of

[1] Water Measurement Manual, United States Department of the Interior, Bureau of Reclamation, Third Edition.

discharge. The constant head orifice turnout has become an increasingly popular device for the diversion, control and measurement of canal flow into laterals.[2]

The velocity through an orifice is developed from the Bernoulli equation to be:[3]

$$v = \sqrt{2gh}$$

The discharge (flow rate) is a product of the velocity times the area: [3]

$$Q = av$$

In computing the flow rate for an orifice, the coefficient of discharge is applied to the above formula:

$$Q = Cav = Ca\sqrt{2gh}$$

Values for the coefficient of discharge for orifices are shown in Figure 4-6.[3]

The total volume of water that passes through an orifice is based on the time that the flow rate occurs. One cubic foot per second (cfs) will develop 1.98 acre feet (a.f.) of water in a 24 hour period. The equation for determining the Volume of water is shown below:

$$V = Qt$$

The following fifteen items should be followed to maximize the accuracy of an orifice type of turnout:[1]

(1) The upstream edges of the orifice should be straight, sharp, and smooth.

(2) The upstream face of the orifice wall should be vertical.

(3) The top and bottom edges of the orifice opening should be level.

(4) The sides of the opening should be truly vertical.

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[2] Hydraulics Laboratory Report No. Hyd-216, United States Department of the Interior, Bureau of Reclamation

[3] Handbook of Hydraulics, King & Brater, Fifth Edition.

(5) The inset orifice plates must be flush, and the upstream face of the supporting bulkhead with the fasteners must be countersunk on the upstream side.

(6) The distance from the opening edges to the boundary and the water surface, both on the upstream and downstream sides, should be greater than twice the least dimension of the orifice opening.

(7) The face of the plates must be free of grease and oil.

(8) Avoid orifice plate knife edges because they are a safety hazard and can damage easily; orifice opening plate perimeter should be between 0.03 and 0.08 inch (in) thick.

(9) If the plates are thicker than condition (8), the plate edges should be reduced to the required thickness by chamfering the downstream edge of the orifice plates to an angle of at least 45 degrees.

(10) Flow edges of plates require machining or filing perpendicular to the upstream face to remove burrs or scratches and should not be smoothed off with abrasive cloth or paper.

(11) The edges of the supporting bulkhead wall cutout to receive the orifice opening plate should be located at least one wall thickness from the orifice opening edges.

(12) For submerged flow, the effective head on the orifice is the actual difference in elevation between the water surfaces upstream and

downstream from the orifice wall. The differential head should be at least 0.2 foot (ft.)

(13) For free flow, the effective head on the orifice is the difference in elevation between the upstream water surface and the center of the orifice opening.

(14) The cross-sectional area of the water prism 20 to 30 ft upstream from the orifice should be at least eight times the cross-sectional area of the orifice.

(15) The selected type of head measuring device must be compatible with required project accuracy and the amount of head loss that is acceptable.

The measurement of flow through the orifice plate turnout is dependent on a number of variables. These variables are discussed below:

Area – The District utilizes three difference orifice sizes. They are 12 inch, 24 inch, or 36 inch in width. The area of the orifice is based on one of the above sizes times the opening. The opening is varied depending on the required flow rate. As mentioned previously in Attachment C, the slide on the orifice is moved up or down in three inch increments.

The coefficient of discharge for an orifice is based on laboratory studies previously sited. The District will also be providing the Irrigation Training & Research Center (ITRC) at California Polytechnic State University with one orifice turnout

structure of each size to conduct further testing and updating of the coefficient of discharge. Based on this study, the coefficient used in the District's calibration tables may be modified. This analysis should be completed prior to the 2014 irrigation season.

Head – The head on the orifice plate is the difference between the water level on the upstream and downstream sides of the orifice. This difference is determined by measuring vertically from a fixed point on the turnout structure to the water surface. The difference in these two measurements represents the head used in determining velocity, which can then be converted to flow rate and eventually to the quantity of water.

The accuracy of this system in determining the total volume of water delivered is a function of the accuracy in which each of the above measurements are determined and the physical features of the turnout and site. By implementing the fifteen items previously listed, the best management practices will have been achieved. An accuracy of 2± percent can be achieved in the effective discharge coefficient.[1] Further studies will be conducted by ITRC on the District's turnout. These studies may lead to modification in the coefficient factor currently used in determining the quantity of water delivered. The District's canal system is controlled by in channel weirs to maintain a constant water level within the canal. The District has installed 34 ITRC Flap Gates in their canals where necessary to improve the stability of the water level within the canal. Over the next three years, additional confirmation investigations will be conducted to determine if there are other canals that are experiencing significant variations in water levels. Depending on that investigation, additional ITRC Flap Gates may be required. Studies done on the

impacts of fluctuating canal water levels on the Volume of water measured have found the impact to average less than 0.2 percent (see SBX7 Flow Rate Measurement Compliance for Agricultural Irrigation Districts, ITRC, Cal Poly State University, Attachment M). This fluctuation in canal water level has little impact on the annual Volume of water delivered.

The District has looked to studies conducted by ITRC on Volumetric accuracy determinations in evaluating the acceptability of their submerged orifice measurement device turnouts for making field measurements. The studies by ITRC have determined the overall volumetric accuracy to be in the range of 93 percent (see SBX7 Flow Rate Measurement Compliance for Agricultural Irrigation Districts, ITRC, Cal Poly State University, Attachment M). This is well within the 12 percent volumetric accuracy required.

With the District's proposed maintenance plan, verification procedures, ditch tender training, best management practices, additional water level monitoring along with testing on the coefficient of discharge for their orifice plate submerged orifice measurement device by ITRC, the accuracy of their water measurements should be maintained.

E

DEVICE CORRECTION ACTION REQUIREMENTS FOR WATER MEASUREMENT

*(California Code of Regulation **§597.4(e)(4)**)*

District commitment is to measure the instantaneous flow and calculated volume at District owned and operated turnouts. The District has determined that several private lateral headgates cannot be measured to the standard required by this Plan (see Reference Attachment B). It is the intent of the District to hold a Section 6 Proposition 218 Election in 2013 to fund the necessary improvements to be constructed and operational on or before 2015.

In addition, there are turnouts that cannot be measured to the standard required by this Plan (see Reference Attachment N). It is the intent of the District to include this item in the above stated Section 6 Proposition 218 Election in 2013 to fund the necessary improvements to be constructed and operational on or before 2025 subject to available funding (see Table 2).

The District will contact and address landowner installed booster pump flow meters by means of a consent form to ensure compliance with calibration timing, repairs, maintenance and replacement by either District or landowner. Initial review has determined less than twenty (20) locations where a consent form will be required.

F

FARM-GATE MEASUREMENT (AF)

Alta Irrigation District

	2008	2009	2010	2011	2012
January					
February					
March					
April			1,236	9,312	
May	9,591	10,135	22,836	26,019	12,856
June	28,671	25,030	29,828	25,288	23,390
July	27,206	28,503	34,470	31,497	26,454
August	10,698	24,479	30,369	29,507	13,037
September			25,006	24,008	
October			177	3,364	
November					
December					
Total Deliveries	76,165	88,147	143,923	148,994	75,738

Table 4, Monthly and Annual Total Aggregate Farm-Gate Deliveries (AF)

CHAPTER 4

A

Private Lateral Headgate Turnout List

	Turnout	MeasurementType	Subsystem	PrivateDitch	Booster	TurnoutType	LastDelivery	MeterType
1	B01.00-11	Flow:Discharge	B01	WAGNER & ARKEL PVT - ALTA MAIN		2' Suberged Orif.	8/15/2012 12:00	
2	B01.00-13	Flow:Discharge	B01	HANEY PVT P/L - ALTA MAIN		2' Suberged Orif.	8/15/2012 7:00	
3	B01.00-20	Flow:Discharge	B01	ROHRER PVT - ALTA MAIN		2' Suberged Orif.	8/15/2012 7:00	
4	B01.00-23	Flow:Discharge	B01	KANAWYER PVT - ALTA MAIN		1' Submerged Orif.	6/19/2012 7:00	
5	B01.01-05	Flow:Discharge	B01	PRINZ PVT - ALTA MAIN		1' Submerged Orif.	6/23/2011 7:00	
6	B01.01-07	Flow:Discharge	B01	KING PVT - ALTA MAIN	YES	2' Suberged Orif.	8/14/2012 16:00	
7	B02.16-02	Flow:Reading	B02	GIOLETTI PVT - MT CAMPBELL			8/15/2012 7:00	Estimated Overflow in CSF
1	H03.07-01	Flow:Discharge	H03	ALAMEDA PVT - WAHTOKE		1' Submerged Orif.	8/13/2012 7:00	
2	H03.07-03	Flow:Discharge	H03	ROGERS PVT - WAHTOKE		1' Submerged Orif.	8/2/2012 15:00	
3	H04.06-01	Flow:Discharge	H04	WEST ELTER PVT - ELTER		2' Suberged Orif.	8/15/2012	
4	H06.00-05	Flow:Discharge	H06	COLE PVT P/L - REEDLEY MAIN		1' Submerged Orif.	8/12/2012 18:00	
5	H06.00-09	Flow:Discharge	H06	WHITE PVT P/L - REEDLEY MAIN		1' Submerged Orif.	8/13/2012	
6	H06.01-03	Flow:Discharge	H06	EITZEN PVT P/L - REEDLEY MAIN		2' Suberged Orif.	8/15/2012 7:00	
7	H06.02-05	Flow:Discharge	H06	WARNER PVT - REEDLEY MAIN		1' Submerged Orif.	8/15/2012	
8	H06.07-06	Flow:Discharge	H06	MURPHY PVT - REEDLEY MAIN		1' Submerged Orif.	8/13/2012 7:00	
9	H08.04-04	Flow:Discharge	H08	HIEBERT PVT - E REEDLEY		1' Submerged Orif.	9/12/2006 7:00	
10	H08.05-01	Flow:Discharge	H08	TROTH PVT - E REEDLEY		1' Submerged Orif.	9/25/2011 11:00	
11	H08.05-02	Flow:Discharge	H08	MERRITT #2 - E REEDLEY		2' Suberged Orif.	8/15/2012	
12	H08.10-04	Flow:Discharge	H08	AUTSEN PVT - E REEDLEY		1' Submerged Orif.		
13	H10.00-01	Flow:Discharge	H10	SHARP PVT - W REEDLEY	YES	2' Suberged Orif.	9/16/2011 7:00	
14	H10.01-01	Flow:Discharge	H10	KALASHIAN PVT - W REEDLEY		1' Submerged Orif.		
15	H10.01-02	Flow:Discharge	H10	LAINE PVT - W REEDLEY		1' Submerged Orif.	8/4/2012 10:00	
16	H10.02-02	Flow:Discharge	H10	SURABIAN PVT - W REEDLEY		1' Submerged Orif.	7/27/2012 17:00	
17	H10.09-01	Flow:Discharge	H10	KLIEWER PVT P/L - W REEDLEY		1' Submerged Orif.	8/13/2006 7:00	
18	H58.00-04	Flow:Discharge	H58	SMITH PVT - E BRANCH		1' Submerged Orif.	8/15/2012	
19	H58.00-10	Flow:Discharge	H58	MILLER PVT - E BRANCH		2' Suberged Orif.	8/15/2012	
20	H58.00-13	Flow:Discharge	H58	HOBSON PVT - E BRANCH		1' Submerged Orif.		
21	H58.00-26	Flow:Discharge	H58	OLSEN PVT P/L - E BRANCH	YES	2' Suberged Orif.	8/15/2012	
22	I12.04-01	Flow:Discharge	I12	LOWEN PVT P/L - BALLARD		1' Submerged Orif.	8/22/2009 8:00	
23	I13.00-00	Flow:Reading	I13	RUTH PVT P/L - BUTTONWILLOW				
24	I13.00-04	Flow:Discharge	I13	ASLANIAN PVT P/L -BUTTONWILLOW		1' Submerged Orif.	6/23/2007 12:00	
25	I13.00-07	Flow:Discharge	I13	RADDISH PVT P/L - BUTTONWILLOW		1' Submerged Orif.	8/9/2012 11:15	
26	I13.02-02	Flow:Discharge	I13	STAY PVT P/L - BUTTONWILLOW		1' Submerged Orif.	7/27/2012 7:00	
27	I13.05-03	Flow:Discharge	I13	BALLARD PVT - BUTTONWILLOW		1' Submerged Orif.	10/1/2011 7:00	
28	I13.18-02	Flow:Discharge	I13	LEHTO PVT P/L - BUTTONWILLOW	YES	2' Suberged Orif.	8/4/2012 7:00	
29	I13.20-04	Flow:Discharge	I13	OLIVER PVT P/L - BUTTONWILLOW		1' Submerged Orif.	6/6/2012 23:00	
30	I13.21-02	Flow:Discharge	I13	TOEWS & CAESAR PVT - BTTNWLLW		2' Suberged Orif.	8/8/2012 7:00	
31	I14.01-04	Flow:Discharge	I14	MORITZ PVT P/L - CURTIS		1' Submerged Orif.		
32	I20.05-01	Flow:Discharge	I20	EBNER PVT - A.N. SMITH		1' Submerged Orif.	8/12/2012 4:00	
33	I22.11-02	Flow:Discharge	I22	MITCHELL CLARK PVT - W GOULD		1' Submerged Orif.	8/3/2012 7:00	
34	I22.12-01	Flow:Discharge	I22	APKARIAN PVT - W GOULD		1' Submerged Orif.	7/30/2012 14:00	
35	I22.12-02	Flow:Discharge	I22	KANAWYER PVT - W GOULD		1' Submerged Orif.	8/2/2012 13:00	
36	I38.05-04	Flow:Discharge	I38	WILLEMS PVT - A.W. CLARK		1' Submerged Orif.	8/6/2012 10:00	
37	I79.02-01	Flow:Discharge	I79	KRAUSE PVT - KNESTRIC		1' Submerged Orif.	8/15/2012 18:00	
38	I79.05-01	Flow:Discharge	I79	SIBLEY PVT P/L - KNESTRIC		2' Suberged Orif.	8/13/2012 7:00	
39	J23.00-02	Flow:Discharge	J23	BELL PVT - CALIF VYD		1' Submerged Orif.	8/15/2012 15:00	
40	J23.03-02	Flow:Discharge	J23	ISAAC PVT - CALIF VYD		1' Submerged Orif.	8/8/2012 22:00	
41	J23.07-02	Flow:Discharge	J23	BELKNAP PVT - CALIF VYD		1' Submerged Orif.	8/13/2012 7:00	
42	J23.16-02	Flow:Discharge	J23	NAJARIAN PVT P/L - CALIF VYD		1' Submerged Orif.	8/12/2012	
43	J23.19-09	Flow:Discharge	J23	LEEDY PVT P/L - CALIF VYD		2' Suberged Orif.	7/15/2012	
44	J23.20-01	Flow:Discharge	J23	DITTENBIR PVT P/L - CALIF VY		1' Submerged Orif.	8/14/2012 7:00	
45	J23.21-01	Flow:Discharge	J23	RANDOLPH PVT P/L - CALIF VYD		1' Submerged Orif.	5/26/2012 11:00	
46	J23.21-02	Flow:Discharge	J23	BURROWS PVT P/L - CALIF VYD		1' Submerged Orif.	7/31/2006 7:00	
47	J23.24-04	Flow:Discharge	J23	BARR PVT P/L - CALIF VYD		1' Submerged Orif.	9/19/2006 7:00	
48	J24.03-01	Flow:Discharge	J24	SCHLOENVOGT PVT - HADEN-BOON		1' Submerged Orif.	8/15/2012 2:00	Estimated Overflow in CSF
49	J24.07-03	Flow:Discharge	J24	LAWAND PVT - HADEN-BOONE		2' Suberged Orif.	8/9/2012 7:00	Estimated Overflow in CSF
50	J25.02-03	Flow:Discharge	J25	DITTENBIR PVT P/L - HOGAN		1' Submerged Orif.	8/13/2012	
51	J25.03-01	Flow:Discharge	J25	EPP PVT - HOGAN		1' Submerged Orif.	8/7/2012	

Private Lateral Headgate Turnout List

	Turnout	MeasurementType	Subsystem	PrivateDitch	Booster	TurnoutType	LastDelivery	MeterType
52	J26.01-04	Flow:Discharge	J26	UNRUH PVT P/L - HORSMAN		2' Suberged Orif.	8/11/2012	
53	J26.01-05	Flow:Discharge	J26	JONES PVT P/L - HORSMAN		1' Submerged Orif.	7/27/2012 7:00	
54	J26.05-01	Flow:Discharge	J26	ZARETZKA PVT P/L - HORSMAN	YES	2' Suberged Orif.	7/10/2012	
55	J26.06-01	Flow:Discharge	J26	CALLISON PVT P/L - HORSMAN		2' Suberged Orif.	8/12/2012 12:00	
56	J26.09-01	Flow:Discharge	J26	HOFER PVT P/L - HORSMAN		1' Submerged Orif.	8/15/2012 14:00	
57	J26.11-01	Flow:Discharge	J26	KLEINSASSER PVT P/L - HORSMAN	YES	1' Submerged Orif.	8/15/2012 14:00	
58	J26.14-02	Flow:Discharge	J26	FERDY HOFER PVT - HORSMAN	YES	1' Submerged Orif.	8/14/2012 7:00	
59	J45.02-02	Flow:Discharge	J45	JACKSON PVT P/L - SMITH MTN		2' Suberged Orif.	8/14/2012 15:00	Estimated Overflow in CSF
60	J45.05-03	Flow:Discharge	J45	MANLOVE PVT P/L - SMITH MTN		1' Submerged Orif.	8/14/2012	
61	J45.06-01	Flow:Discharge	J45	RUSCHAUPT PVT P/L - SMITH MTN		2' Suberged Orif.	8/12/2012 7:00	
62	J45.06-07	Flow:Discharge	J45	PORTER PVT P/L - SMITH MTN		1' Submerged Orif.		
63	J45.10-03	Flow:Discharge	J45	EARHART PVT P/L - SMITH MTN	YES	2' Suberged Orif.	8/10/2012	
64	J45.13-03	Flow:Discharge	J45	NEHF PVT - SMITH MTN		1' Submerged Orif.	8/6/2012 7:00	
65	J45.13-05	Flow:Discharge	J45	CARMICHAEL PVT - SMITH MTN	YES	1' Submerged Orif.		
66	J45.15-03	Flow:Discharge	J45	McCRACKEN PVT - SMITH MTN	YES	1' Submerged Orif.	5/31/2012 7:00	
67	J76.01-02	Flow:Discharge	J76	RHODES PVT - KENNEDY WASTE WAY	YES	2' Suberged Orif.	7/11/2007 11:00	
68	J95.12-01	Flow:Discharge	J95	ROH PVT P/L - SANDRIDGE		1' Submerged Orif.	8/7/2012 7:00	
69	K21.01-10	Flow:Discharge	K21	THIESEN-KNAAK PVT-TRAVER CANAL		2' Suberged Orif.	9/30/2011 19:00	
70	K21.01-13	Flow:Discharge	K21	WARKENTIN PVT - TRAVER CANAL		1' Submerged Orif.	8/9/2012 15:00	
71	K21.03-08	Flow:Discharge	K21	THOMPSON PVT - TRAVER CANAL		2' Suberged Orif.	8/9/2012 16:00	
72	K21.04-05	Flow:Discharge	K21	DILLON PVT - TRAVER CANAL		2' Suberged Orif.	8/15/2012 23:45	
73	K21.06-01	Flow:Discharge	K21	WICKLUND PVT - TRAVER CANAL		2' Suberged Orif.	8/9/2012 18:00	
74	K21.07-04	Flow:Discharge	K21	ANDERSON PVT - TRAVER CANAL		2' Suberged Orif.	8/14/2012 7:00	
75	K29.01-02	Flow:Discharge	K29	BUHLER PVT - CAESAR		1' Submerged Orif.	8/10/2012	
76	K29.04-05	Flow:Discharge	K29	BONDESON PVT P/L - CAESAR		1' Submerged Orif.	7/21/2012 20:00	
77	K29.05-06	Flow:Discharge	K29	RICE PVT P/L - CAESAR		1' Submerged Orif.	7/30/2012 18:00	
78	K29.06-04	Flow:Discharge	K29	STONE PVT P/L - CAESAR		1' Submerged Orif.	8/14/2012 7:00	
79	K29.07-04	Flow:Discharge	K29	WALL PVT P/L - CAESAR		1' Submerged Orif.	7/25/2012 18:00	
80	K29.07-07	Flow:Discharge	K29	CURLE PVT P/L - CAESAR		2' Suberged Orif.	8/12/2012 18:00	
81	K29.08-01	Flow:Discharge	K29	HEDBURG PVT P/L - CAESAR		1' Submerged Orif.	7/29/2012 12:00	
82	K29.09-02	Flow:Discharge	K29	CARLSON PVT P/L - CAESAR		1' Submerged Orif.	8/1/2012 20:00	
83	K29.10-03	Flow:Discharge	K29	HAMMERSTEIN PVT P/L - CAESAR		1' Submerged Orif.	8/1/2006 7:00	
84	K29.13-02	Flow:Discharge	K29	SJOBERG PVT P/L - CAESAR		1' Submerged Orif.	7/17/2012 14:00	
85	K29.14-02	Flow:Discharge	K29	FORK PVT P/L - CAESAR		1' Submerged Orif.	8/15/2012 23:45	
86	K31.00-03	Flow:Discharge	K31	HARTLEY PVT - A.B. CLARK		2' Suberged Orif.	8/15/2012 23:45	
87	K31.04-01	Flow:Discharge	K31	BARSOOM PVT P/L - A.B. CLARK		2' Suberged Orif.	8/15/2012 23:45	
88	K31.05-01	Flow:Discharge	K31	ASLAN PVT P/L - A.B. CLARK		2' Suberged Orif.	6/17/2007 7:00	
89	K31.06-02	Flow:Discharge	K31	KREHBIEL PVT P/L - A.B. CLARK		1' Submerged Orif.		
90	K31.08-03	Flow:Discharge	K31	HODEL PVT - A.B. CLARK		1' Submerged Orif.	8/13/2012 8:30	
91	K31.10-02	Flow:Discharge	K31	HARMS PVT - A.B. CLARK		1' Submerged Orif.	9/30/2011 16:00	
92	K31.13-03	Flow:Discharge	K31	ERRICSON PVT - A.B. CLARK		1' Submerged Orif.	8/13/2012 15:00	
93	K32.04-03	Flow:Discharge	K32	KRUGER PVT P/L - E SEC #20		1' Submerged Orif.	8/3/2012 19:00	
94	K32.06-03	Flow:Discharge	K32	MOORE PVT P/L - E SEC #20		1' Submerged Orif.	7/17/2012	
95	K35.00-02	Flow:Reading	K35	PINKERTON PVT P/L - UPHILL			8/11/2012 14:00	
96	K35.00-05	Flow:Reading	K35	GRAMLEY PVT - UPHILL			8/6/2012 18:00	
97	K36.03-01	Flow:Discharge	K36	EDMOND PVT P/L - W SEC #20		2' Suberged Orif.	7/28/2012 8:00	
98	K75.04-02	Flow:Discharge	K75	THIESEN PVT - KENNEDY SCH HS		1' Submerged Orif.	8/6/2008 7:00	
99	K75.05-01	Flow:Discharge	K75	MARSHALL PVT - KENNEDY SCH HS		2' Suberged Orif.	8/12/2008	
100	K75.06-03	Flow:Discharge	K75	CABRAL PVT - KENNEDY SCH HOUSE		2' Suberged Orif.	8/15/2012 23:45	
101	M39.03-06	Flow:Discharge	M39	DUNN-MADISON PVT - DINUBA TOWN		2' Suberged Orif.	8/15/2012 15:00	
102	M39.04-01	Flow:Discharge	M39	POWELL PVT - DINUBA TOWN		1' Submerged Orif.	8/15/2012 15:00	
103	M39.06-04	Flow:Discharge	M39	THOMAS PVT P/L - DINUBA TOWN		2' Suberged Orif.	8/15/2012 15:00	
104	M39.11-01	Flow:Discharge	M39	BOTTS PVT P/L - DINUBA TOWN		1' Submerged Orif.	8/3/2012 7:00	
105	M39.12-03	Flow:Discharge	M39	HASH PVT - DINUBA TOWN		1' Submerged Orif.	8/1/2012 7:00	
106	M39.13-01	Flow:Discharge	M39	TOEWS PVT P/L - DINUBA TOWN		1' Submerged Orif.		
107	M39.16-04	Flow:Discharge	M39	HARPER PVT P/L - DINUBA TOWN		2' Suberged Orif.	8/15/2012 15:30	
108	M39.18-05	Flow:Discharge	M39	TRUESDALE PVT P/L -DINUBA TOWN		1' Submerged Orif.		
109	M39.20-01	Flow:Reading	M39	CALLISON PVT - DINUBA TOWN			8/7/2012 7:00	

Private Lateral Headgate Turnout List

	Turnout	MeasurementType	Subsystem	PrivateDitch	Booster	TurnoutType	LastDelivery	MeterType
110	M41.01-02	Flow:Discharge	M41	BURUM PVT P/L - DINUBA TOWN		1' Submerged Orif.	8/14/2012 5:00	
111	M43.01-02	Flow:Reading	M43	DUZEVICH PVT P/L RICE-BRUBAKER			10/1/2010 0:01	Estimated Overflow in CSF
112	M51.03-02	Flow:Discharge	M51	TRIPP PVT - NUSS		1' Submerged Orif.	7/27/2012 17:00	
113	M54.01-02	Flow:Discharge	M54	HOPSON PVT - WILSON	YES	1' Submerged Orif.	8/1/2012 6:00	
114	M54.02-01	Flow:Discharge	M54	TOUT PVT P/L - WILSON		2' Suberged Orif.	8/15/2012 14:00	
115	M54.04-03	Flow:Discharge	M54	DUNN PVT P/L - WILSON	YES	2' Suberged Orif.	8/9/2012 15:00	
116	M54.06-02	Flow:Discharge	M54	SHAW PVT P/L - WILSON		2' Suberged Orif.	8/15/2012 14:00	
117	M54.11-01	Flow:Discharge	M54	PENNINGTON PVT - WILSON		2' Suberged Orif.	8/1/2012 8:00	
118	M54.14-02	Flow:Discharge	M54	BENNETT PVT P/L - WILSON		2' Suberged Orif.	8/15/2012 14:00	
119	M54.15-02	Flow:Discharge	M54	LARUE PVT P/L - WILSON		2' Suberged Orif.		
120	M54.16-01	Flow:Discharge	M54	ALBER PVT P/L - WILSON		2' Suberged Orif.	8/15/2012 12:00	
121	M54.17-01	Flow:Discharge	M54	McCRACKEN PVT - WILSON		2' Suberged Orif.	8/12/2012 7:00	
122	M54.21-02	Flow:Discharge	M54	PATTERSON PVT - WILSON		1' Submerged Orif.	8/14/2012 7:00	
123	M54.22-01	Flow:Discharge	M54	ARNOLD PVT P/L - WILSON		2' Suberged Orif.	8/15/2012 14:30	
124	M54.26-01	Flow:Discharge	M54	WILSON-BOONE PVT - WILSON		1' Submerged Orif.	8/15/2012 15:00	
125	M54.27-05	Flow:Discharge	M54	ELLIOTT PVT - WILSON		1' Submerged Orif.	8/15/2012 15:30	
126	M54.28-01	Flow:Discharge	M54	RHODES PVT P/L - WILSON		1' Submerged Orif.	8/15/2012 15:30	
127	M54.30-01	Flow:Discharge	M54	MEADE PVT P/L - WILSON		2' Suberged Orif.	8/15/2012 17:30	
128	O47.04-01	Flow:Discharge	O47	WARD PVT - CAREY-HUNTER		1' Submerged Orif.	8/8/2012 11:00	
129	O47.06-01	Flow:Discharge	O47	HEATHMAN PVT - CAREY-HUNTER		1' Submerged Orif.	9/8/2010 6:00	
130	O47.14-01	Flow:Discharge	O47	WILTON PVT P/L - CAREY-HUNTER		1' Submerged Orif.	7/24/2012 6:00	
131	O47.18-02	Flow:Discharge	O47	CLYDE VINEYARD PVT - CAREY-HTR		2' Suberged Orif.	8/15/2012 5:00	
132	O47.21-02	Flow:Discharge	O47	PERKINS PVT - CAREY-HUNTER		1' Submerged Orif.	8/15/2012 20:00	
133	O50.00-01	Flow:Discharge	O50	ANCHOR VINEYARD PVT - MONSON I		2' Suberged Orif.	8/15/2012 20:00	
134	O50.01-02	Flow:Discharge	O50	ALI BABA PVT P/L - MONSON I		1' Submerged Orif.	8/15/2012 20:00	
135	O56.10-01	Flow:Discharge	O56	ARANGO PVT - WILSON SCH HOUSE		1' Submerged Orif.	8/15/2012 20:00	
136	O56.12-01	Flow:Discharge	O56	CALDERA PVT - WILSON SCH HOUSE		2' Suberged Orif.	8/15/2012 20:00	
137	O60.01-02	Flow:Discharge	O60	RUTLEDGE PVT - McGEE		1' Submerged Orif.	9/21/2010 23:00	
138	O60.04-01	Flow:Discharge	O60	KIDWELL PVT - McGEE		1' Submerged Orif.	8/14/2012 8:00	
139	O60.12-03	Flow:Discharge	O60	COOPER PVT - McGEE	YES	1' Submerged Orif.	8/14/2012 12:00	
140	O61.00-03	Flow:Discharge	O61	RIMMER PVT P/L - MONSON II		1' Submerged Orif.	8/15/2012 20:00	
141	O61.05-01	Flow:Discharge	O61	RHODES PVT P/L - MONSON II		1' Submerged Orif.	8/4/2012 12:00	
142	O61.07-02	Flow:Discharge	O61	SADOIAN PVT P/L - MONSON II	YES	2' Suberged Orif.	7/15/2012	
143	O61.09-01	Flow:Discharge	O61	CLUBB PVT P/L - MONSON II		2' Suberged Orif.	8/15/2012 6:00	
144	O61.15-02	Flow:Discharge	O61	TURK PVT - MONSON II		2' Suberged Orif.	8/15/2012 20:00	
145	O63.02-03	Flow:Discharge	O63	BALAKIAN PVT - NICHOLS-CANN		1' Submerged Orif.	8/9/2012 16:00	
146	T58.00-45	Flow:Discharge	T58	RICE PVT P/L - E BRANCH		2' Suberged Orif.	8/15/2012 20:00	
147	T58.00-50	Flow:Discharge	T58	BOONE PVT - E BRANCH		1' Submerged Orif.	8/15/2012 20:00	
148	T58.01-15	Flow:Discharge	T58	SCHLEICHER PVT - E BRANCH		2' Suberged Orif.	5/29/2012 7:00	
149	T58.02-01	Flow:Discharge	T58	MARTIN PVT P/L - E BRANCH	YES	1' Submerged Orif.	8/13/2012 7:00	Estimated Overflow in CSF
150	T58.03-06	Flow:Discharge	T58	KELLY PVT - E BRANCH	YES	1' Submerged Orif.	8/15/2012 7:00	
151	T58.03-14	Flow:Discharge	T58	ELLISON PVT P/L - E BRANCH		1' Submerged Orif.	8/15/2012 15:00	
152	T58.03-15	Flow:Discharge	T58	DUDLEY COLONY PVT - E BRANCH		1' Submerged Orif.	8/11/2012 18:00	
153	T64.17-05	Flow:Discharge	T64	HALFORD PVT - TOUT		1' Submerged Orif.	8/11/2012 18:00	
154	T64.19-01	Flow:Discharge	T64	BURKDOLL PVT - TOUT		2' Suberged Orif.	8/15/2012 20:00	
155	T64.21-03	Flow:Discharge	T64	SWEET PVT P/L - TOUT		2' Suberged Orif.	8/14/2012 7:00	
156	T64.25-03	Flow:Discharge	T64	ANDREWS PVT - TOUT		2' Suberged Orif.	8/10/2012	
157	T65.10-01	Flow:Discharge	T65	LEDBETTER PVT - BOWHAY		1' Submerged Orif.	8/14/2012 7:00	
158	T65.13-04	Flow:Discharge	T65	WILEMAN PVT - BOWHAY	YES	1' Submerged Orif.	8/14/2012 13:00	
159	T67.03-01	Flow:Discharge	T67	ANANIAN PVT - CLAPP		1' Submerged Orif.	8/15/2012 15:00	
160	T69.04-01	Flow:Discharge	T69	PELOIAN PVT - FLOYD		1' Submerged Orif.	8/2/2012 12:00	
161	T70.08-02	Flow:Discharge	T70	LOPER PVT P/L - LOPER		1' Submerged Orif.	8/15/2012 20:00	
162	T71.01-02	Flow:Discharge	T71	GARABEDIAN PVT P/L - LOVELL		1' Submerged Orif.		
163	T71.02-01	Flow:Discharge	T71	DIERKS PVT - LOVELL		1' Submerged Orif.	8/13/2012 18:00	
164	T71.03-01	Flow:Discharge	T71	WEBER PVT P/L - LOVELL		2' Suberged Orif.	8/12/2012 18:00	
165	W21.09-04	Flow:Discharge	W21	HOUX PVT - TRAVER CANAL		3.5' Submerged Orif.	8/15/2012 23:45	
166	W21.11-06	Flow:Discharge	W21	TAYLOR PVT - TRAVER CANAL		2' Suberged Orif.	5/23/2012 16:00	
167	W74.01-02	Flow:Reading	W74	HOFER PVT - JACK		1' Submerged Orif.		
168	W82.02-02	Flow:Discharge	W82	DEAN PVT - GROVE	YES	2' Suberged Orif.	8/10/2011 6:00	

Private Lateral Headgate Turnout List

	Turnout	MeasurementType	Subsystem	PrivateDitch	Booster	TurnoutType	LastDelivery	MeterType
169	W83.01-02	Flow:Discharge	W83	SENTER PVT P/L - McCLANAHAN		2' Suberged Orif.	8/3/2012 7:00	
170	W83.02-02	Flow:Discharge	W83	BENSON PVT P/L - McCLANAHAN		2' Suberged Orif.	8/14/2012 23:45	
171	W83.03-02	Flow:Discharge	W83	BELL PVT P/L - McCLANAHAN		1' Submerged Orif.	8/5/2012 14:00	
172	W83.04-04	Flow:Discharge	W83	COX PVT - McCLANAHAN		2' Suberged Orif.	8/15/2012 23:45	
173	W83.05-07	Flow:Discharge	W83	STIREWALT PVT - McCLANAHAN		2' Suberged Orif.	9/29/2006 7:00	
174	W83.05-08	Flow:Discharge	W83	ROGERS PVT P/L - McCLANAHAN		2' Suberged Orif.	5/1/2010 7:00	
175	W87.00-03	Flow:Discharge	W87	BARLOW PVT - TRAVER CANAL		2' Suberged Orif.	8/12/2012 9:30	
176	X73.10-01	Flow:Discharge	X73	McCOURT PVT P/L - SONTAG		1' Submerged Orif.	8/14/2012 7:00	
177	X73.12-01	Flow:Discharge	X73	JOHNSON PVT P/L - SONTAG		1' Submerged Orif.	8/15/2012 22:00	
178	X73.16-01	Flow:Discharge	X73	FEARY PVT - SONTAG		1' Submerged Orif.	8/14/2012 7:00	
179	X88.06-01	Flow:Discharge	X88	SHARP PVT - BANKS		2' Suberged Orif.	8/15/2012 20:00	
180	X88.09-03	Flow:Discharge	X88	BENNETT PVT P/L - BANKS		3' Submerged Orif.	8/11/2012 7:00	Estimated Overflow in CSF
181	X89.00-01	Flow:Discharge	X89	PATTERSON PVT P/L - BUTTON		1' Submerged Orif.	9/22/2011 7:00	
182	X89.03-01	Flow:Discharge	X89	JERRY PVT P/L - BUTTON		2' Suberged Orif.	8/15/2012 23:00	
183	X89.07-01	Flow:Discharge	X89	HANEY PVT - BUTTON	YES	2' Suberged Orif.	8/14/2012 7:00	
184	X89.08-02	Flow:Discharge	X89	FRANK PVT P/L - BUTTON		1' Submerged Orif.	8/8/2012 10:00	
185	X89.08-03	Flow:Discharge	X89	VALDEZ PVT P/L - BUTTON		1' Submerged Orif.	7/9/2012 7:00	
186	X89.10-01	Flow:Discharge	X89	TASHJIAN PVT - BUTTON		1' Submerged Orif.	8/15/2012 23:00	
187	X89.10-02	Flow:Discharge	X89	BACON PVT - BUTTON		1' Submerged Orif.	8/15/2012 23:00	
188	X89.11-02	Flow:Discharge	X89	TELLALIAN PVT P/L - BUTTON		1' Submerged Orif.		
189	X89.12-01	Flow:Discharge	X89	PHILLIPS PVT - BUTTON		1' Submerged Orif.	8/8/2012 7:00	

B

Inadequate Means of Measurement
Private Lateral Headgate Turnout List

	Turnout	Measurement Type	Subsystem	Private Ditch	Booster	Turnout Type	Last Delivery	Meter Type
1	B02.16-02	Flow: Reading	B02	GIOLETTI PVT - MT CAMPBELL			8/15/2012 7:00	Estimated Overflow in CSF
2	J24.03-01	Flow: Discharge	J24	SCHLOENVOGT PVT - HADEN-BOON		1' Submerged Orif.	8/15/2012 2:00	Estimated Overflow in CSF
3	J24.07-03	Flow: Discharge	J24	LAWAND PVT - HADEN-BOONE		2' Submerged Orif.	8/9/2012 7:00	Estimated Overflow in CSF
4	J45.02-02	Flow: Discharge	J45	JACKSON PVT P/L - SMITH MTN		2' Submerged Orif.	8/14/2012 15:00	Estimated Overflow in CSF
5	M43.01-02	Flow: Reading	M43	DUZEVICH PVT P/L RICE-BRUBAKER			10/1/2010 0:01	Estimated Overflow in CSF
6	T58.02-01	Flow: Discharge	T58	MARTIN PVT P/L - E BRANCH	YES	1' Submerged Orif.	8/13/2012 7:00	Estimated Overflow in CSF
7	X88.09-03	Flow: Discharge	X88	BENNETT PVT P/L - BANKS		3' Submerged Orif.	8/11/2012 7:00	Estimated Overflow in CSF

C

METHODS and DEVICES

Used in measurement and regulations of flow to
Alta laterals, service ditches and pipelines,
together with tables for filed use.

2008

Alta Irrigation District
Dinuba, CA

MEASUREMENT OF IRRIGATION WATER

The flow of water will be measured and reported as cubic feet per second and the amounts of water as acre feet. For ease of conception, a cubic foot per second, or second foot as it is usually called, may be defined as the flow of water carried by a flume one foot deep and one foot wide, if the water flows at the unit if quantity may be defined as the amount of water required to cover an area of on acre, one foot deep. For convenience in the computations, the following quantities are given:

1. One second foot of water flowing continuously for 12 hours is equivalent to practically one acre foot.
2. One second foot of water flowing for one hour is the equivalent to one acre inch, which is defined as the amount of water required to cover an area of one acre, one inch deep.
3. One second foot of water is equivalent to 7 ½ gallons per second or to 450 gallons per minute.
4. One acre foot of water contains 43,560 cubic feet.

METHODS OF MEASURING WATER

Water can be measured through an undershot gate, or submerged orifice as it is called, by an over pour or weir measurement, and by measuring the cross section of the ditch and obtaining the velocity of water therein by means of floats, or current meter. These ways of measuring water will be referred to as Methods I, II, and III, respectively.

METHOD I – ORIFICE MEASUREMENT

The flow of water in this case depends upon, (a) the difference of water levels above and below the gate, this difference being called the "head" of water upon the gate, and (b) upon the area of the opening through which the water passes. To obtain the difference of water level above and below the gate, proceed as follows:

1. First, from the level line established on the gate, measure vertically to the surface of the water below the gate.
2. Second, from the same level on the gate, measure vertically to the surface of the water above the gate, and as far back of the opening as possible. Get both these measurements in inches. Subtract the last measurement form the first one, and the difference gives the head under which the water is flowing.

To obtain the area of the opening, measure:

1. First, measure the distance vertically from the saw scarf in the stem of the gate, to the stop of the crossbar which is even with the saw mark when the gate is closed.
2. Second, measure the clear width of the gate between the cleats. Get both measurements in inches and multiply them, and the results gives the number of square inches in the opening.

From Table 1 find the coefficient or multiplier corresponding to the head under which the water is flowing through the gate. Multiply this coefficient by the number of square inches in the gate opening, and the result will be the amount of water flowing through the gates in cubic feet per second.

If the water falls freely through the orifice and discharges into the air below the opening, instead of into the water, then the "head" is measured form the surface of the water above the gate to the center of the opening, the area of the opening being obtained in the same manner as above outlined.

METHOD II – WIER MEASUREMENT

While the standard gates are not designed to measure water by an over pour, yet in cases it may be found convenient to construct or adapt gates to this form of measuring.

The flow of water through an over pour gate depends upon the depth, or head, of water above the weir boards. To ascertain the amount of water flowing by Method II, proceed as follows:

1. First, from a level line established on the gate, measure vertically to the top of the weir board, over which the water is flowing. From the same level line, and far back upstream as the length of the gate will allow, measure vertically to the surface of the water. Get both these measurements in inches, and subtract the latter from the former and the difference will give the head or depth of the water on the weir crest.
2. Second, measure the clear width of the weir between the cleats in inches.

From table II, find the coefficient or multiplier corresponding to the head obtained and multiply this coefficient by the number of inches in the width of the gate, and the result will be the amount of water pouring over the gate, in cubic feet per second.

MEHTOD III – VELOCITY MEASURMENT

Velocity may be measured with a current meter of by means of floats. Current meter measurements will not be possible for the ordinary water user, but float measurements while not usually very accurate, can be made close enough to give a fair approximation of the amount of water flowing. To measure water with floats, proceed as follows:

1. First, select a straight stretch of ditch which is fairly clean of weeds, etc., and through which the water flows uniformly, and pace off 30 to 50 feet of this section. Use chips or some form of float that will not be affected by the wind. Note the time in seconds required for the float to traverse the length of the ditch paced. Do this several times and take the average of the time required. Then the length of the ditch in feet, divided by the number of seconds required for the float to cover that distance, and multiplied by eight-tenths (.8) will give the velocity of the water in feet per second.

2. Second, measure the depth and width of the ditch in feet and find how many square feet there are in the cross-section of the water flowing. The number of square feet in the cross-section of the ditch, multiplied by the average velocity in feet per second as found by the floats, will give the amount of water flowing in the ditch, in cubic feet per second.

The foregoing methods of measuring water would be sufficiently accurate for all practical purposes provided all turnouts were of standard size and proper design and construction. Since the present turnouts vary more or less in all these particulars, measurement of the flow of water under present conditions can only be approximate. To prevent guess work the measurement and distribution of water to irrigators and to small lateral ditches, improved, standard, measuring devices were adopted and have been and are being installed as fast as finances permit. These devices are designated as the "Adjustable Rectangular Submerged Orifice" and the "Calibrated Turnout Gate".

THE ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE

The "Adjustable Rectangular Submerged Orifice" is an orifice and slide constructed of galvanized sheet metal, used in conjunction with and placed above a turnout gate, details of which are show in Figure 1. IN the slide stem, seven holes have been drilled, three inches apart from 0 inch to 18 inch. When the gate is closed, the top hole in the slide stem coincides with a hole in an iron strap set in the concrete head. By inserting an iron pin in a hole of the slide stem and the iron strap in the concrete head any desired opening of the slide, at intervals of three inches, may be had.

Example use of tables: With the slide stem set for a six inch opening, a flow of two second feet is required.

Answer: In table III under the third column headed six inches, find two second feet. In the first column to the left, opposite two second feet, find the required head which in this case is 7. Operate the turnout gate either up or down to obtain this head. **Note:** The head is obtained by means of a hook-gauge or other device and is the difference in the water level in the supply ditch and water level below the orifice.

List of variable rectangular submerged orifices at the heads of various ditches in the Alta Irrigation District.

2 Foot Width
Andrews
Austin
Ballard
Barlow
Bump & Edmiston
Clapp
Clark, A & W
Curtis, Lower
Curtis, Upper
Driver
Elter
Floyd
Frane
Frey
Gordon
Gould, East
Grove
Haymaker
Jack
Kirk
Loper
Lovell
McGee
Montague
Mt. Campbell
Nuss
Orosi School House
Parenti
Parks
Peck
Rep
Rice - Brubaker
Small
Sontag
Van Noy
Wilson - Hunter
Windsor

3 Foot Width
Banks
Carpenter
Haden & Boone

3 Foot Width Cont.
Knestric
Nichols - Cann
Sandridge
Traver Town
Wahtoke
Wilson School House

3 1/2 Foot Width
Bowhay
Kennedy Wasteway Slough

4 Foot Width
Gould, West
Hogan
Horsman
Kennedy School house
Kennedy Wasteway
Smith, A.N.
Williams, J.T.

4 1/2 Foot Width
Carey Hunter

6 Foot Width
Caesar
California Vineyard
Clark, A.B.
McClanahan
Tout
Wilson

Parshall Flumes	
Buttonwillow No. 1	8 ft. wide
Button	4 ft. wide
Clements	4 ft. wide
Dinuba Town	4 ft. wide
Monson No. 2	8 ft. wide
Reedley Main	10 ft. wide
Smith Mtn.	4 ft. wide
Traver Main	15 ft. wide

TABLE I

PRESSURE MEASUREMENT

DISCHARGE IN CUBIC FEET PER SECOND,
PER SQUARE INCH OF OPENING

HEAD IN INCHES	COEFFICIENT	HEAD IN INCHES	COEFFICIENT	HEAD IN INCHES	COEFFICIENT
1.0	0.0106	14.5	0.0404	28.0	0.0562
1.5	0.0130	15.0	0.0412	28.5	0.0568
2.0	0.0150	15.5	0.0418	29.0	0.0572
2.5	0.0168	16.0	0.0425	29.5	0.0578
3.0	0.0184	16.5	0.0432	30.0	0.0582
3.5	0.0199	17.0	0.0439		
4.0	0.0212	17.5	0.0444		
4.5	0.0225	18.0	0.0451		
5.0	0.0237	18.5	0.0457		
5.5	0.0249	19.0	0.0464		
6.0	0.0260	19.5	0.0469		
6.5	0.0272	20.0	0.0476		
7.0	0.0281	20.5	0.0481		
7.5	0.0292	21.0	0.0487		
8.0	0.0301	21.5	0.0493		
8.5	0.0310	22.0	0.0498		
9.0	0.0319	22.5	0.0504		
9.5	0.0327	23.0	0.0510		
10.0	0.0336	23.5	0.0516		
10.5	0.0345	24.0	0.0521		
11.0	0.0353	24.5	0.0526		
11.5	0.0361	25.0	0.0531		
12.0	0.0369	25.5	0.0536		
12.5	0.0376	26.0	0.0542		
13.0	0.0383	26.5	0.0548		
13.5	0.0391	27.0	0.0553		
14.0	0.0398	27.5	0.0558		

TABLE II

OVER POUR TABLE

DISCHARGES IN CUBIC FEET PER SECOND, PER
INCH WIDTH OF WIER EACH ONE-QUARTER INCH DEPTH

DEPTH OF OVERPOUR IN INCHES	0	ONE-QUARTER	ONE-HALF	THREE-QUARTERS
0	0.0000	0.0008	0.0024	0.0043
1	0.0067	0.0093	0.0122	0.0155
2	0.0189	0.0225	0.0264	0.0305
3	0.0335	0.0391	0.0437	0.0485
4	0.0537	0.0586	0.0664	0.0690
5	0.0746	0.0803	0.0861	0.0921
6	0.0981	0.1043	0.1106	0.1170
7	0.1236	0.1303	0.1371	0.1440
8	0.1511	0.1582	0.1654	0.1728
9	0.1803	0.1878	0.1955	0.2032
10	0.2111	0.2190	0.2271	0.2353
11	0.2436	0.2519	0.2603	0.2688
12	0.2775	0.2862	0.2950	0.3039
13	0.3129	0.3219	0.3311	0.3404
14	0.3497	0.3592	0.3687	0.3782
15	0.3878	0.3975	0.4074	0.4173
16	0.4273	0.4373	0.4474	0.4576
17	0.4679	0.4782	0.4887	0.4992
18	0.5098	0.5205	0.5312	0.5420
19	0.5528	0.5638	0.5748	0.5859
20	0.5971	0.6083	0.6196	0.6309
21	0.6424	0.6539	0.6655	0.6772
22	0.6889	0.7007	0.7125	0.7244
23	0.7363	0.7484	0.7605	0.7727
24	0.7849	0.7973	0.8098	0.8224

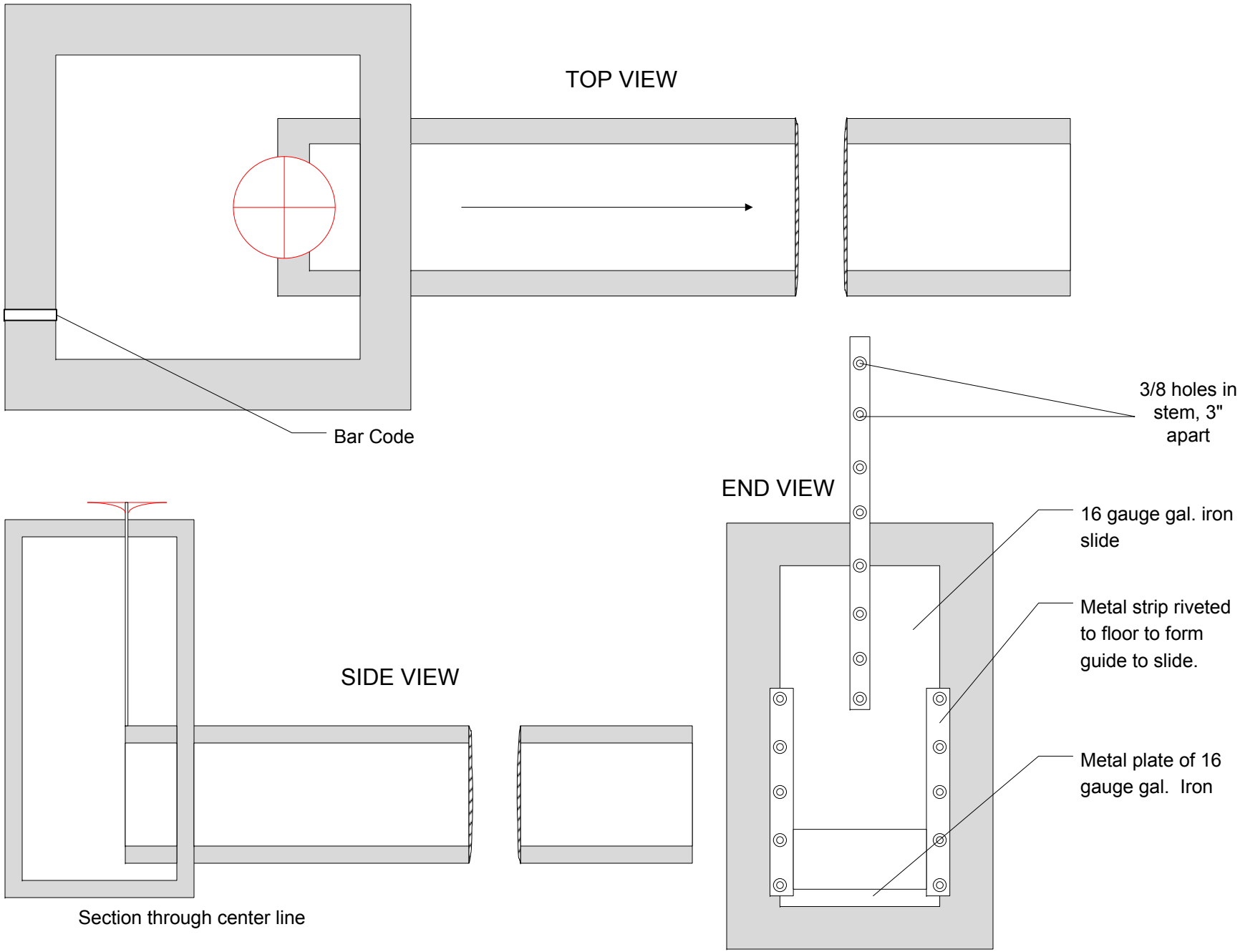
TOP VIEW
Bar Code
3/8 holes in stem, 3" apart
END VIEW
16 gauge gal. iron slide
Metal strip riveted to floor to form guide to slide.
Metal plate of 16 gauge gal. Iron
SIDE VIEW
Section through center line

FIGURE I

TABLE III

DISCHARGE IN CUBIC FEET PER SECOND FOR RECTANGULAR SUBMERGED ORIFICE
1 FOOT SLIDE WIDTH

HEAD IN FEET	3"	6"	9"	1'0"	1'3"	1'6"	2'0"	2'6"	3'0"	3'6"	4'0"	4'6"
0.02	0.17	0.34	0.52	0.69	0.86	1.03	1.38	1.57	2.05	2.41	2.76	3.10
0.04	0.22	0.49	0.73	0.98	1.22	1.47	1.95	2.48	2.94	3.42	3.92	4.40
0.06	0.30	0.60	0.89	1.20	1.49	1.79	2.38	3.00	3.58	4.17	4.78	5.36
0.08	0.34	0.69	1.03	1.38	1.73	2.07	2.76	3.50	4.14	4.82	5.52	6.20
0.10	0.39	0.77	1.16	1.55	1.94	2.32	3.09	3.86	4.65	5.41	6.20	6.95
0.15	0.47	0.94	1.43	1.89	2.36	2.83	3.77	4.72	5.67	6.60	7.57	8.50
0.20	0.54	1.08	1.63	2.18	2.73	3.27	4.36	5.45	6.56	7.63	8.75	9.82
0.30	0.67	1.33	2.00	2.67	3.34	4.01	5.34	6.67	8.03	9.35	10.73	12.05
0.40	0.77	1.54	2.31	3.09	3.86	4.64	6.17	7.71	9.27	10.80	12.39	13.90
0.50	0.86	1.72	2.58	3.46	4.33	5.18	6.90	8.64	10.39	12.08	13.84	15.54
0.60	0.94	1.88	2.82	3.78	4.73	5.66	7.55	9.44	11.36	13.35	15.12	17.00
0.70	1.02	2.03	3.06	4.09	5.12	6.13	8.16	10.21	12.27	14.29	16.37	18.38
0.80	1.08	2.16	3.24	4.33	5.42	6.50	8.70	10.81	13.00	15.14	17.35	19.50
0.90	1.15	2.31	3.46	4.63	5.80	6.96	9.25	11.58	13.90	16.18	18.54	20.80
1.00	1.22	2.44	3.66	4.90	6.12	7.34	9.78	12.23	14.70	17.10	19.60	22.00
1.10	1.28	2.56	3.84	5.14	6.44	7.70	10.28	12.85	15.45	17.98	20.60	23.10
1.20	1.33	2.66	3.99	5.34	6.67	8.00	10.66	13.35	16.00	18.62	21.35	24.00
1.30	1.39	2.78	4.17	5.59	6.98	8.37	11.15	13.96	16.75	19.50	22.30	25.05
1.40	1.44	2.88	4.32	5.78	7.22	8.65	11.54	14.45	17.33	20.18	23.10	25.95
1.50	1.49	2.98	4.46	5.98	7.47	8.95	11.93	14.93	17.92	20.85	23.90	26.80
1.60	1.54	3.07	4.61	6.17	7.70	9.25	12.32	15.41	18.50	21.52	24.84	27.70
1.70	1.59	3.17	4.76	6.37	7.96	9.54	12.71	15.90	19.10	22.20	25.42	28.60
1.80	1.63	3.27	4.60	6.57	8.20	9.84	13.10	16.38	19.70	22.90	26.22	29.47
1.90	1.68	3.37	5.05	6.77	8.45	10.10	13.50	16.88	20.30	23.60	27.02	30.38
2.00	1.72	3.44	5.16	6.90	8.63	10.35	13.80	17.27	20.74	24.13	27.62	31.00
2.10	1.75	3.51	5.27	7.06	8.82	10.57	14.10	17.36	21.20	24.62	28.22	31.70
2.20	1.80	3.61	5.42	7.25	9.06	10.85	14.48	18.10	21.73	25.30	29.00	32.53
2.30	1.84	3.68	5.53	7.40	9.25	11.08	14.78	18.46	22.20	25.80	29.60	33.20
2.40	1.89	3.78	5.67	7.60	9.50	11.37	15.16	18.98	22.80	26.50	30.39	34.00
2.50	1.93	3.86	5.77	7.74	9.67	11.60	15.45	19.30	23.22	27.00	31.00	34.80
2.60	1.96	3.93	5.90	7.89	9.85	11.82	15.75	19.70	23.66	27.50	31.56	35.40
2.70	2.00	4.00	6.00	8.03	10.05	12.04	16.04	20.02	24.10	28.00	32.12	36.10
2.80	2.03	4.07	6.11	8.18	10.22	12.26	16.34	20.04	24.55	28.58	32.75	36.75
2.90	2.07	4.15	6.22	8.33	10.41	12.47	16.62	20.80	25.00	29.05	33.30	37.40
3.00	2.11	4.22	6.33	8.48	10.60	12.70	16.91	21.16	25.45	29.60	33.90	38.06

TO FIND THE DISCHARGE OF RECTANGULAR SUBMERGED ORIFICIES OF VARIOUS WIDTHS. Having the head and gate opening given, find the discharge for a 1 foot orifice from the above table, multiply this amount by the width in feet of the orifice in question.

TABLE IV

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

DISCHARGE IN CUBIC FEET PER SECOND FOR FLUMES OF VARIOUS THROAT WIDTHS											
UPPER HEAD	4'	6'	8'	10'	15'	UPPER HEAD	4'	6'	8'	10'	15'
0.20	1.3					2.35	61.6	93.8	126.3	159.1	227.0
0.25	1.8	2.6				2.40	63.7	97.0	130.7	164.6	236.0
0.30	2.4	3.5	4.6			2.40	65.8	100.2	135.1	170.0	242.0
0.35	3.1	4.5	5.9			2.50	67.9	103.5	139.5	175.8	250.0
0.40	3.8	5.6	7.3	9.1		2.55	70.1	106.8	143.9	181.6	258.0
0.45	4.5	6.7	8.9	11.0		2.60	72.3	110.2	148.4	187.4	267.0
0.50	5.4	7.9	10.5	13.0	19.0	2.65	74.5	113.7	153.0	193.2	275.0
0.55	6.2	9.2	12.2	15.2	22.0	2.70	76.7	117.0	157.7	199.1	283.0
0.60	7.1	10.6	14.1	17.5	25.0	2.75	78.8	120.5	162.4	205.1	292.0
0.65	8.1	12.1	16.0	19.9	29.0	2.80	81.2	124.0	167.2	211.2	300.0
0.70	9.1	13.6	18.0	22.5	33.0	2.85	83.5	127.6	172.0	217.3	309.0
0.75	10.2	15.2	20.1	25.1	36.0	2.90	85.8	131.1	176.9	223.9	317.0
0.80	11.3	16.8	22.4	27.9	40.0	2.95	88.2	134.8	181.8	229.8	326.0
0.85	12.4	18.5	24.6	30.8	45.0	3.00	9.6	138.4	186.8	236.1	335.0
0.90	13.6	2.3	27.0	33.7	49.0	3.05	93.0	142.1	191.8	242.4	344.0
0.95	14.8	22.1	29.5	36.8	53.0	3.10	95.4	145.8	197.0	248.9	353.0
1.00	16.0	24.0	32.0	40.0	58.0	3.15	97.8	149.6	201.9	255.5	362.0
1.05	17.3	25.9	34.6	43.3	63.0	3.20	100.3	153.4	207.2	262.0	371.0
1.10	18.6	27.9	37.3	46.7	67.0	3.25					381.0
1.15	19.9	30.0	40.1	50.1	72.0	3.30					390.0
1.20	21.3	32.1	42.9	53.7	77.0	3.35					400.0
1.25	22.7	34.3	45.8	57.4	82.0	3.40					409.0
1.30	24.2	36.5	48.8	61.0	88.0	3.45					419.0
1.35	25.7	38.7	5.8	65.0	93.0	3.50					428.0
1.40	27.2	41.0	54.9	68.9	99.0	3.55					438.0
1.45	28.8	43.4	58.1	72.9	105.0	3.60					448.0
1.50	30.3	45.8	61.4	77.0	111.0	3.65					458.0
1.55	31.9	48.3	64.7	81.2	116.0	3.70					468.0
1.60	33.6	50.8	68.1	85.5	123.0	3.75					478.0
1.65	35.3	53.3	71.6	89.8	129.0	3.80					489.0
1.70	37.0	55.9	75.1	94.3	135.0	3.85					500.0
1.75	38.7	58.6	78.7	98.8	142.0	3.90					510.0
1.80	40.4	61.3	82.3	103.4	148.0	3.95					520.0
1.85	42.2	64.0	86.0	108.1	154.0	4.00					531.0
1.90	44.0	66.8	89.8	112.9	161.0	4.05					542.0
1.95	45.9	69.6	93.6	117.7	168.0	4.10					553.0
2.00	47.8	72.5	97.5	122.6	175.0	4.15					564.0
2.05	49.7	75.4	101.4	127.6	182.0	4.20					574.0
2.10	51.6	78.4	105.4	32.7	189.0	4.25					585.0
2.15	53.5	81.4	109.5	137.8	197.0	4.30					596.0
2.20	55.5	84.4	113.6	143.0	204.0	4.35					609.0
2.25	57.5	87.5	117.8	148.3	212.0	4.40					618.0
2.30	59.6	90.6	122.0	153.7	219.0	4.45					630.0

TABLE V

DISCHARGE IN SECOND FEET ADJUSTABLE
RECTANGULAR SUBMERGED ORIFICE
2 FEET SLIDE WIDTH

HEAD IN FEET	NET SLIDE WIDTH IN FEET AND INCHES							
	3"	6"	9"	1.0"	1.3"	1.6"	1.9"	2.0"
0.02	0.3	0.7	1.0	1.4	1.8	2.1	2.5	2.8
0.04	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
0.06	0.6	1.2	1.8	2.4	3.0	3.6	4.3	4.9
0.08	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6
0.10	0.8	1.6	2.4	3.1	3.9	4.7	5.5	6.3
0.12	0.8	1.7	2.6	3.4	4.3	5.2	6.0	6.9
0.40	0.9	1.9	2.8	3.7	4.6	5.6	6.5	7.4
0.16	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
0.18	1.0	2.1	3.2	4.2	5.3	6.3	7.4	8.4
0.20	1.1	2.2	3.3	4.4	5.5	6.7	7.8	8.9
0.22	1.1	2.3	3.5	4.7	5.8	7.0	8.2	9.3
0.24	0.2	2.4	3.7	4.9	6.1	7.3	8.5	9.7
0.26	1.2	2.5	3.8	5.1	6.3	7.6	8.9	10.1
0.28	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5
0.30	1.3	2.7	4.1	5.4	6.8	8.1	9.5	10.9
0.32	1.4	2.8	4.2	5.6	7.0	8.4	9.9	11.3
0.34	1.4	2.9	4.3	5.8	7.2	8.7	10.1	11.6
0.36	0.4	3.0	4.5	6.0	7.5	8.9	10.4	11.9
0.38	1.5	3.1	4.6	6.1	7.7	9.2	10.7	12.3
0.40	1.5	3.1	4.7	6.3	7.9	9.4	11.0	12.6
0.45	1.6	3.3	5.0	6.6	8.3	10.0	11.7	13.3
0.50	1.7	3.5	5.3	7.0	8.8	10.5	12.3	14.0
0.55	1.8	3.7	5.5	7.4	9.2	11.1	12.9	14.8
0.60	1.9	3.9	5.8	7.7	9.6	11.6	13.5	15.5
0.65	1.9	4.0	6.0	8.0	10.0	12.0	14.0	16.0
0.70	2.0	4.2	6.2	8.3	10.4	12.5	14.6	16.7
0.75	2.1	4.3	6.5	8.6	10.8	12.9	15.1	17.3
0.80	2.2	4.5	6.7	8.9	11.1	13.4	15.6	17.8
0.85	2.2	4.6	6.9	9.2	11.5	13.8	16.1	18.4
0.90	2.3	4.7	7.1	9.5	11.8	14.2	16.6	18.9
0.95	2.3	4.9	7.3	9.7	12.1	14.6	17.0	19.4
1.00	2.4	5.0	7.5	10.0	12.4	14.9	17.4	19.9

TABLE VI

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

HEAD IN FEET	3 FOOT SLIDE WIDTH IN FEET AND TENTHS OF FEET											
	.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0
0.02	0.4	0.8	1.3	1.7	2.1	2.5	3.0	3.4	3.8	4.2	5.3	6.4
0.04	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	7.4	8.9
0.06	0.7	1.4	2.2	2.9	3.6	4.4	5.1	5.8	6.6	7.3	9.1	10.9
0.08	0.8	1.7	2.5	3.4	4.2	5.1	5.9	6.8	7.6	8.4	10.6	12.7
0.10	0.9	1.9	2.8	3.8	4.7	5.6	6.6	7.5	8.5	9.4	11.8	14.1
0.12	1.0	2.0	3.0	4.1	5.2	6.2	7.2	8.3	9.3	10.3	12.9	15.5
0.14	1.1	2.2	3.4	4.5	5.6	6.7	7.8	8.9	0.0	11.2	13.9	16.7
0.16	1.2	2.4	3.6	4.8	6.0	7.2	8.3	9.6	10.8	11.9	14.9	17.9
0.18	1.3	2.5	3.8	5.1	6.3	7.6	8.8	10.1	11.4	12.6	15.8	19.0
0.20	1.3	2.6	4.0	5.3	6.7	8.0	9.3	10.7	12.0	13.3	16.6	20.0
0.22	1.4	2.8	4.2	5.6	7.0	8.4	9.8	11.2	12.6	14.0	17.5	21.0
0.24	1.0	2.9	4.4	5.9	7.3	8.8	10.2	11.7	13.2	14.6	18.3	21.9
0.26	1.5	3.0	4.6	6.1	7.6	9.1	10.6	12.2	13.7	15.2	19.0	22.8
0.28	1.6	3.1	4.7	6.3	7.9	9.5	11.0	12.6	14.2	15.8	19.7	23.7
0.30	1.6	3.2	4.9	6.5	8.1	9.8	11.4	13.1	14.7	16.3	20.4	24.4
0.32	1.7	3.4	5.1	6.8	8.4	10.1	11.8	13.5	15.2	16.9	21.1	25.3
0.34	1.7	3.5	5.2	7.0	8.7	10.4	12.1	13.9	15.6	17.4	21.7	26.1
0.36	1.8	3.6	5.5	7.2	8.9	10.7	12.5	14.3	16.1	17.9	22.4	26.8
0.38	1.8	3.7	5.5	7.4	9.2	11.0	12.9	14.8	16.6	18.4	23.0	27.6
0.40	1.9	3.8	5.7	7.6	9.4	11.3	13.2	15.1	17.0	18.9	23.6	28.3
0.45	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	25.0	30.0
0.50	2.1	4.2	6.4	8.4	10.5	12.6	14.7	16.9	19.0	21.1	26.4	31.6
0.55	2.2	4.4	6.7	8.9	11.1	13.3	15.5	17.7	19.9	22.0	27.7	33.2
0.60	2.3	4.6	7.0	9.3	15.0	13.8	16.1	18.5	20.8	23.1	28.8	34.7
0.65	2.4	4.8	7.2	9.6	12.0	14.4	16.8	19.2	21.6	24.0	30.0	36.0
0.70	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	31.2	37.5
0.75	2.5	5.1	7.8	10.4	12.9	15.5	18.1	20.7	23.3	25.9	32.3	38.8
0.80	2.6	5.3	8.0	10.7	13.4	16.0	18.7	21.4	24.0	26.7	33.4	40.1
0.85	2.7	5.5	8.3	11.0	13.8	16.5	19.2	22.1	24.8	27.5	34.4	41.3
0.90	2.8	5.6	8.5	11.4	14.2	17.0	19.8	22.7	25.5	28.3	35.4	42.5
0.95	2.9	5.8	8.8	11.7	14.5	17.4	20.3	23.3	26.2	29.1	36.4	43.6
1.00	3.0	5.9	9.0	11.9	14.9	17.9	20.9	23.9	26.9	29.8	37.3	44.8
1.05	3.0	6.1	9.2	12.2	15.3	18.3	21.4	24.5	27.5	30.6	38.2	45.9
1.10	3.1	6.2	9.4	12.5	15.7	18.8	21.9	25.0	28.2	31.3	39.2	47.0
1.15	3.2	6.4	9.6	12.8	16.0	19.2	22.4	25.7	28.6	32.0	40.0	48.0
1.20	3.2	6.5	9.9	13.1	16.4	19.6	22.9	26.2	29.5	32.7	40.9	49.1

TABLE VII

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

HEAD IN FEET	3.5 FOOT SLIDE WIDTH IN FEET AND TENTHS OF FEET									
	.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0
0.02	0.5	1.0	1.5	2.0	2.5	3.7	4.9	6.1	7.4	8.6
0.04	0.7	1.4	2.1	2.8	3.5	5.2	7.0	8.7	10.4	12.2
0.06	0.8	1.7	2.5	3.4	4.2	6.4	8.5	10.6	12.7	14.9
0.08	1.0	2.0	2.9	3.9	4.9	7.4	9.8	12.2	14.7	17.2
0.10	1.1	2.2	3.3	4.4	5.5	8.3	11.0	13.7	16.5	19.3
0.12	0.2	2.4	3.6	4.8	6.0	9.0	12.0	15.1	18.1	21.0
0.14	0.3	2.6	3.9	5.2	6.5	9.7	13.0	16.2	19.5	22.8
0.16	0.4	2.8	4.2	5.6	7.0	10.4	13.9	17.4	20.9	24.4
0.18	0.5	2.9	0.4	5.9	7.4	11.1	14.7	18.5	22.1	25.8
0.20	1.6	3.1	4.7	6.2	7.8	11.7	15.6	19.5	23.4	27.2
0.22	1.6	3.3	4.9	6.5	8.2	12.2	16.3	20.4	24.4	28.5
0.24	1.7	3.4	5.1	6.8	8.5	12.8	17.1	21.4	25.6	29.8
0.26	1.8	3.6	5.3	7.0	8.9	13.3	17.8	22.2	26.6	31.1
0.28	1.8	3.7	5.5	7.3	9.2	13.8	18.4	23.0	27.6	32.2
0.30	1.9	3.8	5.7	7.6	9.5	14.2	19.0	23.8	28.5	33.2
0.32	2.0	3.9	5.9	7.8	9.8	14.7	19.7	24.6	29.5	34.4
0.34	2.0	4.1	6.1	8.1	10.1	15.2	20.3	25.4	30.4	35.5
0.36	2.1	4.2	6.3	8.4	10.5	15.7	20.9	26.2	31.4	36.6
0.38	2.1	4.3	6.4	8.6	10.7	16.1	21.4	26.8	32.2	37.5
0.40	2.2	4.4	6.6	8.8	11.0	16.5	22.0	27.5	33.0	38.4
0.45	2.3	4.7	7.0	9.3	11.7	17.5	23.3	29.2	35.0	40.8
0.50	2.5	4.9	7.4	9.9	12.3	18.4	24.6	30.7	36.8	43.0
0.55	2.6	5.2	7.7	10.3	12.9	19.3	25.8	32.2	38.6	45.1
0.60	2.7	5.3	8.1	10.7	13.5	20.2	26.9	33.6	40.4	47.1
0.65	2.8	5.6	8.4	11.2	14.0	21.0	28.0	35.0	42.1	49.0
0.70	2.9	5.8	8.7	11.6	14.6	21.8	29.1	36.4	43.7	50.9
0.75	3.0	6.0	9.0	12.0	15.1	22.6	30.1	37.6	45.2	52.7
0.80	3.1	6.2	9.3	12.4	15.5	23.3	31.1	38.8	43.6	54.4
0.85	3.2	6.4	9.6	12.8	16.1	24.1	32.1	40.0	48.1	56.1
0.90	3.3	6.6	9.9	13.2	16.5	24.8	33.0	41.2	49.5	58.0

TABLE VIII

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

HEAD IN FEET	4 FOOT SLIDE WIDTH IN FEET AND TENTHS OF FEET										
	.2	.4	.6	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0
0.02	0.55	1.15	1.70	2.25	2.85	4.20	5.60	7.00	8.40	9.80	11.30
0.04	0.80	1.60	2.40	3.20	4.00	5.95	8.00	9.95	11.90	13.95	15.90
0.06	0.95	1.95	2.90	3.90	4.80	7.30	9.70	12.15	14.55	17.00	19.50
0.08	1.15	2.25	3.35	4.45	5.60	8.45	11.20	14.00	16.80	19.60	22.50
0.10	1.25	2.50	3.75	5.05	6.30	9.45	12.60	15.70	18.85	22.05	25.10
0.12	1.35	2.75	4.10	5.50	6.85	10.30	13.75	17.25	20.65	24.10	27.50
0.14	1.50	2.95	4.45	5.95	7.45	11.10	14.85	18.55	22.30	26.00	29.70
0.16	1.60	3.20	4.80	6.40	8.00	11.90	15.90	19.80	23.85	27.85	31.80
0.18	1.70	3.35	5.05	6.75	8.45	12.65	16.80	21.10	25.25	29.50	33.70
0.20	1.80	3.55	5.35	7.10	8.90	13.35	17.80	22.30	26.70	31.41	35.50
0.22	1.85	3.75	5.60	7.45	9.35	13.95	18.65	23.30	27.90	32.55	37.30
0.24	1.95	3.90	5.85	7.75	9.75	14.60	19.55	24.40	29.25	34.10	38.90
0.26	2.05	4.10	6.05	8.10	10.15	15.20	20.30	25.40	30.40	35.55	40.50
0.28	2.10	4.25	6.30	8.40	10.50	15.75	21.05	26.30	31.50	37.05	42.00
0.30	2.15	4.35	6.50	8.70	10.85	16.25	21.75	27.20	32.60	38.00	43.50
0.32	2.25	4.45	6.75	8.95	11.25	16.85	22.55	28.10	33.70	39.35	45.00
0.34	2.30	4.65	6.95	9.25	11.55	17.35	23.20	29.00	34.75	40.55	46.40
0.36	2.40	4.80	7.15	9.55	11.95	17.90	23.90	29.90	35.85	41.80	47.70
0.38	2.50	4.90	7.30	9.80	12.25	18.35	24.50	30.60	36.75	42.85	49.00
0.40	2.55	5.00	7.50	10.05	12.70	18.38	25.15	31.40	37.70	43.90	50.30
0.45	2.65	5.35	8.00	10.65	13.35	19.95	26.65	33.35	40.00	46.65	53.30
0.50	2.85	5.60	8.40	11.25	14.05	21.00	28.10	35.35	42.10	49.15	56.20
0.55	2.95	5.90	8.75	11.80	14.75	22.05	29.50	36.85	44.15	51.55	59.00
0.60	3.10	6.10	9.25	11.90	15.45	23.10	30.80	38.45	46.50	53.85	61.60
0.65	3.20	6.40	9.60	12.80	16.00	24.00	32.00	40.00	48.05	56.00	64.10
0.70	3.30	6.65	9.95	13.30	16.65	24.90	33.25	41.55	49.85	58.15	66.60
0.75	3.45	6.85	10.30	13.75	17.25	25.80	34.45	43.00	51.60	60.20	68.90
0.80	3.55	7.10	10.65	14.20	17.75	26.65	35.55	44.40	53.30	62.15	71.20
0.85	3.65	7.30	11.00	14.65	18.35	27.55	36.70	45.80	54.95	64.15	73.30
0.90	3.75	7.55	11.00	15.10	18.85	28.35	37.75	47.15	56.60	66.20	75.50
0.95	3.80	7.75	11.60	15.50	19.40	29.10	38.80	48.40	58.10	67.90	77.50
1.00	3.97	7.95	11.90	15.90	19.90	29.80	39.70	49.70	59.60	69.60	79.50
1.05	4.10	8.10	12.20	16.30	20.40	30.60	40.70	50.90	61.10	71.30	81.50
1.10	4.20	8.30	12.50	16.70	20.80	31.40	41.70	52.10	62.50	73.00	83.40
1.15	4.30	8.50	12.80	17.10	21.10	32.20	42.70	53.30	64.00	74.60	85.40
1.20	4.40	8.70	13.10	17.50	21.70	32.70	43.50	54.50	65.40	76.20	85.30

TABLE IX

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

HEAD IN FEET	4.5 FOOT SLIDE WIDTH IN FEET AND TENTHS OF FEET											
	.2	.4	.6	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
0.02	0.6	1.3	1.9	2.5	3.2	4.7	6.3	7.9	9.5	11.0	12.6	14.4
0.04	0.9	1.8	2.7	3.6	4.5	6.7	9.0	11.2	13.4	15.7	17.9	20.4
0.06	1.1	2.2	3.3	4.4	5.4	8.2	10.9	13.7	6.4	19.1	21.8	24.8
0.08	1.3	2.5	3.8	5.0	6.3	9.5	12.6	15.8	8.9	22.0	25.2	28.7
0.10	1.4	2.8	4.2	5.7	7.1	10.6	14.2	17.7	21.2	24.8	28.3	32.2
0.12	1.5	3.1	4.6	6.2	7.7	11.6	15.5	19.4	23.2	27.1	31.0	35.3
0.14	1.7	3.3	5.0	6.7	8.4	12.5	16.7	20.9	25.1	29.2	33.4	38.0
0.16	1.8	3.6	5.4	7.2	9.0	13.4	17.9	22.2	26.8	31.3	35.8	40.7
0.18	1.9	3.8	5.7	7.6	9.5	14.2	18.9	23.7	28.4	33.2	37.9	43.1
0.20	2.0	4.0	6.0	8.0	10.0	15.0	20.0	25.1	30.0	35.0	40.0	45.6
0.22	2.1	4.2	6.3	8.4	10.5	15.7	21.0	26.2	31.4	36.6	41.8	47.7
0.24	2.2	4.4	6.6	8.7	11.0	16.4	22.0	27.4	32.9	38.4	43.8	49.9
0.26	2.3	4.6	6.8	9.1	11.4	17.1	22.8	28.6	34.2	40.0	45.6	52.0
0.28	2.4	4.8	7.1	9.5	11.8	17.7	23.7	29.6	35.4	41.9	47.0	53.8
0.30	2.4	4.9	7.3	9.8	12.2	18.3	24.5	30.6	36.7	42.8	48.9	55.6
0.32	2.5	5.0	7.6	10.1	12.7	19.0	25.4	31.6	37.9	44.3	50.5	57.5
0.34	2.6	5.2	7.8	10.4	13.0	19.5	26.1	32.6	39.1	45.6	52.0	59.3
0.36	2.7	5.4	8.0	10.7	13.4	20.1	26.9	33.6	40.3	47.0	53.6	61.2
0.38	2.7	5.5	8.2	11.0	13.8	20.6	27.6	34.4	41.3	48.2	55.0	62.7
0.40	2.8	5.6	8.4	11.3	14.4	21.2	28.3	35.3	42.4	49.4	56.5	64.4
0.45	3.0	6.0	9.0	12.0	15.0	22.4	30.0	37.5	45.0	52.5	59.9	68.2
0.50	3.2	6.3	9.4	12.6	15.8	23.6	31.6	40.0	47.4	55.3	63.0	72.0
0.55	3.3	6.6	9.8	13.3	16.6	24.8	33.2	41.5	49.7	58.0	66.2	75.6
0.60	3.5	6.9	10.4	13.9	17.4	26.0	34.7	43.3	51.9	60.6	69.2	78.8
0.65	3.6	7.2	10.8	14.4	18.0	27.0	36.0	45.0	54.0	63.0	72.0	82.0
0.70	3.7	7.5	11.2	15.0	18.7	28.0	37.4	46.7	56.0	65.4	74.6	85.0
0.75	3.9	7.7	11.6	15.5	19.4	29.0	38.8	48.4	58.0	67.7	77.4	88.0
0.80	4.0	8.0	12.0	16.0	20.0	30.0	40.0	50.0	60.0	69.9	79.8	91.0
0.85	4.1	8.2	12.4	16.5	20.6	31.0	41.3	51.6	61.8	72.2	82.4	94.0
0.90	4.2	8.5	12.7	17.0	21.2	31.9	42.5	53.1	63.7	74.4	84.9	96.7

TABLE X

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

HEAD IN FEET	6 FOOT SLIDE WIDTH IN FEET AND TENTHS OF FEET														
	.2	.4	.6	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
	SECOND FEET														
0.02	0.8	1.7	2.5	3.4	4.3	6.4	8.5	10.6	12.8	15.0	17.0	19.2	21.1	23.2	25.2
0.04	1.2	2.4	3.6	4.8	6.0	8.9	12.0	14.9	17.9	21.1	23.8	26.9	29.8	32.8	35.7
0.06	1.5	2.9	4.4	5.8	7.3	11.0	14.7	18.2	22.0	25.4	29.1	32.9	36.4	40.2	43.7
0.08	1.7	3.4	5.1	6.8	8.4	12.7	17.0	21.4	25.4	29.8	33.8	38.1	42.2	46.5	50.6
0.10	1.9	3.8	5.7	7.6	9.5	14.3	19.1	23.8	28.8	33.4	38.0	42.8	47.5	52.3	56.8
0.12	2.0	4.1	6.2	8.2	10.3	15.4	20.8	25.8	31.0	36.3	41.3	46.5	51.5	56.8	61.8
0.14	2.2	4.5	6.7	8.9	11.2	16.7	22.5	27.9	33.6	39.3	44.7	50.4	55.8	61.5	66.9
0.16	2.4	4.8	7.2	9.6	11.9	17.9	24.0	29.8	35.9	42.1	47.8	53.9	59.7	65.8	71.6
0.18	2.5	5.1	7.6	10.0	12.6	19.0	25.5	31.6	38.1	44.5	50.7	57.1	63.2	69.7	75.8
0.20	2.6	5.3	8.0	10.7	13.3	20.0	26.8	33.3	40.1	46.9	53.3	60.1	66.6	73.4	79.8
0.22	2.8	5.6	8.4	11.2	14.0	21.0	28.2	35.0	42.1	49.2	56.0	53.2	69.9	77.1	83.8
0.24	2.9	5.9	8.8	11.7	14.6	21.9	29.5	36.5	44.0	51.5	58.6	66.0	73.1	80.6	87.6
0.26	3.0	6.1	9.1	12.2	15.2	22.8	30.7	38.0	45.8	53.6	60.9	68.7	76.1	83.8	91.2
0.28	3.1	6.3	9.5	12.6	15.8	23.7	31.8	39.4	47.5	55.5	63.2	71.2	78.9	86.9	94.6
0.30	3.2	6.5	9.8	13.1	16.3	24.4	32.8	40.7	49.0	57.4	65.3	73.6	81.5	89.8	97.7
0.32	3.4	6.8	10.1	13.5	16.9	25.3	34.0	42.2	50.8	59.5	67.6	76.3	84.4	93.1	101.2
0.34	3.5	7.0	10.4	13.9	17.4	26.1	35.0	43.4	52.3	61.2	69.6	78.5	86.9	95.7	104.1
0.36	3.6	7.2	10.7	14.3	17.9	26.8	36.1	44.7	53.9	63.0	71.7	80.8	89.5	98.6	107.3
0.38	3.7	7.4	11.0	14.8	18.4	27.6	37.1	46.0	55.4	64.8	73.8	83.2	92.1	101.5	110.4
0.40	3.8	7.6	11.3	15.1	18.9	28.3	38.1	47.2	56.9	66.5	75.7	85.3	94.5	104.1	113.3
0.45	4.0	8.0	12.0	16.0	20.0	30.0	40.3	49.9	60.1	70.3	80.0	90.2	99.9	110.1	119.8
0.50	0.2	8.4	12.6	16.9	21.1	31.6	42.5	52.7	63.5	74.3	84.5	95.3	105.5	116.2	126.4
0.55	4.4	8.7	13.3	17.7	22.1	33.2	44.6	55.3	66.6	77.9	88.7	100.0	110.7	122.0	132.7
0.60	4.6	9.3	13.8	18.5	23.1	34.7	46.6	57.8	69.6	81.4	92.5	104.3	115.5	127.3	138.5
0.65	4.8	9.6	14.4	19.3	24.0	36.0	48.4	60.1	72.0	84.6	96.3	108.5	120.2	132.4	144.1
0.70	5.0	10.1	15.0	20.0	25.0	37.5	50.4	62.5	75.3	88.0	100.1	112.9	125.0	137.8	149.9
0.75	5.1	10.4	15.5	20.7	25.9	38.8	52.1	64.6	77.8	91.0	103.6	116.8	129.3	142.5	155.0
0.80	5.3	10.7	16.0	21.4	26.7	40.1	53.8	66.8	80.4	94.1	107.0	120.6	133.5	147.2	160.1
0.85	5.5	11.0	16.5	22.1	27.5	41.3	55.5	68.8	82.9	96.9	110.3	124.3	137.6	151.7	165.0
0.90	5.6	11.4	17.0	22.7	28.3	42.5	57.1	70.8	85.2	99.7	113.4	127.8	141.5	156.0	169.7
0.95	5.8	11.7	17.4	23.3	29.1	43.6	58.6	72.7	87.6	102.4	116.5	131.4	145.5	160.3	174.4
1.00	5.9	11.9	17.9	23.9	29.8	44.8	60.1	74.6	89.8	105.1	119.5	134.7	149.2	164.4	178.8
1.05	6.1	12.2	18.3	24.5	30.6	45.9	61.7	76.4	92.1	107.7	122.5	138.1	152.9	168.5	183.3
1.10	6.2	12.5	18.8	25.1	31.3	47.0	63.1	78.3	94.3	110.3	125.5	141.5	156.6	172.6	187.8
1.15	6.4	12.8	19.0	25.6	32.0	48.0	64.6	80.1	96.4	112.8	128.3	144.6	160.1	176.5	192.0
1.20	6.5	13.1	19.6	26.2	32.7	49.1	66.0	81.8	98.6	115.3	131.1	147.8	163.7	180.4	196.2

TABLE XI

SHOWING FREE FLOW DISCHARGE FOR PARSHALL FLUME

HEAD IN FEET	16 FOOT SLIDE WIDTH IN FEET AND TENTHS OF FEET													
	.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
0.02	2.7	5.5	8.2	10.9	13.7	16.4	19.1	21.8	24.6	27.4	34.2	41.0	47.8	54.6
0.04	3.8	7.7	11.5	15.4	19.2	23.0	26.8	30.7	34.6	38.4	48.0	57.5	67.2	76.8
0.06	4.7	9.4	14.1	18.9	23.6	28.3	33.0	37.7	42.4	47.1	58.9	70.6	82.4	94.2
0.08	5.5	10.9	16.4	21.8	27.2	32.7	38.2	44.0	49.1	54.5	68.2	81.8	95.5	109.0
0.10	6.1	12.2	18.2	24.3	30.4	36.4	42.5	48.6	54.7	60.8	76.0	91.2	106.5	120.2
0.12	6.7	13.3	20.0	26.6	33.3	40.0	46.6	53.2	60.0	66.6	83.2	100.0	116.5	132.1
0.14	7.0	14.0	21.0	28.0	35.0	42.0	49.0	56.0	63.0	70.0	87.8	105.2	123.0	140.2
0.16	7.5	15.0	22.5	30.0	37.5	45.0	52.5	60.0	67.5	75.0	93.8	112.5	131.2	150.0
0.18	7.9	15.9	23.8	31.8	39.7	47.7	55.6	63.5	71.5	79.4	99.3	119.0	139.0	159.0
0.20	8.1	16.3	24.4	32.6	40.7	48.7	57.0	65.0	73.2	81.4	101.7	122.0	142.2	162.8
0.22	8.6	17.1	25.7	34.2	42.7	51.3	60.0	68.5	77.0	85.5	107.0	128.4	150.0	170.1
0.24	8.8	17.6	26.4	35.2	44.0	52.7	61.5	70.4	79.2	88.0	110.0	132.0	154.0	176.0
0.26	9.2	18.4	27.6	36.8	45.9	55.0	64.3	73.5	82.5	91.8	115.0	138.0	161.0	184.0
0.28	9.4	18.7	28.2	37.4	46.8	56.2	65.5	75.0	84.4	93.7	117.0	141.0	164.0	188.0
0.30	9.8	19.1	28.6	38.1	47.6	57.1	66.7	76.2	85.7	95.2	119.0	143.0	167.0	191.0
0.32	9.9	19.8	29.6	39.4	49.3	59.2	69.0	79.0	88.8	98.7	123.3	148.0	172.5	197.0
0.34	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	125.0	151.0	175.2	200.0
0.36	10.3	20.6	31.0	41.3	51.6	61.8	71.5	82.5	93.0	103.0	129.0	155.0	181.0	206.0
0.38	10.6	21.2	31.8	42.5	53.2	63.7	74.5	85.0	95.5	106.0	133.0	159.3	186.0	212.0
0.40	10.7	21.4	32.2	42.8	53.6	64.2	75.0	85.7	96.5	107.0	134.0	161.0	188.0	214.0
0.45	11.4	22.7	34.0	45.4	56.7	68.0	79.5	90.8	102.0	114.0	142.6	171.0	199.7	228.0
0.50	11.8	23.6	35.4	47.2	58.9	70.7	82.5	94.2	106.0	118.0	147.3	177.0	206.0	236.0
0.55	12.4	24.8	37.2	49.5	62.0	74.3	86.7	99.0	111.4	124.0	155.0	186.0	216.5	248.0
0.60	12.9	25.8	38.8	51.7	65.0	77.5	90.5	103.3	116.4	129.4	162.0	194.0	226.0	258.0
0.65	13.4	26.8	40.3	53.7	67.2	80.5	94.0	107.4	121.0	134.4	168.0	202.0	235.0	268.2
0.70	14.0	28.0	42.0	56.0	70.0	84.0	98.0	112.0	126.0	140.0	175.0	210.0	245.0	280.0
0.75	14.5	28.9	43.3	57.8	72.2	86.7	101.0	115.5	130.0	144.5	181.0	216.3	253.0	289.0
0.80	14.9	29.8	44.7	59.7	74.7	89.5	104.6	119.5	134.4	149.2	186.8	224.0	261.0	298.2
0.85	15.4	30.8	46.2	61.6	77.0	92.4	106.9	123.1	138.6	154.0	192.4	231.0	269.0	308.0
0.90	15.8	31.7	47.5	63.5	79.3	95.0	111.0	127.0	143.0	158.5	198.0	238.0	277.5	317.0
0.95	16.3	32.6	48.8	65.0	81.5	97.6	114.0	130.0	146.5	162.8	203.0	244.0	285.0	325.2
1.00	16.7	33.3	50.0	66.6	83.4	100.0	116.7	133.0	150.0	166.5	208.0	250.0	292.0	333.5
1.05	17.1	34.2	51.3	68.5	85.6	102.8	120.0	137.0	154.0	171.0	214.0	257.0	300.0	342.0
1.10	17.5	35.0	53.0	70.0	87.5	105.0	122.7	140.0	157.8	175.0	219.0	263.0	306.0	350.0
1.15	17.9	35.8	53.7	71.4	89.5	107.5	125.4	143.2	161.0	179.0	224.0	268.5	313.5	358.0
1.20	18.3	36.6	55.0	73.3	91.6	110.0	128.0	146.5	165.0	183.0	229.0	274.6	320.0	366.0

D

AMENDED
GROUNDWATER MANAGEMENT PLAN

ADOPTED JUNE 10, 2010

ALTA IRRIGATION DISTRICT

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GROUNDWATER MANAGEMENT PLAN

I. INTRODUCTION

A. General

The Kings River ("River"), which provides the surface water supply for the Alta Irrigation District, a California Irrigation District ("District"), is one of the largest streams entering the San Joaquin Valley. The River's watershed covers 1,742 square miles, ranging in elevation from 500 to 14,000 feet above sea level. The majority of the watershed area is located in the high Sierra Mountains and receives heavy snowfall in the winter months. Usually, this snow melts slowly. Thus in average years, the River does not reach its highest stage until the middle of May or early June. The current yearly average runoff for the Kings River is 1,689,700 acre-feet. However, the average runoff does not guarantee this volume will be developed in any given year. The variation with the amount of runoff is great, not only from year to year, but also from month to month. As a result of this great variation, there were alternating periods of flood and drought in the drainage area of the River until Pine Flat Dam was completed in 1954.

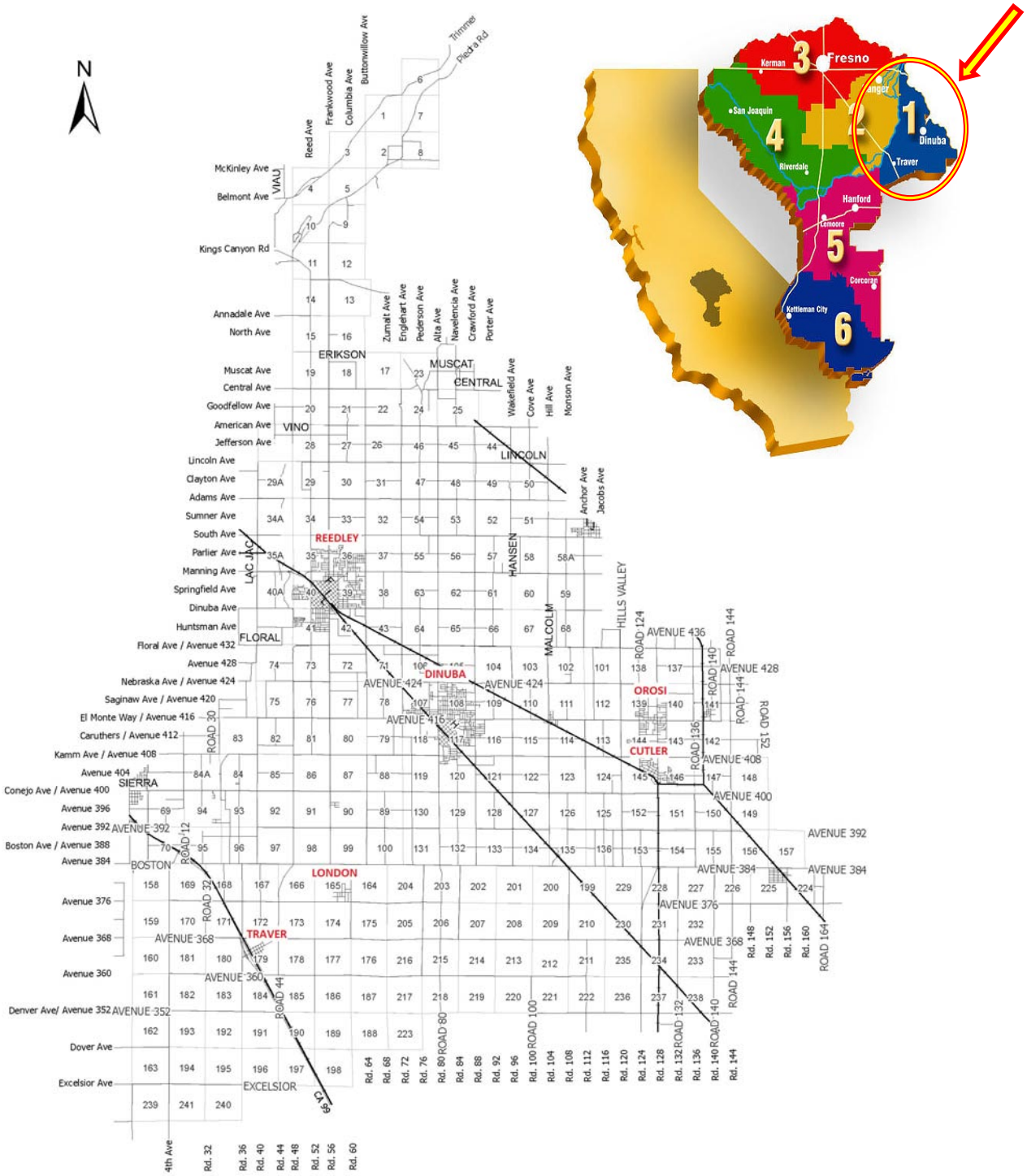
Rainfall occurs primarily in the winter months with virtually no rainfall in the summer months. The average annual rainfall within the District for the fifty-year period preceding 1956 was 11.39 inches with the annual crop use per acre ranging from 24 to 36 inches. As a result, the agricultural crops within the District cannot and do not depend upon rainfall for all their irrigation needs; instead, they depend upon surface water deliveries and deep well pumps.

Historical water deliveries to the service area of the District were initiated in 1882 by a private water company called the "76" Land and Water Company. In 1887, the California legislature passed the Wright Act, which conferred on farming communities the powers of municipalities to purchase, construct and operate irrigation works. On July 7, 1888, sixty-six landowners interested in developing a new public irrigation district filed petitions with the Tulare County Clerk. The District would now comprise 130,000 acres in Tulare, Fresno and Kings Counties and would become the Alta Irrigation District. The present communities of Dinuba, Reedley, Traver, Cutler, and Orosi lie within these boundaries.

Historically, the District enjoyed a shallow water table. In the early 1900's the distance from the ground surface to the groundwater table averaged less than ten feet. However, each successive drought period during the last fifty years has caused an increase in the agricultural groundwater pumping. Consequently the water table has

dropped significantly. As agricultural land is paved over for urbanization, the competition for control of water resources among agricultural, urban and environmental interests will significantly increase.

B. Map of District



C. Purpose and Goals

The Alta Irrigation District has long recognized the importance of groundwater to its service area. On August 14, 1994 its Board of Directors initially adopted a Groundwater Management Plan **(*see APPENDIX, AB 3030 Groundwater Management Plan, Attachment A*)**. Later they amended that Plan in order to be in compliance with SB 1938 **(*see APPENDIX, Notice of Intent, Attachment B*)**. The District intends to continue using the existing AB 3030 Groundwater Management Plan and to include in it the information required by SB 1938 under WC 10753.7 as allowed for in Section 10750.9(b), (hereinafter referred to as the "Plan").

The Plan being adopted under SB 1938 incorporates and advocates a regional perspective on groundwater management planning by establishing basin-wide management objectives for the Plan to achieve. In addition, the proposed Plan would require additional monitoring of groundwater levels, subsidence and water quality to evaluate and determine proposed management actions.

The principal action item in the Plan will be gathering and evaluating additional data concerning quantity and quality of groundwater so the District can develop and implement management actions and best management practices on a local and regional basis. Those actions will enhance the valuable groundwater resource by at least reducing the long-term groundwater level decline in the area and by addressing groundwater quality issues that impact potable water supplies. The District is now pursuing many of the action items already identified in the plan and will, when the Plan is adopted, begin pursuing additional actions. Other action items will require further study prior to implementation.

Water users in the District use conjunctively both surface water and groundwater so the District well understands that both surface water and groundwater are necessary to meet the water demands of the area and are critical to achieving a successful water management program. The goals developed and implemented through the Plan will be designed to achieve and maintain this primary single purpose in all groundwater and surface water management actions. Activities to accomplish this goal may range from addressing water quality issues to importing additional water supplies. Specific actions recommended for implementation are discussed in Section VI.

The proposed Plan will reduce duplication of activities by local agencies, which will utilize it in their long-term planning activities within the District. The Plan will be flexible by allowing updates to be made as needed, based on the additional information that is gathered through the monitoring programs.

The District is funding preparation of the Plan. Future activities required to fully implement the Plan may require additional funding sources. SB 1938 allows for the levying of groundwater assessments or fees under certain circumstances and according to specific procedures. Prior to instituting a fee structure, the District must hold an election on whether or not to impose these levies. A majority of the votes cast at the election will be required to implement any levy to provide additional funding.

D. Reasons for Updating Plan

Historically, the use of groundwater within the State of California has not been regulated except in basins where the groundwater extraction rights have been adjudicated by the courts or special management districts have been authorized by the state legislature. Groundwater accounts for approximately one-third of the water used within the state and will become even more important in the future with the growth of competing demands on groundwater resources. The District's primary role as a regional water resource agency is to sustain and improve its conjunctive use programs to enhance surface and groundwater supply and quality. The principal reason for updating the Plan will be to institute regionally-based management actions that will address the issues of long-term water supply and water quality using, for example, groundwater banking. This approach will require more intensive monitoring efforts along with implementation of action items as part of a regional management plan. This Plan will enable the District to make a comprehensive effort either through participating in the Upper Kings Basin Integrated Regional Water Management Plan Joint Powers Authority ("JPA") or adopting principles linking the various SB 1938 plans in the Kings Sub-basin. The JPA is more fully discussed in Section V of this Plan. The Kings Sub-basin is defined under Bulletin 118 **(*see APPENDIX, Kings Sub-basin, Bulletin 118, Attachment C*)**. The JPA's primary focus will be to monitor water quality, depth to groundwater and subsidence on a regional basis. Localized trends will be addressed through the SB 1938 Plans of various agencies.

E. Advisory Committee

To initiate the groundwater management plan, the District formed a regionally diverse advisory committee comprised of representatives of the following agencies: City of Dinuba, City of Reedley, County of Tulare, Alta Irrigation District, Kings River Conservation District, Cutler Public Utility District, Orosi Public Utility District and Community Water Center. Upon adoption of the Plan by the Alta Irrigation District Board of Directors, the SB 1938 Advisory Committee will be terminated. The purpose of the SB 1938 Advisory Committee is to incorporate localized community interest and input from public agencies that overlie Alta Irrigation District's sphere of interest.

F. Public Participation

All meetings of the SB 1938 Advisory Committee would be noticed on the District's website and any member of the public can attend the meeting or email comments on the website pertinent to the Plan **(*see APPENDIX, Attached Meeting Notices and Minutes, Attachment D*)**. In addition, all information received from the public will be noted and reviewed at those public meetings and in the minutes of such meetings.

II. EXISTING CONDITIONS

A. Groundwater Basin

The Alta Irrigation District overlies a portion of a groundwater sub-basin designated as the Kings Sub-basin. The California Department of Water Resources has designated this basin to be a critically overdrafted groundwater basin. The District has been monitoring groundwater levels for at least the last seventy-five years. The results of this monitoring effort are consistent with the findings of the Department of Water Resources. The water level measurements taken within the District show a continued downward trend in the groundwater elevations within the District's boundaries. This average overdraft is approximately 22,000 acre feet per year.

The total water supply available to the District is extremely variable and dependent on the snowpack that occurs in the Sierra Nevada Mountain Range to the east. The pumping within the groundwater basin is inversely proportional to the surface water supply made available from runoff within the Kings River Watershed.

The boundaries of the District include land within three counties, two incorporated cities and numerous unincorporated urban water districts. All of the urban communities, along with many individual residences scattered throughout the District, are dependent on the groundwater supply to meet their domestic demands. Surface water is currently not available to meet those needs. The conjunctive use of both the groundwater and surface supplies is necessary to meet the irrigation requirements within the District. This irrigation demand represents by far the largest water use within the basin.

The District recognizes that the continuation of the agricultural, municipal and industrial developments within the basin is dependent on maintaining an adequate water supply. With the conjunctive use that already occurs within the District, adequate surface water supplies are necessary to achieve a water balance. However,

additional facilities to develop new water supplies can be constructed to increase water resources within the District.

B. Geology

The District is located in the eastern portion of the San Joaquin Valley and southern half of the Great Valley geomorphic province of California. The District is part of the valley, which is a nearly flat northwest to southeast trending alluvial plain. Alluvial sediments are found within the District and are bounded on the east by granitic rocks of the Sierra Nevada. The alluvium within the District is a heterogeneous mix of clay, silt, sand and gravel (USGS, 1968). The soils within the District are complex with the unconsolidated alluvial fans being made up of varied textured material. The upper soils vary from very heavy clays near the base of the Sierra Nevada (on the east side of the District) to relatively coarse sand near the western boundary along the Kings River. Much of the area is underlain by hardpan that restricts the vertical percolation of the water. These areas are typically ripped and/or soil amendments are applied to improve the vertical percolation. Throughout the District there are isolated locations of coarse grained material with high percolation rates. These are typically found at locations where old streambeds historically meandered throughout the District.

Along the east side of the District, the basement complex is shallow and the aquifer depth is very limited. The granite bedrock slopes quickly westward within the District resulting in a deeper aquifer along the western boundary of the District. The bedrock depth is approximately 500 feet below the ground surface along the eastern perimeter of the District and increases to 5,500 feet near its southwest limits. The coarse, sandy materials that are found along the west side of the District are reflected in the higher specific yields for those soils, which are typically 50 percent to 100 percent greater than for the finer textured clay materials found on the east side of the District. This same correlation is also found in the deeper soils, which are much less permeable and have significantly lower specific yields than the upper soils. Therefore, the specific yields from wells drilled into the deeper portions of the aquifer are considerably less than the yields from shallower wells.

C. Hydrology

The hydrology of this area is principally impacted by the snowpack that occurs within the Kings River Watershed and to a limited extent by both the local runoff from the foothills lying just easterly of the District and the precipitation that occurs within the District. The water table within the District is unconfined and typically flows in a southwesterly direction. Groundwater extractions are made for agricultural,

municipal and industrial purposes. These extractions are very significant during periods when there is little surface water available to augment the water needs within the District. The groundwater levels, during those periods, experience a significant decline. Surface water made available to the irrigation canals and pipelines through diversion from the Kings River provides a stabilizing factor on the groundwater levels. This surface water supply reduces the amount of pumping, provides recharge and is the principal contributing factor that influences the groundwater conditions. This effect is evident in years of below normal runoff when a rapid decline in the groundwater level is experienced. Based on the District's fall 2009 groundwater measurements, the average depth to groundwater level was 53.16 feet.

D. Climate

The area is semi-arid with mild winters and hot, dry summers. The average rainfall, based on District records, is approximately 11 inches per year. The majority of this rainfall occurs from November through April. With the long, hot summers that normally occur in the valley, there is about 6 feet of evaporation per year with the majority of that evaporation occurring during the period May through October. The winds in the area are principally from the northwest with a southeast wind usually indicating that a rainstorm is imminent.

E. Surface Water Supplies

The District is located east of the Kings River in the Central San Joaquin Valley. To the east of the District are the Sierra Nevada Foothills. The District is composed primarily of alluvial fans sloping to the southwest with elevations ranging from about 425 feet at the northern point to 270 feet in the southwest corner. The incorporated communities within the district are Reedley (population 23,000) and Dinuba (population 21,700). There are also several unincorporated communities, housing clusters and individual rural residences.

The primary economy within the District is agriculture or businesses related to agriculture. The primary crops grown within the region are grapes, nectarines, plums, peaches and citrus. Due to the relatively high land prices and high production costs in for hand labor, spraying and fertilizer, the average parcel size is approximately 36 acres. There are approximately 4,000 agricultural parcels within the district.

Initially, agricultural production in the region was primarily dry land farming; but with the development of a dependable surface water supply and groundwater wells and a willingness of farmers to take the risk of raising high value crops, the cropping

pattern changed to perennial crops and the need for a stable water supply became paramount.

The estimated average irrigation crop demand within the District is 325,000 acre feet and the average surface water supply is 148,416 acre feet; therefore, there is a strong reliance on an alternate water supply: groundwater.

The District diverts water from the Kings River at the "Cobbles Weir" and measures water into the District at a computer-controlled headgate ("Headgate") located near the community of Piedra. Downstream of the Headgate are 78 ditch laterals serving approximately 4,000 agricultural parcels. The total length of canals and pipelines is between 350 and 400 miles. The canal widths vary from 4 to 100 feet; lengths range from 3,000 feet to nearly 18 miles **(*see APPENDIX, KRCD Surface Water Study Table 111-1, Attachment E*)**.

The range of annual diversions from the Headgate during a recent twenty-year period were as follows: 248,042 acre feet in 1993 (highest annual diversion); 58,284 acre feet in 1990 (lowest annual diversion) and 150,261 acre feet was the average annual diversion. The average time period for each water run within said twenty-year period is 115 days; the shortest water run being 48 days; and the longest water run being 183 days **(*see AID Twenty-Year Diversion Table as Table 1*)**. The District's diversion and storage rights are based upon riparian and appropriative claims as well as contractual agreements and licenses granted by the State Water Resources Control Board. Such agreements control the use of District's rights in conjunction with the rights of the other twenty-seven (27) entities storing and diverting water from the Kings River. All the twenty-eight (28) entities comprise the Kings River Water Association. It is typical for weather patterns and the resulting volume of water in storage to vary significantly from year to year, thus illustrating the necessity of water storage in the production of perennial crops.

Table 1: AID Twenty –Year Diversion Table

Year	HG Diversion	Days Ran
2009	150,834	107
2008	131,685	89
2007	76,225	54
2006	211,646	161
2005	212,052	165
2004	128,426	91
2003	137,603	100
2002	133,219	99
2001	124,465	92
2000	166,411	139
1999	147,120	117
1998	172,176	182
1997	214,341	156
1996	221,084	152
1995	235,729	178
1994	122,697	92
1993	248,042	183
1992	66,624	58
1991	107,017	81
1990	58,284	48
1989	89,807	69

F. Water Management Strategies

Alta Irrigation District operates an "arranged delivery system" allowing farmers to order water on or off within the system with at least 24 hour's notice. Primarily, water orders are called in between 7:00 a.m. and 3:00 p.m. each day; with a subsequent coordinating meeting each morning and afternoon to determine changes within the system. All water use is measured on a daily basis. The District uses a calibrated submerged orifice to determine the instantaneous flow rate. The District is in the process of updating its distribution system by requiring cumulative flow meters on all turnouts when open canals are replaced by pipelines.

Daily water measurements are the basis of the District's levying a volumetric surcharge, which pays for all water-run related costs **(*see APPENDIX, Table 9 FUTURE DISTRICT OPERATIONAL BUDGET, Engineer's Report Proposition***

***218 Procedures, December 2005, Attachment F*)**. The conjunctive use pattern of utilizing surface water in wet years and relying more on groundwater in dry years helps to maintain sufficient water supplies to irrigate the predominantly permanent crops. The most beneficial use of surface water is to motivate farmers to avoid using their groundwater pumps, thus leaving in place and conserving the groundwater to be utilized only when needed.

In 1990, Alta Irrigation District commissioned the Kings River Conservation District to complete a "Surface Water Study" to study and review the District's surface water delivery system. A system water balance was evaluated in wet and dry years to determine seepage evaporation, evapotranspiration (ET) of bank vegetation, and operational spillage. The study showed that seepage (estimated to be approximately 23 percent of the District's total diversion) was the most significant loss in the system.

The water flow in the District's canals and pipelines is measured by means of overflow weirs, undershot gates, parshall flumes or a current meter. The District has developed rating tables that are used to set the proper flow rate in each of the canals and pipelines. However, the District may reallocate water from the different laterals if the demand warrants such reallocation.

The District has instituted a water allocation formula to equitably distribute water to farmers based on the estimated snowpack runoff. The formula is based on four days per twenty acres utilizing one cubic foot per second per entitlement percentage. Approximately eighty percent of the District's irrigable acres receive one hundred percent entitlement; the remaining acreage is entitled to receive seventy-five percent, fifty percent, twenty-five percent, or no surface water entitlement. Historically, the lower water entitlement areas either were not farmed or were being farmed to low value crops. The allocation formula is set by the Board of Directors and can be adjusted by lengthening or shortening the number of irrigation days per twenty acres. Typically, in less than average water years, water is held in storage until peak demand occurs in May, June and July.

Water regulating reservoirs used by the District have been designed to better maintain constant flows in the lower areas of the district. In 1991, the district developed the fifty-seven acre Button Ponding Basin, which is fed by five tributary canals. The flow rates of those canals have been prone to fluctuate between midweek and weekend days. All the inflow entering the regulating basin is now being stored for downstream agricultural deliveries when needed. Additional regulating reservoirs are being evaluated for future construction.

In any conjunctive use area, groundwater recharge is a critical part of the overall Plan. For many years, the District has maintained recharge basins along the southwesterly perimeter of its boundaries. They are located in areas of highly permeable soils. In addition, some effective recharge results simply from conveying water through the District's canals, even though the majority of the soil types are such that the recharge capability of the soil is very limited.

The District has been conducting extensive research to locate additional recharge sites in the eastern portion of the District, since that area is severely impacted in dry years due to the low specific yields and the limited water storage depth of the aquifers. In 1987, the District was selected for funding through the Proposition 44 program to develop a groundwater recharge basin in an area that had limited groundwater resources. The site appeared to have soil types that would be conducive to recharge efforts. An in-depth geological study was undertaken and it was determined that the site would not be effective for groundwater recharge. The District has continued its efforts to locate sites for developing percolation basins in the eastern part of the District, but it is not likely that a suitable location will be found.

To proceed with a groundwater recharge program, additional surface water supplies are necessary to fully implement the Plan. The District's average annual water supply is already committed. The surface water necessary to conduct an extensive program is available only in wet years when additional water supplies or floodwaters are available on the Kings River. The District's goal has been and will be to make beneficial use of those waters by recharging the underground. For the most part, District conveyance facilities are currently available to transport these waters to the basin locations. Unfortunately, the prospects for locating effective recharge basin sites within the areas of greatest need are not promising.

The District will also be negotiating with cities interested in jointly funding new recharge sites. If suitable sites are located within or adjacent to the boundaries of a municipal jurisdiction, the possibility of a joint use facility would be evaluated. The potential exists for water to be delivered to all or part of the site for recharge purposes during a portion of the year, with consideration given to other uses during the remainder of the year.

As a complement to the District's local recharge program, one of the action items is to evaluate "groundwater banking". This could be accomplished by assisting the recharge efforts of other districts that have access to better groundwater recharge sites. Floodwaters would be recharged (banked) in a district thereby improving groundwater levels in its service area. The amount of water banked would be quantified on an annual basis and an agreement developed so that the District would

have rights to extract or receive a stipulated portion of the water banked through the joint agreement. In both the short and long terms, this approach appears to be the most effective way for the District to benefit the Basin Plan Area. In addition, investigations will continue on potential local recharge sites.

In 2009, the District did aggressively implement groundwater management projects to address issues of localized overdraft. The District and the City of Dinuba developed a recharge project to collect storm water and other surplus water supplies in a series of basins comprising 28 acres. The project will be effective in utilizing local supplies to mitigate groundwater pumping within the City of Dinuba. The District implemented the Harder Pond Banking Project to recharge stormwater and other surplus water supplies in the westerly portion of the District. The project will enable the District to direct water supplies to designed recharge areas and by means of extraction wells, to make more efficient downstream agricultural deliveries. The District is also moving forward with the Traver Pond Banking Project, which will also allow water to be recharged and extracted for downstream agricultural deliveries. The Harder and Traver Banking Projects are designed to conserve and thus generate the two million gallons per day of potable surface water for the proposed surface water treatment plant to serve Cutler and Orosi **(*see APPENDIX, Water Banking Annual Report, Attachment G*)**.

Water banking is an important tool available to the District enabling it to better utilize available water supplies. The water banked will always exceed the extraction amount. The water remaining in the ground will bolster the groundwater in the immediate area of the banking project. The water extracted will be utilized to supplement the surface water deliveries, thereby reducing downstream groundwater extractions.

Additional locations for future banking projects will continue to be evaluated by the District. Where suitable locations are found and it is determined additional water is available to effectively utilize the site, the District will seek additional funding. Expansion of the Harder and Traver Pond sites will also be considered.

III. WATER QUALITY

A. Surface Water Quality

The surface water supply for the District consists principally of diversions from the Kings River. The snowpack and rainfall within the Kings River watershed produce extremely high quality water with very low amounts of dissolved salts. This has allowed consistently high agricultural yields to occur on the heavier soils, which

are not freely drained, without causing a serious drainage problem. The surface water also provides an excellent source of water for recharging the District's groundwater supply. It is important that the District maintain the high quality of this water. To this end, the District has been active in identifying any surface water discharges within the Basin that may negatively impact water quality. These will be continually monitored and may require a discharger to obtain a permit through the NPDES process. Anyone causing overland surface flows that are found to be detrimental to the District's water supply, groundwater or surface water, will be put on notice that they must either eliminate the discharge or clean those flows to avoid compromising the quality of the District's water supply.

The District regulates municipal storm water discharges into District facilities by enforcing the terms of permits granted by the District to those dischargers. The permits specify the exact area being drained and/or flow allowed to be discharged. Permit conditions require that the quality of this discharged water meet the existing and future standards set by the Regional Water Quality Control Board. The right to discharge can be terminated at any time the conditions of the permit are not met by the discharger.

B. Groundwater Quality/Source Water Quality Protection

Except for dibromochloropropane (DBCP) and nitrates, the quality of groundwater in the District is high because its source is excellent Kings River surface water flowing from the western slope of the Sierras. This results in having excellent quality water for recharge within the Kings River Watershed. When the groundwater is used for domestic purposes, construction of ground level treatment facilities to remove specific contaminants or the drilling of deeper uncontaminated wells have been required. The nitrate contamination is usually the result of agricultural fertilizer, domestic sewage, livestock wastes, or from natural sources. In some isolated locations, nitrate levels in groundwater have also caused problems for the agricultural pumpers. Since DBCP is no longer used for nematode control, concentration levels are expected to drop over time. In addition, some wells require chlorination because of bacteriological concerns. The groundwater management plan will include locally cost effective recommended procedures to maintain the existing excellent water quality **(*see Best Management Practices, Section VI.B.15, page 23*)**. In the Kings Sub-basin, typical contaminates of concern in the water used for domestic purposes are DBCP and nitrates.

Groundwater wells are prevalent throughout the District. The wells are used by cities, agricultural producers, industrial developments and individual homeowners. With the many water production wells, there is a risk that cross-aquifer contamination

can occur. The greatest potential for groundwater contamination within the basin is cross-aquifer flow through improperly abandoned wells and the improper sealing of new wells. Therefore, it is necessary that proper sealing of new wells and abandonment of old wells always be accomplished. At a minimum, the water well standards of Tulare, Kings & Fresno Counties along with Bulletin 74 requirements must be met. In addition, it may be advantageous to require construction standards that exceed those presently mandated by either the county or state. With the continual raising of standards for drinking water, maintaining the quality of the groundwater becomes ever more important.

Water quality is an important aspect of groundwater management. Contamination of the groundwater, resulting in a limitation on its use, is equivalent to a reduction in total water supply with a negative impact on the water balance for the Kings Sub-basin. This loss of supply will require obtaining additional supplies or incurring additional costs for treatment of the contamination.

C. Well Abandonment

An objective of the Plan is to maintain superior water quality within the District. This is of extreme importance because the municipal, industrial and agricultural users need a dependable high quality water supply. A reduction in the quality of the groundwater is tantamount to a loss of water supply, since the quality problem will require additional funding for the construction of treatment facilities. This cleanup will be necessary to allow the water to be integrated into the system.

One of the action items listed in the Plan recommends increased monitoring of groundwater quality in selected areas. This monitoring information will be collected and utilized to evaluate the best management practices available to reduce and/or eliminate the contamination. In addition, the action items recommend working with the Department of Water Resources and the counties of jurisdiction in upgrading water well standards. Since the natural minerals occur in low concentrations, the major thrust of the water quality monitoring and recommended practices will be to prevent chemical contamination.

The quality of both surface and groundwater within the District must be maintained. The Plan provides a mechanism that will help achieve those long-term goals. The initial action of increasing the amount of monitoring will provide the additional data needed to proceed with future programs to maintain water quality.

D. Water Quality Monitoring and Protocols

The District performed general groundwater quality testing for nitrates and DBCP for a three-year period: 1997, 1998 and 1999. The reason for performing the general water quality sampling was to determine and prioritize areas of interest. In the future, the District will need to study how and why nitrate and DBCP levels are exceeding relevant water quality standards **(*see Section VI. PLANNED ACTIONS AND REPORTS, B. Management Actions, 14. Regional Monitoring*)**.

E. Goals, Objectives and Strategies

There is little potential for increasing the water supply through wastewater reclamation in this basin. The majority of the wastewater is currently being utilized for the irrigation of agricultural crops or groundwater recharge with only a minor portion being consumed through evaporation basins. The District will continue to work with the wastewater treatment agencies, where practical, to reduce the amount of effluent disposed of through evaporation. In addition, the District will continue to promote the past practices of reusing all wastewater effluent within the local basin, in order to maintain the total water balance within the area. In a water deficient region such as the District, the reuse of the wastewater effluent is a key element of establishing and maintaining a water balance.

IV. WATER MAPPING

A. Depth to Groundwater / Water Quality Mapping

The District has been monitoring groundwater levels for the last seventy-five (75) years. This is accomplished through water level measurements taken in the late fall and early spring. A map of the District showing the well locations has been attached **(*see APPENDIX, Map of Well Locations, Attachment H*)**. As wells are lost, new wells are substituted to maintain the continuity of the grid pattern. From these readings, groundwater contour maps have been made depicting both the water elevation and changes in groundwater levels. Groundwater level readings are obtained utilizing an electric well sounder.

Based on the water level readings, the overall trend has shown a declining groundwater level within the District. This decline has been periodically interrupted by a short-term groundwater recovery during wet years when surface water supplies are abundant and groundwater pumping is reduced. Based on this long-term data, it has been determined that it would take approximately 22,000 acre-feet per year of additional surface water to correct the overdraft situation that presently exists. Based

on average porosity and specific yield considerations, this amount of overdraft results in a decline in the groundwater storage of one foot for every 7,000 acre-feet of overdraft. This storage can be regained if sufficient surface water supplies are made available to reduce the amount of groundwater pumping that is necessary to meet the water demands. In addition, the overdraft results in additional pumping costs to overcome the increased lift. As the water table continues to drop, the pumping occurs from lower portions of the aquifer, which have lower porosity and specific yield factors than those found in the upper portions of the unconfined aquifer. The long-term impact is a greater incremental reduction in the available groundwater storage capacity per acre-foot of overdraft. Using the historical data collected and the transmissivity of the aquifer, a determination can be made of the estimated quantity of inflow and/or outflow of groundwater within the limits of the District. This data also will allow the District to evaluate areas that are more severely impacted during periods of sustained drought due to the low yield of the wells and the limited depth of the aquifer. This is an important water management tool that is useful to the District in developing long-term planning decisions.

The collection of this data will be continued with the Plan. The information that has been prepared from this data in the past includes the following:

1. Maps of spring and fall water elevations.
2. Maps of spring and fall depth to groundwater.
3. Maps showing the changes in groundwater levels over time.

In addition, the groundwater reports can include estimates of changes in groundwater storage, water delivered, water use, and overdraft. This information will allow the District to better evaluate the effectiveness of various management actions as stated in Section VI.

The District will use the results of water quality monitoring that is being proposed as one of the action items to augment the information obtained through the historical water level readings. The District will take water quality samples in critical areas adjacent to urban centers and known locations of contamination. By correlating the water quality tests and the groundwater level measurements, the District will improve its ability to effectively manage the groundwater by utilizing monitoring data and applying it to a management action. For example, this information can provide the additional data needed to establish programs to reduce the movement of any contaminants. Typically, the urban centers have a higher concentration of wells resulting in a cone of depression within and surrounding the community. This can accelerate the movement of contaminants towards the urban well fields. Using the information gathered through the Plan, the District could pursue an additional future

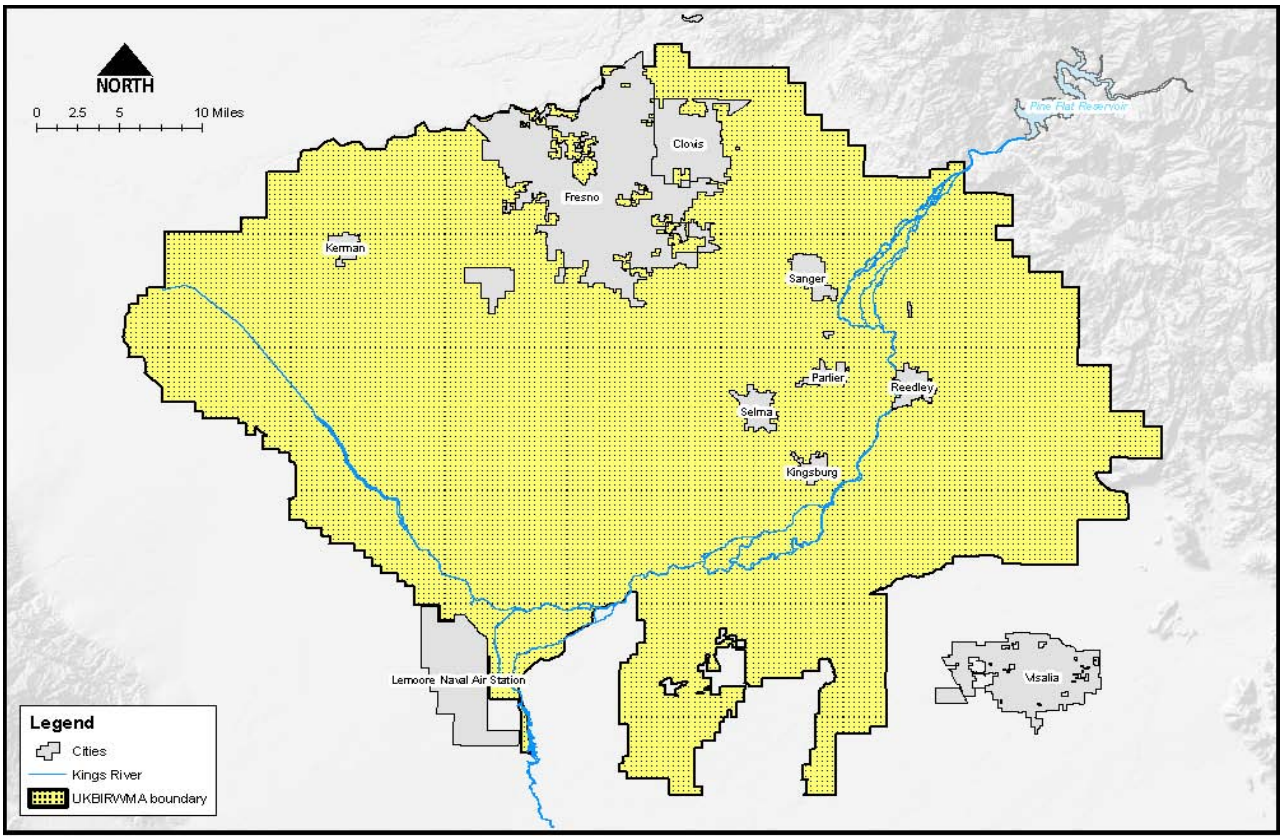
action item; namely, the analysis of the potential benefits of creating a hydraulic barrier or modification of the local pumping regime to reduce or impede the migration of any contamination.

V. BASIN MANAGEMENT OBJECTIVES

A. Upper Kings IRWMP

The Upper Kings Water Forum in 2003 and 2004 reviewed criteria to determine and identify concerns, issues and purposes for an integrated planning process to be undertaken by the Upper Kings Integrated Regional Water Management Plan ("IRWMP"). The intent was to develop a framework enabling urban, agricultural and environmental interests to formulate a consensus on regional problems, issues and conflicts. The IRWMP was established on July 27, 2007.

B. Map of JPA Service Area



C. Goals and Management Objectives

As identified in the IRWMP, the constituents established goals to address the primary problems and issues in the region, which are:

1. Halt, and ultimately reverse, the current overdraft and provide for sustainable management of surface and groundwater;
2. Increase the water supply reliability , enhance operational flexibility, and reduce system constraints;
3. Improve and protect water quality;
4. Provide additional flood protection; and
5. Protect and enhance aquatic ecosystems and wildlife habitat.

Additionally, the Upper Kings Basin IRWMP established water management objectives, which are to:

1. Define local and regional opportunities for groundwater recharge, water reuse/reclamation, and drinking water treatment;
2. Develop large scale regional conjunctive use projects and artificial recharge facilities to:
    a. Enhance operational flexibility of existing water facilities, consistent with existing agreements, entitlements, and water rights;
    b. Improve the ability to store available sources of surface water in the groundwater basin;
    c. Capture storm water and flood water currently lost in the region;
    d. Provide multipurpose groundwater recharge facilities that provide flood control, recreation and ecosystem benefits; and
    e. Integrate the fishery management plan;
3. Promote 'in-lieu' groundwater recharge to reduce reliance on groundwater through reclamation and reuse of treated wastewater, surface water treatment and delivery for municipal drinking water, and delivery of untreated water for agricultural use;
4. Negotiate and develop institutional arrangements and cost sharing for water banking, water exchange, water reclamation, and water treatment;
5. Design programs to improve water conservation and water use efficiency by all water users;
6. Identify interconnections or improvement of conveyance systems to provide multiple benefits; and
7. Enhance wildlife habitat through surface water reclamation, recharge, and treatment facilities.

D. Local Agency Coordination

To plan and implement regional goals and management objectives, the IRWMP has adopted regional planning objectives **(*see APPENDIX, IRWMP Chapter 5 Goals and Objectives, Attachment I*)** and has provided a framework and forum to mediate conflicts among urban, agricultural and environmental interests in the region.

Currently, the Upper Kings Basin Water Forum has established an Upper Kings Basin Water Forum Joint Powers Authority ("JPA") to provide for more structure and governance in the administration and implementation of the IRWMP on September 10, 2009. The current JPA member agencies are attached **(*see APPENDIX, JPA Member Agencies, Attachment J*)**.

VI. PLANNED ACTIONS & REPORTS

A. Historical Trends

District will prepare a biennial report compiling, recording and reviewing:

1. Annual monitoring data, which will include as a minimum, water quality, depth to groundwater, trends, findings and changes
2. Attainment/nonattainment of goals
3. Actions, coordination, activities and disputes with other agencies
4. Recommendations

B. Management Actions

The District will continue to pursue the thirteen (13) action items identified in the AB 3030 Plan, which will be implemented according to the Rules and Regulations **(*see APPENDIX, AB 3030 Groundwater Management Plan, Attachment A*)**, as amended from time to time. However, this Plan will provide the additional elements required to satisfy the requirements of an SB 1938 Plan. To have a successful Plan, it is not necessary to implement all of the action items identified. The last three items would be implemented only as a last resort due to the occurrence of emergency conditions within the Basin Plan Area. It is important that all the potential action items be identified and contingency plans developed in case any one of them becomes necessary. It is recommended that the District implement items one (1) through six (6) immediately and/or as it is now continuing to pursue them. Upon approval of the Plan, the District should begin investigations into items seven (7), eight (8) and fifteen (15), and submit a staff report regarding their status within one year. Action items nine (9) thru fourteen (14) will require additional staff study, board approval, public hearing and a possibly, a funding source. If funding is necessary to implement a portion of the Plan, then an election will be required prior to instituting an assessment or other levy. The District believes that through the management activities listed in the Plan, the District can preserve the groundwater resource and avoid the drastic steps identified in the last three action items.

1. Water Monitoring: The District shall continue to monitor water levels every six months. In addition, it will also assist in water quality sampling. Further, the District will prepare maps depicting the information gathered during the monitoring phase, as well as reports quantifying the water demands, surface water and groundwater supplies. This monitoring and reporting will assist the District in evaluating the effectiveness of the various elements of the program. The monitoring process will soon detect any migration of contaminated plumes thereby allowing ample additional time for plans to be developed and implemented before presently unaffected portions of the basin are impacted. The District will coordinate and assist in implementing a management program to address groundwater quality issues, especially in the east side of the District.

2. Direct Recharge: The District will continue to use surface waters when available to recharge the underground by sinking those waters in its basins. Basin sites will be located in the areas of greatest need. The District will actively seek the cooperation of other government entities in construction of such sites.

3. Indirect/In-lieu Recharge: The District has approximately 250 miles of unlined canals. The indirect recharge is accomplished through the seepage that occurs in some reaches of the canals. In addition, during winter months many of the natural channels carry surface runoff that recharges the groundwater. These old channels are typically located in the more permeable soils. The effective amount of this recharge varies from year to year and is dependent upon the amount of runoff that occurs. Additional water supplies will be pursued for groundwater recharge in natural channels and during non-irrigation seasons in the District's canals. By providing surface water to the area, the District has reduced the amount of groundwater pumping that would have otherwise occurred, resulting in an effective in-lieu recharge program. The District will continue efforts to maximize the amount of surface water available to users within its boundaries.

4. Water Conservation - Water Regulation: The District has a long-standing practice of conjunctive water use. Conjunctive use is the integration of surface and groundwater supplies to meet the total water demand. In the past, a cooperative program termed the "mobile lab" has been operated by the Kings River Conservation District in cooperation with local irrigation districts to measure applied water efficiencies. The purpose of this program has been to promote on-farm water conservation. The District has strongly supported programs that conserve water along with enhancing crop production.

Through the construction of water regulating basins, the District has been able to conserve and more efficiently utilize water within its system. The most recent

regulating basin was constructed on a 50-acre site in the southeast portion of the District.

The Alta Irrigation District, the cities and the unincorporated water purveyors, all have water conservation plans. The Plan will encourage agricultural, industrial and residential users to implement water conservation measures throughout the basin. Existing and new irrigation methods, reuse of industrial water and domestic water saving devices will all be encouraged. The water use requirements of new developments will also be evaluated to insure compatibility with this water deficient basin.

5. No Net Exportation of Groundwater: Since the District is located within an over-drafted basin, it is prudent to utilize groundwater resources within the District's boundaries. Effluent discharged by the City of Reedley ("Agency") from its sewer treatment plant into the Kings River should not be considered to be prohibited exportation of groundwater if such effluent recharges or benefits underground supplies available to landowners in the District.

6. Intra-district Water Transfer: Water transfers within the District have taken place on a routine basis. Each year the District evaluates the water transfer policy and specifies the circumstances warranting internal water transfers. Approximately 60 transfers are approved each year within the District.

7. Well Drilling and Abandonment: Portions of the groundwater have been contaminated, principally by volatile organic chemicals or nitrates. This contamination is most prevalent in the upper aquifers. Interaquifer mixing can occur through inadequate seals or improperly abandoned wells. Working through the Department of Water Resources and the county of jurisdiction, the District will seek to upgrade standards for construction and abandonment of water wells to reduce the potential for aquifer contamination.

8. Groundwater Banking: Given the scarcity of suitable recharge sites within the District, the District will cooperate with other agencies that have soil types more suitable for recharge basins. The District could then recharge (bank) surface water within their boundaries for withdrawal at a later time. This arrangement can provide benefit to the groundwater basins for both the District and the cooperating agency. The District benefits because it has few areas suitable for recharge. The participating agency receives the benefit of reduced pumping lifts during the time the water is banked and retains a percentage of the banked water that is not extracted by the District. In spite of having only limited recharge areas, the District does have two banking projects within its own boundaries and under its own management: the

Harder Pond and Traver Pond projects. In the future, the District will continue to expand its own water banking potential to address water resource issues. The intent of both banking projects is to address groundwater quality issues in the easterly areas of the District by using surface water to mitigate groundwater pumping for drinking water purposes.

9. Inter-district Water Transfer: Water transfers between different water districts are currently taking place. In the past, the District has completed such transfers on a limited basis. This mechanism would be used to increase the total water supply within the District or to augment the water supply in specific areas of the basin during critically dry years.

10. Reduction in Groundwater outflow: The direction and quantity of groundwater flow is susceptible to changes that occur to the hydraulic gradient. The groundwater level measurements taken twice a year within the District will identify the direction of groundwater flow. Typically, this outflow has been to the west and southwest creating hydraulic barriers by mounding of the groundwater can lead to a reduction in the amount of water that leaves the District. This can be an especially effective procedure along the perimeter of the District. Likewise, increased pumping by landowners along the perimeter of the basin can increase the groundwater outflow. The District will continue its efforts to assure that all necessary steps are taken to reduce the amount of such groundwater outflow.

11. Pumping Restrictions: Pumping restrictions would definitely reduce the amount of groundwater use. This is a controversial item so pumping restrictions would be the last item the District would consider. This step could have severe economic implications since the local economy that has been developed with a reliance on groundwater would be detrimentally impacted. Initially, any program requiring pumping restrictions would be voluntary rather than mandatory. From a practical standpoint, only if the urban water supplies are being severely restricted, will mandatory agricultural pumping restrictions be implemented.

12. Additional Water Supply and Storage: The generation of additional water supplies would enhance the local groundwater levels. Present political realities prevent developing additional water by building dams and surface water storage projects. As a result, additional water supplies will most likely come through water conservation efforts, recycling and storm water supplies. The limiting factor to securing additional water supplies is addressing actual or perceived environmental considerations.

13. Redistribution of Surface Water: There is a tremendous difference in the aquifer characteristics within the District. These affect both storage capability and yield. The impacts of recent droughts are evidenced by the continued lowering in groundwater levels for those areas with limited aquifer depth versus portions of the basin that are located over a deeper and higher yielding aquifer. During critically dry years, all or a disproportionately high percentage of the available surface water may need to be directed to the severely impacted areas. Increased pumping could then occur in those areas having better groundwater conditions to offset the redistribution of the available surface water supply.

14. Regional Monitoring: The District will help urban, agricultural and environmental interests to better monitor and implement management strategies affecting the region and basin. Currently, Alta Irrigation District is a founding member of the Upper Kings Basin Integrated Regional Water Management Authority ("JPA") representing portions of Fresno, Kings and Tulare Counties. The JPA would be the means to address the monitoring of groundwater levels, water quality, subsidence, impacts of changes in surface water quality or groundwater pumping that may impact groundwater quality and address regional trends on a basin or sub-basin basis.

15. Implement Locally Cost Effective Best Management Practices:

District will:

A. Lead a coordinated effort to increase groundwater pumping for irrigation purposes in the impacted area. This could result in a reduction in surface water deliveries to lands lying easterly of the communities. Increased pumping would extract the contaminated water for surface irrigation of crops and create a cone of depression to pull any contaminants away from domestic wells;
B. Hold workshops with the farm advisor to encourage more effective utilization of fertilizers;
C. Actively encourage implementation of Fresno and Tulare County's program for locating and properly abandoning of groundwater wells;
D. Work and coordinate efforts with interested parties, i.e., extension service, academic experts, etc., to identify potential sources of contamination;
E. Develop a program with the farm operators and testing laboratories to evaluate nitrate applications on individual parcels;

F. Use various media sources to disseminate information on fertilizer application, problems and availability of programs to assist farm operators;
G. Search out funding sources to help develop programs for farm operators; and
H. Lead a coordinated effort to alter surface water supplies/groundwater pumping available to the lands near those communities to more effectively manage groundwater movement to minimize the degradation of water quality.

C. Current and Future Monitoring Results

The District intends to compile, review and analyze monitoring data on an annual basis and to develop a bi-annual report to synthesize the data and trends. Incidental information that may be of landowner interest will be posted on the District's website.

D. Summary of Coordinated Actions with Water Management & Land Use Agencies

District shall endeavor to enter into a Memorandum of Understanding with Water Management and Land Use Agencies within the District **(*see APPENDIX, MOU, Attachment K*)**.

E. Implementation Schedule

1. Management Action Item Number 1, (Monitoring Groundwater Levels) will continue. The District will actively pursue the implementation of programs to address groundwater quality issues.

2. Management Action Item Number 2, (Direct Recharge) will continue to be implemented.

3. Management Action Item Number 3, (Indirect/In Lieu Recharge) will continue as a basic District operation.

4. Management Action Item Number 4, (Water Conservation – Water Regulation) District will continue to promote water conservation activities and water ruse programs.

5. Management Action Item Number 5, (No Net Exportation of Groundwater) is a basic philosophy of the District that will continue.

6. Management Action Item Number 6, (Intra-District Water Transfer) is a basic philosophy of the District that will continue.

7. Management Action Item Number 7, (Well Drilling and Abandonment) is critical to maintaining groundwater quality. The District will work with agencies of jurisdiction to upgrade the standard.

8. Management Action Item Number 8, (Groundwater Banking) is a basic philosophy of the District that will continue. Currently the District is working on the Traver Pond Banking Project which is to be completed and operational on or before December 31, 2011. Currently the land has been purchased and the environmental documents are being prepared for review and comment. The District will be actively pursuing additional areas for groundwater banking in cooperation with other entities.

   Management Action Item Number 8 (Groundwater Banking) and the groundwater quality issues identified in Management Action Item Number 1 (Water Monitoring), will be addressed in a planning grant for the Orosi Water Supply Study. That grant is expected to be authorized by December 31, 2010. The estimated time to complete the planning grant is eighteen months. Listed below are the identified items to be addressed in the planning grant:

   a. Identify location for surface water treatment plant
   b. Identify Pipeline alignments and right-of-way requirements
   c. Environmental documentation
   d. 30% design level plans for project
   e. Develop organizational structure and service area
   f. Finalize Orosi and Cutler treatment plant capacity requirements
   g. Meet with adjacent communities regarding potential water needs and treatment plant capacity
   h. Identify water supply, transfer requirements and conveyance facility agreements
   i. File application for regional water supply permit
   j. Adoption of funding

Within the next five years, the Plan proposes to commence construction of a regional surface water treatment plant to serve the northeast portion of the District.

9. Management Action Item Number 9, (Inter-District Water Transfer) the District will pursue these opportunities as they develop and are beneficial to the Districts water management plan.

10. Management Action Item Number 10, (Reduction in Groundwater Outflow) this activity will continue to be studied and evaluated by the District for possible future implementation.

11. Management Action Item Number 11, (Pumping Restrictions) this activity will continue to be studied and evaluated by the District for possible future implementation.

12. Management Action Item Number 12, (Additional Water Supply and Storage) this activity will continue to be studied and evaluated by the District for possible future implementation.

13. Management Action Item Number 13, (Redistribution of Surface Water) this activity will continue to be studied and evaluated by the District for possible future implementation.

14. Management Action Item Number 14, (Regional Monitoring) is a basic philosophy of the District that will continue. Additionally the District will be implementing a subsidence network along with monitoring of groundwater and groundwater depths through the JPA on or before December 31, 2010.

15. Management Action Item Number 15, (Implement Locally Cost Effective Best Management Practices) is a basic philosophy of the District that will continue. Ongoing efforts in this regard will continue. Additional Best Management Practices will be implemented as they are deemed prudent and economically feasible.

F. Dispute Resolution

Under current law, a district with an adopted groundwater management plan, i.e., AB 3030, SB 1938, or an amended AB 3030 plan, is the groundwater authority for the lands within such defined boundaries. Alta Irrigation District has an existing

obligation to manage groundwater, as defined under AB 3030, which under this Plan would also comply with the provisions of SB 1938 and the resulting obligations for implementation thereof. The Plan provides that disputes would be addressed by the Board of Directors of Alta Irrigation District.

VII. RE-EVALUATION OF PLAN

A. Amendment of Plan

Prior to amending the Plan, the District shall hold a hearing, after publication of notice pursuant to Section 6066 of the Government Code, on whether or not to adopt a resolution of intention to draft an amendment to the Plan. After the conclusion of the hearing, and if the District adopts a resolution of intention to amend the Plan, the District shall publish the resolution of intention in the same manner that notice for the hearing was published.

B. Schedule to Update the Plan

The District will review, and if necessary, update the Plan every five years on years ending in zero and five. Prior to adopting a resolution of intention to update the Plan, the District administering the Plan shall hold a hearing, after publication of notice pursuant to Section 6066 of the Government Code, on whether or not to adopt a resolution of intention to draft a resolution of intention to adopt an update to the Plan. After the conclusion of the hearing, and if the District adopts a resolution of intention to update the Plan, the District shall publish the resolution of intention in the same manner that notice for the hearing was published.

APPENDIX
SCHEDULE OF ATTACHMENTS

Attachment A	**AB 3030 Groundwater Management Plan (1994)**
Attachment B	**Notice of Intent to Adopt a SB 1938 Groundwater Management Plan (July 10, 2008)**
Attachment C	**Bulletin 118, Department of Water Resources**
Attachment D	**SB 1938 Advisory Meeting Notice and Minutes**
Attachment E	**Table 111-1, KRCD Surface Water Study (1991)**
Attachment F	**Table 9, Future District Operating Budget - Engineer's Report Proposition 218 Procedures (2005)**
Attachment G	**Water Banking Annual Report (2009)**
Attachment H	**Map of Monitoring Well Locations**
Attachment I	**Section 5 Goals and Objectives, Upper Kings Basin IRWMP**
Attachment J	**Member Agencies Upper Kings Basin IRWMP Authority**
Attachment K	**Memorandum of Understanding with Overlapping Local Agencies**

ATTACHMENT A

AB 3030 Groundwater Management Plan (1994)

Groundwater Management Plan

Adopted August 14, 1994

By

ALTA IRRIGATION DISTRICT

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GROUNDWATER MANAGEMENT PLAN

I. INTRODUCTION

A. General

The Kings River ("River"), which provides the surface water for the Alta Irrigation District, a California Irrigation District ("District"), is one of the largest streams entering the San Joaquin Valley. The River's watershed covers 1,742 square miles, ranging in elevation from 500 to 14,000 feet above sea level. The majority of the watershed area is in the high Sierra Mountains and receives heavy snowfall in the winter months. This snow melts slowly. Thus in average years, the River does not reach its highest stage until the middle of May or early June. The current yearly average runoff for the Kings River is 1,689,700 acre feet. However, the average runoff does not guarantee this quantity in any given year. Variation is great, not only from year to year, but also from month to month. As a result of this great variation, there were alternating periods of flood and drought in the drainage area of the River until Pine Flat Dam was completed in 1954.

Rainfall occurs primarily in the winter months with virtually no rainfall in the summer months. The average annual rainfall for the fifty-year period preceding 1956 was 11.39 inches with the annual crop use per acre ranging from 24 to 36 inches. As a result, the agricultural crops within the District do not depend upon rainfall for their irrigation needs; but instead depend upon surface water deliveries and deep well pumps.

Historical water deliveries were initiated in 1882 by a private water company called the "76" Land and Water Company. In 1887, the California legislature passed the Wright Act, which conferred on farming communities the powers of municipalities to purchase, construct and operate irrigation works. On July 7, 1888, sixty-six landowners interested in developing a new public irrigation district filed petitions with the Tulare County Clerk. The District would now comprise 130,000 acres in Tulare, Fresno and Kings Counties and would become the Alta Irrigation District. The present communities of Dinuba, Reedley, Traver, Cutler, and Orosi lie within these boundaries.

Historically, the district had a shallow water table; in the early 1900's the distance from the ground surface to the groundwater table averaged less than ten feet with each successive drought period resulting in an increase in the agricultural groundwater pumping, the water table has dropped significantly over the last fifty years. As agricultural land is paved over for urbanization, the competition for control

of water resources among agricultural, urban and environmental interests will be significantly increased.

B. Purpose and Goals

The Alta Irrigation District has long recognized the importance of groundwater to the area. With the new state Legislation, AB 3030 (Section 10750, et. seq. California Water Code), an opportunity is available to the District to prepare and implement a Groundwater Management Plan ("Plan") on a local basis in-lieu of a mandated plan administered by the State of California Department of Water Resources. While this legislation allows for separate plans to be developed by each water purveyor, such as cities and special districts, within the irrigation district, a well conceived Plan covering the entire District will be more manageable and will have the potential to provide greater benefit. Separate plans prepared by the individual communities will not be effective, since groundwater does not recognize political boundaries. In addition, the availability of groundwater pumped to serve a community can be impacted by activities that take place a considerable distance beyond local boundaries. There is common use of the groundwater resource and it is hoped that this coordinated Plan will be of benefit to competing interests using the groundwater resource. The coordination will be accomplished through the establishment of Memorandums of Understanding between the District and the local agencies.

The proposed Plan recognizes that the conjunctive use of the water supplies within the District must be continued. To achieve this delicate hydrologic equilibrium requires the management of both surface and groundwater supplies. The long-term continuation of this balance will be the principal benefit to be derived from the Plan. Retaining all existing surface and groundwater supplies within the District is critical to maintaining this delicate balance.

The principal action item in the Plan will be gathering and evaluating additional data concerning the quantity and quality of groundwater. Action items will be developed to enhance the valuable groundwater resource by promoting those actions necessary to reduce the long-term groundwater level decline in the area. Many of the action items identified are currently being conducted or will begin with adoption of the Plan. Other action items will require further study prior to implementation.

Through the proposed Plan, duplication of activities by local jurisdictions will be reduced and the adopted Plan can be utilized in the long-term planning activities of all the agencies within the District. The Plan will be flexible allowing updates to be

made as needed, based on the additional information that is gathered through the monitoring programs.

The Plan preparation is being funded by the Alta Irrigation District. The water quality sampling and testing costs will be shared among the City of Reedley, City of Dinuba, Alta Irrigation District and other local agencies. Future activities required to fully implement the Plan may require funding sources in addition to those outlined. AB 3030 allows for the levying of groundwater assessments or fees under certain circumstances and according to specific procedures. Prior to instituting a fee structure, the District must hold an election on whether or not to proceed with the enactment of the assessments. A majority of the votes cast at the election will be required to implement an additional funding assessment.

C. Institutional Requirements

Historically, the use of groundwater within the state of California has not been regulated except in a few basins where the rights have been adjudicated by the courts or special management districts have been authorized by the state legislature. Groundwater accounts for approximately one-third of the water used within the state. With the continued increasing demand being placed on the limited water supplies of the state, groundwater usage is being scrutinized to a much greater extent.

II. EXISTING CONDITIONS

A. Groundwater Basin

The Alta Irrigation District overlies a portion of a larger groundwater basin designated as the Kings River Basin. The California Department of Water Resources has designated this basin to be a critically over drafted groundwater basin. The District has been monitoring groundwater levels for at least the last seventy-five years. The results of this monitoring effort are consistent with the findings of the Department of Water Resources. The water level measurements taken within the District show a continued downward trend in the groundwater elevations within the District's boundaries. This average overdraft is approximately 22,000 acre feet per year.

The total water supply available to the District is extremely variable and dependent on the snowpack that occurs in the Sierra Nevada mountain range to the east. The pumping within the groundwater basin is inversely proportional to the surface water supply made available by runoff within the Kings River watershed.

The boundaries of the District include land within three counties, two incorporated cities and numerous unincorporated urban water districts. All of the urban communities, along with many individual residences scattered throughout the District, are dependent on the groundwater supply to meet their domestic demands. Surface water is currently not available to meet those needs. The conjunctive use of both the groundwater and surface supplies is necessary to meet the irrigation requirements within the District. This irrigation demand represents by far the largest water use within the basin.

The District recognizes that the continuation of the agricultural, municipal and industrial developments within the basin is dependent on maintaining an adequate water supply. With the conjunctive use that already occurs within the District, adequate surface water supplies are necessary to achieve a water balance. Both the groundwater and surface supplies are already fully developed and cannot be augmented by increased groundwater production.

B. Geology

The District is located in the eastern portion of the San Joaquin Valley and southern half of the Great Valley geomorphic province of California. The District is part of the valley which is a nearly flat northwest to southeast trending alluvial plain. Alluvial sediments are found within the District and are bounded on the east by granitic rocks of the Sierra Nevada. The alluvium within the District is a heterogeneous mix of clay, silt, sand and gravel (USGS, 1968). The soils within the District are complex with the unconsolidated alluvial fans being made up of varied textured material. The upper soils vary from very heavy clays near the base of the Sierra Nevada (on the east side of the District) to relatively coarse sand near the western boundary along the Kings River. Much of the area is underlain by hardpan that restricts the vertical percolation of the water. These areas are typically ripped and/or soil amendments are applied to improve the vertical percolation. Throughout the District there are isolated locations of coarse grained material with high percolation rates. These are typically found at locations where old stream beds historically meandered throughout the District.

Along the east side of the District, the basement complex is shallow and the aquifer depth is very limited. The granite bedrock slopes quickly westward within the District resulting in a deeper aquifer along the western boundary of the District. The bedrock depth is approximately 500 feet below the ground surface along the eastern perimeter of the District and increases to 5,500 feet near its southwest limits. The coarse, sandy materials that are found along the west side of the District are reflected in the higher specific yields for those soils which are typically 50 percent to100

percent greater than for the finer textured clay materials found on the east side of the District. This same correlation is also found in the deeper soils which are much less permeable and have significantly lower specific yields than the upper soils. Therefore, the specific yields from wells drilled into the deeper portions of the aquifer are considerably less than the yields from shallower wells.

C. Hydrology

The hydrology of this area is principally impacted by the snowpack that occurs within the Kings River watershed and to a limited extent by both the local runoff from the foothills lying just easterly of the District and the precipitation that occurs within the District. The water table within the District is unconfined and typically flows in a southwesterly direction. Groundwater extractions are made for agricultural, municipal and industrial purposes. These extractions are very significant during periods when there is little surface water available to augment the water needs within the District. The groundwater levels, during those periods, experience a significant decline. Surface water made available to the irrigation canals and pipelines through diversion from the Kings River provides a stabilizing factor on the groundwater levels. This surface water supply reduces the amount of pumping, provides recharge and is the principal contributing factor that influences the groundwater conditions. This effect is evident in years of below normal runoff when a rapid decline in the groundwater level is experienced. Based on the District's fall 1993 groundwater measurements, the average groundwater level was 53.16 feet below ground.

D. Climate

The area is semi-arid with mild winters and hot, dry summers. The average rainfall, based on District records, is approximately 11 inches per year. The majority of this rainfall occurs from November through April. With the long, hot summers that normally occur in the valley, there is about 6 feet of evaporation per year with the majority of that evaporation occurring during the period May through October. The winds in the area are principally from the northwest with a southeast wind usually indicating that a rain storm is imminent.

E. Surface Water Management

Alta Irrigation District operates a "demand" system allowing farmers to order water on or off within the system. Primarily, water orders are called in between 7:00 a.m. and 8:00 a.m. each morning; with a subsequent coordinating meeting each morning to determine changes within the system. The conjunctive use pattern of utilizing surface water in wet years and relying more on ground water in dry years

helps to maintain sufficient water supplies to the District's significant acreage of permanent crops. The most beneficial use of surface water is to turn off the farmer's groundwater pump, thus conserving the groundwater to be utilized when needed.

All primary canal and pipeline measuring locations are measured daily prior to 7:00 a.m. Each farmer's delivery is measured at least once a day. The District uses a calibrated submerged orifice to determine the instantaneous flow rate. The District is in the process of updating its distribution system by requiring cumulative flow meters on all turnouts when open canals are replaced by pipelines.

In 1990, Alta Irrigation District commissioned the Kings River Conservation District to complete a "Surface Water Study" to study and review the District's surface water delivery system. A system water balance was evaluated in wet and dry years to determine seepage evaporation, evapotranspiration (ET) of bank vegetation, and operational spillage. The study showed that seepage (estimated to be approximately 23 percent of the District's total diversion) was the most significant loss in the system (see Exhibit "A").

The water flow in the District's canals and pipelines is measured by means of overflow weirs, undershot gates, parshall flumes and a current meter. The District has developed rating tables to set the proper flow rate in each of the canals and pipelines. However, the District may reallocate water from the different laterals if the demand warrants such reallocation.

The District has instituted a water allocation formula to equitably distribute water to farmers. The formula is based on four days per twenty acres utilizing one cubic foot per second per entitlement percentage. Approximately eighty percent of the District's irrigable acres receive one-hundred percent entitlement; the remaining acreage is entitled to receive seventy-five percent, fifty percent, twenty-five percent, or no surface water entitlement. Historically, the lower water entitlement areas either were not farmed or were being farmed to low value crops. The allocation formula is set by the Board of Directors and can be adjusted by lengthening or shortening the number of irrigation days per twenty acres. Typically, in less than average water years, water is held in storage until peak demand occurs in May, June and July.

Water regulating reservoirs have been designed to better maintain constant flows in the lower areas of the district. In 1991 the district developed the fifty-seven acre Button Ponding Basin which is fed by five tributary canals. The flow rates within the canals served by the pond, have been prone to large fluctuation between mid-week and weekend days. All the inflow is now funneled into the ponding basin with a single discharge point: the result being that on weekend's additional water *is*

stored in the basin; and on weekdays, when there is normally higher demand, additional water is used from the storage basin. Additional regulating reservoirs are being evaluated for future construction.

F. Surface Water supply

The District *is* located east of the Kings River in the Central San Joaquin Valley (see Exhibit "B"). To the east of the District are the Sierra Nevada Foothills. The District is composed primarily of alluvial fans sloping to the southwest with elevations ranging from about 425 feet at the northern point to 270 feet in the southwest corner. The incorporated communities within the district are Reedley (population 18,000) and Dinuba (population 13,700). There are also several unincorporated communities, housing clusters and individual rural residences.

The primary economy within the District is agriculture or agriculturally related business. The primary crops grown within the region are grapes (22,056 acres), nectarines (14,394 acres), plums (12,285 acres), and peaches (10,080 acres). Due to the relatively high land prices and high production costs in terms of hand labor, spraying and fertilizer costs, the average parcel size is approximately 36 acres. There are approximately 4,000 farm parcels within the district.

Initially, agricultural production in the region was primarily dry land farming; but with the development of a dependable surface water supply and a willingness of farmers to risk high value crops, the cropping pattern changed to perennial crops and need for a stable water supply became apparent.

The estimated crop demand within the District is 325,000 acre feet and the average surface water supply is 148,416 acre feet; therefore, there is a strong reliance on an alternate water supply; i.e., groundwater.

The District diverts water from the Kings River at the "Cobbles Weir" and measures water into the District at a computerized headgate ("Headgate") located near the community of Piedra. Downstream of the Headgate are 78 ditch laterals serving approximately 4,000 farm parcels. The total length of canals and pipelines is between 350 and 400 miles. The canal widths vary from 4 to 70 feet; lengths range from 3,000 feet to nearly 18 miles (see Exhibit "D")

The annual diversions from the Headgate during a recent twenty-year period were as follows: 253,269 acre feet in 1980 (highest annual diversion); 38,721 acre feet in 1977 (lowest annual diversion) and 148,446 acre was the average annual diversion.

The average time period for each water run within such twenty-year period is 112 days; the shortest water run being 28 days; and the longest water run being 195 days (see Exhibit "C"). The District's diversion and storage rights are based upon riparian and appropriative claims as well as contractual agreements and licenses granted by the state Water Resources Control Board. Such agreements stipulate the use of District's rights in conjunction with the rights of the other twenty-seven (27) entities storing and diverting water from the Kings River: the twenty-eight (28) entities comprise the Kings River Water Association. It is typical for weather patterns and the resulting water storage to vary significantly from year to year, thus illustrating the value of water storage in the production of perennial crops.

III. WATER QUALITY

A. Groundwater Quality

Overall, the quality of the groundwater within the basin is very good. This is the result of the excellent quality of the basin recharge waters originating in the Kings River watershed. The most prevalent water quality problems occurring within this basin are caused by synthetic chemicals. The predominant chemical contamination is DBCP. When the groundwater is used for domestic purposes, construction of ground level treatment facilities to remove the contaminants or the drilling of deeper uncontaminated wells has been required. The contamination has not resulted in any problems when the well water is used for irrigation purposes. Additional contaminates of the water used for domestic purposes include nitrate and bacteriological. The nitrate contamination is usually the result of agricultural fertilizer, domestic sewage, or livestock wastes. In some isolated locations, nitrate levels in groundwater have also caused problems for the agricultural pumpers. The groundwater management plan will include recommended procedures to maintain the existing excellent water quality. Initially, this will include additional water quality monitoring.

Groundwater wells are prevalent throughout the District. The wells are used by cities, agricultural producers, industrial developments and individual homeowners. With the many water production wells, there is a risk that cross aquifer contamination can occur. The greatest potential for groundwater contamination within the basin is cross aquifer contamination through abandoned wells and the improper sealing of new wells. Therefore, it is necessary that proper sealing of new wells and abandonment of old wells is always accomplished. At a minimum, the water well standards of Tulare, Kings & Fresno Counties along with Bulletin 74 requirements must be met. In addition, it may be advantageous to require construction standards that exceed those presently mandated by either the county or state. With the continual raising of

standards for drinking water, maintaining the quality of the groundwater becomes ever more important.

B. Surface Water Quality

The surface supply for the District consists principally of diversions from the Kings River. The snowpack and rainfall within the Kings River watershed produce extremely high quality water with very low amounts of dissolved salts. This has allowed consistently high yields to occur on the heavier soils that are not freely drained without the development of a serious drainage problem. The surface water also provides an excellent source of water for recharging the District's groundwater supply. It is important that the quality of this water be maintained. To this end, the District has been active in identifying surface water discharges within the Basin that may impact water quality. These will be continually monitored and may require the issuance of permits through the NPDES process. Anyone causing overland surface flows that are found to be detrimental to the District's water supply will be put on notice that they must either eliminate or clean those flows to avoid impacting the quality of the District's water supply.

Municipal storm water discharges into District facilities are regulated by permits between the discharger and the District. The permits are specific as to area being drained and/or flow allowed to be discharged. Permit conditions require that the quality of this water meet the existing and future standards set by the Regional Water Quality Control Board. The right to discharge can be terminated at any time the conditions of the permit are not met by the discharger.

C. Water Quality Requirements/Objectives

A primary objective of the Plan is to maintain the water quality within the District. This is of extreme importance because the municipal, industrial and agricultural users need a dependable high quality water supply. A reduction in the quality of the groundwater is tantamount to a loss of water supply, since the quality problem will require additional costs for the construction of treatment facilities. This cleanup will be necessary to allow the water to be integrated into the system.

One of the action items listed in the Plan recommends increased monitoring of groundwater quality in selected areas. This monitoring information will be collected and utilized to evaluate the best management practices to reduce and/or eliminate the contamination. In addition, the action items recommend working with the Department of Water Resources and the counties of jurisdiction in upgrading certain provisions of the water well standards. Since the natural minerals occur in low

concentrations, the major thrust of the water quality monitoring and recommended practices will be to prevent chemical contamination.

The quality of both surface and groundwater within the District must be maintained. The Plan provides a mechanism that will help achieve those long-term goals. The initial action of increasing the amount of monitoring will provide the additional data needed to proceed with future programs to maintain water quality.

D. Wastewater Reclamation

There is little potential for increasing the water supply through wastewater reclamation in this basin. The majority of the wastewater is currently being utilized for the irrigation of agricultural crops or groundwater recharge with only a minor portion being consumed through evaporation basins. The District will continue to work with the wastewater agencies, where practical, to reduce the amount of effluent disposed of through evaporation. In addition, the District will continue to promote the past practices of reusing all wastewater effluent within the local basin, in order to maintain the total water balance within the area. In a water deficient region such as the Alta Irrigation District, the reuse of the wastewater effluent is a key element of establishing a water balance.

IV. GROUNDWATBR CONDITIONS

A. Groundwater Mapping

The District has been monitoring- the groundwater level for the last seventy-five (75) years. This is accomplished through water level measurements taken in the late fall and early spring. A map of the District showing the well locations has been attached (see Exhibit "E"). As wells are lost, new wells are substituted to maintain the continuity of the grid pattern. From these readings, groundwater contour maps have been made depicting both the water elevation and changes in groundwater levels. This mapping has shown drastic differences between various regions of the District during the last drought period.

Based on the water level readings, the overall trend has shown a declining groundwater level within the District. This decline has been periodically interrupted by a short-term groundwater recovery. Based on this long-term data, it has been determined that it would take approximately 22,000 acre-feet per year of additional surface water to correct the overdraft situation that presently exists. Based on average porosity and specific yield considerations, this results in a decline in the groundwater storage of one foot for every 7,000 acre-feet of overdraft. This storage can be

regained if sufficient surface water supplies are made available to reduce the amount of groundwater pumping that is necessary to meet the water demands. In addition, the overdraft results in additional pumping costs to overcome the increased lift. As the water table continues to drop, the pumping occurs from lower portions of the aquifer which have lower porosity and specific yield factors than those found in the upper portions of the unconfined aquifer. The long-term impact is a greater incremental reduction in the available groundwater storage per acre foot of overdraft. Using the historical data collected and the transmissivity of the aquifer, a determination can be made of the estimated quantity of inflow and/or outflow of groundwater within the limits of the District. This data also will allow the District to evaluate areas that are more severely impacted during periods of sustained drought due to the low yield of the wells and the limited depth of the aquifer. This is an important water management tool that is useful to the District in developing long term planning decisions.

The collection of this data will be continued with the Plan. The information that has been prepared from this data in the past includes the following:

1. Maps of spring and fall water elevations.
2. Maps of spring and fall depths to groundwater.
3. Maps showing the changes in groundwater levels over time.

In addition, the groundwater reports can include estimates of changes in groundwater storage, water delivered, water use, and overdraft. This will allow an evaluation of the management activities to be made.

The water quality monitoring that is being proposed as one of the action items will be used to augment the information obtained through the historical water level readings. The water quality samples will be taken *in* critical areas adjacent to urban centers and known locations of contamination. With the compilation of the quality tests and the groundwater level measurement, the District will improve its ability to effectively manage the groundwater.

This information can provide the additional data needed to establish programs to reduce the movement of the contaminates. Typically, the urban centers have a higher concentration of wells resulting in a cone of depression within and surrounding the community. This can accelerate the movement of contaminates towards the urban well fields with the information gathered through the Plan, an additional future action item could include the analysis of the potential benefits of creating a hydraulic barrier or modification of the local pumping regime to reduce or impede the migration of the contamination.

B. Groundwater Recharge

In any conjunctive use area, groundwater recharge is a critical part of the overall Plan. For many years, the District has maintained recharge basins along the southwesterly perimeter of its boundaries. They are located in areas of highly permeable soils. In addition, some amount of affective recharge is also obtained through the District's 700 miles of canals, even though the majority of the soil types are such that the recharge capability of the soil is very limited.

The District has been conducting extensive research to locate additional recharge sites in the eastern portion of the District, since that area is severely impacted in dry years due to the low specific yields and the limited depth of the aquifers. In 1987, the District was selected for funding through the Proposition 44 program to develop a groundwater recharge basin in an area that had limited groundwater resources. The site appeared to have soil types that would be conducive to recharge efforts. An in-depth geological study was undertaken and it was determined that the site would not be effective for groundwater recharge. The District has continued in their efforts to locate additional sites, but so far a suitable location has not been found.

To proceed with a groundwater recharge program, additional surface water supplies are necessary to fully implement the Plan. The District's average annual water supply is already committed. The surface water necessary to conduct an extensive program is available only in wet years when additional water supplies or flood waters are available on the Kings River. The District's goal has been and will continue in the future to make beneficial use of those waters by recharging the underground. For the most part, District conveyance facilities are currently available to transport these waters to the basin locations. Unfortunately, the prospects for locating effective recharge basin sites within the areas of greatest need are not promising.

The District will also be looking at joint recharge sites with the cities. If suitable sites are located within the boundaries of a municipal jurisdiction, the possibility of a joint use facility would be evaluated. The potential exists for water to be delivered to all or part of the site for recharge purposes during a portion of the year, with consideration given to other uses during the remainder of the year.

As a complement to the District's local recharge program, one of the action items is to evaluate "groundwater banking". This could be accomplished by assisting the recharge efforts of other districts that have access to better groundwater recharge sites. Flood waters would be recharged (banked) in a particular district thereby improving their groundwater levels. The amount of water banked would be quantified

on an annual basis and an agreement developed so that the District would have .rights to a stipulated portion of the water banked through the joint agreement. In both the short and long terms, this approach appears to be the most effective way for the Basin Plan Area to proceed. In addition, investigations will continue on potential local recharge sites.

V. ACTION ITEMS

A. Groundwater Management Program

There have been thirteen (13) action items identified for the Plan and those items will be implemented according to the Rules and Regulations (see Exhibit "Fit), as amended from time to time. To have a successful Plan, it is not necessary to implement all of the action items identified. The last three items would be required only as a last resort due to the occurrence of emergency conditions within the Basin Plan Area. It is important that all the potential action items be identified and contingency plans developed in case anyone of them becomes necessary. It is recommended that items one (1) through six (6) be implemented immediately. Investigations into items seven (7) and eight (8) should begin upon approval of the Plan with a staff report regarding their status provided within one year. Action items nine (9) through thirteen (13) will require additional staff study, board approval and public hearings. If funding is necessary to implement a portion of the Plan, then an election will be required prior to instituting an assessment. It is felt that through the management activities listed in the Plan, the District can preserve the groundwater resource and avoid the drastic steps identified in the last three action items.

1. Water Monitoring: The District shall continue to monitor water levels every six months In addition, it will also assist in sampling for water quality testing. Further, the District will prepare maps depicting the information gathered through the monitoring phase, as well as reports quantifying the water demands, surface water and groundwater supplies. These summaries will assist the District in evaluating the effectiveness of the various elements of the program. The migration of contaminated plumes can be detected earlier though the monitoring process allowing additional time for plans to be developed and implemented before additional portions of the basin are impacted.

2. Direct Recharge: The District will continue to use surface waters when available to recharge the underground by sinking those waters in its basins. Basin sites will be located in the areas of greatest need. The District will actively seek the cooperation of other government entities in construction of such sites.

3. Indirect/In-lieu Recharge: The District has approximately 250 miles of unlined canals. The indirect recharge *is* accomplished through the seepage that occurs in some reaches of the canals. In addition, during winter months many of the natural channels carry surface runoff that recharges the groundwater. These old channels are typically located in the more permeable soils. The effective amount of this recharge varies from year to year and is dependent upon the amount of rainfall that occurs. Additional water supplies will be pursued for groundwater recharge in natural channels and during non-irrigation seasons in the District's canals. By providing surface water to the area, the District has reduced the amount of groundwater pumping, resulting in an effective in-lieu recharge program. The District will continue efforts to maximize the amount of surface water available to users within its boundaries.

4. Water Conservation - Water Regulation: The District has a long standing practice of conjunctive water use. Conjunctive use is the integration of surface and groundwater supplies to meet the total water demand. Recently, a cooperative program called the "mobile lab," has been operated by the Kings River Conservation District with support from the local irrigation districts. The purpose of this program has been to promote on-farm water conservation. The District has strongly supported programs that conserve water along with enhancing crop production. Through the construction of water regulating basins, the District has been able to conserve and more efficiently utilize water within its system. The most recent regulating basin was constructed on a 50-acre site in the southeast portion of the District. The Alta Irrigation District, the cities and the unincorporated water purveyors, all have water conservation plans. Water conservation efforts will be encouraged throughout the basin for agricultural, industrial and residential users. Existing and new irrigation methods, reuse of industrial water and domestic water saving devices will all be encouraged. The water use requirements of new developments will also be evaluated to insure compatibility with this water deficient basin.

5. No Exportation of Groundwater: Since the District is located within an overdrafted basin, it is prudent to utilize groundwater resources within the District's boundaries. Effluent discharged by the City of Reedley ("Agency") from its sewer treatment plant into the Kings River should not be considered to be prohibited exportation of groundwater if such effluent recharges or benefits underground supplies available to landowners in the District.

6. Intra-district Water Transfer: Water transfers within the District have taken place on a routine basis. Each year the District evaluates the water transfer policy and specifies the circumstances warranting internal water transfers. Approximately 60 transfers are approved each year within the District.

7. Well Drilling and Abandonment: Portions of the groundwater have been contaminated principally by volatile organic chemicals or nitrates. This contamination is most prevalent in the upper aquifers. Interaquifer mixing can occur through inadequate seals or improperly abandoned wells. Working through the Department of Water Resources and the county of jurisdiction, the District will seek to upgrade standards for construction and abandonment of water wells to reduce the potential for aquifer contamination.

8. Groundwater Banking: With the scarcity of suitable recharge sites within the District, the Alta Irrigation District will look to other agencies that have soil types more suitable for recharge basins. The District could then recharge (bank) surface water within the boundaries of the Agency for withdrawal at a later time. This arrangement can provide benefit to the groundwater basins for both the and the cooperating Agency. The District benefits since otherwise it has few areas suitable for recharge and the participating Agency receives the benefit of reduced pumping lifts during the time the water is banked.

9. Inter-district Water Transfer: Water transfers between different water districts are currently taking place. New legislation is being proposed that will enhance the water transfer process. In the past, the District has completed such transfers on a limited basis. This mechanism would be used to increase the total water supply within the District or to augment the water supply in specific areas of the basin during critically dry years.

10. Reduction in Groundwater outflow: The direction and quantity of groundwater flow is susceptible to changes that occur to the hydraulic gradient. The groundwater level measurements taken twice a year within the District will identify the direction of groundwater flow. Typically, this outflow has been to the west and southwest creating hydraulic barriers by mounding of the groundwater can lead to a reduction in the amount of water that leaves the District. This can be an especially effective procedure along the perimeter of the District. Likewise, increased pumping by landowners along the perimeter of the basin can increase the groundwater outflow. The District will continue its efforts to assure that all necessary steps are taken to reduce the amount of such groundwater outflow.

11. Pumping Restrictions: Pumping restrictions would definitely reduce the amount of groundwater use. This is a controversial item and pumping restrictions would be the last item to be considered. This step could have severe economic implications since the local economy that has been developed with a reliance on groundwater would be detrimentally impacted. Initially, any program requiring pumping restrictions would be voluntary rather than mandatory. From a practical

standpoint, only if the urban water supplies are being severely restricted, will mandatory agricultural pumping restrictions be implemented.

12. Additional Water supply and Storage: The generation of additional water supplies would enhance the local groundwater. Present political realities prevent developing additional water by building dams and water storage projects. As a result, additional water supplies will most likely come through water conservation efforts, recycling and storm water supplies. The limiting factor to securing additional water supplies is addressing actual or perceived environmental considerations.

13. Redistribution of Surface Water: There is a tremendous difference in the aquifer characteristics within the District. This is evident in both storage capability and yield. The impact of the recent and apparently ongoing drought is evidenced by the larger drop in water level for those areas with limited aquifer depth versus portions of the basin that are located over a deeper and higher yielding aquifer. During critically dry years, all or a disportionately high percentage of the available surface water may need to be directed to the severely impacted areas. Increased pumping could then occur in those areas having better groundwater conditions to offset the redistribution of the available surface water supply.

B. Memorandum of understanding

The District shall endeavor to enter into a Memorandum of Understanding with public or private entities providing water service in accordance with Water Code section 10755.2. It is hoped that such local agencies will adopt and implement this Plan within their boundaries to provide a coordinated groundwater management program in accordance with that section.

IN WITNESS WHEREOF, the Alta Irrigation District has executed this Groundwater Management Plan as of **October 14, 1994.**

"DISTRICT"

ALTA IRRIGATION DISTRICT, a
California Irrigation District

BY Norman Waldner
Norman Waldner, President

BY Janelle M. Cochran
Janelle M. Cochran, Secretary

MEMORANDUM OF UNDERSTANDING
BETWEEN
ALTA IRRIGATION DISTRICT
AND
LOCAL AGENCY

ARTICLE I – AGREEMENT

The articles and provisions contained herein constitute a bilateral and binding agreement by and between ALTA IRRIGATION DISTRICT, a California Irrigation District ("District") and LOCAL AGBNCY, A Public Agency ("Agency").

ARTICLE II – RECOGNTION

The District has developed a Groundwater Management Plan ("Plan") with input from several local agencies which are water purveyors with overlapping spheres of influence within the District. It is the intent of District to allow and encourage such agencies to coordinate efforts and be a part of the District's Plan by means of a separate Memorandum of Understanding ("MOU") between each agency and District.

ARTICLE III - PURPOSE

It is the purpose of this MOU, entered willingly, between District and Agency, to document the interests and responsibilities of both parties in the adoption and implementation of a coordinated Plan. It is also hoped that such MOU will promote and provide a means to establish an orderly process to share information, develop a course of action and resolve any misunderstandings or differences that may arise.

ARTICLE IV - COORDINATION

There shall be an annual coordinating meeting ("Meeting") between the District and the Agency. District shall give notice to the Agency thirty (30) days prior to date of the Meeting. If there are concerns or questions regarding the Plan, Agency shall transmit its concerns in writing to District seven (7) days prior to the Meeting.

ARTICLE IV - OBLIGATIONS

The Plan shall be binding on the parties hereto unless superseded by the MOU or amendment thereto. It is agreed between both parties that District shall pay one-third of the cost and expense of water quality testing I sampling and monitoring and Agency shall pay prorated portion of two-thirds of such cost provided that the total annual cost payable by each party shall not exceed six thousand eight hundred dollars ($6,800). Within one year from the date hereof, the parties shall establish procedures and arrangements to carry out such sampling, testing and monitoring.

ARTICLE VI – AREA OF PLAN

The plan shall be effective in all areas within the Agency boundaries. The Plan shall also be effective in any area annexed to the Agency Subsequent to the adoption of the Plan.

ARTICLE VII – TERM

The initial term of the MOU shall commence on the date hereof and continue for five (5) years, and shall continue year to year thereafter, unless terminated by written notice given at least one (1) year prior to such termination.

"DISTRICT"

ALTA IRRIGATION DISTRICT, a California Irrigation District

By_____
Norman Waldner, President

By_____
Janelle M. Cochran, Secretary

"AGENCY"

LOCAL AGENCY, a Public Agency

By_____

By_____

Table III-1
Alta I.D. Canal Seepage for Wet (1984) and Dry (1990) Years

Canal Name	Length (mi)	Seepage (cfs)	1984 Seepage (AF)	1984 Seepage % of Diversion	1990 Seepage (AF)	1990 Seepage % of Diversion
Alta Main	8.9	11.2	3,592	1.7%	1,071	1.8%
A.B. Clark	4.4	2.5	810	0.4%	242	0.4%
A.N. Smith	1.8	0.2	62	0.0% *	18	0.0% *
A.W. Clark	2.9	0.6	186	0.1%	56	0.1%
Andrews	2.5	0.4	130	0.1%	39	0.1%
Ballard	2.8	0.2	79	0.0% *	23	0.0% *
Banks	17.7	4.4	1,409	0.7%	151	0.3%
Bowhay	3.1	1.1	336	0.2%	100	0.2%
Bump & Edmison	1.8	0.2	64	0.0% *	19	0.0%
Button	15.0	4.2	1,345	0.6%	281	0.5%
Buttonwillow	11.0	8.9	2,830	1.3%	844	1.4%
Caesar	5.3	4.4	1,397	0.7%	417	0.7%
California Vineyard	6.9	6.1	1,938	0.9%	578	1.0%
Carey-Hunter	7.7	2.8	885	0.4%	263	0.5%
Carpenter	1.2	0.0	10	0.0% *	3	0.0% *
Clapp	1.5	0.0	5	0.0% *	2	0.0% *
Clements	4.0	2.1	667	0.3%	199	0.3%
Clough	3.9	1.6	502	0.2%	15	0.0% *
Cross Creek W.W.	1.9	0.4	129	0.1%	4	0.0% *
Curtis Cutoff	1.5	0.5	155	0.1%	46	0.1%
Lower Curtis Cutoff	0.9	0.2	73	0.0% *	22	0.0% *
Upper Curtis Cutoff	1.0	0.1	19	0.0% *	6	0.0% *
Dinuba Town	8.8	4.7	1,507	0.7%	449	0.8%
East Branch	15.5	18.0	5,753	2.7%	1,715	2.9%
East Gould	1.5	0.1	31	0.0% *	9	0.0% *
East Reedley	5.5	1.8	563	0.3%	168	0.3%
East Section 20	1.2	0.1	20	0.0% *	6	0.0% *
Elter	2.5	0.1	38	0.0% *	11	0.0% *
Floyd	1.5	0.1	42	0.0% *	13	0.0% *
Frane	1.4	0.0	3	0.0% *	1	0.0% *
Gordon	1.0	0.1	41	0.0% *	12	0.0% *
Grove	1.7	0.0	16	0.0% *	5	0.0% *
Haden & Boone	2.7	0.4	141	0.1%	42	0.1%
Hogan	2.1	0.1	37	0.0% *	11	0.0% *
Horsman	5.0	1.7	550	0.3%	164	0.3%
J.T. Williams	2.4	0.0	9	0.0% *	3	0.0% *
Jack	1.2	0.3	103	0.0% *	31	0.1%
Kennedy School House	5.0	0.3	82	0.0% *	24	0.0% *
Kennedy Waste Way	7.3	3.7	1,168	0.5%	347	0.6%
King	4.4	3.1	979	0.5%	206	0.4%
Kirk	1.7	0.3	84	0.0% *	25	0.0% *
Knestric	5.6	0.8	254	0.1%	76	0.1%
Loper	3.2	0.5	162	0.1%	48	0.1%
Lovell	2.0	0.4	136	0.1%	41	0.1%
McBriar	2.0	0.0	8	0.0% *	2	0.0% *
McClanahan	5.9	4.8	1,527	0.7%	446	0.8%
Mc Gee	1.9	0.2	54	0.0% *	16	0.0% *
Monson	7.0	3.5	1,128	0.5%	336	0.6%
Montague	1.3	0.2	52	0.0% *	16	0.0% *
Mt. Campbell	3.7	1.5	466	0.2%	139	0.2%
Nichols-Cann	1.9	0.0	6	0.0% *	2	0.0% *
Nuss	1.2	0.0	2	0.0% *	1	0.0% *
Orosi School House	3.2	0.9	279	0.1%	83	0.1%
Parenti	1.3	0.0	4	0.0% *	1	0.0% *
Parks	1.5	0.2	78	0.0% *	23	0.0% *
Peck	0.6	0.0	2	0.0% *	0	0.0% *
Red Williams	1.5	0.2	67	0.0% *	10	0.0% *
Reedley Main	3.0	2.9	917	0.4%	273	0.5%
Reo	1.5	0.2	63	0.0% *	19	0.0%
Rice-Brubaker	2.2	0.3	99	0.0% *	30	0.1%
Sandridge	2.9	0.4	140	0.1%	42	0.1%
Segrue	0.3	0.0	1	0.0% *	0	0.0% *
Smith Mountain	9.3	3.1	977	0.5%	291	0.5%
Sontag	6.7	0.2	59	0.0% *	14	0.0% *
Tout	6.0	1.4	439	0.2%	131	0.2%
Traver Creek	10.1	12.1	3,878	1.8%	1,156	2.0%
Traver Canal	12.3	21.6	6,910	3.2%	1,788	3.1%
Uphill	0.6	0.0	2	0.0% *	0	0.0% *
Van Noy	2.2	0.3	96	0.0% *	18	0.0% *
Wahtoke	5.1	0.7	224	0.1%	67	0.1%
Weise	1.0	0.3	80	0.0% *	2	0.0% *
West Gould	4.9	0.9	281	0.1%	84	0.1%
West Reedley	5.6	1.4	442	0.2%	132	0.2%
West Section 20	1.8	0.1	26	0.0% *	8	0.0% *
Wilson	10.7	7.0	2,220	1.0%	662	1.1%
Wilson Hunter	1.5	0.5	151	0.1%	45	0.1%
Wilson School House	3.4	0.9	287	0.1%	85	0.1%
Windsor	1.3	0.0	3	0.0%	1	0.0%
TOTAL	316.7	154	49,306	23.1%	13,727	23.6%

Note: * Indicates that canal seepage is less than 0.05% of Alta's total district diversion.

Reference: Kings River Conservation District (KRCD)

SCHEDULE OF DIVERSIONS & WATER RUN, 1973 - 1992

DIVERSIONS FROM HEADGATE		WATER RUN	
1973	86,773 Acre Feet	04/16-08/31	138 Days
1974	220,041 Acre Feet	05/15-08/31	139 Days
1975	184,034 Acre Feet	04/21-08/22	124 Days
1976	43,381 Acre Feet	06/14-07/17	34 Days
1977	38,721 Acre Feet	07/01-07/28	28 Days
1978	246,204 Acre Feet	05/11-10/31 & 5 days in Sept.	169 Days
1979	181,999 Acre Feet	05/01-08/31	123 Days
1980	253,269 Acre Feet	04/01-09/13	166 Days
1981	145,581 Acre Feet	05/04-08/14	103 Days
1982	247,599 Acre Feet	04/20-10/31	195 Days
1983	205,445 Acre Feet	04/28-09/29 & 10/02-10/14	167 Days
1984	214,165 Acre Feet	03/31-09/07	161 Days
1985	170,826 Acre Feet	04/28-08/26	121 Days
1986	227,709 Acre Feet	04/07-09/30	177 Days
1987	121,270 Acre Feet	05/04-08/04	93 Days
1988	59,118 Acre Feet	06/13-08/01	50 Days
1989	89,983 Acre Feet	05/28-08/04	69 Days
1990	58,468 Acre Feet	06/21-08/07	48 Days
1991	107,706 Acre Feet	05/21-08/10	82 Days
1992	66,623 Acre Feet	05/28-07/26	59 Days
AVERAGE	**148,446 Acre Feet**	**AVERAGE**	**112 Days**
MOST	**253,269 Acre Feet**	**LONGEST**	**195 Days**
LEAST	**38,721 Acre Feet**	**SHORTEST**	**28 Days**

Reference: Alta Irrigation District
1992 Annual Report

Figure I - 1
Location of Alta
Irrigation District

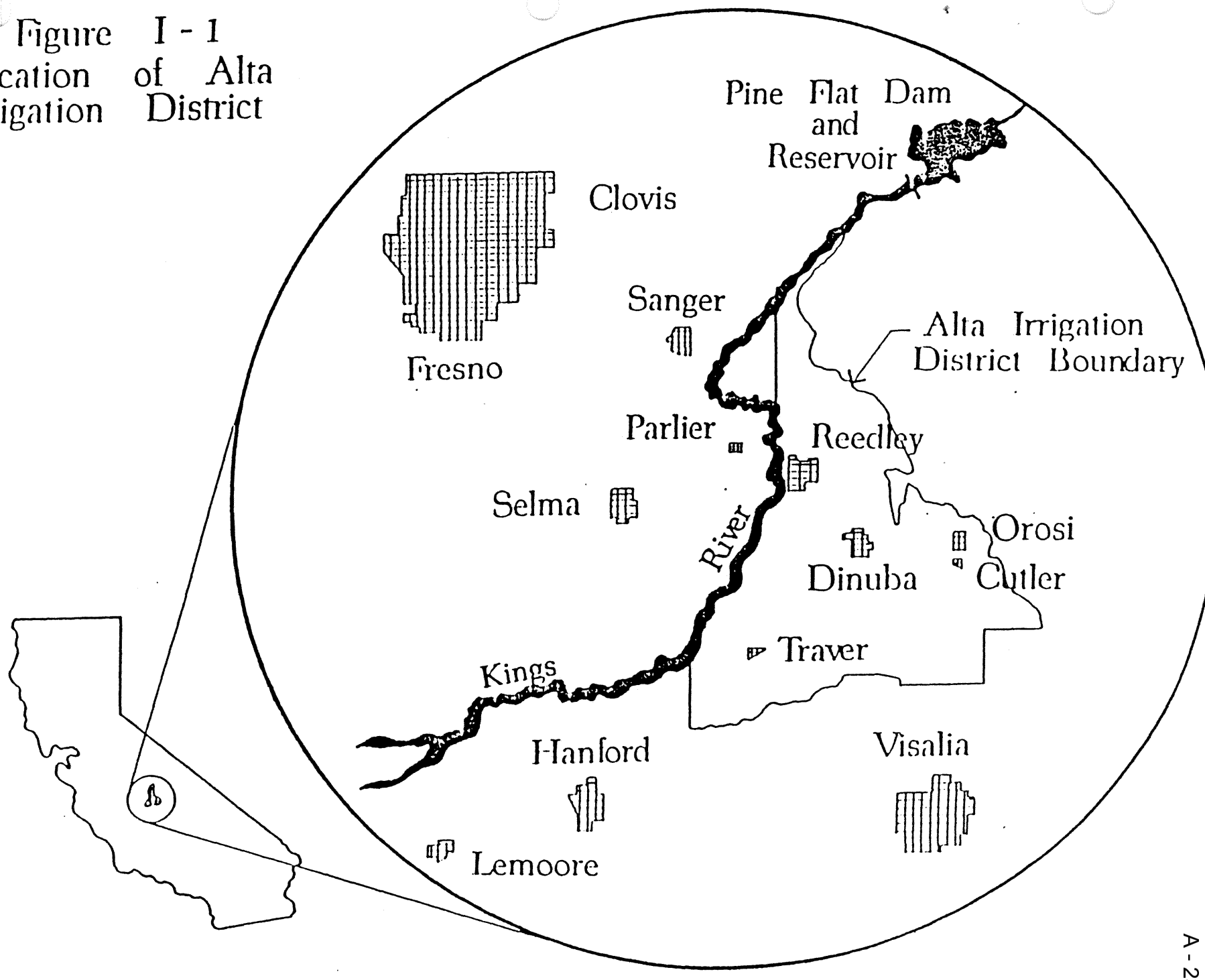

Table I-1
Alta I.D. Canal Specifications

Canal Name	Length (mi)	Average Top Width (ft)	Average Cross Sectional Area (sq ft)	Canal Volume (AF)
Alta Main	8.9	72.4	245	265.3
A.B. Clark	4.4	12.4	19	8.8
A.N. Smith	1.8	5.7	5	0.7
A.W. Clark	2.9	8.3	9	2.6
Andrews	2.5	4.0	3	1.0
Ballard	2.8	9.3	11	1.5
Banks	17.7	13.2	21	44.8
Bowhay	3.1	12.6	20	7.5
Bump & Edmison	1.8	7.3	7	0.6
Button	15.0	17.7	28	50.9
Buttonwillow	11.0	19.9	48	60.4
Caesar	5.3	15.7	27	17.1
California Vineyard	6.9	19.2	46	37.6
Carey-Hunter	7.7	12.9	19	16.0
Carpenter	1.2	10.9	15	1.0
Clapp	1.5	6.1	6	0.3
Clements	4.0	13.5	20	9.7
Clough	3.9	10.7	14	6.8
Cross Creek W.W.	1.9	11.6	17	3.9
Curtis Cutoff	1.5	15.0	24	2.3
Lower Curtis Cutoff	0.9	10.2	13	1.0
Upper Curtis Cutoff	1.0	11.0	14	0.5
Dinuba Town	8.8	13.9	24	24.5
East Branch	15.5	42.8	123	231.5
East Gould	1.5	4.5	2	0.2
East Reedley	5.5	17.5	46	18.1
East Section 20	1.2	8.3	10	1.4
Elter	2.5	6.5	5	1.5
Floyd	1.5	4.8	4	0.6
Frane	1.4	N/A	N/A	0.1
Gordon	1.0	5.7	6	0.5
Grove	1.7	7.5	10	1.2
Haden & Boone	2.7	6.0	6	1.3
Hogan	2.1	5.4	5	0.4
Horsman	5.0	9.2	9	5.7
J.T. Williams	2.4	N/A	N/A	0.8
Jack	1.2	8.0	10	1.4
Kennedy School House	5.0	13.4	23	2.9
Kennedy Waste Way	7.3	13.4	22	15.2
King	4.4	13.8	19	10.1
Kirk	1.7	4.6	4	0.7
Knestric	5.6	6.2	4	2.6
Loper	3.2	6.3	4	1.7
Lovell	2.0	5.7	5	1.1
McBriar	2.0	N/A	N/A	0.8
McClanahan	5.9	15.1	27	18.3
Mc Gee	1.9	4.6	4	1.3
Monson	7.0	13.9	27	23.0
Montague	1.3	4.4	4	0.5
Mt. Campbell	3.7	12.8	20	6.4
Nichols-Cann	1.9	N/A	N/A	0.5
Nuss	1.2	N/A	N/A	0.1
Orosi School House	3.2	7.5	7	2.8
Parenti	1.3	N/A	N/A	0.3
Parks	1.5	7.7	9	0.9
Peck	0.6	N/A	N/A	0.1
Red Williams	1.5	16.1	18	3.3
Reedley Main	3.0	21.5	45	16.7
Reo	1.5	4.5	2	0.4
Rice-Brubaker	2.2	5.4	5	0.8
Sandridge	2.9	15.4	30	5.8
Segrue	0.3	N/A	N/A	0.1
Smith Mountain	9.3	12.8	17	17.9
Sontag	6.7	9.5	12	9.3
Tout	6.0	10.2	13	8.2
Traver Creek	10.1	28.0	78	95.6
Traver Canal	12.3	39.4	58	86.6
Uphill	0.6	N/A	N/A	0.1
Van Noy	2.2	8.9	12	3.3
Wahtoke	5.1	12.8	15	7.1
Weise	1.0	9.1	11	1.3
West Gould	4.9	7.6	10	4.8
West Reedley	5.6	10.6	13	7.6
West Section 20	1.8	7.5	7	1.5
Wilson	10.7	16.4	31	40.1
Wilson Hunter	1.5	10.4	18	3.3
Wilson School House	3.4	11.1	16	6.2
Windsor	1.3	N/A	N/A	0.2
TOTAL	316.7			1,239.1

Notes: Width and area values as N/A denote canals that are completely piped.
Width and area values are for open channel segments only.

WELL LOCATIONS
ALTA IRRIGATION DISTRICT

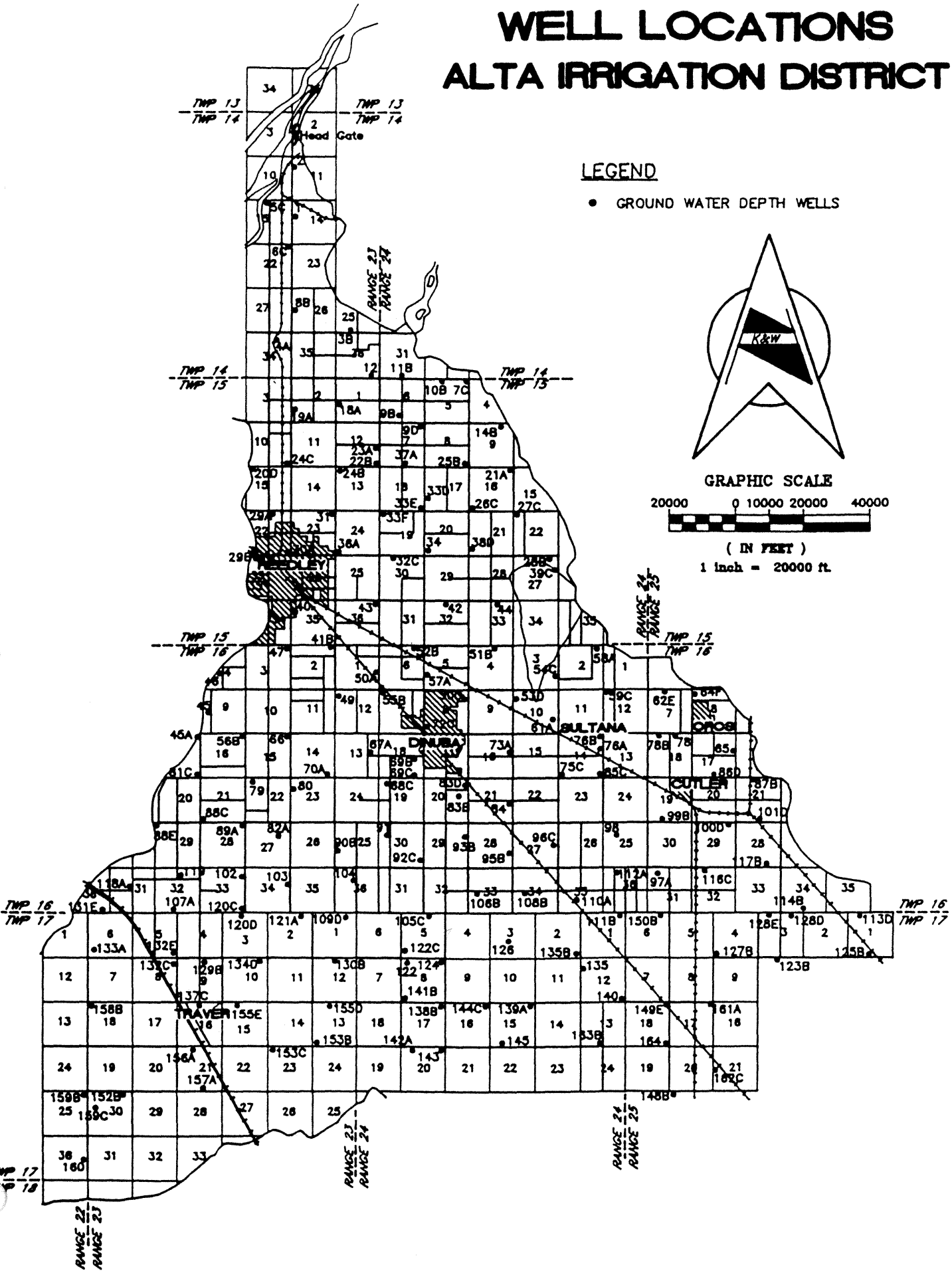

EXHIBIT "F"
GROUNDWATER MANAGEMENT PLAN
RULES AND REGULATIONS
TO IMPLEMENT THE
GROUNDWATER MANAGEMENT PLAN
OF
ALTA IRRIGATION DISTRICT

1. Rules and Regulations Governing Distribution of Water and Maintenance of Distribution System to Alta Irrigation District: The Rules and Regulation adopted by the District on March 9, 1990 and attached hereto as Exhibit "G" are hereby incorporated in these Rules and Regulations.

2. Water Monitoring:

(a) Semi-annual Groundwater Level Measurement: At least twice per year, District shall provide staff at its expense to monitor and measure the depth to standing groundwater at well sites within District. In its sole discretion, District shall select the number and location of well sites. District shall prepare maps as required by the Plan.

(b) Water Quality sampling and testing: District along with other local agencies as defined in water Code Section 10752g, ("Local Agencies") shall implement a water sampling and monitoring program for water quality purposes in accordance with a Memorandum of Understanding entered into by District and those Local Agencies.

3. Direct Recharge: When feasible, District will consider delivery of water to recharge basins owned and maintained by Local Exhibit "F" Agencies within the District. All such deliveries of recharge water shall be at the discretion of District Board of Directors. ("Board of Directors"). The Local Agency owning the recharge basin shall be liable for any damages connected with or arising out of transportation use, storage or recharge of such water. District shall be responsible for any damage to Agency resulting from the intentional or negligent acts of District or its employees or agents.

4. Indirect Recharge:

(a) Canal Recharge: District shall endeavor to monitor and evaluate recharge from canals when appropriate, as determined by District. Canals with good

recharge capabilities will be evaluated for potential use as groundwater recharge facilities to receive recharge water during the off-irrigation season.

(b) Surface Water/Groundwater Pumping: The District shall continue to divert and deliver surface water supplies of the District to reduce groundwater pumping.

5. Water Conservation - Water Regulation: District's policies and procedures promote the beneficial use of water. Specific examples include instantaneous (orifice type of metering) flow measurements at all turnouts; with propeller meters at all turnouts associated with current or future pipeline projects. The District shall continue to promote policies that enhance water conservation policies (see enclosed Alta Irrigation District Rules and Regulations, adopted March 9, 1990). The District Board of Directors has the authority to adopt water conservation and water regulation policies for the District. If Agency adopts and enforces a water conservation plan within its boundaries, such Plan shall be effective to the extent it is not inconsistent with the District's Plan.

6. No Exportation of Groundwater: After the adoption hereof, there shall be no exportation of groundwater that results in any additional net loss to District's total available water supplies. Minor amounts of urban drainage shall not be considered groundwater exportation subject to this paragraph. The District Board of Directors has the authority to renew any mitigating measures proposed to prevent such net loss.

7. Well Drilling and Abandonment: District will work with the agencies of jurisdiction in amending the water well ordinance applicable within the District to require a minimum of fifty (50) foot annular seal on all gravel packed wells.

8. Groundwater Banking: District shall endeavor to promote advantageous groundwater banking projects. The Board of Directors has the authority to control the destination of the District's Kings River water under appropriate licenses.

9. Intra-district water Transfer: District annually adopts a specific policy to address the issue of internal water transfers within the District. The District desires to reduce pumping from the groundwater by better utilization of surface water supplies. The Board of Directors has the authority to control the destination of the District's Kings River water under appropriate licenses.

10. Inter-district water Transfer: District shall endeavor to promote advantageous water transfers (water transfers that increase the water supply available

within the District) between the District and other entities. The Board of Directors has the authority to initiate such transfers.

11. Reduction in Groundwater outflow: The District's current water entitlement allocations result in additional pumping in the south and southwesterly areas of the District which may reduce groundwater outflow under certain circumstances. The groundwater outflow from the District is principally to the south and west. Existing surface water along with supplemental water,' when available, will be used to improve the groundwater barrier along the perimeter of the District to reduce the amount of outflow. The Board of Directors has the authority to adjust water entitlement allocations.

12. Pumping Restrictions: Only under special circumstances would pumping restrictions be imposed. The Board of Directors shall not impose such restrictions until after consulting with Local Agencies and holding a mandatory public hearing at least sixty (60) days prior to the effective date of such restrictions.

13. Additional Water Supply and storage: The Board of Directors could impose such action only by Resolution.

14. Redistribution of Surface Water: The Board of Directors could impose such action by Resolution adopted after a mandatory public hearing held at least sixty (60) days prior to imposing such action.

ATTACHMENT B

Notice of Intent to Adopt a SB 1938 Groundwater Management Plan (July 10, 2008)

RESOLUTION OF INTENT

A RESOLUTION FOR THE ALTA IRRIGATION DISTRICT TO APPROVE AND AUTHORIZE THE NOTICE OF AN INTENT TO UPDATE ALTA IRRIGATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN UNDER Section 10750 et seq. TO BE IN COMPLIANCE WITH SB 1938(Stats 2002, Ch 603)

WHEREAS, **ALTA IRRIGATION DISTRICT**, a public agency duly organized and existing under and by virtue of the laws of the State of California (the "Entity"), has determined that it is in the best interest and to the advantage of the Entity to update its current groundwater management plan. The current groundwater management plan is a AB 3030 type of plan and it is intent of Entity to update its current plan to meet the requirements of a SB 1938 type of plan; and

WHEREAS, the Entity is located in Fresno, Tulare and Kings Counties; and

WHEREAS, participation will include local agencies and interested parties located within the Entity; and

WHEREAS, The Entity will act as the lead agency in the governance of the groundwater management plan, as updated.

NOW, THEREFORE, BE IT RESOLVED BY THE GOVERNING BODY OF THE ENTITY AS FOLLOWS:

Section 1. Findings. The Entity's Governing Body hereby specifically finds and determines that the actions authorized hereby relate to the public affairs of the Entity and the inter-relationship with other water interests within the Upper Kings Sub Basin.

Section 2. Memorandum of Understandings. Existing Memorandum of Understandings, to be updated and entered into by and between the Entity and the local agencies with overlapping spheres of interest within the Entity.

Section 3. Effective Date. This Resolution of Intent shall be advertised under the prescribed guidelines of Government Code 6066 prior to action being considered.

PASSED AND ADOPTED this 10th day of July, 2008 by the following vote:

AYES: Waldner, Marshall, Astiasuain and Halford

NOES: None

ABSENT: Belknap, Krahn and Warkentin

Attested by: Chris M. Kapheim

Chris M. Kapheim, General Manager/Secretary

ATTACHMENT C

Bulletin 118, Department of Water Resources

Tulare Lake Hydrologic Region

Figure 37 Tulare Lake Hydrologic Region

Basins and Subbasins of Tulare Lake Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.08	Kings
5-22.09	Westside
5-22.10	Pleasant Valley
5-22.11	Kaweah
5-22.12	Tulare Lake
5-22.13	Tule
5-22.14	Kern County
5-23	Panoche Valley
5-25	Kern River Valley
5-26	Walker Basin Creek Valley
5-27	Cummings Valley
5-28	Tehachapi Valley West
5-29	Castaic Lake Valley
5-71	Vallecitos Creek Valley
5-80	Brite Valley
5-82	Cuddy Canyon Valley
5-83	Cuddy Ranch Area
5-84	Cuddy Valley
5-85	Mil Potrero Area

Description of the Region

The Tulare Lake HR covers approximately 10.9 million acres (17,000 square miles) and includes all of Kings and Tulare counties and most of Fresno and Kern counties (Figure 37). The region corresponds to approximately the southern one-third of RWQCB 5. Significant geographic features include the southern half of the San Joaquin Valley, the Temblor Range to the west, the Tehachapi Mountains to the south, and the southern Sierra Nevada to the east. The region is home to more than 1.7 million people as of 1995 (DWR, 1998). Major population centers include Fresno, Bakersfield, and Visalia. The cities of Fresno and Visalia are entirely dependent on groundwater for their supply, with Fresno being the second largest city in the United States reliant solely on groundwater.

Groundwater Development

The region has 12 distinct groundwater basins and 7 subbasins of the San Joaquin Valley Groundwater Basin, which crosses north into the San Joaquin River HR. These basins underlie approximately 5.33 million acres (8,330 square miles) or 49 percent of the entire HR area.

Groundwater has historically been important to both urban and agricultural uses, accounting for 41 percent of the region's total annual supply and 35 percent of all groundwater use in the State. Groundwater use in the region represents about 10 percent of the State's overall supply for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins with groundwater wells commonly exceeding 1,000 feet in depth. The maximum thickness of freshwater-bearing deposits (4,400 feet) occurs at the southern end of the San Joaquin Valley. Typical well yields in the San Joaquin Valley range from 300 gpm to 2,000 gpm with yields of 4,000 gpm possible. The smaller basins in the mountains surrounding the San Joaquin Valley have thinner aquifers and generally lower well yields averaging less than 500 gpm.

The cities of Fresno, Bakersfield, and Visalia have groundwater recharge programs to ensure that groundwater will continue to be a viable water supply in the future. Extensive groundwater recharge programs are also in place in the south valley where water districts have recharged several million acre-feet for future use and transfer through water banking programs.

The extensive use of groundwater in the San Joaquin Valley has historically caused subsidence of the land surface primarily along the west side and south end of the valley.

Groundwater Quality

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are high TDS, nitrate, arsenic, and organic compounds.

The areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. High TDS content of west-side water is due to recharge of stream flow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts because of evaporation and poor drainage. In the central and west-side portions of the valley, where the Corcoran Clay confining layer exists, water quality is generally better beneath the clay than above it. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Areas of high nitrate concentrations are known to exist near the town of Shafter and other isolated areas in the San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas. Elevated arsenic levels have been reported in the Tulare Lake, Kern Lake and Buena Vista Lake bed areas. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected throughout the valley, but primarily along the east side where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is DBCP, a now-banned soil fumigant and known carcinogen once used extensively on grapes. Industrial organic contaminants include TCE, DCE, and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

Water Quality in Public Supply Wells

From 1994 through 2000, 1,476 public supply water wells were sampled in 14 of the 19 groundwater basins and subbasins in the Tulare Lake HR. Evaluation of analyzed samples shows that 1,049 of the wells, or 71 percent, met the state primary MCLs for drinking water. Four-hundred-twenty-seven wells, or 29 percent, exceeded one or more MCL. Figure 38 shows the percentages of each contaminant group that exceeded MCLs in the 427 wells.

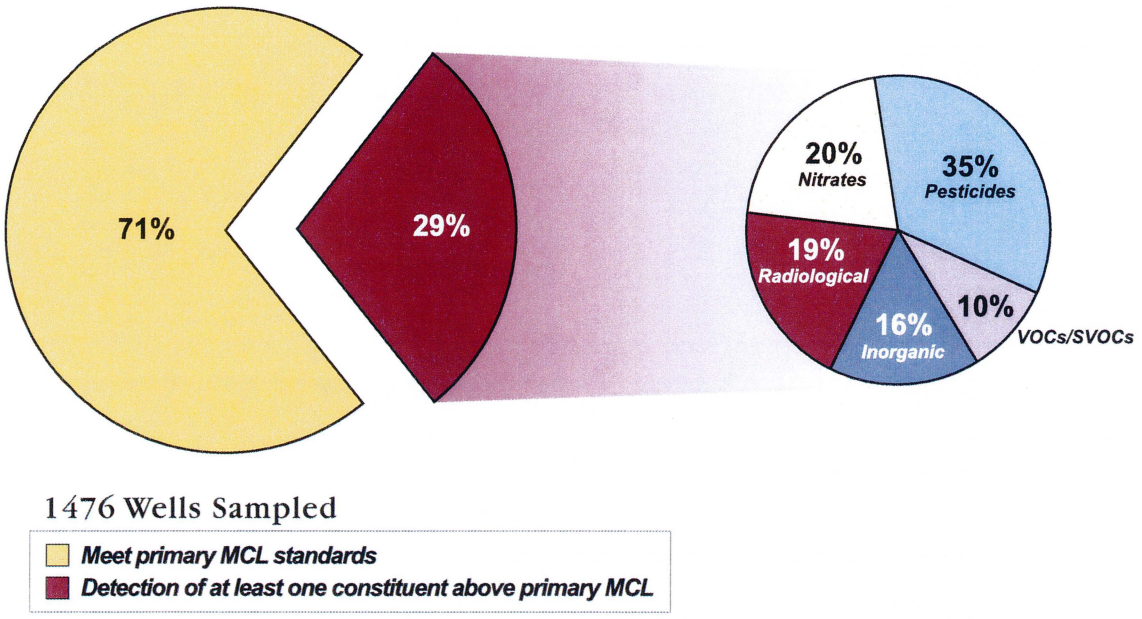

Figure 38 MCL exceedances by contaminant group in public supply wells in the Tulare Lake Hydrologic Region

Table 31 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 31 Most frequently occurring contaminants by contaminant group in the Tulare Lake Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics - Primary	Fluoride – 32	Arsenic – 16	Aluminum – 13
Inorganics - Secondary	Iron – 155	Manganese – 82	TDS – 9
Radiological	Gross Alpha – 74	Uranium – 24	Radium 228 – 8
Nitrates	Nitrate(as NO_3) – 83	Nitrate + Nitrite – 14	Nitrite(as N) – 3
Pesticides	DBCP – 130	EDB – 24	Di(2-Ethylhexyl)phthalate – 7
VOCs/SVOCs	TCE – 17	PCE – 16	Benzene – 6 MTBE – 6

DBCP = Dibromochloropropane
EDB = Ethylenedibromide
TCE = Trichloroethylene
PCE = Tetrachloroethylene
VOC = Volatile organic compound
SVOC = Semivolatile organic compound

Changes from Bulletin 118-80

There are no newly defined basins since Bulletin 118-80. However, the subbasins of the San Joaquin Valley, which were delineated as part of the 118-80 update, are given their first numeric designation in this report (Table 32).

Table 32 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Tulare Lake Hydrologic Region

Subbasin name	New number	Old number
Kings	5-22.08	5-22
Westside	5-22.09	5-22
Pleasant Valley	5-22.10	5-22
Kaweah	5-22.11	5-22
Tulare Lake	5-22.12	5-22
Tule	5-22.13	5-22
Kern County	5-22.14	5-22
Squaw Valley	deleted	5-24
Cedar Grove Area	deleted	5-72
Three Rivers Area	deleted	5-73
Springville Area	deleted	5-74
Templeton Mountain Area	deleted	5-75
Manache Meadow Area	deleted	5-76
Sacator Canyon Valley	deleted	5-77
Rockhouse Meadows Valley	deleted	5-78
Inns Valley	deleted	5-79
Bear Valley	deleted	5-81

Several basins have been deleted from the Bulletin 118-80 report. In Squaw Valley (5-24) all 118 wells are completed in hard rock. Cedar Grove Area (5-72) is a narrow river valley in Kings Canyon National Park with no wells. Three Rivers Area (5-73) has a thin alluvial terrace deposit but 128 of 130 wells are completed in hard rock. Springville Area (5-74) is this strip of alluvium adjacent to Tule River and all wells are completed in hard rock. Templeton Mountain Area (5-75), Manache Meadow Area (5-76), and Sacator Canyon Valley (5-77) are all at the crest of mountains with no wells. Rockhouse Meadows Valley (5-78) is in wilderness with no wells. Inns Valley (5-79) and Bear Valley (5-81) both have all wells completed in hard rock.

Table 33 Tulare Lake Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-22	SAN JOAQUIN VALLEY									
5-22.08	KINGS	976,000	C	3,000	500-1,500	909	-	722	200-700	40-2000
5-22.09	WESTSIDE	640,000	C	2,000	1,100	960	-	50	520	220-35,000
5-22.10	PLEASANT VALLEY	146,000	B	3,300	-	151	-	2	1,500	1000-3000
5-22.11	KAWEAH	446,000	B	2,500	1,000-2,000	568	-	270	189	35-580
5-22.12	TULARE LAKE	524,000	B	3,000	300-1,000	241	-	86	200-600	200-40,000
5-22.13	TULE	467,000	B	3,000	-	459	-	150	256	200-30,000
5-22.14	KERN COUNTY	1,950,000	A	4,000	1,200-1,500	2,258	249	476	400-450	150-5000
5-23	PANOCHE VALLEY	33,100	C	-	-	48	-	-	1,300	394-3530
5-25	KERN RIVER VALLEY	74,000	C	3,650	350	-	-	92	378	253-480
5-26	WALKER BASIN CREEK VALLEY	7,670	C	650	-	-	-	1	-	-
5-27	CUMMINGS VALLEY	10,000	A	150	56	51	-	15	344	-
5-28	TEHACHAPI VALLEY WEST	14,800	A	1,500	454	64	-	19	315	280-365
5-29	CASTAC LAKE VALLEY	3,600	C	400	375	-	-	3	583	570-605
5-71	VALLECITOS CREEK VALLEY	15,100	C	-	-	-	-	0	-	-
5-80	BRITE VALLEY	3,170	A	500	50	-	-	-	-	-
5-82	CUDDY CANYON VALLEY	3,300	C	500	400	-	-	3	693	695
5-83	CUDDY RANCH AREA	4,200	C	300	180	-	-	4	550	480-645
5-84	CUDDY VALLEY	3,500	A	160	135	3	-	3	407	325-645
5-85	MIL POTRERO AREA	2,300	C	3,200	240	7	-	7	460	372-657

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

ATTACHMENT D

SB 1938 Advisory Meeting Notice and Minutes

SB 1938 Advisory Meeting
Alta ID Board Room
Thursday, April 9, 2009, 8:00 a.m.

AGENDA

1. Introductions
2. Review of Handouts
    a. Tulare Lake Hydrologic Region
    b. Requirements of 1938 Plan
    c. Alta's AB 3030 Plan
    d. Specific Goals and Objectives
3. Other Items for Discussion

SB 1938 AVDISORY MEETING
ALTA IRRIGATION DISTRICT BOARD ROOM
Thursday, April 9, 2009, 8:00 a.m.

CALL TO ORDER: The first advisory meeting for the SB 1938 groundwater plan was called to order at 8:00am by Chris Kapheim w/AID. Members present were David Cone w/KRCD, Laurel Firestone w/Community Water Center, Jerry Halford w/AID, David Orth w/KRCD, Russ Robertson w/City of Reedley, Dean Uota w/City of Dinuba, Norman Waldner w/AID, Jim Wegley w/Keller Wegley Engineering, Steve Worthley w/Tulare County and Mike Ayala w/AID.

INTRODUCTIONS: The advisory committee members all did a short self-introduction stating their organization and position.

REVIEW OF HANDOUTS:

Tulare Lake Hydrologic Region: Reviewed existing bulletin

Requirements of 1938 Plan: Committee discussed water quality & groundwater level information, monitoring and reporting plan. The committee discussed integrating regional goals and objectives from the Upper Kings IRWMP to correspond with the District's SB 1398 plan. Furthermore, it was discussed that it would be beneficial to also review data from surrounding areas outside of the Kings sub basin.

Additionally, abandoned wells was discussed as a concern that needs to be addressed county wide. Discussion focused on finding cost efficient means to initiate an incentive based program with landowners to give a reasonable time frame to abandon wells; funding and coordination of such efforts will require further input.

Water Quality Testing was reviewed, with nitrates being a principal concern. KRCD will evaluate current irrigation efficiency analysis to include nitrate testing of pumps.

The Committee reviewed Alta's water quality monitoring efforts for nitrates and DBCP and discussed the County's efforts in nitrate monitoring.

Alta's AB 3030 Plan: Alta's current groundwater plan was reviewed

Specific Goals and Objectives: Reviewed potential goals and objectives:

1. Evaluate a coordinated effort to increase groundwater pumping for irrigation purposes in the impacted area. This could result in a reduction in surface water to lands overlying the lands lying easterly of the communities. Excess pumping would remove the contaminated water for surface irrigation of crops and create a cone of depression away from the domestic wells;

2. Hold workshops with the farm advisor to encourage more effective utilization of fertilizers;

3. Actively encourage implementation of Tulare County's program for locating and properly abandoning of groundwater wells;
4. Work and coordinate efforts with interested parties, i.e., extension service, academic experts, etc., to identify potential sources of contamination;

5. Develop a program with the farm operators and testing laboratories to evaluate nitrate applications on individual parcels;

6. Use various media sources to disseminate information on fertilizer application, problems and availability of programs to assist farm operators;

7. Search out funding sources to work with and develop programs for farm operators; and

8. Evaluate a coordinated effort to alter surface water supplies/groundwater pumping available to the lands to more effectively manage groundwater movement to minimize the degradation to water quality.

ADDITIONAL ITEMS FOR DISCCUSSION: Information will be forwarded to the committee to be reviewed prior to further discussion.

ADJOURNMENT: There being no further items to discuss the meeting was adjourned until the next Advisory Meeting.

Sincerely,

Chris M. Kapheim

Chris M. Kapheim
SB 1938 Advisory Committee

CMK: ma

ATTACHMENT E

Table 111-1, KRCD Surface Water Study (1991)

Table III-1
Alta I.D. Canal Seepage for Wet (1984) and Dry (1990) Years

Canal Name	Length (mi)	Seepage (cfs)	1984 Seepage (AF)	1984 Seepage % of Diversion	1990 Seepage (AF)	1990 Seepage % of Diversion
Alta Main	8.9	11.2	3,592	1.7%	1,071	1.8%
A.B. Clark	4.4	2.5	810	0.4%	242	0.4%
A.N. Smith	1.8	0.2	62	0.0% *	18	0.0% *
A.W. Clark	2.9	0.6	186	0.1%	56	0.1%
Andrews	2.5	0.4	130	0.1%	39	0.1%
Ballard	2.8	0.2	79	0.0% *	23	0.0% *
Banks	17.7	4.4	1,409	0.7%	151	0.3%
Bowhay	3.1	1.1	336	0.2%	100	0.2%
Bump & Edmiston	1.8	0.2	64	0.0% *	19	0.0% *
Button	15.0	4.2	1,345	0.6%	281	0.5%
Buttonwillow	11.0	8.9	2,830	1.3%	844	1.4%
Caesar	5.3	4.4	1,397	0.7%	417	0.7%
California Vineyard	6.9	6.1	1,938	0.9%	578	1.0%
Cary-Hunter	7.7	2.8	885	0.4%	263	0.5%
Carpenter	1.2	0.0	10	0.0% *	3	0.0% *
Clapp	1.5	0.0	5	0.0% *	2	0.0% *
Clements	4.0	2.1	667	0.3%	199	0.3%
Clough	3.9	1.6	502	0.2%	15	0.0% *
Cross Creek W.W.	1.9	0.4	129	0.1%	4	0.0% *
Curtis Cutoff	1.5	0.5	155	0.1%	46	0.1%
Lower Curtis Cutoff	0.9	0.2	73	0.0% *	22	0.0% *
Upper Curtis Cutoff	1.0	0.1	19	0.0% *	6	0.0% *
Dinuba Town	8.8	4.7	1,507	0.7%	449	0.8%
East Branch	15.5	18.0	5,753	2.7%	1,715	2.9%
East Gould	1.5	0.1	31	0.0% *	9	0.0% *
East Reedley	5.5	1.8	563	0.3%	168	0.3%
East Section 20	1.2	0.1	20	0.0% *	6	0.0% *
Elter	2.5	0.1	38	0.0% *	11	0.0% *
Floyd	1.5	0.1	42	0.0% *	13	0.0% *
Frane	1.4	0.0	3	0.0% *	1	0.0% *
Gordon	1.0	0.1	41	0.0% *	12	0.0% *
Grove	1.7	0.0	16	0.0% *	5	0.0% *
Haden & Boone	2.7	0.4	141	0.1%	42	0.1%
Hogan	2.1	0.1	37	0.0% *	11	0.0% *
Horseman	5.0	1.7	550	0.3%	164	0.3%
J. T. Williams	2.4	0.0	9	0.0% *	3	0.0% *
Jack	1.2	0.3	103	0.0% *	31	0.1%
Kennedy School Hous	5.0	0.3	82	0.0% *	24	0.0% *
Kennedy Waste Way	7.3	3.7	1,166	0.5%	347	0.6%
King	4.4	3.1	979	0.5%	206	0.4%
Kirk	1.7	0.3	84	0.0% *	25	0.0% *
Knestric	5.6	0.8	254	0.1%	76	0.1%
Loper	3.2	0.5	162	0.1%	48	0.1%
Lovell	2.0	0.4	136	0.1%	41	0.1%
McBriar	2.0	0.0	8	0.0% *	2	0.0% *
McClanahan	5.9	4.8	1,527	0.7%	446	0.8%
Mc Gee	1.9	0.2	54	0.0% *	16	0.0% *
Monson	7.0	3.5	1,128	0.5%	336	0.6%
Montague	1.3	0.2	52	0.0% *	16	0.0% *
Mt. Campbell	3.7	1.5	466	0.2%	139	0.2%
Nichols-Cann	1.9	0.0	6	0.0% *	2	0.0% *
Nuss	1.2	0.0	2	0.0% *	1	0.0% *
Orosi School House	3.2	0.9	279	0.1%	83	0.1%
Parenti	1.3	0.0	4	0.0% *	1	0.0% *
Parks	1.5	0.2	78	0.0% *	23	0.0% *
Peck	0.6	0.0	2	0.0% *	0	0.0% *
Red Williams	1.5	0.2	67	0.0% *	10	0.0% *
Reedley Main	3.0	2.9	917	0.4%	273	0.5%
Reo	1.5	0.2	63	0.0% *	19	0.0% *
Rice-Brubaker	2.2	0.3	99	0.0% *	30	0.1%
Sandridge	2.9	0.4	140	0.1%	42	0.1%
Segrue	0.3	0.0	1	0.0% *	0	0.0% *
Smith Mountain	9.3	3.1	977	0.5%	291	0.5%
Sontag	6.7	0.2	59	0.0% *	14	0.0% *
Tout	6.0	1.4	439	0.2%	131	0.2%
Traver Creek	10.1	12.1	3,878	1.8%	1,156	2.0%
Traver Canal	12.3	21.6	6,910	3.2%	1,788	3.1%
Uphill	0.6	0.0	2	0.0% *	0	0.0% *
Van Noy	2.2	0.3	96	0.0% *	18	0.0% *
Wahtoke	5.1	0.7	224	0.1%	67	0.1%
Weisse	1.0	0.3	80	0.0% *	2	0.0% *
West Gould	4.9	0.9	281	0.1%	84	0.1%
West Reedley	5.6	1.4	442	0.2%	132	0.2%
West Section 20	1.8	0.1	26	0.0% *	8	0.0% *
Wilson	10.7	7.0	2,220	1.0%	662	1.1%
Wilson Hunter	1.5	0.5	151	0.1%	45	0.1%
Wilson School House	3.4	0.9	287	0.1%	85	0.1%
Windsor	1.3	0.0	3	0.0%	1	0.0%
Total	316.7	154	49,306	23.1%	13,727	23.6%

Note: * indicates that canal seepage is less than 0.05% of Alta's total district diversion.

ATTACHMENT F

Table 9, Future District Operating Budget –

Engineers Report Proposition 218 Procedures (2005)

TABLE 9
FUTURE DISTRICT OPERATIONAL BUDGETS

Volumetric Water Surcharge	**$3.65**	**$3.76**	**$3.90**	**$4.10**
Fiscal Year	**06/07**	**07/08**	**08/09**	**09/10**
Water Run Revenues				
Water Surcharge	$ 365,000	$ 376,000	$ 390,000	$ 410,000
Water Surcharge Penalty	500	500	500	500
Pine Flat Power Income 50%	84,476	84,476	84,476	84,476
Total Water Run Revenues	$ 449,976	$ 460,976	$ 474,976	$ 494,976
Water Run Costs				
Maintenance Ditchtender Trucks	$ 8,000	$ 8,400	$ 8,800	$ 9,200
Fuel - Ditchtender trucks	30,000	33,000	36,000	39,000
Cell Phone - Ditchtenders	6,000	6,000	6,000	6,000
Answering Service	400	400	400	400
Algicide	24,000	24,000	24,000	24,000
Operational Payroll	263,423	270,535	277,840	285,342
Payroll Tax/Benefits	84,885	87,177	89,531	91,948
Drop Boards	6,100	6,400	6,800	7,200
Total Water Run Costs	$ 422,808	$ 435,913	$ 449,371	$ 463,090
Add reserves for maintenance of pipelines	$ 25,000	$ 25,000	$ 25,000	$ 25,000
Net Operational Cash Flow	$ 2,168	$ 63	$ 605	$ 6,886

ATTACHMENT G

Water Banking Annual Report (2009)

ALTA IRRIGATION DISTRICT

WATER BANKING

2009 ANNUAL REPORT

Adopted 03/11/2010

TABLE OF CONTENTS

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Harder Pond Cumulative Recharge and Extraction Data _____ **6**
Harder Pond Cumulative Canal Recharge _____ **6**
Harder Pond Depth to Groundwater Well Levels _____ **7**

Harder Pond Summary and Conclusion _____ *8*

Harder Pond Regional Benefits _____ *9*

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Glossary of Terms _____ *11*

Water Banking Implementation Strategy

Project Yield: Project Yield is determined by measuring the water efficiency benefits of the project which result in a measured volume of conserved water. The basic premise of the program is that it is efficient from a water management perspective to make water deliveries at the lower end of the system from a localized source in the vicinity of the targeted water deliveries rather than delivering water more than 38 miles from the Kings River from AID's storage account in Pine Flat Reservoir. System readjustments and changing variables of demand diminish the efficiency of system deliveries from the Kings River by a factor of two (2).

It would take at least twice the volume of releases from the Kings River to meet surface water demands down steam from localized project sources in the lower reaches of the District. Localized projects can more efficiently meet surface water demands by pumping groundwater that was previously recharged. As a result, the water management efficiency for that delivery has been shown to require a 50% of the water release required to meet localized surface water demands. Making water deliveries from a localized source allows for greater system flexibility and water use efficiency with an end result of more reliable deliveries.

Water Resource Benefits: The Project Yield for Harder and Traver Banking Projects is to be used to address long-term water resource issues within the District. Long-term, where the planning horizon is more than five years, water will be developed for water transfers to meet Cutler-Orosi surface water demands. Short-term, where the planning horizon is less than five years, water will be developed for water transfers to address and improve water use efficiency issues for groundwater or surface water, i.e., Wahtoke Lake Pumping Project.

Available Recharge: Water available for recharge is the total water recharged in the project basins minus fifteen percent minus the extracted water. It is the intent to coordinate pumping during the mid-week periods of Tuesday through Friday to compliment enhanced irrigation demand during the mid-week period. During the non-operational irrigation period, water will be transferred from the East Branch to the Traver Canal via the Willow Creek Project to supply flows to Harder and Traver Banking Projects. The origin of Willow Creek flows is eastside watershed and the measured volume of water utilized shall be accounted for accordingly. In addition, there will also be inflow from the Kings River Watershed that will be accounted for in the water banking program.

Banking Advisory Committee

ATTENDANCE :

Chris Kapheim, Alta ID (GM)
Tom Marshall, Alta ID (Board Member)
Jim Wegley, Alta ID (Consulting Engineer)
Mike Swanson, landowner
Robert Jackson, landowner
Brad Jones, landowner
Jason George, landowner

DISCUSSION:

Chris Kapheim gave a general overview of the Harder Pond and proposed Traver Banking projects and their relative importance to the region. It was emphasized that monitoring data would be shared with Advisory Committee members to encourage information sharing and questions on the banking process. It is anticipated that there will be at least one annual meeting to review the performance of banking projects. Projects will allow water to be recharged in designed projects that will enable the District to address (i) uncontrolled flood flows, (ii) enhance groundwater recharge, (iii) improve water deliveries to downstream landowners from a groundwater source, and (iv) improve the District's water balance (new water) by being able to capture previously uncontrolled sources of water with application to a beneficial use. Furthermore, it was stated that of recharged water, at least 15% would be designated for recharge. Of the water to be extracted for landowner deliveries, such extracted water would be used incrementally to provide better service to landowner demands where it can be shown that there would be no negative influence on neighboring wells. Monitoring would be designed to show operational use of the banking process and resulting groundwater impacts, i.e., landowner groundwater and banking groundwater.

Discussion focused on the need for groundwater extraction. It was mentioned that there will be two wells located at each of the project sites. Water will not be extracted until sufficient groundwater recharge has taken place. It was further explained, that at some District projects (London Pond, Avenue 384) diversion pumps deliver stored water from basins to meet demand from downstream landowners. The London Pond site, based on its soil characteristics, recharges very slowly thus enabling the District to use the stored water for reregulation purposes. Both the Harder Pond and Traver pond have greater recharge potential thus storing the water in the soil aquifer and pumping on demand when necessary has been incorporated into their design features. It was also emphasized that efforts would be implemented to enhance sources of water to banking locations. On wet water years summer flows and winter flows would be utilized.

Banking Advisory Committee

ATTENDANCE:

Chris Kapheim, Alta ID (GM)
Tom Marshall, Alta ID (Board Member)
Jim Wegley, Alta ID (Consulting Engineer)
Dean Thonesen, landowner
Brad Jones, landowner
Mike Swanson, landowner

NOT IN ATTENDANCE:

Brent Smittcamp, landowner

DISCUSSION:

1. Review of the AID Banking Program.

The banking program consists of developing recharge and extraction sites that provide the following benefits: groundwater recharge, flood control, enhanced surface water efficiency and address water quality issues. Water delivered from the Kings River to the lower reaches of the AID has limitations in terms of timing with ordered demands, changes in environmental conditions (weather) and distance from inception to destination (approximately 38 miles). As a result, it has been determined that it is more efficient to store surplus waters in engineered basins and extract necessary volumes to meet demand as opposed to delivering water over extended distances that in some cases take two to three days from the Kings River to landowner delivery. As a result, extracted water from the banking project (Pumping) has a conserved value or Project Yield of twice the amount pumped. The Project Yield is the water available to address groundwater water quality issues in the easterly portion of AID, i.e., Cutler-Orosi areas. Furthermore, the program will take advantage of wintertime storm water flows. Such storm water flows will be recharged into Harder, Dinuba & Traver Pond recharge basins.

2. Review of the Harder Pond Banking Annual Report

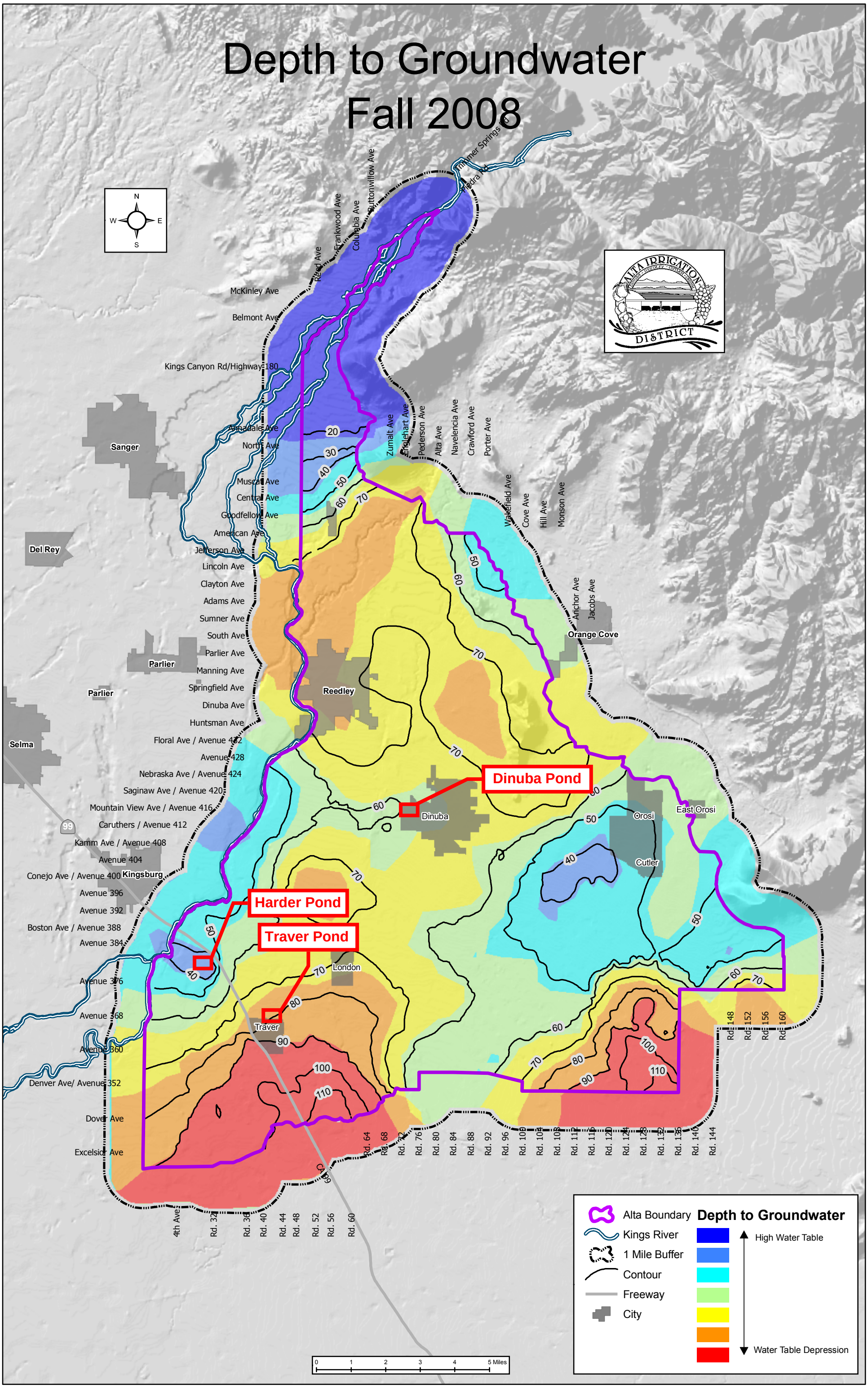
Discussion was held on the review of past practices and results for years 2008 and 2009 for AID's water banking program. AID showed data that illustrated the amount of water recharged in 2008, 563 acre-feet, and an additional 399 acre-feet in 2009. In 2009 188 acre-feet was extracted from the Harder Pond Banking Project. The result for 2009 was that forty-seven percent (47%) of the water recharged in the basins was extracted leaving a remainder of fifty-three percent (53%) for recharge. It was further discussed that in the future AID would extract up to eighty-five (85%) of the recharged water in the basins.

AID did review the monitoring of project wells and adjacent landowners wells. The results thus far illustrate no negative impacts of water extractions from the project site.

A review of regional benefits was discussed in terms of utilization of conserved water from the project and use on an interim basis. In 2009, 113.30 acre-feet was sold to a landowner that was experiencing groundwater limitations.

3. Review of the Traver Banking Project:

AID will be closing escrow in February of 2010 on the Anderson Property (28 acres) in the vicinity of Road 44 and 376. Discussion of how the project will operate and improve water resource flexibility.


Depth to Groundwater
Fall 2008
N
W
E
S
ALTA IRRIGATION DISTRICT
Dinuba Pond
Harder Pond
Traver Pond
Sanger
Del Rey
Parlier
Selma
Reedley
Dinuba
Orosi
East Orosi
Cutler
Orange Cove
London
Traver
Kingsburg
McKinley Ave
Belmont Ave
Kings Canyon Rd/Highway 180
Annadale Ave
North Ave
Muscat Ave
Central Ave
Goodfellow Ave
American Ave
Jefferson Ave
Lincoln Ave
Clayton Ave
Adams Ave
Sumner Ave
South Ave
Parlier Ave
Manning Ave
Springfield Ave
Dinuba Ave
Huntsman Ave
Floral Ave / Avenue 432
Avenue 428
Nebraska Ave / Avenue 424
Saginaw Ave / Avenue 420
Mountain View Ave / Avenue 416
Caruthers / Avenue 412
Kamm Ave / Avenue 408
Avenue 404
Conejo Ave / Avenue 400
Avenue 396
Avenue 392
Boston Ave / Avenue 388
Avenue 384
Avenue 376
Avenue 368
Avenue 360
Denver Ave/ Avenue 352
Dover Ave
Excelsior Ave
Reed Ave
Frankwood Ave
Columbia Ave
Buttonwillow Ave
Summer Springs Rd
Zumalt Ave
Englehart Ave
Pederson Ave
Alta Ave
Navelencia Ave
Crawford Ave
Porter Ave
Wakefield Ave
Cove Ave
Hill Ave
Monson Ave
Anchor Ave
Jacobs Ave
4th Ave
Rd. 32
Rd. 36
Rd. 40
Rd. 44
Rd. 48
Rd. 52
Rd. 56
Rd. 60
Rd. 64
Rd. 68
Rd. 72
Rd. 76
Rd. 80
Rd. 84
Rd. 88
Rd. 92
Rd. 96
Rd. 100
Rd. 104
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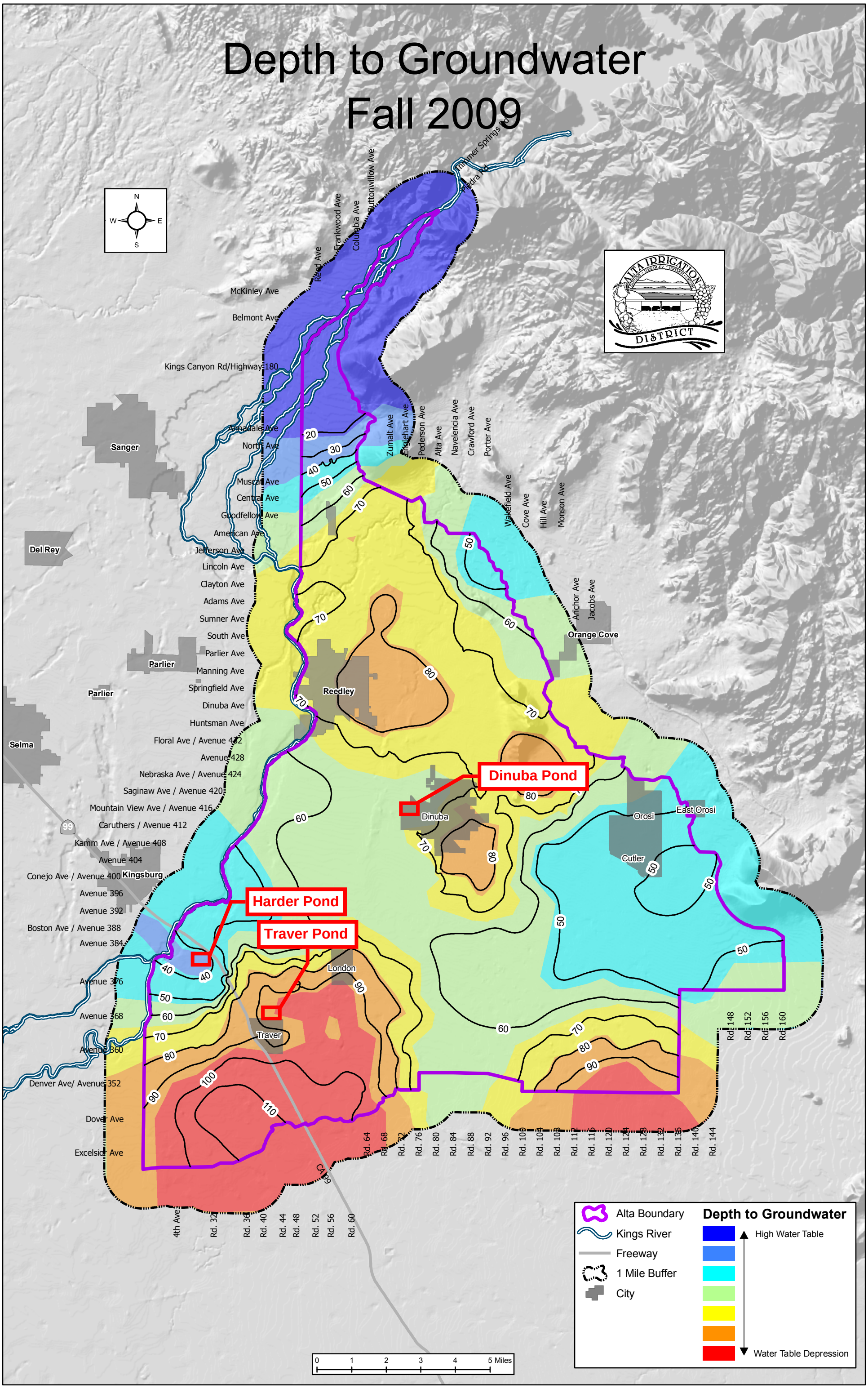
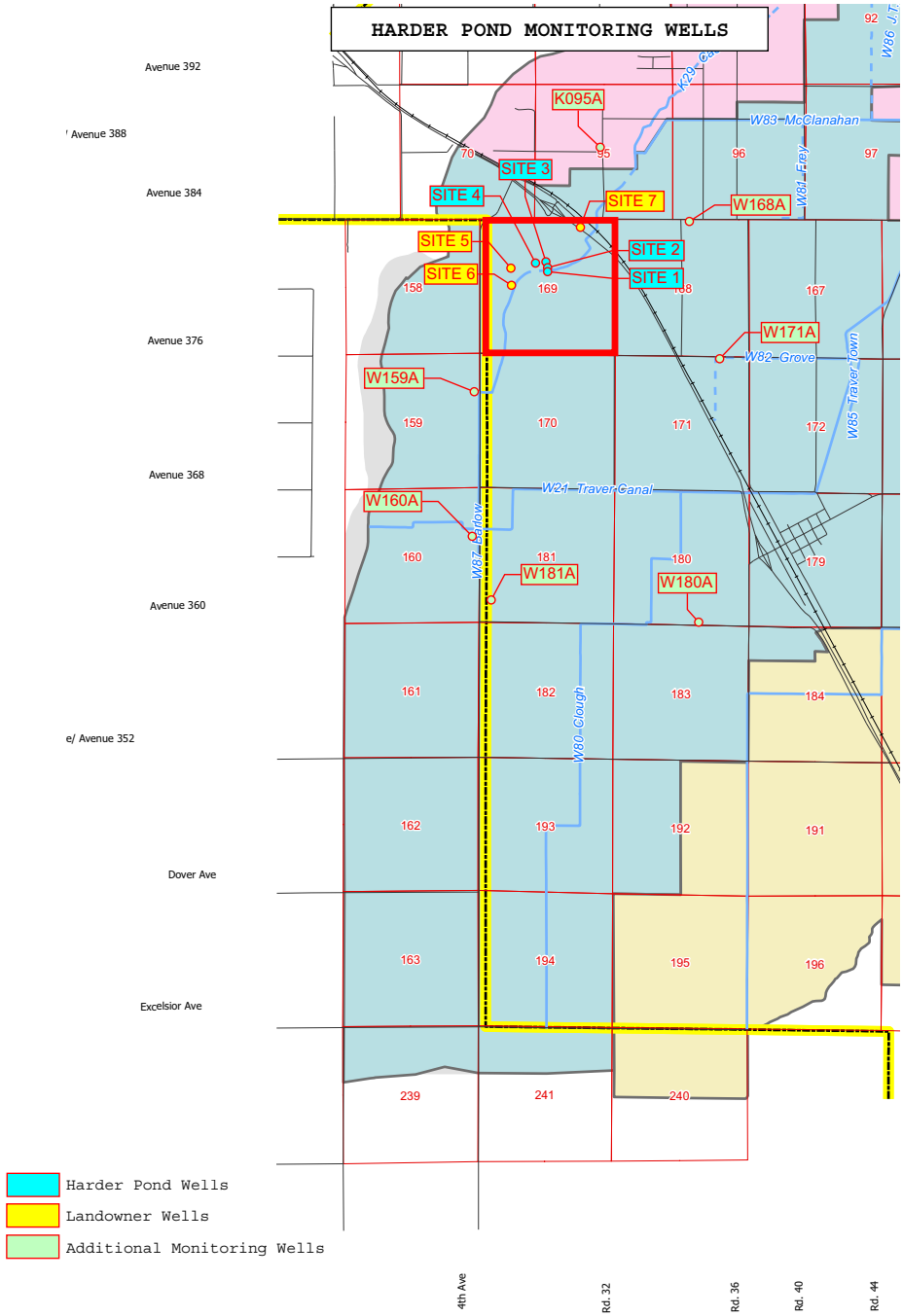
Rd. 120
Rd. 124
Rd. 128
Rd. 132
Rd. 136
Rd. 140
Rd. 144
Rd. 148
Rd. 152
Rd. 156
Rd. 160
CA 99
20
30
40
50
60
70
80
90
100
110
0 1 2 3 4 5 Miles
Alta Boundary
Kings River
1 Mile Buffer
Contour
Freeway
City
Depth to Groundwater
High Water Table
Water Table Depression


Depth to Groundwater
Fall 2009
N
S
E
W
Alta Irrigation District
Sanger
Del Rey
Parlier
Selma
Kingsburg
Reedley
Dinuba
Orange Cove
Orosi
East Orosi
Cutler
London
Traver
Dinuba Pond
Harder Pond
Traver Pond
McKinley Ave
Belmont Ave
Kings Canyon Rd/Highway 180
Annadale Ave
North Ave
Muscat Ave
Central Ave
Goodfellow Ave
American Ave
Jefferson Ave
Lincoln Ave
Clayton Ave
Adams Ave
Sumner Ave
South Ave
Parlier Ave
Manning Ave
Springfield Ave
Dinuba Ave
Huntsman Ave
Floral Ave / Avenue 432
Avenue 428
Nebraska Ave / Avenue 424
Saginaw Ave / Avenue 420
Mountain View Ave / Avenue 416
Caruthers / Avenue 412
Kamm Ave / Avenue 408
Avenue 404
Conejo Ave / Avenue 400
Avenue 396
Avenue 392
Boston Ave / Avenue 388
Avenue 384
Avenue 376
Avenue 368
Avenue 360
Denver Ave/ Avenue 352
Dover Ave
Excelsior Ave
Reed Ave
Frankwood Ave
Columbia Ave
Buttonwillow Ave
Zumalt Ave
Englehart Ave
Pederson Ave
Alta Ave
Navelencia Ave
Crawford Ave
Porter Ave
Wakefield Ave
Cove Ave
Hill Ave
Monson Ave
Anchor Ave
Jacobs Ave
Plummer Springs Rd
Piedra Rd
CA 99
4th Ave
Rd. 32
Rd. 36
Rd. 40
Rd. 44
Rd. 48
Rd. 52
Rd. 56
Rd. 60
Rd. 64
Rd. 68
Rd. 72
Rd. 76
Rd. 80
Rd. 84
Rd. 88
Rd. 92
Rd. 96
Rd. 100
Rd. 104
Rd. 108
Rd. 112
Rd. 116
Rd. 120
Rd. 124
Rd. 128
Rd. 132
Rd. 136
Rd. 140
Rd. 144
Rd. 148
Rd. 152
Rd. 156
Rd. 160
20
30
40
50
60
70
80
90
100
110
0 1 2 3 4 5 Miles
Alta Boundary
Kings River
Freeway
1 Mile Buffer
City
Depth to Groundwater
High Water Table
Water Table Depression


HARDER POND MONITORING WELLS
Avenue 392
Avenue 388
Avenue 384
Avenue 376
Avenue 368
Avenue 360
Avenue 352
Dover Ave
Excelsior Ave
4th Ave
Rd. 32
Rd. 36
Rd. 40
Rd. 44
K095A
SITE 3
SITE 4
SITE 7
W168A
SITE 5
SITE 2
SITE 6
SITE 1
W171A
W159A
W160A
W181A
W180A
W83 McClanahan
W81 Frey
W82 Grove
W85 Traver Town
W21 Traver Canal
W87 Orlow
W80 Clough
K29 Ca
W86 J.T.
70
95
96
97
92
158
169
168
167
159
170
171
172
160
181
180
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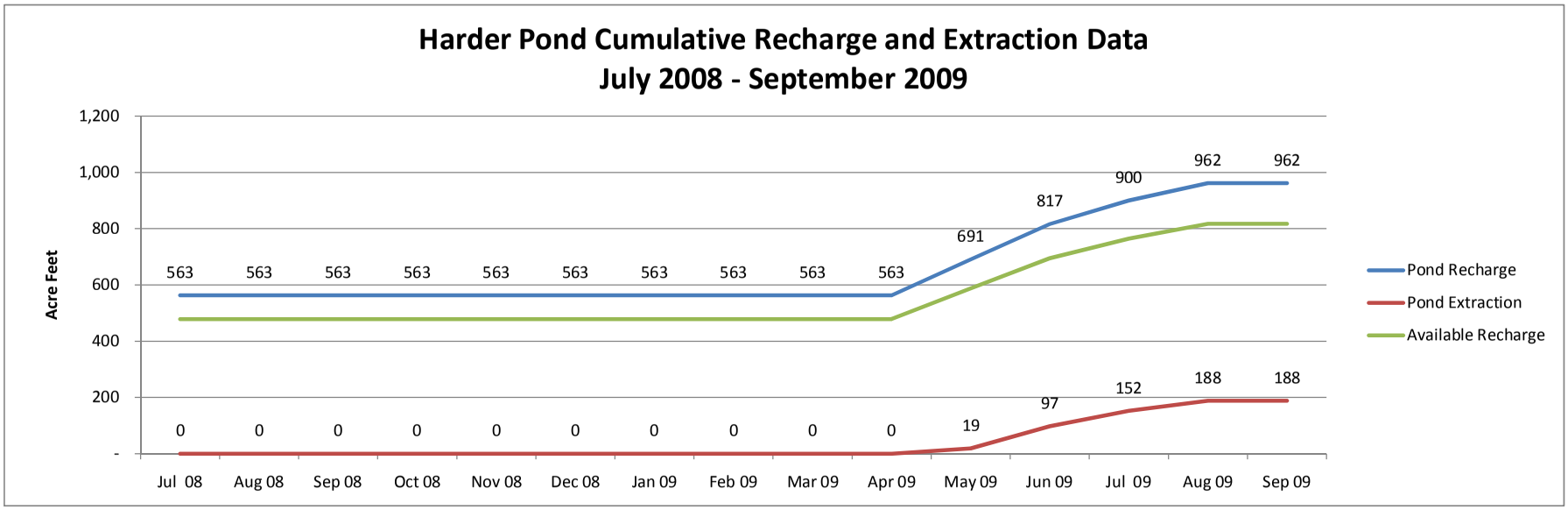
240
Harder Pond Wells
Landowner Wells
Additional Monitoring Wells


Harder Pond Cumulative Recharge and Extraction Data
July 2008 - September 2009
Acre Feet
1,200
1,000
800
600
400
200
-
563
563
563
563
563
563
563
563
563
563
691
817
900
962
962
0
0
0
0
0
0
0
0
0
0
19
97
152
188
188
Jul 08
Aug 08
Sep 08
Oct 08
Nov 08
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Mar 09
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Jun 09
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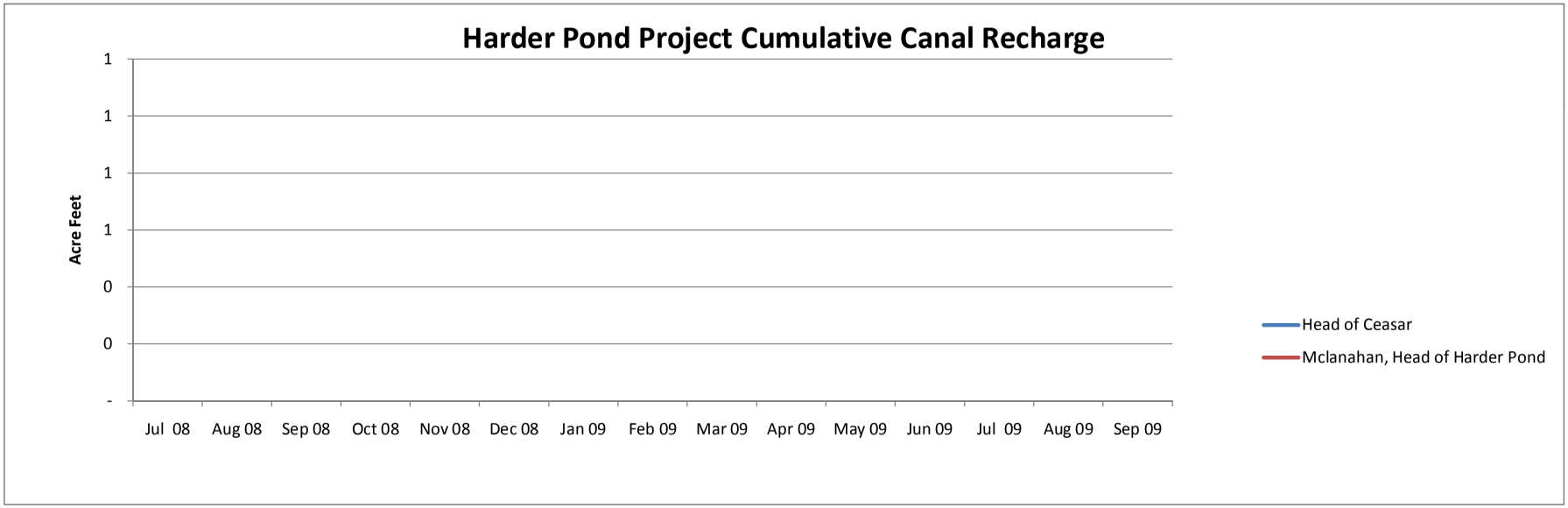
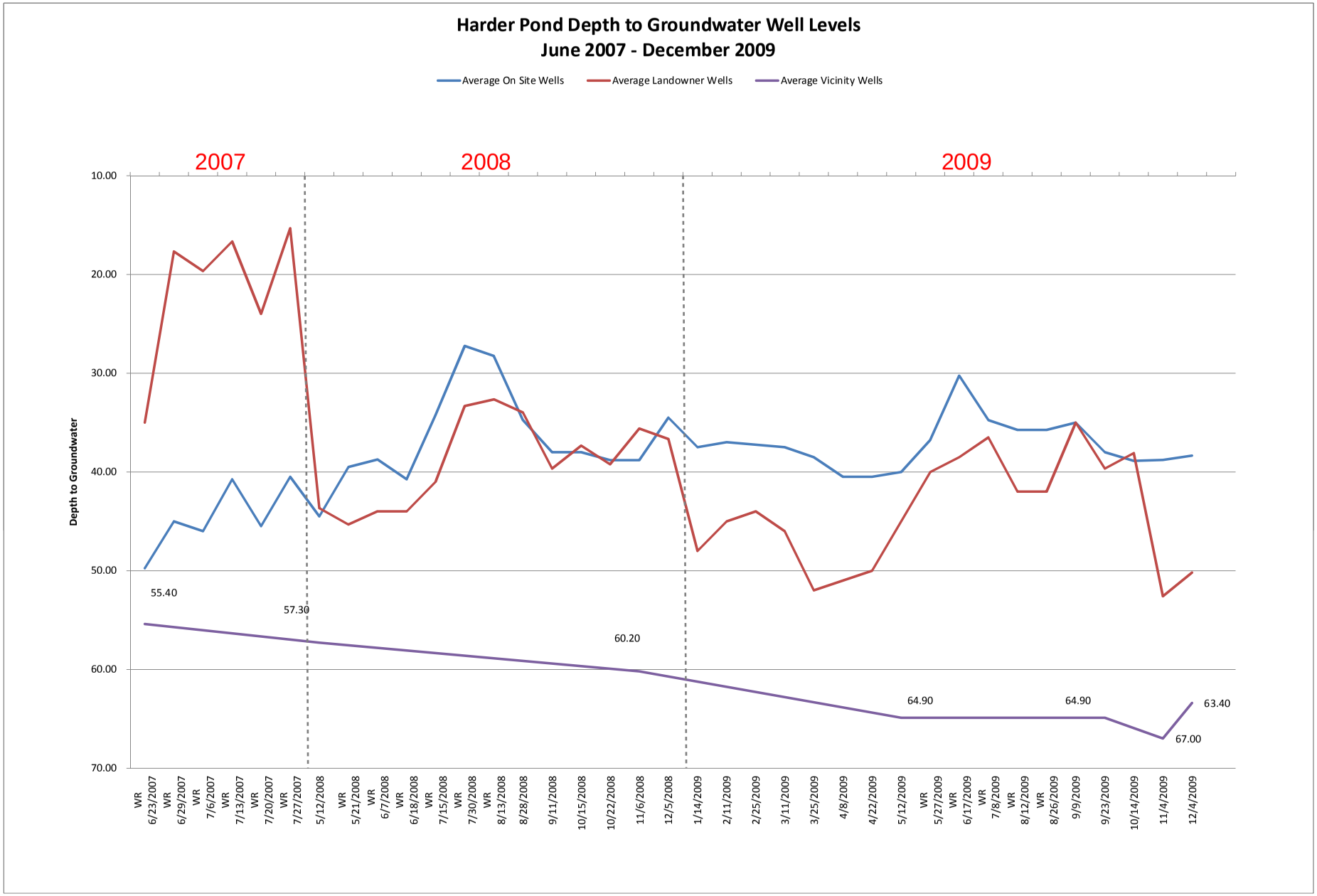
Sep 09
Pond Recharge
Pond Extraction
Available Recharge


Harder Pond Project Cumulative Canal Recharge
Acre Feet
1
1
1
1
0
0
-
Jul 08
Aug 08
Sep 08
Oct 08
Nov 08
Dec 08
Jan 09
Feb 09
Mar 09
Apr 09
May 09
Jun 09
Jul 09
Aug 09
Sep 09
Head of Ceasar
Mclanahan, Head of Harder Pond


Harder Pond Depth to Groundwater Well Levels
June 2007 - December 2009
Average On Site Wells
Average Landowner Wells
Average Vicinity Wells
2007
2008
2009
Depth to Groundwater
10.00
20.00
30.00
40.00
50.00
60.00
70.00
55.40
57.30
60.20
64.90
64.90
67.00
63.40
WR 6/23/2007
WR 6/29/2007
WR 7/6/2007
WR 7/13/2007
WR 7/20/2007
WR 7/27/2007
5/12/2008
WR 5/21/2008
WR 6/7/2008
WR 6/18/2008
WR 7/15/2008
WR 7/30/2008
WR 8/13/2008
8/28/2008
9/11/2008
10/15/2008
10/22/2008
11/6/2008
12/5/2008
1/14/2009
2/11/2009
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/12/2009
WR 5/27/2009
WR 6/17/2009
WR 7/8/2009
WR 8/12/2009
WR 8/26/2009
9/9/2009
9/23/2009
10/14/2009
11/4/2009
12/4/2009

Harder Pond Summary and Conclusion

In May of 2008, during the 2009 operational season (water run) water recharge was initiated at the Harder Pond Project ("Project"). Measured flows at the Harder Pond were used to meet downstream agricultural demand with excess flows being recharged in on-site basins. From May through August of 2008 water was recharged with no extraction of recharged water resulting in 562.9 acre-feet of recharged water credited to the Project. The following winter months resulted in less than average rainfall and snowpack thus precluding the recharge of storm water in the Project.

2009 Water run deliveries were initiated on May 14, 2009 and continued until August 28, 2009. Measured recharged water for the period was 399.3 acre-feet. During the same period 188.31 acre-feet of water was extracted from the Project. For the 2009 water run, the ratio of recharged water to extracted water is forty-seven percent. The pre-determined cumulative maximum recharge to extraction ration for the project is eighty-five percent. As a result, the Project recharge to extraction ratio was well under the allowable maximum.

In review of the Harder Pond Depth to Groundwater Levels (June 2007 – December 2009), adjacent area groundwater levels have dropped from 20 feet in June 2007 to 50 feet in November of 2009. The drop in depicted surrounding groundwater levels is primarily due to less than average water years resulting in lower precipitation and snowpack levels thus reducing surface water deliveries and increasing agricultural groundwater pumping. There was no correlation of groundwater pumping from the Project enhancing the decline of adjacent area groundwater levels. Harder Pond depth to groundwater levels for 2008 and 2009 ranged in the 30 to 40 feet range which is higher than surrounding groundwater levels (see attached Harder Pond Depth to Groundwater Levels on page 6).

Harder Pond Regional Benefits

The Available Recharge water from the Hard Pond Project ("Project") will have short-term and long-term regional benefits. Ultimately, the Available Recharge from the Project will be used to address water quality and supply issues in the easterly portion of the District, i.e., Cutler and Orosi areas. On a short-term basis the Available Recharge can be used to address other local water resource issues.

In 2009, local groundwater resources in the vicinity of Smith Mountain, within the District, experienced significant groundwater limitations. A landowner desired to acquire additional surface water supplies to mitigate groundwater pumping near Smith Mountain. As a result, 500 acre-feet of water was sold from the Project to mitigate the Smith Mountain groundwater impacts. In 2009 operational season, 113.30 acre feet were delivered to landowners with the balance available the following year's operational season.

Financial Data on Harder Pond
For Year Ending 09/30/09

PGE pump costs (2 meters)

10/2008	$	-
11/2008	$	-
12/2008	$	-
1/2009	$	-
2/2009	$	322.14
3/2009	$	115.87
4/2009	$	651.85
5/2009	$	110.43
6/2009		
7/2009	$	1,413.05
8/2009	$	1,195.97
9/2009	$	1,010.47
	$	4,819.78

PGE Power	$	4,819.78
Engineering	$	317.09
Well Monitoring	$	4,069.00
Cash Expenses	$	9,205.87
Depreciation	$	41,263
Total Expenses	$	50,468.54

Engineering (Management)

9/2009	$	317.09
	$	317.09

Well Monitoring

	Quantity	Miles (RT)	Hours		Rate		Total
Vehicle	26	30	0	$	0.55	$	429.00
Employee	26		4	$	35.00	$	3,640.00
						$	4,069.00

based on bi-weekly well monitoring, supervisor rates

5 years on SCADA
15 years on pumps
40 years for everything else

Depreciation			5 Year	15 Year	40 Year	Not Depreciable
Land	$	134,817.81				$ 134,817.81
Extraction Wells and Pumps	$	189,229.08		$ 100,000.00	$ 89,229.08	
Flow Measurement and SCADA	$	73,250.80	$ 73,250.80			
Monitoring Wells	$	33,699.03			$ 33,699.03	
IRTC Flap Gates	$	16,397.00			$ 16,397.00	
Other	$	658,508.79			$ 658,508.79	
	$	1,105,902.51	$ 73,250.80	$ 100,000.00	$ 797,833.90	$ 134,817.81

Annual Depreciation

1-5 years	$	41,262.67
6-15 years	$	26,612.51
16-40 years	$	19,945.85

GLOSSARY OF TERMS

A. Project Yield (PY)

= Conserved Water = Water Available for Transfers
= 2x Pumped Water (PW)
PY=2xPW
50% efficiency from Non Project source, i.e. Kings River

B. Available Water Resource Benefits (AWRB) Long/Short Term

Long Term > 5 years - Water Transfers available for Cutler/Orosi
Short Term > 5 years - Water Transfers available to address/improving water use efficiency
WRB = Project Yield less Water Transferred Delivered
WRB = 2x Pumped Water less Water Transferred Delivered
WRB = 2xPW – WTD

C. Water Transferred (WT)

Total amount of water transferred

D. Water Transferred Delivered (WTD)

Total amount of water transferred measured to date

E. Water Transferred Outstanding Balance (WTOB)

= WT – WTD

F. Available Recharge (AR)

Tracked by water shed = Water Availability
= Meter Readings into the pond, less 15% protected recharge, less pumped water
AR = MR-(.15xMR) – PW
AR = .85MR – PW

G. Project Recharge to Extraction Ratio must be less than 85%

H. Canal Recharge (CR)

Accrued during non operational season
CR = Meter reading at the Head of the Caesar – Meter Reading into the Pond

I. Kings River Water Shed – All water attributed to the Kings River Water Shed

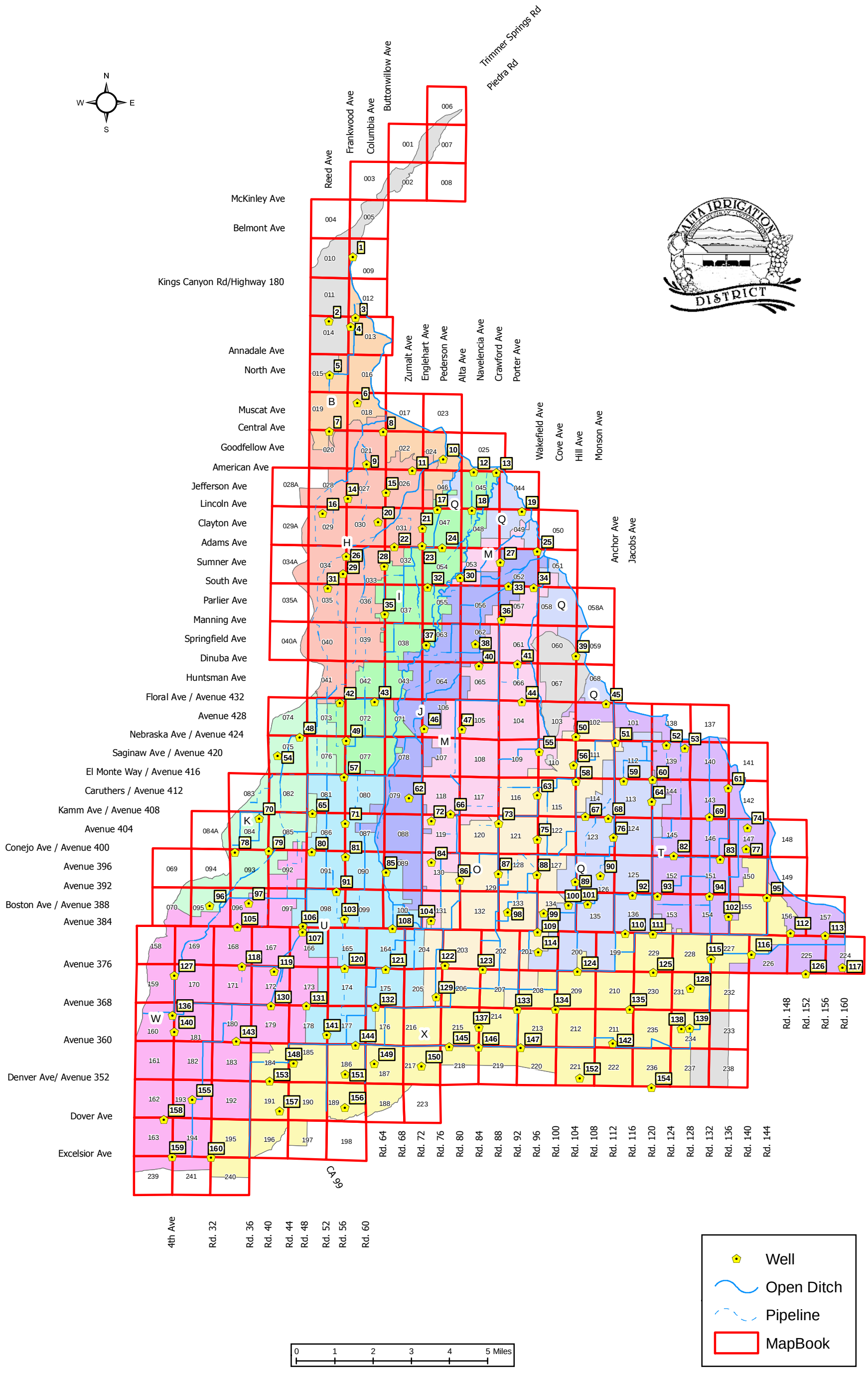
J. Non-Kings River Watershed

Wet Year, watershed attributed to Willow Creek flows

ATTACHMENT H

Map of Monitoring Well Locations

Depth to Groundwater Monitoring Wells



ATTACHMENT I

Section 5 Goals and Objectives, Upper Kings Basin IRWMP

CHAPTER 5 GOALS AND OBJECTIVES

An explanation of the regional planning process and overall integration strategy used to develop the Upper Kings Basin IRWMP is provided in this section along with the description of the goals and objectives. This IRWMP provides a planning framework and management structure from which local water management policies, projects, and programs can be formulated, evaluated, integrated, and implemented. The Water Forum first worked to develop a consensus on the regional problems, issues, and potential conflicts. Goals and objectives were then established to address these issues and to set the stage for the development of the projects, programs, and actions. A planning framework and integration strategy was defined to help the Water Forum work with stakeholders to prioritize projects and alternatives to be included in the IRWMP.

5.1 PROCESS OF DETERMINATION OF REGIONAL PLANNING ISSUES, GOALS, AND OBJECTIVES

The Water Forum worked through the fall of 2003 and winter of 2004 to identify priority problems and issues, and generate a consensus on the purpose and need for the IRWMP. A number of existing information sources, as listed below, were reviewed during this process:

- The original MOU adopted in May 2001 by the DWR, KRCD, AID, CID, and FID;
- The Water Forum Concept Paper (2004);
- Basin Assessment Report (WRIME, 2003b); and
- IRWMP Guidelines (DWR, 2004).

On the basis of the above review, the Water Forum members developed the IRWMP goals, regional planning objectives, and specific water management objectives for the region. These goals and objectives were adopted at the February 2004 Water Forum meeting. These were forwarded to each of the stakeholder groups for consideration before adopting the Resolution of Support for the IRWMP.

5.2 REGIONAL PROBLEMS, ISSUES, AND CONFLICTS

Water Forum participants have identified and developed consensus on priority problems, issues, and sources of potential conflicts in the Kings Basin.

5.2.1 GROUNDWATER OVERDRAFT

Overdraft of the groundwater resource is the primary problem to be addressed in the Upper Kings Basin IRWMP. Overdraft provides a unifying theme for the IRWMP and is the major "driver" for the planning process. The Basin Advisory Panel (BAP) composed of original MOU partners documented that the Kings groundwater basin was in overdraft condition (WRIME, 2003) and recommended that the Water Forum support development of the Kings IGSM to provide a tool to analyze the regional water budget and quantify the nature and extent of overdraft. The Kings IGSM was developed and applied under direction of the Water Forum's Technical Analysis and Data Work Group. The Kings IGSM provides the scientific and technical basis for quantifying the current and potential future overdraft (WRIME 2007b). The area water budget and model results are further explained in Chapter 4 and in Appendix B.

The model and related technical work helped the Water Forum by providing data and analysis results to conclude that the primary water management goal should be to "halt and ultimately reverse the current overdraft of the groundwater aquifer". It is expected that attainment of this goal would "lead to overall maintenance or improvement in the quantity, quality and cost of development of groundwater resources in the region." The continued overdraft over a long period has resulted in the loss of groundwater supply in some areas in the eastern part of the Kings Basin and is not sustainable.

Overdraft increases the competition for the available supply and creates conflicts between agricultural, environmental, and urban water users, and between geographic areas within the region. Declining groundwater levels and groundwater migration across jurisdictional boundaries are also a potential source of increased conflict. In addition, site-specific issues associated with groundwater quality, groundwater recharge, and the need for water and wastewater management facilities to address overdraft have been identified as high priority issues.

5.2.2 WATER SUPPLY RELIABILITY

Water demand has exceeded the available surface and groundwater supplies as they are currently developed and managed with the existing capital facilities and institutional arrangements. A reliable surface water supply is not assured in normal and dry years. Groundwater makes up the balance of urban and agricultural water demands when surface water is not available. In addition, some areas in the basin are entirely reliant on groundwater. Therefore, the long-term sustainability and reliability of the surface and groundwater supply must be addressed in the IRWMP.

An improvement in the capture and storage of storm water and flood water both annually (winter storage for summer use) and during multi-year climatic variations (wet year storage to meet dry year demands) will increase the water supply reliability in the region. The ability to utilize the available groundwater storage is contingent upon construction of capital facilities and on agreements for how to operate and manage the available groundwater storage space. The community, through the Water Forum and IRWMP process, seeks to avoid litigation over water resources and to develop a consensus solution for creating sustainable water supplies with minimum environmental impact.

5.2.3 DEGRADATION OF WATER QUALITY

Degradation of water quality in parts of the IRWMP Region has the potential to reduce the available supply or increase treatment costs. Also, the migration of poor quality water is a factor in the operation of the groundwater basin. Therefore, existing water quality needs to be maintained or improved to ensure that there is water of acceptable quality to meet current and future agricultural, urban, and environmental requirements. A wide range of local, state, and federal programs, both regulatory and voluntary, need to be better coordinated to avoid additional burdensome regulations and to provide benefits to the region.

5.2.4 URBAN DEVELOPMENT

Significant urban development is occurring throughout the planning area, placing increased demands on already stressed resources and increasing the potential for conflicts between existing and new water users. Recent legislation requires urban areas to document and prove that long-term water supplies are available. Potential conflicts exist due to inconsistent planning horizons, lack of compatibility between land use and water supply plans, decreased water quality, and increased treatment costs and requirements for both drinking water and wastewater treatment. Urban areas reduce the amount of applied irrigation water and have a potential effect on the amount of groundwater recharge. Urban water use serves to “harden” the water demand and require a reliable supply of high quality water as compared to agricultural uses. Current urban use is not measured in some areas.

5.2.5 PROTECTION OF WATER RIGHTS

A complex system of water rights exists and is managed by the KRWA on behalf of its 28 members. This water rights system and the associated agreements were put in place to resolve long standing historical conflicts. These agreements demonstrate that local interests can solve and manage conflicts at a local level. The existing agreements, rights, and entitlements

will provide the basis for further basin planning and management because the protection of existing rights is a premise for the IRWMP planning effort and is required to avoid conflicts.

Overlying groundwater rights must also be protected to avoid conflicts. Agreements, similar to those that are used in surface water management, need to be developed for the operation of the groundwater basin and any potential groundwater management facilities for recharge and storage.

5.2.6 SUSTAINING THE AGRICULTURAL ECONOMY

The Kings Basin is a rich agricultural region, and agriculture is a pillar of the local economic and cultural landscape. Agricultural interests developed and paid for many of the local water supply facilities and hold some of the most senior water rights in the Kings Basin. Agricultural and urban users have differences in the ability to pay for new water supplies. Existing agricultural land uses need to be protected to avoid conflicts associated with water and land use conversions.

5.2.7 PROTECTION OF LIFE AND PROPERTY FROM FLOODING

Major storm events have the potential for impacts to existing land use. Regional and local flood control facilities may need improvement to better manage flood runoff and protect existing or proposed land uses. Urbanization increases impervious areas and therefore, will increase runoff, which will have impacts on existing drainage, water delivery infrastructure, and downstream agricultural land uses. Cities and water districts need to work together to avoid these impacts and plan for long-term regional flood control solutions.

5.2.8 PROTECTION OF THE ENVIRONMENT

Community and social programs designed to protect or enhance environmental conditions must be identified and factored into project designs. Environmental protection goals and objectives may be in conflict with other economic development goals and objectives. Integrated solutions to land use and water supply issues also need to factor in potential ecosystem management benefits and costs. Ignoring ecosystem needs could result in projects that do not meet regulatory requirements, are subject to legal challenge, and therefore are subject to schedule delays, cost overruns, or abandonment.

5.2.9 ENVIRONMENTAL JUSTICE

Environmental justice issues can be a source of conflict for IRWMP projects. Therefore, a scientific and open approach needs to be followed in selecting potential project sites. The project sites will be selected based upon soil conditions, water availability, water delivery facilities, agency coordination, and landowner cooperation. Potential projects in areas, towns, or cities will not be rated and prioritized based upon characters of size, ethnicity, economics, or religious beliefs.

5.3 REGIONAL GOALS AND PLANNING OBJECTIVES

The regional goals and planning objectives were established to guide the development of the IRWMP and the planning process. These objectives also defined how the Kings Basin stakeholders integrated other community values into the process to define water management strategies.

5.3.1 REGIONAL GOALS

The regional goals are the broadest statement of intent or purpose for the IRWMP and are intended to address the primary problems and resource conflicts in the region. The Water Forum consulted and elaborated on the original goals and objectives developed by the Basin Advisory Panel (WRIME, 2003b). The goals of the IRWMP are:

- Halt, and ultimately reverse, the current overdraft and provide for sustainable management of surface and groundwater;
- Increase the water supply reliability, enhance operational flexibility, and reduce system constraints;
- Improve and protect water quality;
- Provide additional flood protection; and
- Protect and enhance aquatic ecosystems and wildlife habitat.

5.3.2 REGIONAL WATER RESOURCES OBJECTIVES

Regional water resources objectives were adopted by the Water Forum to address specifically the water resources issues. They are designed to address the priority water supply problems by integrating land, water, and environmental management strategies that will provide multiple benefits and the greatest return on investment. It should be noted that resolution of the groundwater overdraft is still a primary purpose and unifying theme for the IRWMP. The IRWMP water management objectives are:

- Define local and regional opportunities for groundwater recharge, water reuse/reclamation, and drinking water treatment;
- Develop large scale regional conjunctive use projects and artificial recharge facilities to:
  - Enhance operational flexibility of existing water facilities, consistent with existing agreements, entitlements, and water rights;
  - Improve the ability to store available sources of surface water in the groundwater basin;
  - Capture storm water and flood water currently lost in the region;
  - Provide multipurpose groundwater recharge facilities that provide flood control, recreation, and ecosystem benefits; and
  - Integrate the fishery management plan;
- Promote 'in-lieu' groundwater recharge to reduce reliance on groundwater through reclamation and reuse of treated wastewater, surface water treatment and delivery for municipal drinking water, and delivery of untreated water for agricultural use;
- Negotiate and develop institutional arrangements and cost sharing for water banking, water exchange, water reclamation, and water treatment;
- Design programs to improve water conservation and water use efficiency by all water users;
- Identify interconnections or improvement of conveyance systems to provide multiple benefits; and
- Enhance wildlife habitat through surface water reclamation, recharge, and treatment facilities.

5.3.3 REGIONAL PLANNING OBJECTIVES FOR THE UPPER KINGS BASIN IRWMP AND PLANNING PROCESS

The regional planning objectives were adopted by the Water Forum to guide the Upper Kings Basin IRWMP development process. The regional planning objectives reflect community values and acknowledge a range of stakeholder perspectives towards land use, water supply, and environmental resources. Proposed regional planning objectives included:

- Use the Water Forum to help:
  - Create a framework for ongoing regional collaboration and conflict resolution;
  - Coordinate the regional planning process to produce an IRWMP;
  - Define local and regional water management strategies;
  - Evaluate and compare alternatives;

  - Prioritize cost effective local and regional solutions; and
  - Increase public understanding of water management issues.
- Collect and compile water quality baseline data for the region and define opportunities to integrate existing local, state, and federal programs.
- Investigate and resolve legal and institutional issues that may affect project development.
- Identify and pursue sources of funding needed to support project development.
- Compile an inventory of existing water resources plans and policies for the region (including state agencies); include an inventory of local government and water district strategies and initiatives for dealing with water resources problems.
- Develop an integrated hydrologic model to determine regional water budgets, understand how the groundwater basin operates, evaluate and compare alternatives, and support decision making.
- Involve local water districts and land use agencies in generating and confirming the current and future water needs.
- Seek to ensure compatibility and consistency with land use and water supply plans.
- Create and define opportunities to share data and information.
- Develop and implement a community affairs strategy to provide outreach and educate the public and decision makers on water management problems and solutions.
- Evaluate local and regional economic impacts and benefits of proposed projects.
- Identify potential environmental and ecosystem benefits associated with developing the IRWMP.
- Avoid environmental impacts during planning and project design where possible.
- Coordinate needed environmental review of the final alternative projects and programs.

During development of the IRWMP, the Water Forum has realized many of the preliminary planning objectives that were initially established in 2005. The implementation plan contained herein updates the approach to oversight and coordination and establishes long-term strategies for ongoing Water Forum operations. The Water Forum will continue to coordinate stakeholder involvement during implementation of the Upper Kings Basin IRWMP and will use adaptive management to continuously respond to changing circumstances.

ATTACHMENT J

Member Agencies Upper Kings Basin IRWMP Authority

Directors

The Upper Kings Basin Integrated Regional Water Management Authority is governed by a board of directors, which is composed of one representative from each of the 15 member agencies. The directors and alternates are appointed by each member's governing board.

Member Agency	Director
Alta Irrigation District	Norman Waldner, Director Alternate: Chris Kapheim, General Manager
City of Clovis	Harry Armstrong, Mayor Alternate: Mike Leonardo, Public Utilities Director Alternate: Lisa Koehn, Assistant Public Utilities Director
City of Dinuba	Mark Wallace, Mayor Alternate: Dan Meinert, Deputy City Manager Alternate: Dean K. Uota, City Engineer
City of Fresno	Andreas Borgeas, Council Member Alternate: Rene Ramirez, Department of Public Utilities Director
City of Kerman	Trinidad M. Rodriquez, Mayor Alternate: Ken Moore, Public Works Director
City of Kingsburg	Bruce Blayney, Mayor Alternate: David Karstetter, Mayor Pro Tem
City of Parlier	Armando Lopez, Mayor Alternate: Lou Martinez, City Manager
City of Reedley	Steven Rapada, Council Member Alternate: Anita Betancourt, Council Member
City of Sanger	José R. Villarreal, Mayor Alternate: John White, Interim City Manager
City of Selma	Dennis Lujan, Mayor Alternate: D-B Heusser, City Manager Alternate: Roseann Galvan, Administrative Analyst
Consolidated Irrigation District	Robert Nielsen, Jr., Board President Alternate: Phillip Desatoff, General Manager
Fresno Irrigation District	Jeffrey Boswell, Board President Alternate: Gary Serrato, General Manager
Kings County Water District	Barry McCutcheon, President Alternate: Donald Mills, General Manager
Kings River Conservation District	Mark McKean, Board President Alternate: David Orth, General Manager
Raisin City Water District	Jerry K. Boren, President

Alternate:

Board Officers

Chair
Harry Armstrong, Mayor
City of Clovis

Vice Chair
Gary Serrato, General Manager
Fresno Irrigation District

Secretary / Treasurer
David Orth, General Manager
Kings River Conservation District

Last updated 02-26-10

4886 East Jensen Avenue
Fresno, CA 93725

Tel: 559-237-5567
Fax: 559-237-5560

ATTACHMENT K

Memorandum of Understanding with Overlapping Local Agencies

MEMORANDUM OF UNDERSTANDING
BETWEEN
ALTA IRRIGATION DISTRICT
AND
LOCAL AGENCY

ARTICLE I - AGREEMENT

The articles and provisions contained herein constitute a bilateral and binding agreement by and between ALTA IRRIGATION DISTRICT, a California Irrigation District ("District") and LOCAL AGENCY, A Public Agency ("Agency").

ARTICLE II - RECOGNTION

The District has developed an amended Groundwater Management Plan ("Plan") with input from several local agencies which are water purveyors with overlapping spheres of influence within the District. It is the intent of the District to implement the plan with the support and coordination of such local agencies by means of a separate Memorandum of Understanding ("MOU") between each agency and the District.

ARTICLE III - PURPOSE

It is the purpose of this MOU, entered willingly, between District and Agency, to document the interests and responsibilities of both parties in the adoption and implementation of a coordinated Plan. It is also hoped that such MOU will promote and provide a means to establish an orderly process to share information, develop a course of action and resolve any misunderstandings or differences that may arise.

ARTICLE IV - COORDINATION

There shall be bi-annual coordinating meeting ("Meeting") between the District and the Agency. District shall give notice to the Agency thirty (30) days prior to date of the Meeting. If there are concerns or questions regarding the Plan, Agency shall transmit its concerns in writing to District seven (7) days prior to the Meeting.

ARTICLE V - OBLIGATIONS

The Plan shall be binding on the parties hereto unless superseded by the MOU or amendment thereto. It is agreed between both parties that information pertaining to depth to groundwater and groundwater quality shall be shared and coordinated between the parties.

ARTICLE VI - AREA OF PLAN

The plan shall be effective in all areas within the Agency boundaries. The Plan shall also be effective in any area annexed to the Agency Subsequent to the adoption of the Plan.

ARTICLE VII - TERM

The initial term of the MOD shall commence on the date hereof and continue for five (5) years, and shall continue year to year thereafter, unless terminated by written notice given at least one (l) year prior to such termination.

ALTA IRRIGATION DISTRICT

_____
Norman Waldner, President

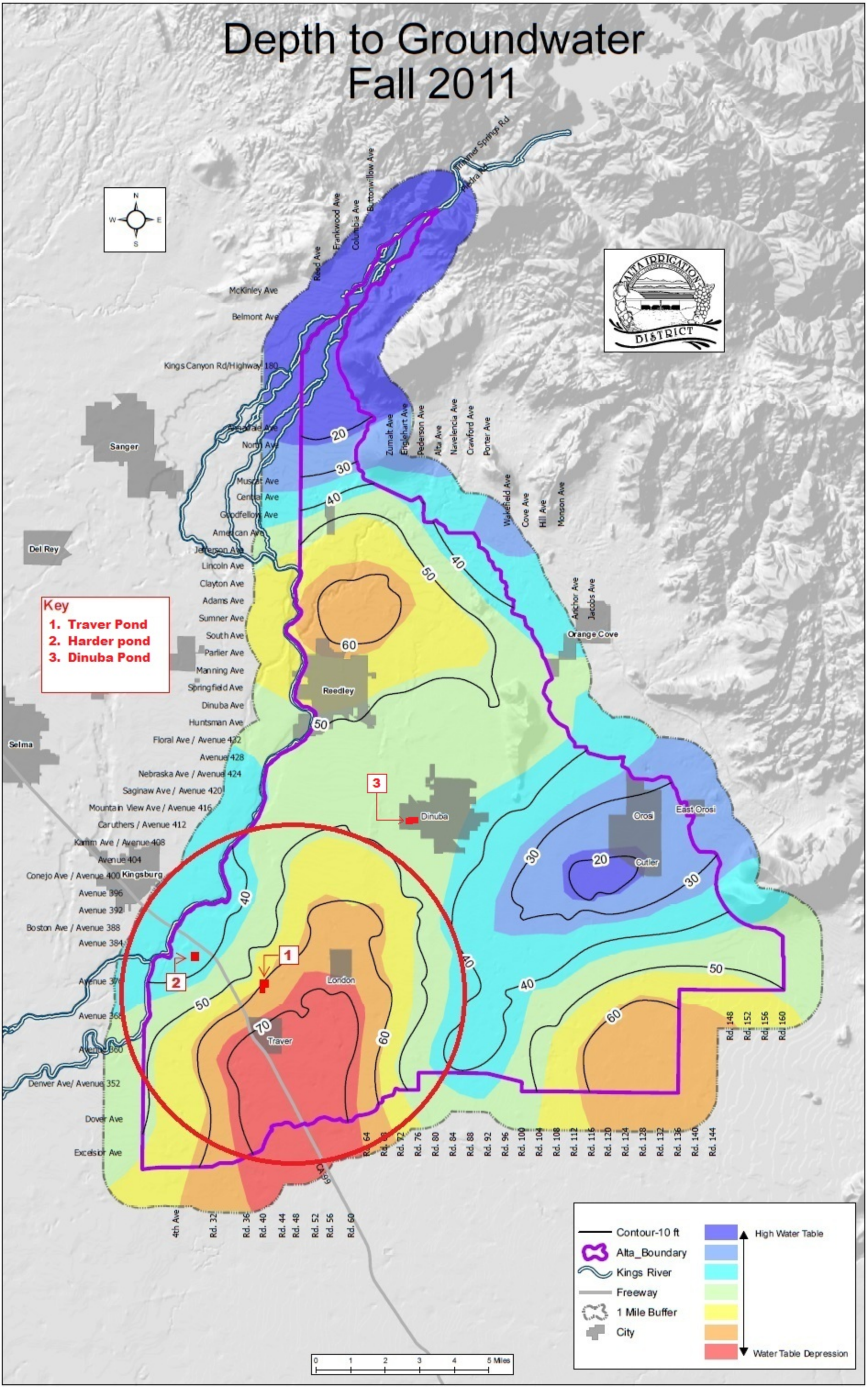
_____ _____
Chris Kapheim, Secretary Date

LOCAL AGENCY

_____
Members Name, President

_____ _____
Members Name, Secretary Date

Depth to Groundwater
Fall 2011



E

ALTA IRRIGATION DISTRICT

WATER BANKING

2011 ANNUAL REPORT

Revised April 12, 2012

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Water Banking Implementation Strategy

Project Yield: Project Yield is determined by measuring the water efficiency benefits of the project which result in a measured volume of conserved water. The basic premise of the program is that it is efficient from a water management perspective to make water deliveries at the lower end of the system from a localized source in the vicinity of the targeted water deliveries rather than delivering water more than 38 miles from the Kings River from AID's storage account in Pine Flat Reservoir. System readjustments and changing variables of demand diminish the efficiency of system deliveries from the Kings River by a factor of two (2).

It would take at least twice the volume of releases from the Kings River to meet surface water demands down steam from localized project sources in the lower reaches of the District. Localized projects can more efficiently meet surface water demands by pumping groundwater that was previously recharged. As a result, the water management efficiency for that delivery has been shown to require a 50% of the water release required to meet localized surface water demands. Making water deliveries from a localized source allows for greater system flexibility and water use efficiency with an end result of more reliable deliveries.

Water Resource Benefits: The Project Yield for Harder and Traver Banking Projects is to be used to address long-term water resource issues within the District. Long-term, where the planning horizon is more than five years, water will be developed for water transfers to meet Cutler-Orosi surface water demands. Short-term, where the planning horizon is less than five years, water will be developed for water transfers to address and improve water use efficiency issues for groundwater or surface water, i.e., Wahtoke Lake Pumping Project. The Project Yield will also help support environmental benefits associated to the Kings River Fisheries Management Program.

Available Recharge: Water available for recharge is the total water recharged in the project basins minus fifteen percent minus the extracted water. It is the intent to coordinate pumping during the mid-week periods of Tuesday through Friday to compliment enhanced irrigation demand during the mid-week period. During the non-operational irrigation period, water will be transferred from the East Branch to the Traver Canal via the Willow Creek Project to supply flows to Harder and Traver Banking Projects. The origin of Willow Creek flows is eastside watershed and the measured volume of water utilized shall be accounted for accordingly. In addition, there will also be inflow from the Kings River Watershed that will be accounted for in the water banking program.

Banking Advisory Committee

COPY

ATTENDANCE:

Chris Kapheim, Alta ID (GM)
Tom Marshall, Alta ID (Board Member)
Jim Wegley, Alta ID (Consulting Engineer)
Dean Thonesen, landowner
Brad Jones, landowner
Mike Swanson, landowner

NOT IN ATTENDANCE:

Brent Smittcamp, landowner

DISCUSSION:

1. Review of the AID Banking Program.

The banking program consists of developing recharge and extraction sites that provide the following benefits: groundwater recharge, flood control, enhanced surface water efficiency and address water quality issues. Water delivered from the Kings River to the lower reaches of the AID has limitations in terms of timing with ordered demands, changes in environmental conditions (weather) and distance from inception to destination (approximately 38 miles). As a result, it has been determined that it is more efficient to store surplus waters in engineered basins and extract necessary volumes to meet demand as opposed to delivering water over extended distances that in some cases take two to three days from the Kings River to landowner delivery. As a result, extracted water from the banking project (Pumping) has a conserved value or Project Yield of twice the amount pumped. The Project Yield is the water available to address groundwater water quality issues in the easterly portion of AID, i.e., Cutler-Orosi areas. Furthermore, the program will take advantage of wintertime storm water flows. Such storm water flows will be recharged into Harder, Dinuba & Traver Pond recharge basins.

2. Review of the Harder Pond Banking Annual Report

Discussion was held on the review of past practices and results for years 2008 and 2009 for AID's water banking program. AID showed data that illustrated the amount of water recharged in 2008, 563 acre-feet, and an additional 399 acre-feet in 2009. In 2009 188 acre-feet was extracted from the Harder Pond Banking Project. The result for 2009 was that forty-seven percent (47%) of the water recharged in the basins was extracted leaving a remainder of fifty-three percent (53%) for recharge. It was further discussed that in the future AID would extract up to eighty-five (85%) of the recharged water in the basins.

AID did review the monitoring of project wells and adjacent landowners wells. The results thus far illustrate no negative impacts of water extractions from the project site.

COPY

A review of regional benefits was discussed in terms of utilization of conserved water from the project and use on an interim basis. In 2009, 113.30 acre-feet was sold to a landowner that was experiencing groundwater limitations.

3. Review of the Traver Banking Project:

AID will be closing escrow in February of 2010 on the Anderson Property (28 acres) in the vicinity of Road 44 and 376. Discussion of how the project will operate and improve water resource flexibility.

ALTA
IRRIGATION
DISTRICT

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P.O. BOX 715
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FAX (559) 591-5190
altaid.org

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ADMINISTRATIVE MANAGER/COLLECTOR

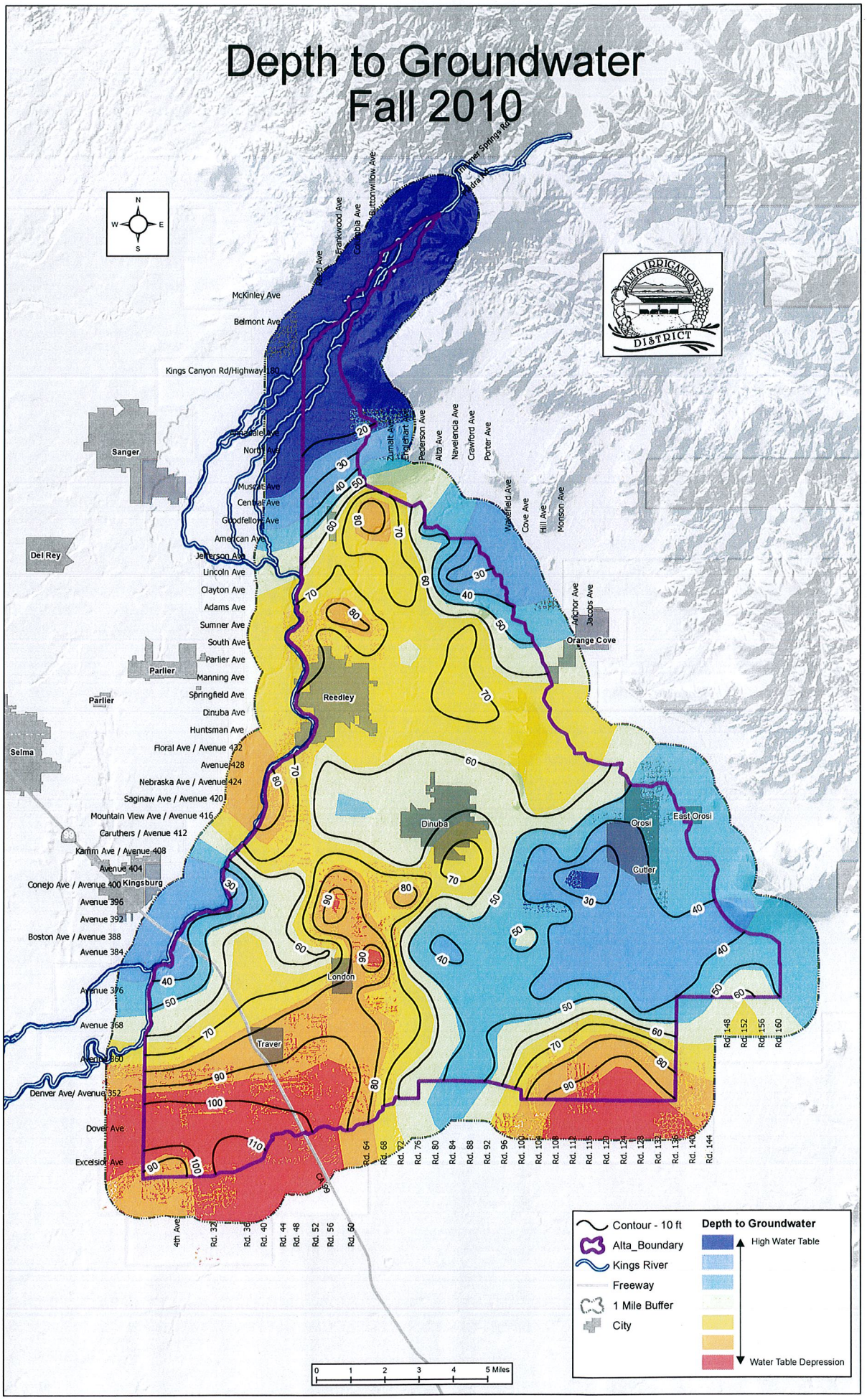
Banking Advisory Committee

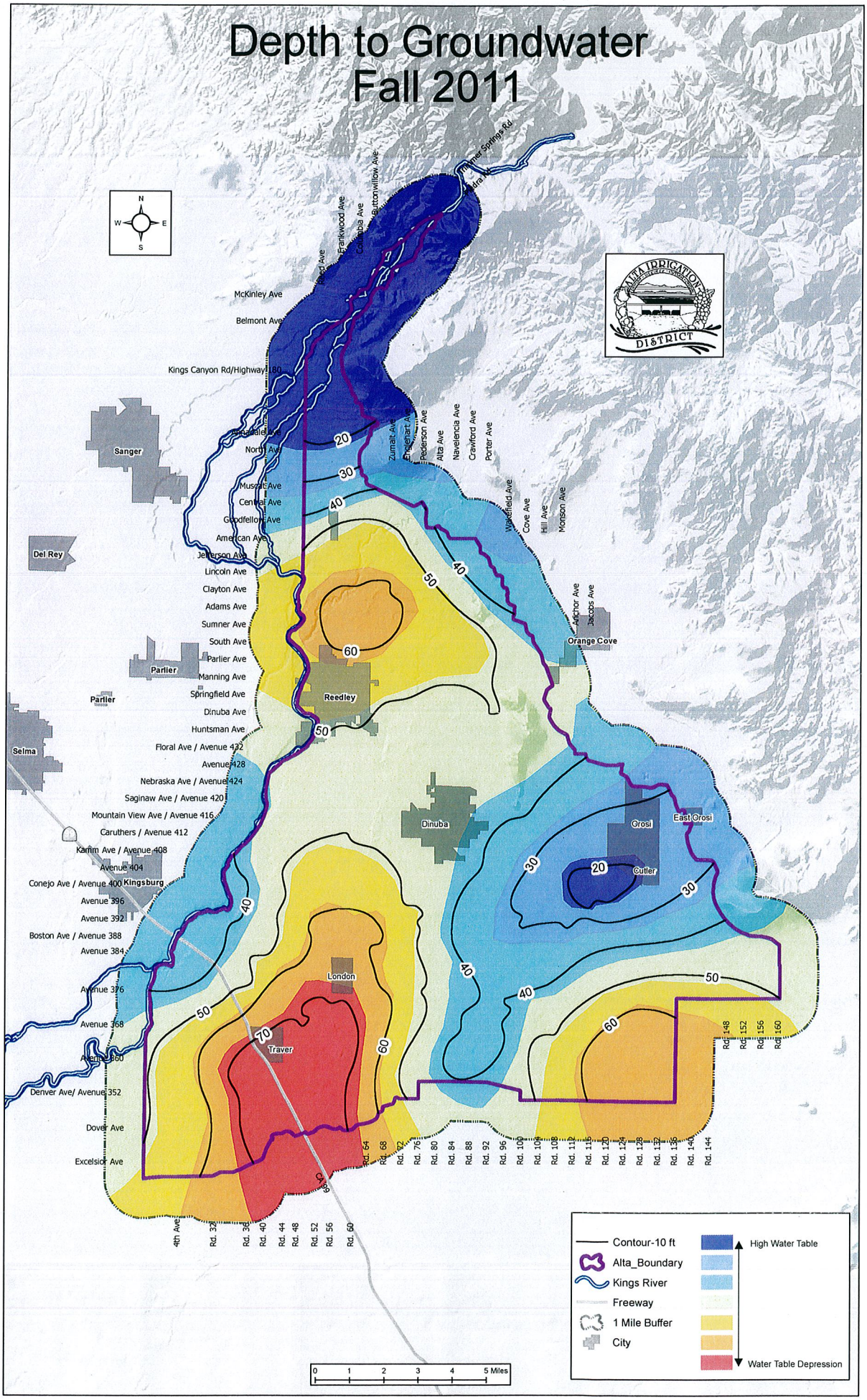
December 29, 2011

To: Chris Kapheim, Alta ID (GM)
Tom Marshall, Alta ID (Board Member)
Jim Wegley, Alta ID (Consulting Engineer)
Mike Swanson, landowner
Dean Thonesen, landowner
Brad Jones, landowner
Brent Smittcamp, landowner

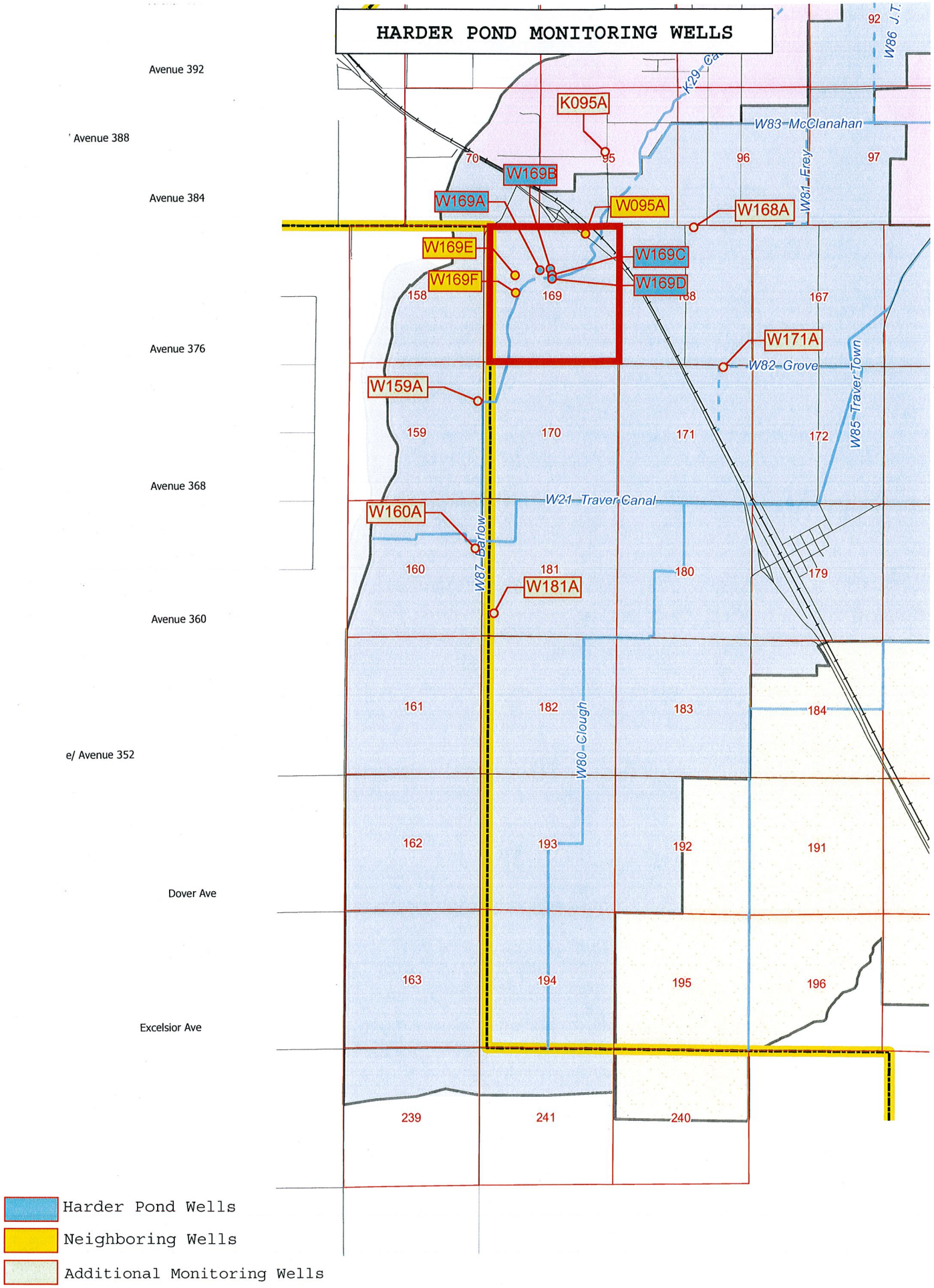
Re: 2011 Water Banking Annual Report.

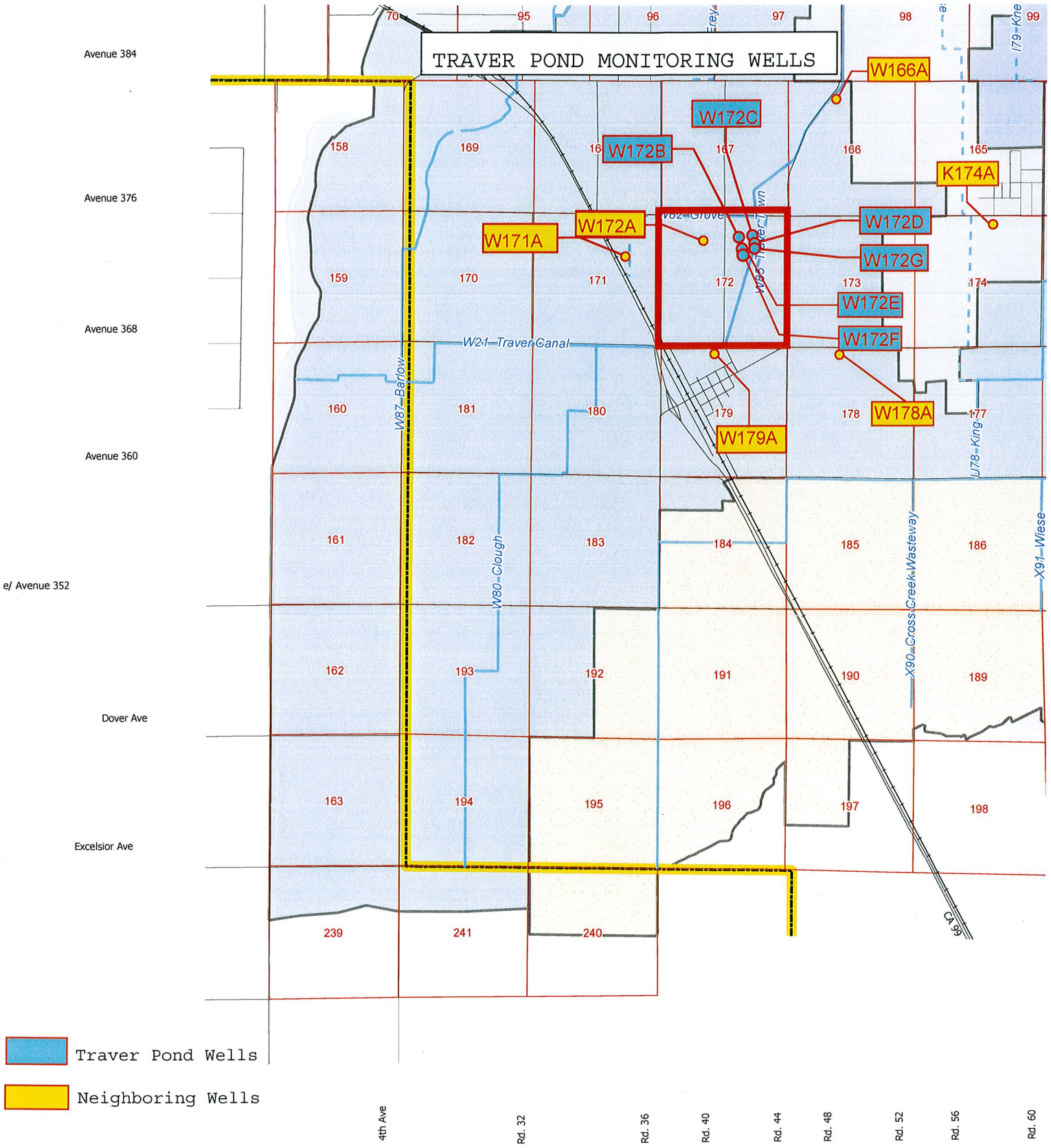
The 2011 Water Banking Annual Report has been mailed to the Banking Advisory Committee for review.

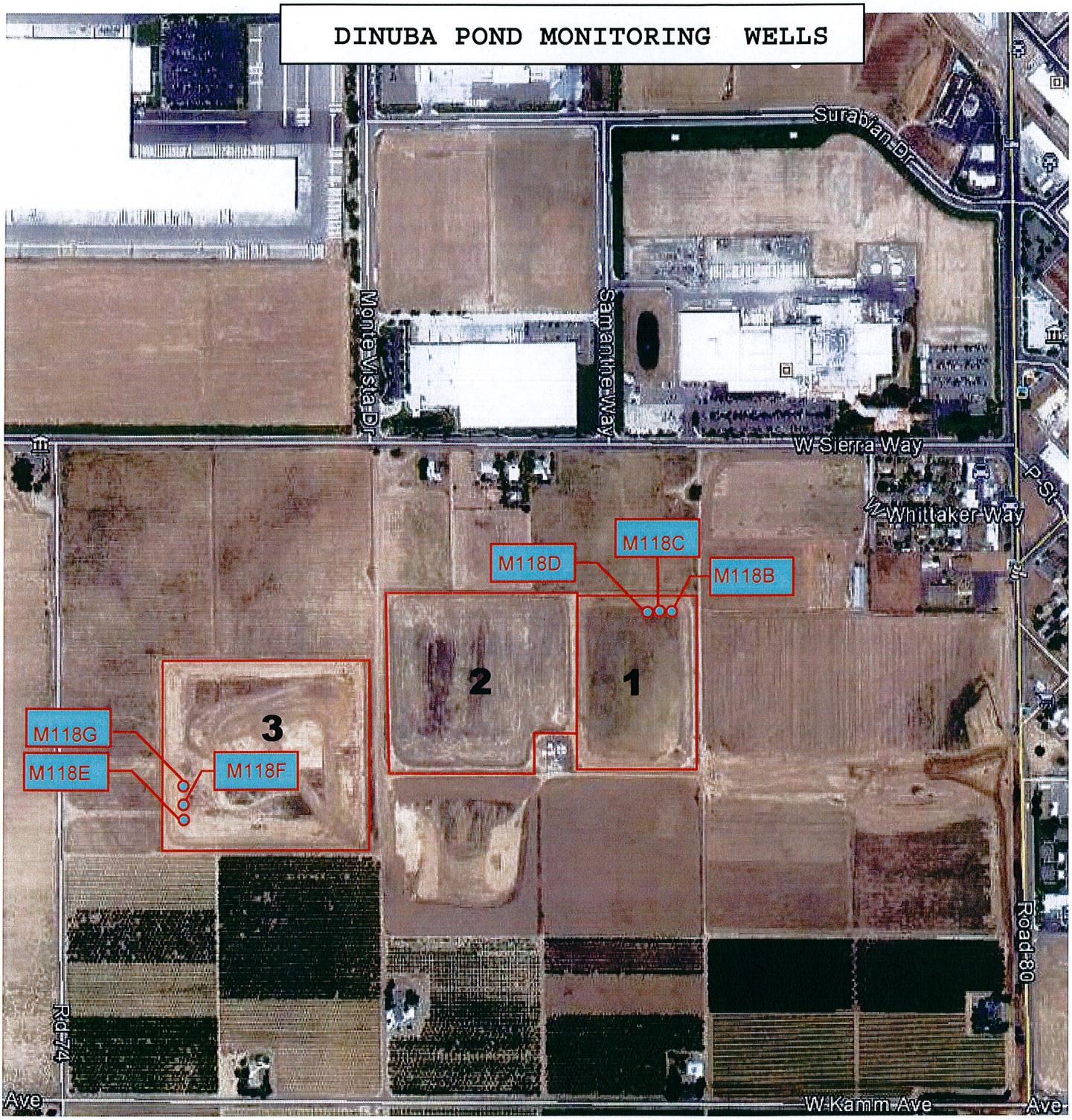

Depth to Groundwater
Fall 2010
N
W
E
S
ALTA IRRIGATION DISTRICT
Contour - 10 ft
Alta_Boundary
Kings River
Freeway
1 Mile Buffer
City
Depth to Groundwater
High Water Table
Water Table Depression
0 1 2 3 4 5 Miles
Sanger
Del Rey
Parlier
Selma
Kingsburg
Reedley
Dinuba
Orange Cove
Orosi
East Orosi
Cutler
London
Traver
McKinley Ave
Belmont Ave
Kings Canyon Rd/Highway 180
Muscat Ave
Central Ave
Goodfellow Ave
American Ave
Jefferson Ave
Lincoln Ave
Clayton Ave
Adams Ave
Sumner Ave
South Ave
Parlier Ave
Manning Ave
Springfield Ave
Dinuba Ave
Huntsman Ave
Floral Ave / Avenue 432
Avenue 428
Nebraska Ave / Avenue 424
Saginaw Ave / Avenue 420
Mountain View Ave / Avenue 416
Caruthers / Avenue 412
Kamm Ave / Avenue 408
Avenue 404
Conejo Ave / Avenue 400
Avenue 396
Avenue 392
Boston Ave / Avenue 388
Avenue 384
Avenue 376
Avenue 368
Avenue 360
Denver Ave/ Avenue 352
Dover Ave
Excelsior Ave
Frankwood Ave
Columbia Ave
Buttonwillow Ave
Zumalt Ave
Englehart Ave
Pederson Ave
Alta Ave
Navelencia Ave
Crawford Ave
Porter Ave
Wakefield Ave
Cove Ave
Hill Ave
Morison Ave
Anchor Ave
Jacobs Ave
Rd. 64
Rd. 68
Rd. 72
Rd. 76
Rd. 80
Rd. 84
Rd. 88
Rd. 92
Rd. 96
Rd. 100
Rd. 104
Rd. 108
Rd. 112
Rd. 116
Rd. 120
Rd. 124
Rd. 128
Rd. 132
Rd. 136
Rd. 140
Rd. 144
Rd. 148
Rd. 152
Rd. 156
Rd. 160
4th Ave
Rd. 32
Rd. 36
Rd. 40
Rd. 44
Rd. 48
Rd. 52
Rd. 56
Rd. 60
Rd. 76


Depth to Groundwater
Fall 2011
N
W
E
S
ALTA IRRIGATION DISTRICT
Sanger
Del Rey
Parlier
Selma
Reedley
Dinuba
Orange Cove
Orosi
East Orosi
Cutler
London
Traver
Kingsburg
McKinley Ave
Belmont Ave
Kings Canyon Rd/Highway 180
Frankwood Ave
Columbia Ave
Buttonwillow Ave
Summer Springs Rd
Zumalt Ave
Englehart Ave
Pederson Ave
Alta Ave
Navelencia Ave
Crawford Ave
Porter Ave
Wakefield Ave
Cove Ave
Hill Ave
Morrison Ave
Anchor Ave
Jacobs Ave
North Ave
Musser Ave
Central Ave
Goodfellow Ave
American Ave
Jefferson Ave
Lincoln Ave
Clayton Ave
Adams Ave
Sumner Ave
South Ave
Parlier Ave
Manning Ave
Springfield Ave
Dinuba Ave
Huntsman Ave
Floral Ave / Avenue 432
Avenue 428
Nebraska Ave / Avenue 424
Saginaw Ave / Avenue 420
Mountain View Ave / Avenue 416
Caruthers / Avenue 412
Karm Ave / Avenue 408
Avenue 404
Conejo Ave / Avenue 400
Avenue 396
Avenue 392
Boston Ave / Avenue 388
Avenue 384
Avenue 376
Avenue 368
Avenue 360
Denver Ave/ Avenue 352
Dover Ave
Excelsior Ave
CA 99
4th Ave
Rd. 32
Rd. 36
Rd. 40
Rd. 44
Rd. 48
Rd. 52
Rd. 56
Rd. 60
Rd. 64
Rd. 68
Rd. 72
Rd. 76
Rd. 80
Rd. 84
Rd. 88
Rd. 92
Rd. 96
Rd. 100
Rd. 104
Rd. 108
Rd. 112
Rd. 116
Rd. 120
Rd. 124
Rd. 128
Rd. 132
Rd. 136
Rd. 140
Rd. 144
Rd. 148
Rd. 152
Rd. 156
Rd. 160
20
30
40
50
60
70
Contour-10 ft
Alta_Boundary
Kings River
Freeway
1 Mile Buffer
City
High Water Table
Water Table Depression
0 1 2 3 4 5 Miles

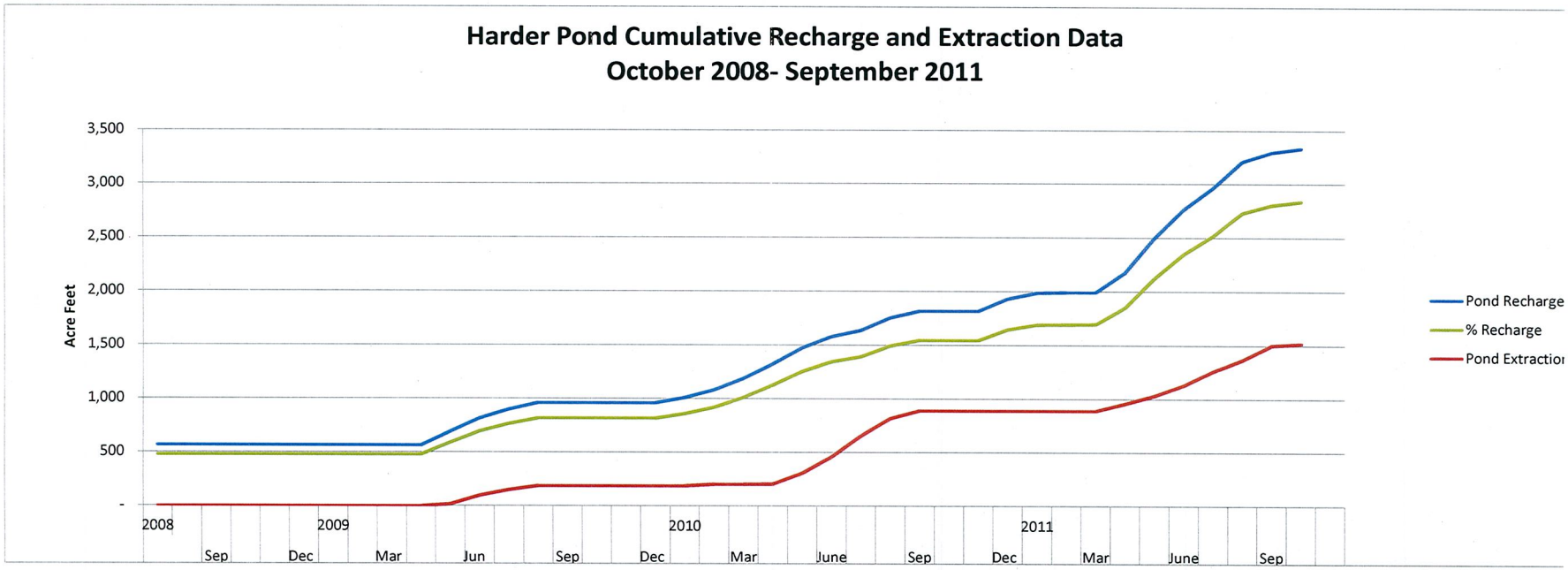
HARDER POND MONITORING WELLS

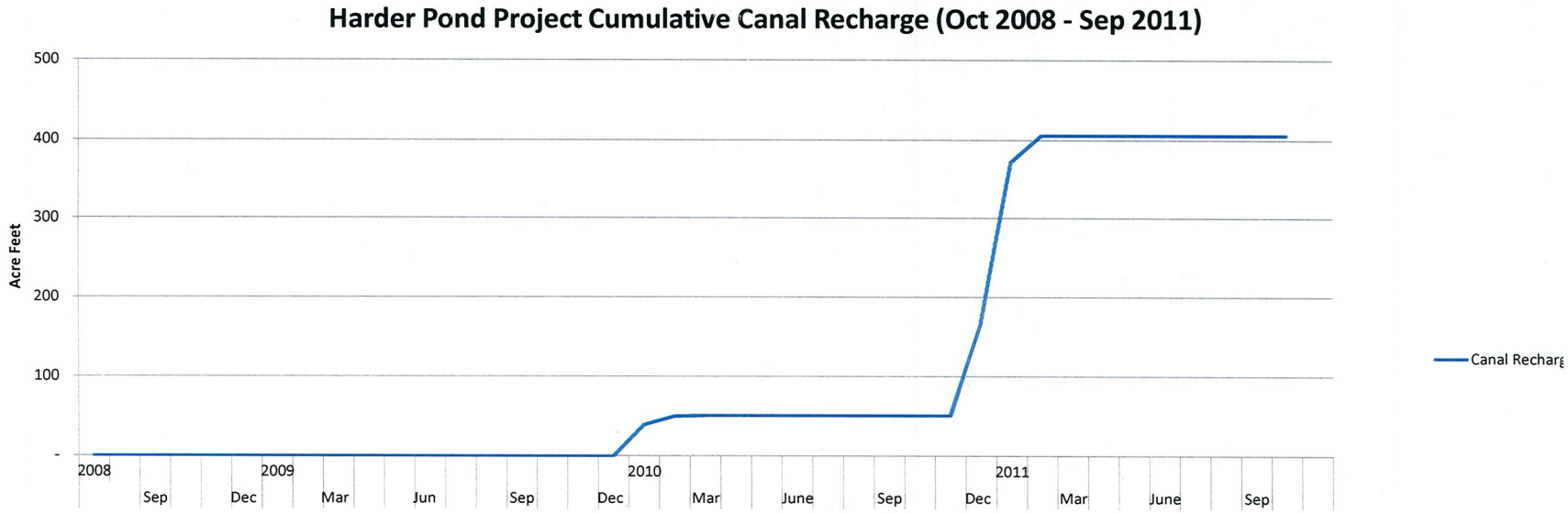



TRAVER POND MONITORING WELLS
W166A
W172C
W172B
K174A
W172A
W171A
W172D
W172G
W172E
W172F
W178A
W179A
Avenue 384
Avenue 376
Avenue 368
Avenue 360
e/ Avenue 352
Dover Ave
Excelsior Ave
W2-1-Traver Canal
W87-Barlow
W80-Clough
X90-Cross Creek-Wasteway
X91-Wiese
U78-King
CA 99
4th Ave
Rd. 32
Rd. 36
Rd. 40
Rd. 44
Rd. 48
Rd. 52
Rd. 56
Rd. 60
Traver Pond Wells
Neighboring Wells

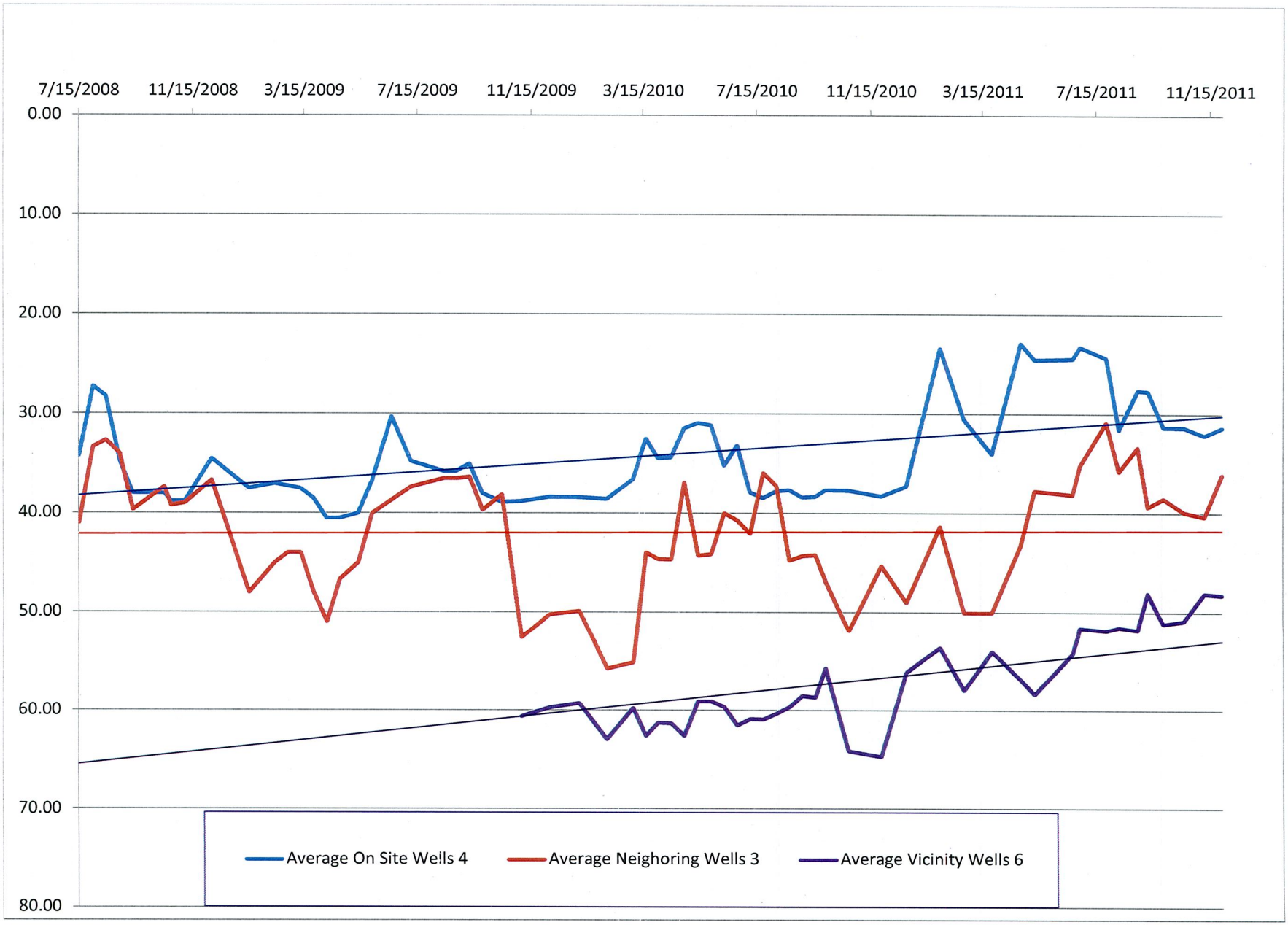


Dinuba Pond Wells


Harder Pond Cumulative Recharge and Extraction Data
October 2008- September 2011
Acre Feet
3,500
3,000
2,500
2,000
1,500
1,000
500
-
2008
2009
2010
2011
Sep
Dec
Mar
Jun
Sep
Dec
Mar
June
Sep
Dec
Mar
June
Sep
Pond Recharge
% Recharge
Pond Extractio


Harder Pond Project Cumulative Canal Recharge (Oct 2008 - Sep 2011)
Acre Feet
500
400
300
200
100
-
2008
2009
2010
2011
Sep
Dec
Mar
Jun
Sep
Dec
Mar
June
Sep
Dec
Mar
June
Sep
Canal Recharg

Harder Pond Depth to Groundwater Well Levels
July 2008 to Nov 2011



Harder Pond Regional Benefits

Due to uncertain groundwater issues west of Smith Mountain, two 500 acre-ft. water transfers were approved taking conserved water from the Harder Pond Water Bank and making deliveries in the impacted area. Currently there is a remaining balance of 297.47 to complete the second water transfer.

Alta Irrigation District
Harder Pond And Traver Pond Bank Monitoring Data
Performance Evaluation for period ending 09/30/2011

revised 04/2/2012

HARDER POND - AVAILABLE RECHARGE is Meter Readings into the North and South Ponds, less 15% (DESIGNATED RECHARGE) less WATER *PUMPED. AVAILABLE RECHARGE places a limit on PUMPING*

Month	Year	Harder Pond Recharge North / South Recharge +	Designated Recharge 15% DR	AVAILABLE RECHARGE WATER AVAILABILITY for pumping *Running Balance* AR / WA
Jan	2010	49.17	7.38	876.11
Feb	2010	70.90	10.64	936.38
Mar	2010	106.74	16.01	1,027.11
April	2010	135.06	20.26	1,141.91
May	2010	152.18	22.83	1,271.26
June	2010	104.60	15.69	1,360.17
July	2010	57.11	8.57	1,408.72
Aug	2010	118.53	17.78	1,509.47
Sep	2010	62.44	9.37	1,562.54
Oct	2010	-	-	1,562.54
Nov	2010	-	-	1,562.54
Dec	2010	116.49	17.47	1,661.56
Jan	2011	53.87	8.08	1,707.35
Feb	2011	5.06	0.76	1,711.65
Mar	2011	1.53	0.23	1,712.95
April	2011	183.30	27.50	1,868.75
May	2011	318.66	47.80	2,139.61
June	2011	266.17	39.93	2,365.86
July	2011	199.45	29.92	2,535.39
August	2011	249.77	37.47	2,747.70
September	2011	86.05	12.91	2,820.84
				2,820.84
				2,820.84
				2,820.84
				2,820.84
				2,820.84
		-	-	2,820.84
Cumulative Totals 03/31/2012		3,318.64	497.80	2,820.84

PUMPED. AVAILABLE RECHARGE places a limit on PUMPING

CANAL RECHARGE
For State Reporting only

Canal Recharge Caesar Reading less Meter at Mclanahan Reporting only CR
39.87
10.82
0.62
-
-
-
-
-
-
-
-
115.28
206.30
33.97
-
-
-
-
-
-
-
-
-
-
-
406.86

For State Reporting only

PROJECT YIELD is based on CONSERVED WATER and is equal to 2x Pumped Water
NET PROJECT YIELD is based on CONSERVED WATER less TRANSFERRED WATER DELIVERED and is equal to WATER AVAILABLE FOR TRANSFERS and is equal to AVAILABLE WATER RESOURCES BENEFIT

PUMPED WATER East/West Pumps P Pumped	CONSERVED WATER PROJECT YIELD behind the dam CW / PY / WAT 2x pumped	TRANSFERRED WATER TW	TRANSFERRED WATER DELIVERED J45.07-05.5 TO DATE TWD	TRANSFERRED WATER OUTSTANDING flood protected *Running Balance* *TW - TWD = TWO*	NET PROJECT YIELD AVAILABLE WATER RESOURCES BENEFIT *Running Balance* *NPY* AWRB
-	-	-		386.70	277.24
15.02	30.04	-		386.70	307.28
-	-	-		386.70	307.28
2.34	4.68	-		386.70	311.96
104.49	208.98	-	36.54	350.16	484.40
149.37	298.74	-	64.80	285.36	718.34
196.55	393.10	-	75.22	210.14	1,036.22
163.60	327.20	-	77.20	132.94	1,286.22
71.98	143.96	500.00	60.40	572.54	1,369.78
-	-	-	-	572.54	1,369.78
-	-	-		572.54	1,369.78
-	-	-		572.54	1,369.78
-	-	-		572.54	1,369.78
-	-	-		572.54	1,369.78
-	-	-		572.54	1,369.78
69.37	138.74	-		572.54	1,508.52
71.53	143.06	-	45.12	527.42	1,606.46
98.56	197.12	-	31.81	495.61	1,771.77
129.41	258.82	-	60.66	434.95	1,969.93
107.27	214.54	-	75.24	359.71	2,109.23
136.40	272.80	-	62.24	297.47	2,319.79
				297.47	2,319.79
				297.47	2,319.79
				297.47	2,319.79
				297.47	2,319.79
				297.47	2,319.79
				297.47	2,319.79
1,511.16	3,022.32	1,000.00	702.53	297.47	2,319.79

less 2011 Exhibit "C" Flows (600.00)

conserved water 3,022.32 less Trans Delivered 702.53 = Net PY Water Available 1,719.79

TRAVER POND - AVAILABLE RECHARGE
W85.00-01

Month	Year	Traver Pond Recharge +	Designated Recharge 15% DR	AVAILABLE RECHARGE WATER AR / WA
August	2011	71.60	10.74	60.86
September	2011	8.81	1.32	68.35
Cumulative Totals 03/31/2012		80.41	12.06	68.35

Financial Data on Harder Pond
For Year Ending 09/30/11

	9/30/2011	9/30/2010
PGE Power	$ 12,129	$ 13,475
Engineering	$ 1,573	$ 1,172
Well Monitoring	$ 7,194	$ 6,886
Cash Expenses	$ 20,895	$ 21,533
Depreciation	$ 41,263	$ 41,263
Total Expenses	$ 62,158	$ 62,795

	2011	2010
Start Date	4/7/2011	4/19/2010
End Date	10/5/2011	10/1/2010
Season Days	181	165
Calculated Cost per Acre Foot		
Total Cost	$ 62,158	$ 62,795
AF Pumped	613	752
AF Created	1,225	1,504
Cost A/F Created	$ 50.74	$ 41.75

PGE pump costs (2 meters)

	9/30/2011	9/30/2010
October	$ 1,790	
November	$ 359	$ 87
December	$ 67	$ 92
January	$ 103	$ 85
February	$ 119	$ 147
March	$ 89	$ 386
April	$ 91	$ 152
May	$ 1,473	$ 917
June	$ 1,799	$ 2,723
July	$ 1,610	$ 3,031
August	$ 2,776	$ 2,921
September	$ 1,853	$ 2,934
	$ 12,129	$ 13,475

Engineering (Management)

	9/30/2011	9/30/2010
October	$ 188	
November		
December		
January	$ 48	$ 156
February	$ 103	$ 378
March	$ 71	
April	$ 48	$ 379
May		$ 45
June		$ 173
July	$ 48	$ 42
August	$ 48	
September	$ 1,021	
	$ 1,573	$ 1,172

Well Monitoring

		Quantity	Miles (RT)	Hours	Rate	2011 Total	2010 Total
A) Vehicle	Supervisor Monitoring	26	40		$ 0.56	$ 577	$ 429
A) Employee	Supervisor Monitoring	26		4	$ 35.00	$ 3,640	$ 3,640
B) Vehicle	Oper Well Measure 6 mo	14	30		$ 0.56	$ 233	$ 198
B) Employee	Oper Well Measure 6 mo	14		4	$ 35.00	$ 1,960	$ 1,680
B) Vehicle	Main Well Measure 6 mo	5	30		$ 0.56	$ 83	$ 99
B) Employee	Main Well Measure 6 mo	5		4	$ 35.00	$ 700	$ 840
						$ 7,194	$ 6,886

A) Based on bi-weekly well monitoring, supervisor rates (it is checked daily during operations as part of water divider's route)

B) Well measurements are taken twice a month during operations, once a month the rest of the year.

Depreciation

		5 Year	15 Year	40 Year	Not Depreciable
Land	$ 134,818				$ 134,818
Extraction Wells and Pumps	$ 189,229		$ 100,000	$ 89,229	
Flow Measurement and SCADA	$ 73,251	$ 73,251			
Monitoring Wells	$ 33,699			$ 33,699	
IRTC Flap Gates	$ 16,397			$ 16,397	
Other	$ 658,509			$ 658,509	
	$ 1,105,903	$ 73,251	$ 100,000	$ 797,834	$ 134,818
		$ 14,650	$ 6,667	$ 19,946	

Annual Depreciation

SCADA, Pumps, Balance	1-5 years	$ 41,263
Pumps, Balance (SCADA has been fully depreciated)	6-15 years	$ 26,613
Balance (SCADA and Pumps have been fully depreciated)	16-40 years	$ 19,946

November 8, 2011

District General Groundwater Well Monitoring Protocols

1. Monitoring Timing

   A. Spring measurements are to be initiated on or near March 1 of each year

   B. Fall measurements are to be initiated on or near November 1 of each year

2. Measurement only includes approved monitoring wells

3. Replacement well request (using a Replacement Monitoring Well Form) will be made by the Superintendent and approved by the General Manager for such reasons as landowner abandonment of well or permanent lack of access to well.

4. Follow-up measurements shall be scheduled approximately 15 days from the original measurement period for wells that were previously pumping or temporarily inaccessible wells

5. Re-testing of wells will require taking a secondary measurement, during the initial measurement period, where the difference in measurement from the prior measurement (spring to fall) exceeds 15 feet, either way, or if oil or some other influence is noticed, thus requiring a secondary measurement using a steel tape.

5. Superintendent to submit raw data for well monitoring to Controller upon completion of monitoring

Water Banking Monitoring Protocols

1. Monitoring Wells on the water banking site (designed monitoring wells) are to be purged prior to measurement

2. In purging monitoring wells, there should be a minimum of a 15 minute time delay between purging well and taking measurements

3. Vicinity wells should not be purged

4. All site and vicinity monitoring wells for banking projects, e.g., Harder Pond, Traver Pond and Dinuba Pond are to be measured twice per month during water run and the month prior to and subsequent to water run.

5. Remaining months require monitoring well measurements only once a month

6. Monthly measurements shall be performed on the first of each month with a three day variance either before or after the first of each month

7. Bi-monthly measurements shall be performed on the 1st and 15th of each month with a three day variance either before or after.

Harder Pond Summary and Conclusion

2011 is the fourth year of actively recharging surface water in Harder Pond and the third year of groundwater extractions. The cumulative recharge (minus the 15% designated recharge) is 2,820.84 acre feet. The cumulative amount of extracted (pumped water) is 1,511.16 acre feet. The cumulative extraction to recharge percentage for the project, to date, is 53.57%. The environmental requirements of 600 acre-feet were used to support the Kings River Fisheries Management Program. This amount is taken from the Net Project Yield Available Water.

In review of the monitoring data, the depth to in the immediate vicinity of the project is slightly elevated in comparison to surrounding monitoring wells. On September 30, 2011 the monitoring wells in the immediate vicinity of the project were 30 feet to groundwater whereas surrounding groundwater monitoring wells were 42 feet to groundwater.

Traver Pond Summary and Conclusion

The Traver Pond is still under construction but a total of 80.41 acre feet of water was recharged in 2011.

Dinuba Pond Summary and Conclusion

The Dinuba Pond was completed in 2011 and data will be shown from this point forward.

GLOSSARY OF TERMS

A. Project Yield (PY)

CW = Conserved Water = Water Available for Transfers
= 2x Pumped Water (PW)
PY=2xPW
50% efficiency from Non Project source, i.e. Kings River

B. Available Water Resource Benefits (AWRB) Long/Short Term

Long Term > 5 years - Water Transfers available for Cutler/Orosi
Short Term > 5 years - Water Transfers available to address/improving water use efficiency
WRB = Project Yield less Water Transferred Delivered
WRB = 2x Pumped Water less Water Transferred Delivered
WRB = 2xPW – TWD

C. Transferred Water (TW)

Total amount of water transferred

D. Transferred Water Delivered (TWD)

Total amount of water transferred measured to date

E. Water Transferred Outstanding Balance (WTOB)

= TW – TWD

F. Available Recharge (AR)

Tracked by water shed = Water Availability
= Meter Readings into the pond, less 15% protected recharge, less pumped water
AR = MR-(.15xMR) – PW
AR = .85MR – PW

G. Project Recharge to Extraction Ratio must be less than 85%

H. Canal Recharge (CR)

Accrued during non operational season
CR = Meter reading at the Head of the Caesar – Meter Reading into the Pond

F

DRAFT

WATER SUPPLY STUDY
CUTLER - OROSI AREA

FEBRUARY, 2007

Dennis R. Keller / James H. Wegley
Consulting Civil Engineers

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SECTION 1
INTRODUCTION
WATER SUPPLY STUDY
CUTLER - OROSI AREA

BACKGROUND

The Orosi Public Utility District (OPUD) and the Cutler Public Utility District (CPUD) provide domestic water to the residents of the unincorporated communities of Orosi and Cutler, respectively. Each district relies solely on groundwater to meet the water demands of its customers. OPUD presently utilizes four wells. CPUD has two active wells.

In Orosi, the water quality and quantity of the existing groundwater supply delivered to the water users is good. Nitrate levels at inactive well sites, however exceed the regulatory standard of 45 mg/l. The community of Cutler is experiencing a similar situation, although CPUD's existing wells are currently experiencing elevated nitrate levels which are jeopardizing the long term viability of the existing water supply.

PURPOSE

Currently, each district has sufficient water supply to meet existing water demands. Additional water supplies, however, are necessary to meet future water needs or to insure sufficient water supplies in the event any existing wells experience elevated contamination over time that require either district to remove well(s) from active status. Two very different options that represent potential solutions for addressing the districts' future water demands are: treatment of the groundwater or the use and treatment of surface waters. The purpose of this Report is to evaluate each water supply option and establish the most feasible approach.

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SECTION 2
DISTRICT WATER SUPPLY FACILITIES
WATER SUPPLY STUDY
CUTLER - OROSI AREA

GENERAL

The Cutler Public Utility District (CPUD) and the Orosi Public Utility District (OPUD) are located in Tulare County, approximately 15 miles north of the City of Visalia. The locations of the districts are shown on Figure 2-1. The residents of Cutler and Orosi are served by County maintained roads and State Route 63 which runs north and south through the middle portions of the districts.

Since the districts do not have access to a surface water supply, the domestic water supplies are developed through the pumping of groundwater. Each district's water supply system consists of groundwater wells, storage tanks, hydropneumatic tanks and appurtenances. The water supply facilities for each district are described in this section of the report.

CUTLER PUBLIC UTILITY DISTRICT

CPUD has a good groundwater supply in terms of most water quality constituents. CPUD is able to meet bacteriological standards without providing chlorination of the individual wells. There are concerns, however, regarding potential DBCP and/or nitrate contamination of the aquifer serving the community. CPUD has lost two existing wells because of high concentrations of nitrates and one well is not connected to the system because of high concentrations of DBCP. Water testing for all existing and new wells have shown elevated nitrate concentrations that are continuing to increase over time.

Wells

CPUD has a total of four developed wells. The data for the wells is summarized in Table 2-1. Two of the wells are active and two of the wells are inactive at this time. The two inactive wells were taken out of service because water test results exceeded the Maximum Contaminant Level (MCL) limit for nitrates. Well Nos. 5 and 6 are the two active wells that supply water for the community.

Additional Wells

There is a well within CPUD (Well No. 7) that is not owned by CPUD. The well is owned by the Tulare County Redevelopment Agency and is used for fire flow at a local industry. This well has water that shows concentrations of DBCP which exceeds its MCL. CPUD has considered taking ownership if the owner supplies treatment for DBCP. CPUD also has two proposed wells in various stages of development. Well No. 8 was completed in April, 2006. Water quality testing, however, has revealed high nitrate concentrations approaching the MCL. Future use of Well No. 8 is uncertain. Well No. 9 was drilled on the site for a proposed blending tank facility for CPUD. The well facility, when completed, will allow for water from Well Nos. 3 and 4 to be used in combination with flows from Well No. 5 and Well No. 9. The availability of sufficient quantities of low nitrate concentration water from CPUD's wells is uncertain.

TABLE 2-1
CPUD GROUNDWATER WELLS
WATER SUPPLY STUDY
CUTLER - OROSI AREA

WELL NO.	DATE DRILLED	DEPTH (Feet)	FLOW RATE (g.p.m.)	STATUS
3	1951	298	797	Inactive
4	1961	368	334	Inactive
5	1962	500	1,000	Active
6	1979	540	497	Active
7	1991	400	700	Not connected to system.
8	2006	330	300	Not complete.
9	Test hole only.	--	--	Not complete.
TOTAL ACTIVE WELL CAPACITY			1,497 (2.2 MGD)	

CPUD utilizes one elevated water tank for water system storage and pressure. The tank holds 50,000 gallons. The tank is connected to the distribution system by a common fill inlet and outlet configuration. CPUD's water supply and distribution system is shown on Figure 2-2.

OROSI PUBLIC UTILITY DISTRICT

OPUD also has a good groundwater supply in terms of most water quality parameters. There are concerns, however, regarding potential EDB, DBCP and/or nitrate contamination of

the aquifer serving the community. OPUD has had to destroy one well (Well No. 3) because of high concentrations of DBCP and EDB. One well (Well No. 6) has been designated as inactive due to high nitrate concentrations.

Wells

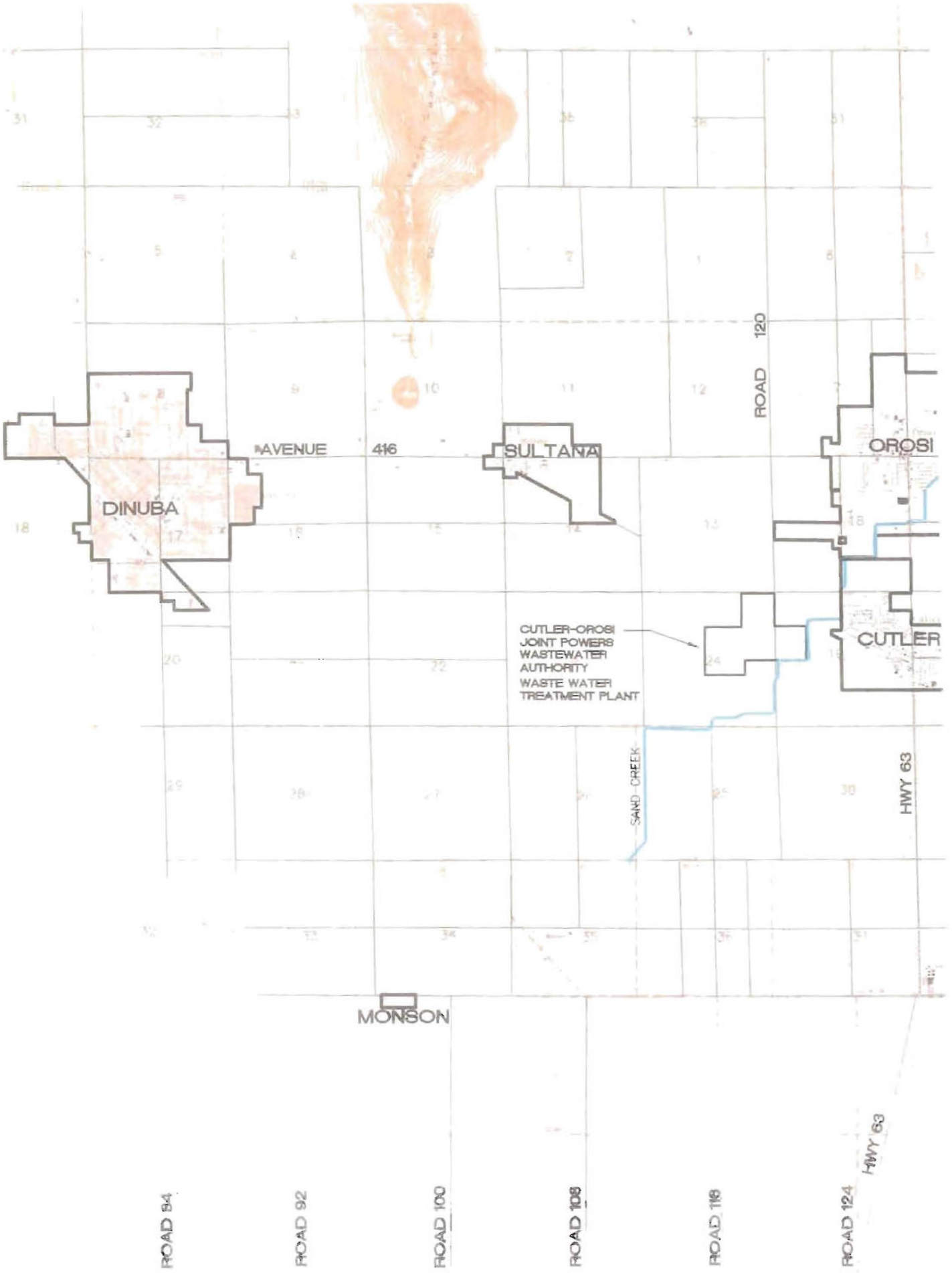
OPUD has a total of six developed wells. The information regarding the active wells is summarized in Table 2-2. Four of the wells are active and two of the wells are inactive at this time. Well No. 6 is inactive and was taken out of service because water test results exceeded the MCL limit for nitrates. Well No. 9 is also considered inactive due to high nitrates and is not connected to the system because of a development dispute. Well Nos. 4, 5A, 7 and 8 are the four active wells that supply water for the community.

TABLE 2-2
OPUD GROUNDWATER WELLS
WATER SUPPLY STUDY
CUTLER - OROSI AREA

WELL NO.	DATE DRILLED	DEPTH (Feet)	FLOW RATE (g.p.m.)	STATUS
4	1966	425	500-600	Active
5A	1990	433	700	Active
6	1977	291	200-300	Inactive
7	1981	400	600-800	Active
8	1996	455	850	Active
9	1993	400	285	Not connected
10	2006		--	Test hole only
TOTAL WELL CAPACITY			2,650-2,950 (3.8 - 4.2 MGD)	

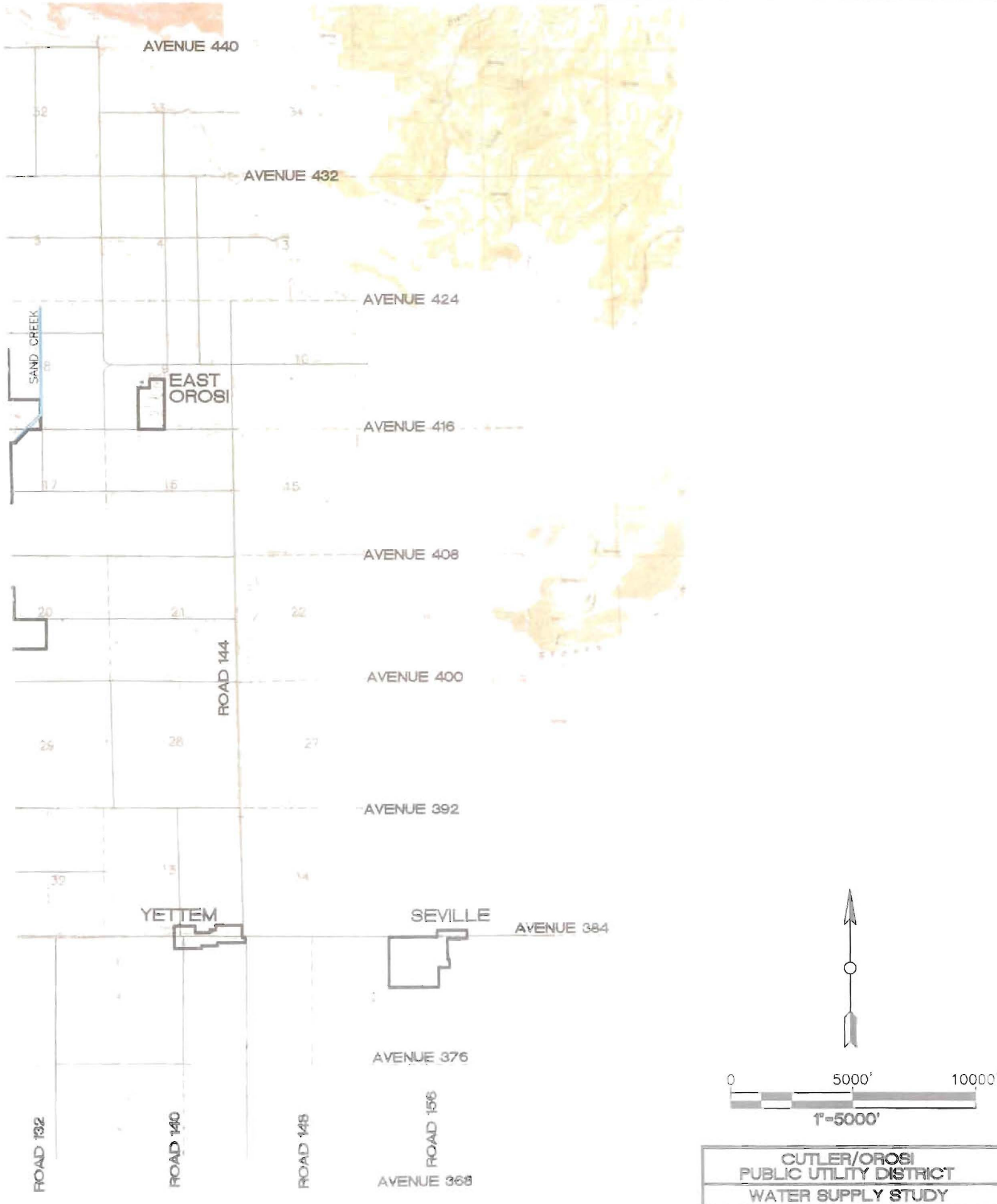
Storage

OPUD has one ground level water storage tank and four hydropneumatic tanks that also provide some limited water storage. The ground level tank has a capacity of 750,000 gallons and delivers water to the system through two booster pumps located at the site of Well No. 5A. There is a 10,000 gallon hydropneumatic tank at each of the active wells. OPUD's water supply and distribution system is shown on Figure 2-3.



LV and Property\ ID\dwg\Water Supply Study 2006\Figure 2-3.dwg

FIGURE 2-1



CUTLER/OROSI PUBLIC UTILITY DISTRICT

WATER SUPPLY STUDY

CUTLER-OROSI AREA

KELLER/WEGLEY

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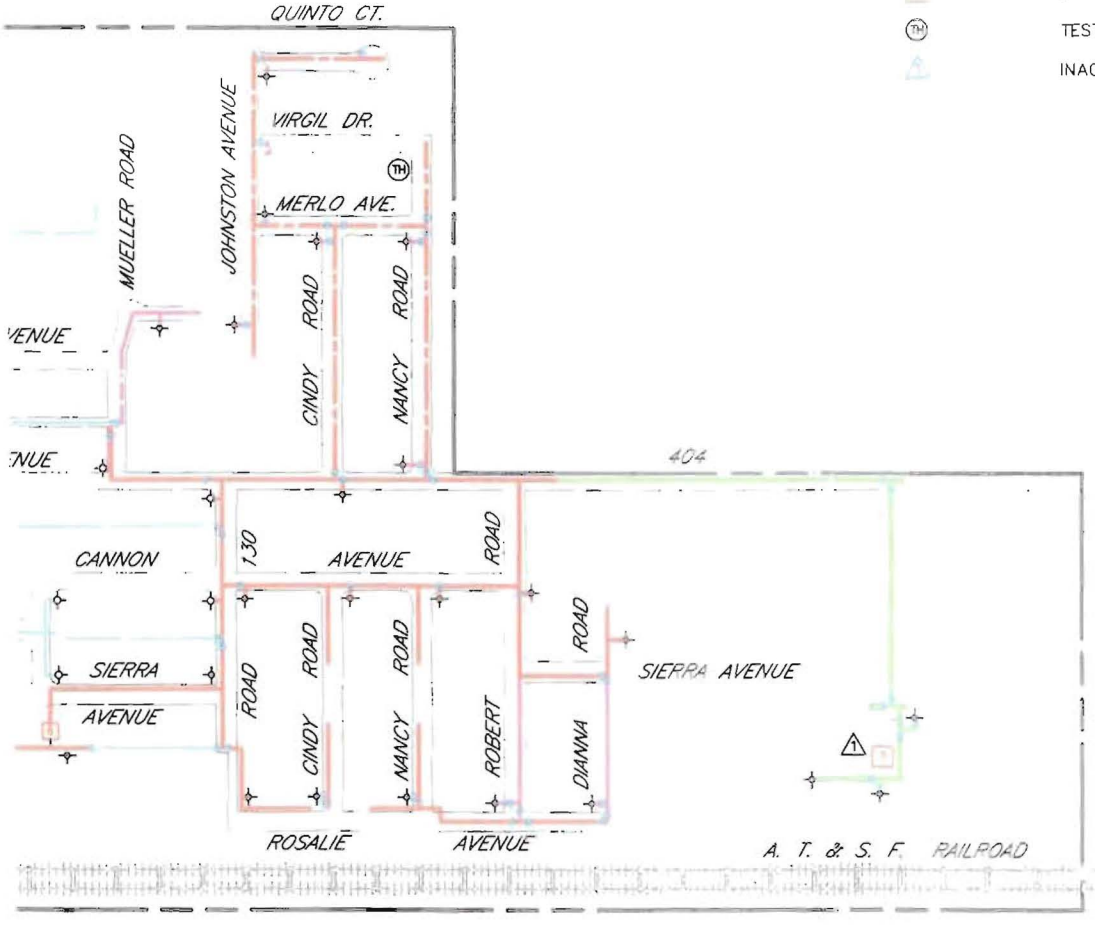
LEGEND

- DISTRICT BOUNDARY
- EXISTING 10" PVC PIPELINE
- EXISTING 8" AC PIPELINE
- EXISTING 8" CAST IRON PIPELINE
- EXISTING 8" PVC PIPELINE
- EXISTING 6" AC PIPELINE
- EXISTING 6" CAST IRON PIPELINE
- EXISTING 6" STEEL PIPELINE
- EXISTING 4" AC PIPELINE
- EXISTING 4" STEEL PIPELINE
- EXISTING 2" STEEL PIPELINE
- EXISTING GATE VALVE
- EXISTING FIRE HYDRANT
- EXISTING WHARF HEAD FIRE HYDRANT
- EXISTING WATER TOWER
- EXISTING WELL SITE AND NUMBER
- TEST HOLE NO. 8
- INACTIVE WELL



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CUTLER
PUBLIC UTILITY DISTRICT
WATER SUPPLY STUDY
CUTLER-OROSI AREA

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LEGEND

DISTRICT BOUNDARY

EXISTING BLOW-OFF ASSEMBLY

EXISTING WHARF HEAD TYPE FIRE HYDRANT

EXISTING PUMPER TYPE FIRE HYDRANT WITH SHUT-OFF VALVE

EXISTING GATE VALVE

(1) EXISTING WELL LOCATION AND NUMBER AS SHOWN. PUMP DISCHARGES INTO HYDROPNEUMATIC TANK.

(5) EXISTING WELL LOCATION AND NUMBER AS SHOWN. PUMP DISCHARGES INTO STORAGE TANK.

[1] EXISTING BOOSTER PUMP LOCATION AND NUMBER AS SHOWN. PUMPS DISCHARGEMATIC INTO HYDROPNEU TANK.

EXISTING 2" STEEL WATER LINE

EXISTING 3" STEEL WATER LINE

EXISTING 4" AC WATER LINE

EXISTING 4" STEEL WATER LINE

EXISTING 6" AC WATER LINE

EXISTING 6" PVC WATER LINE

EXISTING 8" AC WATER LINE

EXISTING 8" PVC WATER LINE

EXISTING 8" DUCTILE IRON WATER LINE

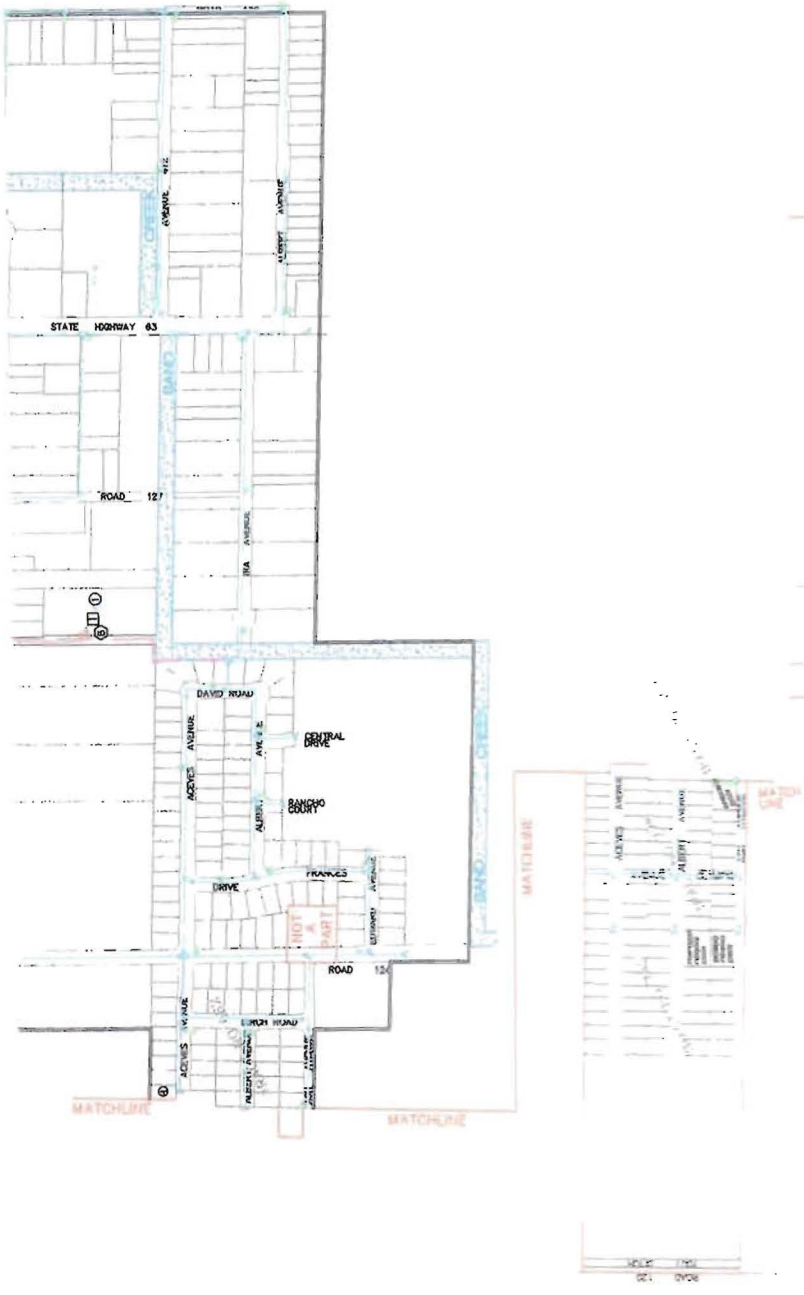
EXISTING 10" AC WATER LINE

EXISTING 10" PVC WATER LINE

EXISTING 10" DUCTILE IRON WATER LINE

EXISTING 12" DUCTILE IRON WATER LINE

EXISTING 16" DUCTILE IRON WATER LINE



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OROSI
PUBLIC UTILITY DISTRICT
WATER SUPPLY STUDY
CUTLER-OROSI AREA

SECTION 3
PROJECTED WATER DEMANDS
WATER SUPPLY STUDY
CUTLER - OROSI AREA

GENERAL

The purpose of this section is to evaluate historical water usage for the Orosi Public Utility District (OPUD) and the Cutler Public Utility District (CPUD) and establish projected water demands. The projected water demands serve as the basis of water supply alternative development.

POPULATION DATA

Table 3-1 summarizes the United States Census population data of the two communities for the period 1980 through 2000. During this time period, the population in Tulare County increased by an average of approximately two percent per year. The present population within the districts are a combination of permanent and seasonal residents. The majority of the residents are employed in the larger urban centers of Tulare County, at industries and businesses located with the Orosi and Cutler areas or on adjacent agriculturally related enterprises. Most of the seasonal residents are employed within the agricultural services industry. There is potential for both moderate population increases and decreases in each community related to fluctuations in the economic environment of this part of Tulare County.

As shown in Table 3-1, Orosi has experienced more consistent growth of the two communities. For the purpose of this study, an annual growth rate of three percent was used. Cutler on the other hand, has experienced more sporadic growth. The most recent census period

documented very little population growth. A population growth rate of one percent was used for population projections within the community of Cutler.

TABLE 3-1
HISTORICAL POPULATION DATA
WATER SUPPLY STUDY
CUTLER - OROSI AREA

	1980	1990	2000	ANNUAL GROWTH RATE (1)
Tulare County	245,738	311,921	368,021	2.04%
Orosi	4,076	5,486	7,318	2.97%
Cutler	3,149	4,450	4,491	1.79%

NOTE:
1. Based upon 20-year population change.

To develop projected populations for the two communities, a facility design period of twenty years was established. Table 3-2 summarizes the population projections for the next twenty years at five-year intervals.

TABLE 3-2
PROJECTED POPULATIONS
WATER SUPPLY STUDY
CUTLER - OROSI AREA

YEAR GROWTH RATE	OROSI 3%	CUTLER 1%
2000	7,318	4,491
2007	9,000	4,815
2012	10,434	5,061
2017	12,096	5,319
2022	14,022	5,590
2027	16,255	5,875

documented very little population growth. A population growth rate of one percent was used for population projections within the community of Cutler.

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2027	16,255	5,875

ESTIMATED WATER USE

Table 3-3 summarizes OPUD's water production for the 10-year period from 1996 to 2005. Based upon the estimated population for that time period, the average water use was 169 gallons per capita per day (gpcd). OPUD, however, completed a water meter installation program in 2004, which resulted in a significant reduction in per capita water use as shown in Table 3-3. Based on the assumption that the water conservation which occurred during the first two years after the installation of the water meters would continue a projected water use in Orosi, of 150 gpcd was used. This per capita daily use represents a balance between historical and the most recent water use trend. The 2027 projected annual water use is estimated to be approximately 900 million gallons which is equivalent to 2.4 million gallons per day (MGD).

Table 3-4 summarizes CPUD's water production from 1996 to 2005. The average water use was approximately 208 gpcd based upon population estimates for this time period. CPUD does not utilize individual water meters on each service. To develop a projected water use amount, 205 gpcd was used. Although water use has been decreasing over the past four years, this per capita daily use reflects a combination of the historical average water use with recent water usage figures. The projected 2027 annual water use in Cutler is estimated to be approximately 440 million gallons (1.2 MGD)

PROJECTED WATER NEEDS

Table 3-5 summarizes each district's current water capacity and projected water demands and needs. A peaking factor was established to estimate the projected peak water demand during the month of highest water use.

TABLE 3-3
OROSI PUBLIC UTILITY DISTRICT HISTORIC AND PROJECTED WATER USE
WATER SUPPLY STUDY
CUTLER-OROSI AREA

Year	Population Estimate (1)	Total Water Production (MG) (2)	Average Use (MGD)	Water Use/Person (gpcd) (3)
1996	6,479	424.03	1.162	179
1997	6,679	462.51	1.267	190
1998	6,886	461.36	1.264	184
1999	7,098	464.22	1.272	179
2000	7,318	457.80	1.254	171
2001	7,538	464.83	1.274	169
2002	7,764	475.95	1.304	168
2003	7,997	469.79	1.287	161
2004	8,236	484.06	1.326	161
2005	8,484	387.77	1.062	125
Average		455.23	1.25	169
Projected Water Use				
2027	16,255	889.96	2.438	150

Notes:
1. Population for Year 2000 based upon census data.
   One percent annual growth used for other years.
2. District data.
3. Based upon estimated population.

TABLE 3-4
CUTLER PUBLIC UTILITY DISTRICT HISTORIC AND PROJECTED WATER USE
WATER SUPPLY STUDY
CUTLER-OROSI AREA

Year	Population Estimate (1)	Total Water Production (MG) (2)	Average Use (MGD)	Water Use/Person (gpcd) (3)
1996	4,314	319.52	0.875	203
1997	4,358	350.19	0.959	220
1998	4,402	332.32	0.910	207
1999	4,446	351.18	0.962	216
2000	4,491	361.42	0.990	220
2001	4,536	342.19	0.938	207
2002	4,581	355.93	0.975	213
2003	4,627	344.79	0.945	204
2004	4,673	342.47	0.938	201
2005	4,720	333.26	0.913	193
Average		343.33	0.94	208
Projected Water Use				
2027	5,875	439.60	1.204	205

Notes:
1. Population for Year 2000 based upon census data.
   One percent annual growth used for other years.
2. District data.
3. Based upon estimated population.

TABLE 3-5
PROJECTED WATER NEEDS
WATER SUPPLY STUDY
CUTLER-OROSI AREA

	CPUD	OPUD
Total Active Water Supply Capacity (1)	1,497 gpm	2,950 gpm
Firm Water Supply Capacity (2)	497 gpm 0.7 MGD	2,100 gpm 3.0 MGD
Projected Average Water Demand (2027)	1.2 MGD	2.4 MGD
Peak Demand Factor	1.7 (3)	1.5 (3)
Projected Peak Water Demand (2027)	2.1 MGD	3.6 MGD
Projected Water Needs - Average Demand (2027)	0.5 MGD	-
Projected Water Needs - Peak Demand (2027)	1.4 MGD	0.6 MGD

Note:
1. See Tables 2-1 and 2-2.
2. Water supply capacity with largest active well out of service.
3. Peak Demand Factor based upon ratio of highest monthly water use to average monthly water use using historical data.

CPUD's lack of water supply capacity affects both existing and projected water needs. Each CPUD well must be in service to meet existing water demands. The existing wells will not be able to meet projected average nor projected peak water demands. Additional water supply is necessary. CPUD needs approximately 1.4 MGD to meet projected peak water demands.

Recent projects completed by OPUD have significantly augmented OPUD's water supply. Well No. 8 increased OPUD's potential water supply. OPUD installed water meters which has resulted in significantly reduced water use. Subsequently, OPUD will not need any additional water supply to meet projected average water demands. OPUD will, however, need an additional 0.6 MGD to meet projected peak water demands.

SECTION 4
TREATMENT PROCESS CONSIDERATIONS
WATER SUPPLY STUDY
CUTLER - OROSI AREA

PURPOSE

The Cutler Public Utility District (CPUD) and Orosi Public Utility District (OPUD) presently rely entirely on groundwater for domestic water supply purposes. Additional water supplies need to be developed to meet projected water needs. Since each district is experiencing elevated nitrates and other contaminants in the local groundwater, the additional water supplies must originate from the treatment of groundwater or from a supplemental surface water supply. Due to drinking water regulations, any surface water supply will require treatment.

The purpose of this section is to present information and data for consideration and subsequent development and to identify treatment process alternatives that address the districts' needs.

DRINKING WATER REGULATIONS

There are several drinking water regulations that warrant special consideration during the development of the Project alternatives for the districts. These regulations are:

1. National Primary Drinking Water Regulations;
2. Long Term 2 Enhanced Surface Water Treatment Rule; and
3. Disinfectant/Disinfection By-Product Rule.

National Primary Drinking Water Regulations (NPDWR)

The NPDWR establishes the current drinking water standards for public water systems.

The standards represent threshold levels of contaminant levels in drinking water. These levels are known as Maximum Contaminant Levels (MCLs). The California Department of Health Services enforces these MCLs, as well as establishes additional MCLs. Contaminant concentrations below the MCLs can be achieved naturally as a result of good source water quality or through treatment to reduce the concentration.

Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

The LT2ESWTR establishes water quality monitoring and treatment requirements for surface water treatment plants and subsequent monitoring. Both districts use groundwater as the only source for their domestic water supply and, therefore, are not presently subject to LT2ESWTR. Development of a surface water treatment plant, however, would require compliance with the LT2ESWTR.

The LT2ESWTR enhances treatment requirements established by the Surface Water Treatment Rule (SWTR) in 1989. The SWTR requires filtration and disinfection of surface water sources. The treatment requirements of the LT2ESWTR are based upon source water monitoring. Monitoring results determine a "bin" placement that establishes the extent of additional treatment requirements.

Disinfectant/Disinfection By-Products (D/DBP) Rule

Each district uses chlorine to accomplish disinfection of its water supply and to provide a disinfectant residual in the distribution system. Subsequently, the districts are subject to the D/DBP Rule.

The D/DBP Rule establishes MCLs for disinfection by-products that result from chlorine disinfection. The rule has two steps. Stage 1 has been in effect for the districts since 2004.

Stage 1 of the D/DBP Rule establishes numerous limits for trihalomethanes and haloacetic acids along with additional monitoring requirements. Stage 2 was promulgated in January, 2006, and will become effective for the districts in April, 2008. Stage 2 of the D/DBP Rule establishes more detailed monitoring and rule compliance measures.

Disinfection by-products are formed when chlorine reacts with organic material (precursors) in the water source. Typically, surface waters have higher concentrations of disinfection by-product precursors as compared to groundwater. Water treatment processes must be designed to reduce precursor concentrations and to implement optimal operation procedures in utilizing disinfection to minimize the formation of disinfection by-products.

WATER QUALITY

Groundwater

Table 4-1 summarizes recent general water quality constituents for OPUD's water supply wells. Overall, the groundwater quality is good. Nitrate and arsenic represent the only constituents of concern. Since elevated nitrate levels exist in Well Nos. 7 and 8., the District has conducted more frequent testing at these locations. Table 4-2 summarizes recent nitrate concentrations for OPUD's active groundwater wells. Historic nitrate concentrations for OPUD's inactive well is summarized in Table 4-3. The arsenic levels in the District's wells are well below the new standard of 10 mg/l.

The groundwater quality for CPUD's water supply wells is very similar to OPUD's groundwater. Table 4-4 presents the test results from CPUD's most recent testing effort. CPUD monitors nitrate and DBCP on a monthly basis due to elevated concentrations. Table 4-5 summarizes recent test results for nitrates and DBCP at CPUD's active wells.. Well No. 6 has

TABLE 4-1
OROSI PUBLIC UTILITY DISTRICT - GROUNDWATER QUALITY
WATER SUPPLY STUDY
CUTLER-OROSI AREA

CONSTITUENTS	Units	Well 4 8/24/04	Well 5A 8/24/04	Well 7 8/24/04	Well 8 8/15/05
Alkalinity (as CaCO3)	mg/L	160	150	190	180
Aluminum (Al) (Primary)	ug/L	< 50.0	< 50.0	< 50.0	< 50.0
Antimony	ug/L	< 6.0	< 6.0	< 6.0	< 6.0
Arsenic (As)	ug/L	2	3	2	3
Barium (Ba)	ug/L	< 100.0	< 100.0	< 100.0	< 100.0
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate (HCO3)	mg/L	200	180	230	220
Cadmium (Cd)	ug/L	< 1.0	< 1.0	< 1.0	< 1.0
Calcium (Ca)	mg/L	40	34	48	48
Carbonate Alkalinity(CO3)	mg/L	< 1	< 1	< 1	1
Chloride (Cl)	mg/L	16	11	17	14
Chromium (Total Cr)	ug/L	< 10.0	< 10.0	< 10.0	< 10.0
Color (Unfiltered)	UNITS	< 1	< 1	< 1	1
Copper (Cu)	ug/L	< 50.0	< 50.0	< 50.0	< 50.0
Cyanide	ug/L	< 100.0	< 100.0	< 100.0	< 100.0
Fluoride (F) Temp. Depend.	mg/L	0.1	0.1	0.1	0.1
Hardness (as Ca CO3)	mg/L	160	140	200	190
Hydroxide Alkalinity (OH)	mg/L	< 1	< 1	< 1	1
Iron (Fe)	ug/L	< 100.0	< 100.0	< 100.0	< 100.0
Lead (Pb)	ug/L	< 5.0	< 5.0	< 5.0	< 5.0
Magnesium (Mg)	mg/L	16	13	19	17
Manganese (Mn)	ug/L	< 20.0	< 20.0	< 20.0	< 20.0
MBAS (Foaming Agents)	ug/L	< .05	< .05	< .05	0.05
Mercury (Mn)	ug/L	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	ug/L	< 10.0	< 10.0	< 10.0	< 10.0
Nitrate (NO3)	mg/L	20	16	26	32
Odor Threshold at 60° C	TON	1	1	1	1
pH (Laboratory)	Std Units	8	8.1	8	8.2
Potassium (K)	mg/L	3	3	3	4
Selenium (Se)	ug/L	< 5.0	< 5.0	< 5.0	< 5.0
Silver (Ag)	ug/L	< 10.0	< 10.0	< 10.0	< 10.0
Sodium (Na)	mg/L	21	20	24	25
Specific Conductance (E.C.)	umhos/cm	390	330	450	470
Sulfate (SO4)	mg/L	9	6	14	ND
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0
Total Filterable Residue at 180° C (TDS)	mg/L	280	250	320	330
Turbidity (Lab)	NTU	< .1	0.2	< .1	0.2
Zinc (Zn)	ug/L	< 50.0	< 50.0	< 50.0	< 50.0

TABLE 4-2
OROSI PUBLIC UTILITY DISTRICT - NITRATE DATA FOR ACTIVE WELLS
WATER SUPPLY STUDY
CUTLER-OROSI AREA

Sample Date	Well 4 NO3 (mg/L)	Well 5A NO3 (mg/L)	Well 7 NO3 (mg/L)	Well 8 NO3 (mg/L)
2/10/04				19
3/23/04			29	
4/27/04			26	30
8/24/04	20	16	26	39
11/9/04			33	17
1/20/05			34	25
2/8/05			32	18
5/10/05			37	25
8/15/05	20	16	24	32
12/13/05			33	43
6/6/2006			36	18
8/8/2006	22	18	32	21
Average	21	17	31	26
Maximum	22	18	37	43
Minimum	20	16	24	17
No. of Samples	3	3	11	11

TABLE 4-3
OROSI PUBLIC UTILITY DISTRICT - NITRATE DATA FOR INACTIVE WELLS
WATER SUPPLY STUDY
CUTLER-OROSI AREA

Sample Date	Well 6 NO3 (mg/L)
9/21/89	21
7/14/92	198
9/29/92	39.8
7/5/94	44
9/29/94	168
11/3/94	138
12/12/94	120
7/17/02	140
Average	109
Maximum	198
Minimum	21
No. of Samples	8

TABLE 4-4
CUTLER PUBLIC UTILITY DISTRICT - GROUNDWATER QUALITY
WATER SUPPLY STUDY
CUTLER-OROSI AREA

CONSTITUENTS	Units	Well 05 8/10/04	Well 06 8/10/04
Alkalinity (as CaCO3)	mg/L	200	170
Aluminum (Al) (Primary)	ug/L	< 50.0	< 50.0
Antimony	ug/L	< 6.0	< 6.0
Arsenic (As)	ug/L	3	3
Barium (Ba)	ug/L	140	140
Beryllium	ug/L	< 1.0	< 1.0
Bicarbonate (HCO3)	mg/L	200	170
Cadmium (Cd)	ug/L	< 1.0	< 1.0
Calcium (Ca)	mg/L	55	44
Carbonate Alkalinity(CO3)	mg/L	< 1	< 1
Chloride (Cl)	mg/L +	29	22
Chromium (Total Cr)	ug/L	< 10.0	< 10.0
Color (Unfiltered)	UNITS	< 1	< 1
Copper (Cu)	ug/L	< 50.0	< 50.0
Cyanide	ug/L	< 100.0	< 100.0
Dibromochloropropane (DBCP)	ug/L	0.039	0.19
Fluoride (F) Temp. Depend.	mg/L	0.2	0.1
Hardness (as Ca CO3)	mg/L	220	180
Hydroxide Alkalinity (OH)	mg/L	< 1	< 1
Iron (Fe)	ug/L	< 100.0	< 100.0
Lead (Pb)	ug/L	< 5.0	< 5.0
Magnesium (Mg)	mg/L	20	16
Manganese (Mn)	ug/L	< 20.0	< 20.0
MBAS (Foaming Agents)	ug/L	< 0.05	< 0.05
Mercury (Mn)	ug/L	< 1.0	< 1.0
Nickel	ug/L	< 10.0	< 10.0
Nitrate (NO3)	mg/L	31	26
Odor Threshold at 60° C	TON	1	1
pH (Laboratory)	Std Units	8	8
Potassium (K)	mg/L	4	3
Selenium (Se)	ug/L	< 5.0	< 5.0
Silver (Ag)	ug/L	< 10.0	< 10.0
Sodium (Na)	mg/L	32	30
Specific Conductance (E.C.)	umhos	530	450
Sulfate (SO4)	mg/L +	20	13
Thallium	ug/L	< 1.0	< 1.0
Total Filterable Residue at 180° C (TDS)	mg/L +	360	310
Turbidity	NTU	< 0.1	0.1
Zinc (Zn)	ug/L	< 50.0	< 50.0

TABLE 4-5
CUTLER PUBLIC UTILITY DISTRICT - NITRATE AND DBCP DATA FOR ACTIVE WELLS
WATER SUPPLY STUDY
CUTLER -OROSI AREA

Sample Date	Well No. 5		Well No. 6	
	Nitrate (NO3) (mg/L)	DBCP (ug/L)	Nitrate (NO3) (mg/L)	DBCP (ug/L)
2/10/04	31	0.03		
3/2/04			40	0.16
4/27/04			35	0.16
5/20/04	30	0.3 (1)	46	0.16
6/8/04			36	0.14
7/27/04			43	0.2
8/10/04	31	0.039	26	0.19
8/20/04			40	0.16
9/7/04			48	0.17
9/10/04			28	
9/14/04			49	
10/26/04			35	0.22
11/2/04		0.045	38	0.26
11/23/04				0.16
12/20/04			46	
1/4/05			39	0.2
2/1/05	35	0.061	41	0.18
3/1/05			32	0.21
4/5/05			30	0.24
4/25/05				0.19
5/17/05	40	0.036	33	0.22
6/7/05			48	0.22
6/13/05			26	
7/5/05			30	0.21
8/15/05	31	0.045	48	0.15
8/29/05			48	
9/1/05			25	
9/20/05			27	0.23
10/4/05			46	
10/10/05			31	
12/27/05			39	0.22
12/30/05	31	0.075		
3/14/06	< 2 (1)		36	0.22
4/4/06			34	0.23
5/2/06	38	0.036	29	0.32
6/6/06			26	0.23
7/11/06			32	0.2
8/8/06	33	0.048	31	0.23
Average	33	0.05	37	0.20
Maximum	40	0.08	49	0.32
Minimum	30	0.03	25	0.14
No. of Samples	9	9	34	28

Note:
1. Result is considered not typical when compared to other data.
   Potential sampling or analytical error.

exceeded the MCL for nitrate on several occasions. Table 4-6 summarizes nitrate concentrations at CPUD's inactive wells. Like OPUD, the arsenic levels in the CPUD wells are well below the new standard of 10 mg/l.

As evidenced by the testing results, nitrates are impacting the groundwater in the community. Locating a groundwater source in the Cutler-Orosi area that is low in nitrates, has been and will continue to be difficult. The future use of existing wells may also be jeopardized by increasing nitrate levels. Although arsenic levels are well below current regulatory standards, the potential for more stringent standards exist, which may subsequently require a need for treatment.

Surface Water

There is no natural surface water supply in the vicinity of the districts. A surface water supply for domestic purposes will have to be transported to the area through Alta Irrigation District's open channels, the Friant-Kern Canal, a dedicated pipeline or a combination of all three. The Alta Irrigation District surface water supply originates in the Kings River watershed, with their headgate on the Kings River being located downstream of Piedra. Storage of their water supply is provided by Pine Flat Dam.

The districts conducted a short-term surface water testing program to compile preliminary data for consideration in the selection of a treatment process. The samples were collected at the head of the Alta Irrigation District's Tout Ditch which is located near Avenue 120, just northwest of Orosi. Table 4-7 summarizes the testing results for the routine samples. In addition, a detailed analysis for water quality constituents was conducted. Table 4-8 summarizes the detailed water quality results.

TABLE 4-6
CUTLER PUBLIC UTILITY DISTRICT - NITRATE AND DBCP DATA FOR INACTIVE WELI
WATER SUPPLY STUDY
CUTLER-OROSI AREA

Sample Date	Well No. 3	Well No. 4
	Nitrate (NO3) (mg/L)	Nitrate (NO3) (mg/L)
11/27/91	61	
2/13/92	62	
3/7/92	57	
4/7/92	59.5	
9/17/97		44
12/19/97		47
9/23/98		48
12/3/98		49
Average	60	47
Maximum	62	49
Minimum	57	44
No. of Samples	4	4

TABLE 4-7
SURFACE WATER TESTING RESULTS (1)
WATER SUPPLY STUDY
CUTLER-OROSI AREA

PARAMETER	UNITS	SAMPLE TYPE AND DATE														Average	No. of Samples
		Flood 4/6/2006	T22 7/6/2006	7/13/2006	7/20/2006	7/27/2006	8/3/2006	Expanded 8/10/2006	8/17/2006	8/24/2006	8/31/2006	9/7/2006	Expanded 9/14/2006	9/21/2006	9/28/2006		
Turbidity	NTU	67	-	2.2	2.6	2.3	2.0	-	3.1	1.8	1.4	1.8	-	1.4	1.5	2.0	10
Coliform, Total	MPN/100 ml	-	-	-	> 23	-	> 23	Present	> 23	-	-	50	300	-	50	78.2	6
Coliform, Fecal (E. Coli)	MPN/100 ml	-	-	-	> 23	-	16.1	Present	23	-	-	23	No Sample	-	30	23.0	5
Temperature	Deg F	-	-	63	64	65	65	-	-	65	-	69	-	-	66	65.3	7
pH	-	7.9	7.5	-	-	-	-	7.2	-	-	-	-	7.1	-	-	7.3	3
Conductivity (EC)	umho/cm	220	28	-	-	-	-	-	-	-	-	-	-	-	-	28	1
Dissolved Organic Carbon (DOC)	mg/l	9.2	-	-	-	-	-	1.3	-	-	-	-	0.78	-	-	1.0	2
Total Dissolved Solids (TDS)	mg/l	210	32	-	-	-	-	21	-	-	-	-	23	-	-	25.3	3
Total Organic Carbon (TOC)	mg/l	13	-	-	-	-	-	1.3	-	-	-	-	0.95	-	-	1.1	2
Total Suspended Solids (TSS)	mg/l	67	-	-	-	-	-	< 5	-	-	-	-	< 5	-	-	< 5	2
Alkalinity	mg/l	-	29	-	-	-	-	11	-	-	-	-	11	-	-	17	3
Bicarbonate	mg/l	-	29	-	-	-	-	11	-	-	-	-	11	-	-	17	3
Calcium	mg/l	-	3.1	-	-	-	-	2.1	-	-	-	-	2	-	-	2.4	3
Carbonate	mg/l	-	< 1	-	-	-	-	< 1	-	-	-	-	< 1	-	-	< 1	2
Hardness	mg/l	-	10	-	-	-	-	0.9	-	-	-	-	6.6	-	-	5.8	3
Hydroxide	mg/l	-	< 1	-	-	-	-	< 1	-	-	-	-	< 1	-	-	< 1	2
Magnesium	mg/l	-	0.67	-	-	-	-	0.4	-	-	-	-	0.38	-	-	0.5	3

Note:
1. Location: Tout Ditch, Alta Irrigation District; water source - Kings River.

TABLE 4-8
SURFACE WATER CHARACTERIZATION (1)
WATER SUPPLY STUDY
CUTLER-OROSI AREA

Parameter	Units	Date 7/6/2006
Alkalinity	mg/l	29
Aluminum	mg/l	0.19
Antimony	ug/l	< 2
Arsenic	ug/l	< 2
Barium	mg/l	< 0.05
Bicarbonate	mg/l	29
Cadmium	ug/l	< 1
Calcium	mg/l	3.1
Carbonate	mg/l	< 1
Chloride	mg/l	< 1
Chromium - Total	ug/l	< 10
Color	units	15
Conductivity (EC)	umho/cm	28
Copper	ug/l	< 50
Cyanide	ug/l	< 20
Fluoride	mg/l	< 0.1
Hardness	mg/l	10
Hydroxide	mg/l	< 1
Iron	mg/l	0.21
Langlier Index		-1.8
Lead	ug/l	< 5
Magnesium	mg/l	0.67
Manganese	mg/l	< 0.01
MBAS (Surfactants)	mg/l	< 0.05
Mercury	ug/l	< 0.4
Nickel	ug/l	< 10
Nitrate	mg/l	< 1
Nitrite	mg/l	< 0.05
Odor	TON	1.0
pH	-	7.5
Potassium	mg/l	< 2
Selenium	ug/l	< 2
Silver	ug/l	< 10
Sodium	mg/l	1.7
Sulfate	mg/l	< 2
Thallium	ug/l	< 1
Total Dissolved Solids	mg/l	32
Turbidity	NTU	2.5
Zinc	mg/l	< 0.05

NOTES:
(1) Samples collected 7/6/06.
Location: Alta Irrigation District, Tout Ditch.
Source: Kings River.

The water quality of the surface water is good and can be considered typical of summer (post-runoff) high Sierra waters. The water has a low turbidity and solids concentrations. The water's alkalinity is also low which may affect the selection of potential treatment options.

Summary

In general, the groundwater quality in the area is relatively good. Existing and future nitrate concentrations present concerns for both districts. DBCP contamination remains a concern to CPUD.

The water quality of the most convenient surface water supply is excellent. The test results do not reveal any constituent warranting special concerns. The water appears suitable for domestic purposes with standard treatment processes.

TREATMENT ALTERNATIVES

The treatment options available to the districts can be divided into two primary categories: groundwater treatment and surface water treatment.

Groundwater Treatment

There are several alternatives available to accomplish groundwater treatment. One option is to blend high nitrate water with low nitrate water originating from a new water source (i.e., new well). Blending is an acceptable nitrate reduction approach to the Department of Health Services. Based upon the existing groundwater quality data, however, it appears unlikely that a suitable blending source (i.e., an additional well) with a sufficiently low nitrate concentration can be identified. Treatment of an existing source would likely be necessary to facilitate a blending alternative.

Ion exchange and reverse osmosis represent two available treatment technologies for removing nitrates from the groundwater. The ion exchange process utilizes a resin specifically designed for removing a target containment. The resin attracts the contaminant and subsequently removes the contaminant from the water by binding with it. Reverse osmosis is a membrane based process in which contaminants are removed under pressure onto a membrane barrier. Treated water permeates the membrane while the contaminants are rejected by the membrane.

Surface Water Treatment

Due to existing and recently enacted regulations governing surface water treatment, the surface water treatment processes available to the districts will need to demonstrate minimum performance standards. Presently, surface water treatment must accomplish 99.9 percent removal of Giardia lamblia and 99.99 percent removal of viruses through filtration and disinfection. Most conventional treatment processes can accomplish these goals through proper design and operation.

Under the LT2ESWTR, monitoring results for cryptosporidium in the source water can require enhanced treatment requirements. Preliminary research into the presence of giardia and cryptosporidium levels in high Sierra Mountain waters have shown them to be present at low levels. For the purposes of this study, a total of 99.99 percent of giardia and cryptosporidium removal must be achieved for surface water supply. The required removal percentage can be achieved using either conventional treatment on alternative treatment processes. Actual giardia and cryptosporidium concentrations will need to be established through monitoring prior to final design of any surface water treatment process.

Conventional filtration and disinfection generally cannot achieve the anticipated giardia/cryptosporidium removal requirements without process and operational enhancements and controls. An alternate disinfectant, such as ultraviolet (UV) light may also be required in combination with chlorine, to reduce the potential for increased disinfection by-products formation.

An alternate treatment process to conventional filtration is the use of membrane filtration. Micro filtration and ultra filtration membranes can achieve up to 99.9999 percent removal of giardia and cryptosporidium. The reason these processes can achieve the higher removal rates is due to the very small pore openings in the membranes of less than 0.1 micron (μm; 1/25,000th of an inch).

GROUNDWATER TREATMENT CONSIDERATIONS

Three methods of groundwater treatment were identified for consideration as an alternative to developing a surface water supply to meet the districts' projected water demands. The purpose of this section is to present preliminary considerations for each method and identify the groundwater treatment method that will be developed in greater detail.

Blending

Blending of different source water supplies is an acceptable nitrate reduction approach to the Department of Health Services. Several drawbacks exist, however, to implement this approach in the Cutler - Orosi area. First, there have not been any low nitrate groundwater sources identified within the districts, as nitrates have been found throughout the local groundwater at various concentrations. In addition, suitable well sites are not readily available.

Blending does not address the presence of nitrates in the groundwater and its effectiveness will be limited to the nitrate levels of the source groundwater. Blending, therefore, will not be considered further as a permanent groundwater treatment method.

Ion Exchange

Ion exchange represents an alternative that removes nitrates from the water supply. The ion exchange process consists of using resins designed specifically to remove nitrates from the water source. During operation, nitrate laden water contacts the resin on which the nitrates are attached through an electrochemical exchange. Once the resin loses its exchange capability, it is recharged by rinsing with a brine solution to remove the nitrates from the resin. The rinseate can be disposed of in the sanitary sewer if the local wastewater treatment facility has the capability and available capacity. Otherwise, other approved means will be necessary.

Ion exchange presents several advantages. First, nitrates are removed through treatment. In general, variable nitrate levels will have little effect on removal efficiencies. In addition, there exists flexibility in treatment capacities to incorporate a blending approach. The primary disadvantage to the ion exchange process is the resin regeneration by-products. Special handling considerations will be necessary if the by-products cannot be discharged to the sewer system and treated at the regional wastewater facilities.

Reverse Osmosis

Reverse osmosis is another treatment technology that is capable of removing nitrates. Reverse osmosis utilizes a membrane to remove contaminants dissolved in the water. The groundwater is fed into a pressurized vessel in which the water is forced through the membrane. Treated water passes through the membrane as the contaminants are retained at the membrane's

surface. The membranes are cleaned periodically to prevent fouling and to maintain their performance.

There are several advantages to reverse osmosis. Nitrates are physically removed from the source water through reverse osmosis. Reverse osmosis will remove other contaminants as well, including dissolved contaminants. Treatment capacities can be adjusted to utilize blending to achieve target nitrate levels, thereby reducing the capital and operational costs of the treatment equipment. There are, however, several disadvantages to a reverse osmosis process. A pretreatment system consisting of ultra-filtration can be required to ensure effective and proper operation of the reverse osmosis process. Due to the complexity of the reverse osmosis process and pretreatment requirements, capital costs are higher when compared to other treatment technologies. Finally, the treatment residuals and associated wastewater may require special handling, including pretreatment, prior to disposal.

For the purpose of this study, the ion exchange process has been selected for detailed consideration as the treatment alternative for nitrate removal from the groundwater. The ion exchange method was selected for the following reasons:

1. The process provides nitrate removal;
2. Blending can be incorporated with the process;
3. The handling of treatment residuals is less problematic due to the selective nature of the resin; and
4. Capital and operational costs for ion exchange will be less than reverse osmosis as a result of a more simplified treatment process.

Surface Water Treatment Considerations

An alternative to groundwater treatment is the use of surface water as a domestic water source. For the purposes of this report and subsequent evaluations, it is assumed that a surface water supply has been identified and can provide an adequate amount of water to meet the districts' water demands.

Surface water treatment will need to be accomplished through a combination of conventional treatment and filtration, membrane filtration and disinfection. Each element has specific considerations that will help formulate the preferred approach for detailed consideration.

Filtration

Conventional treatment and filtration consists of coagulation/flocculation and sedimentation processes followed by single or dual media gravity filters. Chemicals are added during coagulation to improve the settling characteristics of suspended material in the water. The filters are used to remove the very fine suspended material that could not be removed by sedimentation. The primary advantage to this approach is that the process has been proven effective and has been utilized on various surface waters for decades. Design and operation is straightforward. Several disadvantages exist for the conventional treatment process. First, conventional treatment will not achieve the new treatment removal standards as required by the LT2ESWTR without the use of appropriate disinfection practices. Second, the excellent water quality of the proposed surface water supply may prove problematic for efficient conventional treatment processes and result in poor cost effectiveness.

Direct filtration, another surface water treatment process, eliminates the use of the sedimentation process. Untreated surface water flows thrugh the coagulation/flocculation

process and then is applied directly to a single or dual media filter either by gravity or under pressure. Direct filtration is primarily used on high quality surface waters. It is a proven treatment process that greatly simplifies treatment operations. Typically, it is less costly than conventional treatment. Direct filtration does not, however, handle significant water quality variations readily. In addition, there are increased treatment removal standards in the LT2ESWTR which are higher than those established for conventional treatment.

Membrane filtration is a comparatively new treatment process. It is becoming more prevalent due to increased treatment regulations and improving cost competitiveness with other treatment processes. The primary advantage of membrane filtration is that this process can fully achieve the cryptosporidium removal requirements of the LT2ESWTR. The removal credit is established by demonstration testing, certification and operational monitoring. Another advantage to membrane filtration is that the technology configuration is packaged in modular units which provide streamlined construction and expansion. Backwash and treatment residuals can be handled in a similar manner to that of conventional treatment. The primary disadvantage to membrane filtration is that variable water quality can adversely impact membrane performance and operation.

For the purpose of this study, membrane filtration has been selected for detailed development of the filtration element of surface water treatment. The selection of membrane filtration as the treatment method of choice was based on the following reasons:

1. Membrane filtration can provide giardia and cryptosporidium removal levels that meet the LT2ESWTR; and

2. Membrane filtration is modular and components are integrally designed making initial construction and future expansion straightforward.

Disinfection

There are several options available to the districts for consideration of disinfection practices. The options consist of chlorination, chloramination, UV disinfection, ozonation and chlorine dioxide.

Chlorination utilizes chlorine to accomplish disinfection. The process can use gaseous or liquid chlorine or sodium hypochlorite. The districts currently use liquid sodium hypochlorite at each of the individual well site. Chlorine is a strong disinfectant and provides a lasting residual in the water for continued disinfection. Its use, however, produces disinfection by-products (DBPs), especially when used with surface waters. Regulations limiting the DBP levels in drinking water will affect the operational practices for chlorination. Liquid and gaseous chlorine also have special safety and handling requirements.

Chloramination combines chlorine and ammonia to form the disinfectant. Chloramines are a weaker disinfectant than chlorine, but provide a longer lasting residual. A common practice is to utilize chlorine as the primary disinfectant at the treatment plant and then combine with ammonia to provide chloramines within the distribution system for residual disinfection. A concern with the use of chloramines is the potential for the formation of nitrates in the distribution system. Utilizing chloramination disinfection also requires the handling and storage of two chemicals.

Ultra-violet (UV) light disinfection is more common in wastewater treatment. Its use, for drinking water, however, is increasingly becoming more prevalent due to germicidal

effectiveness and the new regulations regarding DBP formation in the distribution systems. UV disinfection consists of utilizing mercury vapor lamps that produce ultraviolet light which destroys disease causing organisms. UV disinfection has several advantages:

1. UV disinfection provides proven disinfectant effectiveness that exceeds the new disinfection/requirements;
2. UV light does not produce DBPs; and
3. There are also several different configurations of UV disinfection available which provide design and operational flexibility.

UV does not, however, provide a residual disinfection in the water supply, and, therefore, requires a second disinfectant to maintain a disinfection residual in the distribution system. Another disadvantage to UV disinfection is that it requires a large amount of power.

Ozonation is a proven water treatment disinfectant. Ozone is produced by directing oxygen gas between dielectric plates to convert oxygen into ozone. Ozone is a strong disinfectant that dissipates rapidly in water, and, like UV, it does not provide a lasting residual. Although ozone does not produce chlorinated DBPs, it may produce ozonated DBPs when treating certain surface waters. Since ozone does not produce a lasting disinfectant residual, an additional disinfectant is typically required. Another disadvantage in using ozone as a disinfection is that ozone production is a complicated process which utilizes highly technical equipment and requires a large amount of power.

Chlorine dioxide is also a proven water treatment disinfection, although its use is not as common as the other disinfectants. Chlorine dioxide is created by mixing chlorine and sodium chlorite. It is a strong disinfectant that does not produce trihalomethane or haloacetic acid DBPs.

Chlorine dioxide does, however, produce other regulated DBPs. In general, the chlorine dioxide process represents complicated operational considerations, although simplified designs are becoming available.

For the purposes of this study, the selected disinfection practices for detailed development will be UV light for use at the water treatment plant and chlorination for the distribution system disinfection. For chlorination, a liquid sodium hypochorite system will be considered. This combination of disinfection methods were selected for the following reasons:

1. UV disinfection can achieve the required disinfection levels without DBP formation;
2. Design and operation of the UV process is straightforward. It does not involve any complex technologies; and
3. Utilizing chlorine in the distribution system maintains the current practice for the existing groundwater wells. There is little likelihood of taste and odor problems resulting from mixing disinfectants.

SECTION 5
TREATMENT PROCESS COMPARISONS
WATER SUPPLY STUDY
CUTLER-OROSI AREA

GENERAL

Based upon projected water demands and existing groundwater quality issues regarding contaminants, the Cutler Public Utility District (CPUD) and the Orosi Public Utility District (OPUD), additional water supply and treatment will be necessary.

Section 4 described the preliminary review of the feasible treatment of options for the districts. Two options have been identified for further development and comparison:

1. Ion exchange for nitrate removal from existing groundwater resources (wells); and
2. Membrane filtration and UV disinfection of surface water.

This section develops each treatment process in greater detail to facilitate evaluation and comparisons.

GROUNDWATER TREATMENT

An ion exchange process to remove nitrate from the districts' existing groundwater supplies represents the most feasible treatment process for groundwater.

Process Description

A typical process schematic for the ion exchange process is shown on Figure 5-1. Ion exchange utilizes engineered resin material to remove the nitrate from the water. High nitrate water flows through treatment vessels that contain resin. The water contacts the resin within the

vessel and flows out of the vessel. Nitrate concentrations in the treated water are very low, typically less than 5 mg/l. The treated water is blended with groundwater to achieve a target nitrate concentration. This blending approach reduces the overall size of the ion exchange process and the quantity of resin per volume of treated water that must be regenerated.

When the resin is no longer removing nitrate as determined by monitoring equipment, the resin must be regenerated. Multiple ion exchange modules are utilized to ensure water production during the resin regeneration process. Resin regeneration consists of pumping a brine solution into the resin modules to remove the nitrates from the resin. The rinseate requires disposal into the sewer or other approved means.

Conceptual Design

The design and configuration of the ion exchange process is straightforward. In general, ion exchange processes are modular package-treatment type systems. Using water quality data, the ion exchange manufacturer sizes and configures equipment to complete an ion exchange system.

The ion exchange process typically includes resin vessels, resin media, distributor and underdrain systems, interconnecting piping, brine make-up system, flow meters, electrical, controls, alarms and appurtenances. The equipment can be skid-mounted to simplify construction. To provide safe year-round access to the equipment and optimal operating conditions, it is proposed that the ion exchange process be installed inside a building structure.

The districts currently use liquid sodium hypochlorite for chlorine disinfection at each of their wells. It is proposed this same type of system be utilized at groundwater treatment locations.

Due to the quantities of brine required to accomplish regeneration and other chemical uses , on-site chemical storage will also be required.

Locations

Each district has unique considerations regarding potential locations for the nitrate removal process. In Cutler, CPUD's inactive wells are located approximately 400 feet apart. CPUD also has set aside a centrally located site for a potential blending project. This site is approximately 900 feet away from the inactive wells. CPUD's active wells (Well Nos. 5 and 6) are within 2,000 feet of the site. Due to the availability of the tentative blending project site, CPUD's ion exchange equipment should be located there. The location is shown in Figure 5-2. A detailed layout of the site is shown in Figure 5-2.

Presently, OPUD has two wells (Well No. 6 and Well No. 9) that are unavailable due to high nitrates. These wells are located on opposite sides of the community. In addition, OPUD's remaining wells are spread throughout the District.

OPUD does not own any property within the central portion of the community that could serve as a treatment system location. Therefore, OPUD's ion exchange treatment process approach will consist of treatment units at each well site for Well Nos. 6 and 9. A typical well site layout is shown in Figure 5-3. Actual site conditions and dimensions will require adjustments to the location of equipment and/or modifications to configuration (design) of the equipment.

Waste Disposal Options

A brine solution is used to regenerate the ion exchange resin. Upon completion of the regeneration process, the nitrate-laden solution must be disposed. Common disposal options are:

1. Discharging to the local sewer for treatment at a wastewater facility;
2. Injection into a deep well;
3. Use of evaporation ponds; and
4. Contract disposal at an approved facility.

The quantity of regeneration rinseate will be a function of nitrate levels, ion exchange resin, process design and flow. Based upon preliminary design concepts proposed by various manufacturers, the regeneration flow could vary between 30,000 gallons per day (gpd) to as high as 76,000 gpd, depending on design and regeneration frequency. Nitrate concentrations in the regeneration byproduct could be as high as 3,300 mg/l. High concentrations of sulfides (1,000 mg/l) and chlorides (10,500 mg/l) will also be present.

Ideally, discharging the regeneration product into the sewer system for subsequent treatment and disposal would represent the solution for handling the ion exchange waste products. The districts however, have discharge limitations established in their respective wastewater ordinances. Pretreatment or dilution prior to discharge will be necessary. Pretreatment to reduce the constituents represents a costly approach as separate processes would be required for each constituent. Dilution of the regeneration product is also not feasible due to the high volume of water needed for blending of the waste product to achieve acceptable discharge concentrations. Sewer discharge of the regeneration product is, therefore, not feasible.

Deep well injection represents another waste disposal approach. This disposal consists of pumping the waste into a deep groundwater aquifer. This approach is not feasible in the Cutler Orosi area since there are no confining soil layers that isolate water bearing layers. This

approach also requires state regulatory approvals. No such disposal practices currently exist in the region.

Evaporation ponds provide another method for regeneration product disposal. This approach consists of storing the water in ponds to allow evaporation. The ponds would be designed with liners to prevent percolation and protect the groundwater. This approach is straightforward, however, a significant amount of land would be required. The size of the ponds would be dependent on waste discharge flow, precipitation and evaporation rates. For a waste discharge of 30,000 gallons per day, approximately 7.5 acres of ponds would be required under normal climatic conditions. Larger ponds would be necessary to accommodate "wet" rainfall years. The ponds would have to be cleaned of solids on an intermittent basis. Due to the high levels of nitrates and other degeneration byproducts, pond design and disposal of pond solids may require special permitting from the Regional Water Quality Control Board.

The last option available to the districts for regeneration product disposal is hauling the product to an appropriate disposal site. This option would consist of temporary storage tanks and contracted handling and disposal. An advantage to this approach is the districts do not have to provide and operate disposal facilities. If contract disposal were utilized, the districts would be responsible for all contract conditions, including fee increases. In general, disposal occurs at large wastewater treatment facilities where small quantities of waste do not impact overall wastewater treatment effectiveness. Since there are few large wastewater facilities nearby, it is likely that the total disposal will be impacted by the transportation fees which reflect the distance to the facility.

Considerations for regeneration disposal present serious drawbacks to the ion exchange process. Evaporation ponds and contract work disposal represent the most feasible approaches. Evaporation ponds provide significant capital cost considerations for an ion exchange approach. Contract waste disposal presents annual cost that need to be considered with an ion exchange approach.

Preliminary Cost

Several manufacturers exist that can provide the ion exchange process equipment. This should provide a situation that keeps equipment costs competitive. Some manufacturers utilize proprietary configuration and/or equipment that will have to be accounted for during the design and bidding phases.

Capital costs for ion exchange treatment processes will include costs for:

- Site/location preparation;
- Ion exchange equipment;
- Building enclosure;
- Piping and appurtenances
- Electrical and controls;
- Monitoring equipment; and
- Resin regeneration waste handling facilities.

The capital cost for CPUD's ion exchange approach represents a centralized location that requires additional pipelines to bring the water to the treatment facility. OPUD's capital costs reflect the need to construct satellite facilities at designated wells. A significant contingency

exists since these approaches were developed without the completion of a detailed design. If an ion exchange process is selected, detailed design would result in more refined costs.

Two cost alternatives for groundwater treatment were developed. One cost alternative incorporates the construction of disposal ponds for the ion exchange regeneration product. This approach will require the identification, acquisition and development of an offsite location and associated delivery system. Table 5-1 summarizes the estimated capital cost to each district for this approach to nitrate removal. CPUD's cost is estimated to total approximately $6.51 million. The cost for a single well in OPUD is estimated to be approximately $7.8 million. Providing nitrate removal at remaining OPUD wells would increase OPUD's capital costs respectively (i.e., two wells will result in two times the capital cost). A significant portion of the capital cost for each district corresponds to the regeneration water disposal ponds. Larger ponds are necessary for OPUD due to larger regeneration volumes resulting from higher nitrate levels in the groundwater.

The second cost alternative for groundwater treatment is to contract with a waste hauler to transport and dispose of the ion exchange regeneration byproduct. Table 5-2 summarizes the estimated capital cost to each district if contractual waste hauling is implemented. The estimated cost to each district is significantly lower than the pond alternative. CPUD's cost is estimated to total approximately $3.46 million. OPUD's project cost is estimated to be approximately $2.65 million. This approach will, however, require annual operational considerations.

Annual costs are comprised of costs that will be incurred on a regular basis. The districts' ion exchange processes will have annual costs related to the following:

- Labor for operations and maintenance;

TABLE 5-1
PRELIMINARY COST ESTIMATE - GROUNDWATER TREATMENT WITH PONDS
WATER SUPPLY STUDY
CUTLER - OROSI AREA

ITEM	DETAILS		AMOUNT CPUD	AMOUNT OPUD (1)
1. Site/Location Preparation			$ 81,250.00	$ 100,000.00
	Fencing, paving, etc			
2. Ion Exchange Equipment				
	Modular, brine regeneration system		$ 325,000.00	$ 400,000.00
	Installation		$ 130,000.00	$ 160,000.00
	Electrical and Controls		$ 97,500.00	$ 120,000.00
3. Water Treatment Plant Building			$ 400,000.00	$ 440,000.00
	Equipment enclosure			
4. Piping and Appurtenances				
	Existing site piping modifications, new piping		$ 75,000.00	$ 75,000.00
	Water supply/delivery pipelines and connections		$ 580,000.00	$ -
5. Electrical and Controls - other equipment, facilities			$ 100,000.00	$ 100,000.00
6. Monitoring Equipment			$ 30,000.00	$ 30,000.00
	Nitrate analyzers			
7. Regeneration Waste Recovery/Handling Facilities			$ 1,930,000.00	$ 3,100,000.00
	Off site locations, Lined evaporation ponds, piping			
	SUBTOTAL		$ 3,748,750.00	$ 4,525,000.00
	Contractor Profit, Bonds and Insurance at 10 %		$ 374,875.00	$ 452,500.00
	Contingency at 20 %		$ 749,750.00	$ 905,000.00
	Inflation at 10 %		$ 374,875.00	$ 452,500.00
	TOTAL CONSTRUCTION COST		$ 5,248,250.00	$ 6,335,000.00
	Engineering	7%	$ 367,400.00	$ 443,500.00
	CEQA, Permits, Preliminary Study	2%	$ 105,000.00	$ 126,700.00
	Legal/Administration	2%	$ 105,000.00	$ 126,700.00
	Inspection, Surveying, Testing	11%	$ 577,300.00	$ 696,900.00
	TOTAL PROJECT COST		$ 6,402,950.00	$ 7,728,800.00

Note:
1. Cost for one well. Additional well(s) will increase cost accordingly.

TABLE 5-2
PRELIMINARY COST ESTIMATE - GROUNDWATER TREATMENT WITH CONTRACT DISPOSAL
WATER SUPPLY STUDY
CUTLER - OROSI AREA

ITEM	DETAILS		AMOUNT CPUD	AMOUNT OPUD (1)
1. Site/Location Preparation			$ 81,250.00	$ 100,000.00
	Fencing, paving, etc			
2. Ion Exchange Equipment				
	Modular, brine regeneration system		$ 325,000.00	$ 400,000.00
	Installation		$ 130,000.00	$ 160,000.00
	Electrical and Controls		$ 97,500.00	$ 120,000.00
3. Water Treatment Plant Building			$ 400,000.00	$ 440,000.00
	Equipment enclosure			
4. Piping and Appurtenances				
	Existing site piping modifications, new piping		$ 75,000.00	$ 75,000.00
	Water supply/delivery pipelines and connections		$ 580,000.00	$ -
5. Electrical and Controls - other equipment, facilities			$ 100,000.00	$ 100,000.00
6. Monitoring Equipment			$ 30,000.00	$ 30,000.00
	Nitrate analyzers			
7. Regeneration Waste Recovery/Handling Facilities			$ 175,000.00	$ 100,000.00
	Storage, pumps and piping			
	SUBTOTAL		$ 1,993,750.00	$ 1,525,000.00
	Contractor Profit, Bonds and Insurance at 10 %		$ 199,375.00	$ 152,500.00
	Contingency at 20 %		$ 398,750.00	$ 305,000.00
	Inflation at 10 %		$ 199,375.00	$ 152,500.00
	TOTAL CONSTRUCTION COST		$ 2,791,250.00	$ 2,135,000.00
	Engineering	7%	$ 195,400.00	$ 149,500.00
	CEQA, Permits, Preliminary Study	2%	$ 55,800.00	$ 42,700.00
	Legal/Administration	2%	$ 55,800.00	$ 42,700.00
	Inspection, Surveying, Testing	11%	$ 307,000.00	$ 234,900.00
	TOTAL PROJECT COST		$ 3,405,250.00	$ 2,604,800.00

Note:
1. Cost for one well. Additional well(s) will increase cost accordingly.

- Chemicals;
- Electrical cost for pumping and equipment; and
- Storage, handling and disposal of waste products.

Operations and maintenance costs consist of the costs associated with the districts' efforts to utilize the process. Costs associated with the storage, handling and disposal of the ion exchange process' waste products will vary depending on the method. Contract disposal of the ion exchange waste will have very routine costs. Evaporation ponds will have intermittent costs as ponds are cleaned and the residuals need disposal. The estimated annual costs to the districts for an ion exchange process are summarized in Tables 5-3 and 5-4.

Table 5-3 summarizes the projected annual operations and maintenance costs for CPUD. Brine and pumping costs represent the largest portions of the annual cost. The high annual cost represents a serious concern regarding ion exchange as a water supply alternative. Contractual disposal of the waste products is not feasible due to its extremely high cost.

Table 5-4 summarizes the projected annual operations and maintenance costs for OPUD. The brine costs represent the largest portion of the annual cost. This situation results from the frequent regeneration of the ion exchange media due to the high nitrate concentrations of OPUD's groundwater supply. As with CPUD, the high annual cost for OPUD's ion exchange alternative is a serious concern to the viability of this alternative. Contract disposal of the regeneration waste product is also not feasible for OPUD.

The total cost for groundwater treatment is summarized in Table 5-5. Table 5-5 provides the costs for each waste disposal alternative for each district. Since the water demand projections utilized a duration of twenty years , the present worth of each district's annual costs have also

TABLE 5-3
ANNUAL OPERATIONS AND MAINTANCE COST - GROUNDWATER TREATMENT FOR CPUD
WATER SUPPLY STUDY
CUTLER-OROSI AREA

CUTLER PUBLIC UTILITY DISTRICT - 1,200 g.p.m. ion exchange system, single location.

COST CATEGORY	DESCRIPTION	AMOUNT	UNITS	UNIT COST ($/unit)	TOTAL COST	NOTES
LABOR						
	Routine operations	520	hrs/yr	$ 40.00	$ 20,800.00	Higher operational certification required.
	Regeneration monitorin	416	hrs/yr	$ 40.00	$ 16,600.00	Higher operational certification required.
CHEMICALS AND MATERIALS						
	Brine Cost	2,500,000	lbs/yr	$ 0.05	$ 125,000.00	
	Chlorine	3,650	gal/yr	$ 0.75	$ 2,737.50	Liquid chlorine (hypochlorite) proposed.
	Resin Replacement	60	cf/yr	$ 150.00	$ 9,000.00	Resin replaced once every five years.
	Misc. Materials		Lump Sum		$ 20,510.63	
ELECTRICAL						
	Pumping	90	hp	$ 0.15	$ 88,200.00	Wells back on-line. 24 hour operation.
	Equipment	48	kW-hr/day	$ 0.15	$ 17,500.00	
	Misc. Power	6	kW-hr/day	$ 0.15	$ 2,200.00	
ANNUAL OPERATIONS AND MAINTENANCE COST					$ 302,548.13	Cost for onsite disposal of waste products.
	Additional Cost for Waste Disposal:					
	Transportation	18,500,000	gal/yr	$ 0.15	$ 2,775,000.00	Contractual disposal of waste products if on site disposal not utiltized.

TABLE 5-4
ANNUAL OPERATIONS AND MAINTANCE COST - GROUNDWATER TREATMENT FOR OPUD
WATER SUPPLY STUDY
CUTLER-OROSI AREA

OROSI PUBLIC UTILITY DISTRICT - 400 g.p.m., single well site.

COST CATEGORY	DESCRIPTION	AMOUNT	UNITS	UNIT COST ($/unit)	TOTAL COST	NOTES
LABOR						
	Routine operations	260	hrs/yr	$ 40.00	$ 10,400.00	Higher operational certification required.
	Regeneration monitoring	416	hrs/yr	$ 40.00	$ 16,600.00	Higher operational certification required.
CHEMICALS AND MATERIALS						
	Brine Cost	9,900,000	lbs/yr	$ 0.05	$ 495,000.00	
	Chlorine	2,600	gal/yr	$ 0.75	$ 1,950.00	Liquid chlorine (hypochlorite) proposed.
	Resin Replacement	60	cf/yr	$ 150.00	$ 9,000.00	Resin replaced once every five years.
	Misc. Materials		Lump Sum		$ 75,892.50	
ELECTRICAL						
	Pumping	35	hp	$ 0.15	$ 34,300.00	Wells back on-line. 24 hour operation.
	Equipment	24	kW-hr/day	$ 0.15	$ 8,800.00	
	Misc. Power	3	kW-hr/day	$ 0.15	$ 1,100.00	
ANNUAL OPERATIONS AND MAINTENANCE COST					$ 653,042.50	Cost for onsite disposal of waste products.
	Additional Cost for Waste Disposal:					
	Transportation	34,500,000	gal/yr	$ 0.15	$ 5,175,000.00	Contractual disposal of waste products if on site disposal not utiltized.

TABLE 5-5
SUMMARY OF PRELIMINARY COST ANALYSES - GROUNDWATER TREATMENT
WATER SUPPLY STUDY
CUTLER-OROSI AREA

	CPUD		OPUD (one well)	
	with ponds	w/o ponds	with ponds	w/o ponds
PROJECT COST	$ 6,403,000	$ 3,405,300	$ 7,728,800	$ 2,604,800
ANNUAL OPERATIONS COST	$ 302,500	$ 3,077,500	$ 653,000	$ 5,828,000
Present Worth of Annual Cost 6 % interest; term of 20 years	$3,469,700	$35,298,700	$7,489,900	$66,846,700
TOTAL COST (per District)	$ 9,872,700	$ 38,704,000	$ 15,218,700	$ 69,451,500

	TOTAL CUTLER-OROSI AREA COST	
	with waste disposal ponds	utilizing contractual waste disposal
TOTAL CAPITAL COST	$14,131,800	$6,010,100
PRESENT WORTH OF ANNUAL COST	$10,959,600	$102,145,400
TOTAL COST TO CUTLER-OROSI AREA	$25,091,400	$108,155,500

been compiled. The present worth of the contractual disposal of work products further demonstrates the economic infeasibility of this approach for each district.

Subsequently, the most cost effective approach regarding ion exchange for groundwater treatment is to construct local disposal ponds. The total capital cost to provide groundwater treatment and meet the projected water needs is approximately $14.3 million. The overall present worth of this project is about $25.1 million.

SURFACE WATER TREATMENT

Based upon preliminary considerations regarding surface water treatment technologies and processes, membrane filtration followed by ultra-violet (UV) light disinfection presents the best approach.

Process Description

A typical process schematic for the surface water treatment system is shown on Figure 5-4. The primary elements of this approach are membrane filters and UV disinfection components. The membranes will consist of hollow membrane material with pore sizes between $1x10^{-4}$ and $1x10^{-6}$ meter in diameter. Water is forced through the pores. The membranes effectively remove Giardia cysts and cryptosporidium oocysts. Particulates are trapped on the membrane's surface until removed by backwashing.

The membrane process utilizes two backwash modes. The most frequently utilized mode is a standard backwash procedure where water and air are used to scour the surface of the membrane to clean the membrane surface. Periodically, the membrane process needs to undergo an in-place cleaning with weak chemical cleaning solutions. Due to the extent of equipment

functions, the membrane process generally operates automatically; manual operation, however, is possible.

After filtration, the treated water will be subjected to UV light to accomplish the necessary degree of disinfection. UV light is a very effective disinfectant. It does not, however, provide any disinfectant residual to be carried throughout the water distribution system. Since the districts utilize chlorine for disinfection of the groundwater, a chlorination system for the distribution system is also necessary.

Location

Several considerations exist regarding potential locations for the surface water treatment facility. Surface water sources in the vicinity are the Kings River and the Friant-Kern Canal. The Friant-Kern Canal represents the closest source; it is approximately 4 miles from Orosi. Irrigation canals bring Kings River water close to the Orosi and Cutler communities. These canals, however, experience local discharges that may significantly alter the water quality. A pipeline to bring Kings River water from Wahtoke Lake would be approximately 13 miles and therefore, cost prohibitive.

Conceptual Design

The surface water treatment approach consists of several components including:

- Intake structure and pump station;
- Transmission pipeline;
- Membrane treatment process;
- UV disinfection system;
- Chlorination system; and

- Treated water storage tank and pump station.

Preliminary design considerations are discussed below.

The Friant-Kern Canal (FKC) represents the closest source of surface water. The distance from the FKC to the districts ranges from 2 to 4 miles. A turnout structure at the FKC would consist of a wet well, vertical turbine pumps and fine mesh screens to prevent debris from entering the turnout structure and damaging the pumps. For 2 MGD, approximately 70 horsepower (hp) pumps and a 15-inch diameter pipeline will be necessary. Multiple pump and/or control arrangements are feasible to provide incremental water supply needs. Refined pumping arrangements can be developed during detailed design. Flow by gravity from the FKC may be possible which would reduce the project cost.

The design and configuration of surface water treatment elements of this approach is straightforward. A general site plan for the surface water facilities is shown on Figure 5-5. A detailed layout of this treatment components is shown on Figure 5-6.

Membrane filters processes are modular units that are packaged with the necessary components and controls. Several options exist regarding membrane process configurations depending on membrane pore size, flow and pressure orientation. Ultra-filtration membranes represent a smaller pore size than micro-filtration membranes and, therefore, a more stringent barrier. Ultra-filtration membranes should be utilized in the treatment process to provide a higher level of removal credit. Membrane systems are configured to operate under pressure or vacuum. Typically, membrane flow and pressure conditions are associated with manufacturer membrane designs which can be determined during detailed design.

Based upon water quality, the raw surface water can be fed directly to the membranes. To increase the capability of the membranes under more variable water conditions, pretreatment

elements of coagulation/flocculation and sedimentation can be considered.

Backwash water can be considered typical of residuals originating from conventional under treatment plants. Generally, backwash water has high concentrations of solids. Backwash water will be recovered in on-site ponds for evaporation and percolation. Due to chemical addition, the cleaned-in-place (CIP) backwash rinseate will be neutralized prior to disposal. It is proposed that small lined evaporation ponds be constructed to handle the neutralized CIP waste.

Several configurations exist for UV disinfection. Drinking water applications typically utilize closed-pipe systems that tie directly into treated water piping. UV lamps are positioned inside special pipe fittings. The number of lamps to accomplish disinfection will be established by the treated water quality.

A chlorination system will be necessary to provide a disinfectant residual in the distribution system. Based upon a chlorine dose of 2 mg/l, approximately 33 pounds of chlorine will be required daily to treat 2 MGD. Approximately 1,000 pounds of chlorine is needed to provide 30 days supply. A gaseous chlorine system is recommended due to the significant volume of liquid chlorine (hypochlorite) necessary to provide an equivalent amount of chlorine. Risk management issues can be anticipated and addressed during detail design.

Preliminary Cost

The capital cost to provide a surface water treatment approach will consist of the following costs:

- intake structure and pump station;
- transmission pipeline;
- site/location preparation;

- membrane treatment process;
- UV disinfection process;
- chlorination system;
- building;
- water storage tank and pump stations;
- membrane residual recovery ponds;
- standby generator; and
- delivery system/distribution system piping.

Most, if not all, of the components of surface water treatment plan are represented by multiple manufacturers. Several manufacturers exist for the membrane process and UV disinfection equipment which should provide a cost-competitive situation. These processes, however, can include proprietary features that will need to be addressed during detailed design and project bidding.

Table 5-6 summaries the estimated capital cost for surface water treatment. The project cost is estimated to be approximately $17.4 million.

A surface water treatment plant presents several annual (recurring) cost considerations. Annual operations and maintenance costs will be associated with the following:

- labor;
- chemicals and materials; and
- electrical costs for treatment processes and pumping.

Since the districts do not own surface water rights, the water supply for the facility will need to be purchased. This cost of water represents an additional annual cost.

TABLE 5-6
PRELIMINARY COST ESTIMATE - SURFACE WATER TREATMENT
WATER SUPPLY STUDY
CUTLER - OROSI AREA

ITEM	DETAILS		AMOUNT
1.	Intake Structure and Pump Station		$ 280,000.00
	Pumps, Screens, Structure, Modifications		
2.	Transmission Pipeline		$ 1,500,000.00
	15-inch diameter, 4 miles long		
3.	Water Treatment Plant Site		
	Land Purchase - 10 acres		$ 200,000.00
	Sitework; preparation (fencing, paving, etc.)		$ 350,000.00
4.	Membrane Treatment Process		
	2 MGD, modular, clean in place process		$ 1,300,000.00
	Installation		$ 520,000.00
	Electrical and Controls		$ 400,000.00
5.	UV Disinfection System		
	2 MGD		$ 250,000.00
	Installation		$ 100,000.00
	Electrical and Controls		$ 75,000.00
6.	Chlorination System - For Distribution System		$ 100,000.00
	Additional chemical processes, treatment appurtenances		
7.	Water Treatment Plant Building		$ 720,000.00
	Equipment enclosure, lab area		
8.	Treated Water Storage Tank and Pump Station		$ 3,000,000.00
9.	Backwash Recovery Ponds		
	Ponds - (2) one acre ponds, (2) 2,200 sf ponds, piping		$ 125,000.00
10.	Standby Generator and Automatic Transfer Switch		$ 100,000.00
11.	Distribution System Piping		$ 1,000,000.00
	SUBTOTAL		$ 10,020,000.00
	Contractor Profit, Bonds and Insurance at 10 %		$ 1,002,000.00
	Contingency at 20 %		$ 2,004,000.00
	Inflation at 10 %		$ 1,002,000.00
	TOTAL CONSTRUCTION COST		$ 14,028,000.00
	Engineering	7%	$ 982,000.00
	CEQA, Permits, Preliminary Study	2%	$ 280,600.00
	Legal/Administration	2%	$ 280,600.00
	Inspection, Surveying, Testing	11%	$ 1,543,100.00
	TOTAL PROJECT COST		$ 17,114,300.00

Table 5-7 summarizes the anticipated annual costs for surface water treatment. Purchasing the new water represents the largest cost due to its local importance and availability. Electrical costs represents the single largest operational cost consideration, primarily due to pumping requirements.

The total cost for surface water treatment is summarized in Table 5-8. Table 5-8 also provides each districts' cost share proportioned according to each districts' water demands. Table 5-8 also presents the present worth of the annual costs over a project duration of 20 years. The total present worth of this potential project is about $22.8 million.

COMPARISON

Ion exchange for groundwater treatment and membrane filtration for surface water treatment represent two very different approaches to address projected water needs in the Cutler - Orosi area. Common considerations exist to each water supply approach. Each treatment approach will require an increased level of operator certification due to the advanced levels of the treatment processes. Also, most of the treatment components are modular which will facilitate faster construction and incremental treatment capacities if desired.

Table 5-9 summarizes the advantages and disadvantages to each approach. Table 5-10 provides a comparison of the potential project costs for each treatment approach.

Groundwater treatment presents the lowest capital cost which results from having existing well sites and fewer disinfection process requirements. A suitable site for surface water treatment facility has not been established. Locations for ion exchange waste disposal ponds, however, also need to be identified.

TABLE 5-7
ANNUAL OPERATIONS AND MAINTANCE COST - SURFACE WATER TREATMENT PLANT
WATER SUPPLY STUDY
CUTLER-OROSI AREA

COST CATEGORY	DESCRIPTION	AMOUNT	UNITS	UNIT COST ($/unit)	TOTAL COST	NOTES
LABOR						
	Routine operations	1,040	hrs/yr	$ 40.00	$ 41,600.00	Higher operational certification required.
	CIP monitoring	416	hrs/yr	$ 40.00	$ 16,600.00	Higher operational certification required.
CHEMICALS AND MATERIALS						
	CIP Process					
	Citric Acid	4,200	lbs/yr	$ 0.50	$ 2,100.00	Acid wash step
	Sodium Hydroxide	1,100	lbs/yr	$ 0.85	$ 935.00	Caustic clean step, acid neutralization.
	Hydrochloric Acid	800	lbs/yr	$ 0.20	$ 160.00	Caustic neutralization.
	Sodium Hypochlorite	2,900	lbs/yr	$ 0.75	$ 2,175.00	Chlorination cleaning, includes amount for dechlorination.
	Chlorine - Disinfection	12,200	lbs/yr	$ 0.75	$ 9,150.00	Gas chlorine proposed due to quantities.
	Misc. Materials		Lump Sum		$ 2,200.00	
ELECTRICAL						
	Pumping - Supply	70	hp	$ 0.15	$ 68,600.00	Supply to WTP. 24 hour operation.
	Backwash Process	25,000	kW-hr/yr	$ 0.15	$ 3,750.00	
	CIP Process	3,800	kW-hr/yr	$ 0.15	$ 570.00	One CIP per unit, per month.
	UV Disinfection	130,000	kW-hr/yr	$ 0.15	$ 19,500.00	24 hour operation.
	Misc. Equipment Power	8,000	kW-hr/yr	$ 0.15	$ 1,200.00	
	Pumping - Delivery	40	hp	$ 0.15	$ 39,200.00	
ANNUAL OPERATIONS AND MAINTENANCE COST					$ 207,740.00	Cost for onsite disposal of waste products.
	Annual Cost of Water	2,300	ac-ft/yr	$ 120.00	$ 276,000.00	
TOTAL ANNUAL COST					$ 483,740.00	

TABLE 5-8
SUMMARY OF PRELIMINARY COST ANALYSES - SURFACE WATER TREATMENT
WATER SUPPLY STUDY
CUTLER-OROSI AREA

		TOTAL COST		DISTRICT SHARE (1) CPUD 70%		DISTRICT SHARE (1) OPUD 30%
PROJECT COST	$	17,114,300	$	11,980,010	$	5,134,290
ANNUAL OPERATIONS COST	$	483,740	$	338,618	$	145,122
Present Worth of Annual Cost 6 % interest; term of 20 years	$	5,548,500	$	3,883,950	$	1,664,550
TOTAL COST	$	22,662,800	$	15,863,960	$	6,798,840

Note:

1. Based upon 2 MGD total flow; 1.4 MGD - CPUD, 0.6 MGD - OPUD.

TABLE 5-9
SUMMARY OF ADVANTAGE AND DISADVANTAGES
WATER SUPPLY STUDY
CUTLER-OROSI AREA

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
Groundwater Treatment	Lowest capital cost Nitrate removal recaptures existing water supply Modular components streamline installation schedule	Highest overall cost Highest annual operations and maintenance costs Multiple locations necessary Waste disposal locations needed; unable to site with ion exchange equipment Well sites may affect ion exchange configuration Increased level of operator certification required Variable water quality in area may affect other wells
Surface water treatment	Lowest overall cost Lowest annual operations maintenance costs Single location needed; fewer operators/hours necessary Provides reliable water supply Modular components can support phased implementation Reduces need for groundwater pumping and subsequent overdraft conditions. Minimal water quality concerns	Highest capital cost No existing rights to surface water supply Final location not yet identified Risk management requirements for gaseous chlorine system Increased level of operator certification required Increased regulatory requirements

TABLE 5-10
COMPARISON OF PRELIMINARY COST ANALYSES
WATER SUPPLY STUDY
CUTLER-OROSI AREA

		GW TREATMENT TOTAL COST		SW TREATMENT TOTAL COST
PROJECT COST	$	14,131,800	$	17,114,300
ANNUAL OPERATIONS COST	$	955,500	$	483,740
Present Worth of Annual Cost 6 % interest; term of 20 years	$	10,959,600	$	5,548,500
TOTAL COST	$	25,091,400	$	22,662,800

The primary advantage to groundwater treatment is that this approach represents the lowest capital cost. Lower costs result from utilizing available well sites and small capacity disinfection systems. Groundwater treatment recaptures existing nitrate laden groundwater supplies. Finally, ion exchange processes are modular packaged units which would streamline implementation.

Groundwater treatment, however, presents several significant disadvantages. This approach result in the highest annual operations and maintenance costs due to chemical (brine) costs associated with resin regeneration. Additional man-hours are also required to monitor multiple locations. Disposal of the ion exchange regeneration by-products will require separate, offsite disposal facilities. Suitable locations for the necessary evaporation ponds have not been identified and may be a considerable distance from the well sites. Finally, nitrate levels in the groundwater have increased and have shown a significant amount of variability in the Cutler - Orosi area. Operational costs will increase as a result of continued increase in nitrate levels and subsequent treatment of the groundwater. Additional wells in the area may also be lost in the future to high nitrate levels, resulting in an additional water quantity that will require nitrate removal. Finally, other contaminants, such as DBCP will require additional treatment processes for removal.

Utilizing surface water provides several advantages to the Cutler - Orosi area. This approach represents the lowest overall cost over the 20-year water demand projection. Although surface water treatment has a high initial cost, the annual operations and maintenance costs are significantly lower than those for groundwater treatment. Lower annual costs result from man-hours necessary for a single treatment facility and lower chemical costs. An additional advantage

is that surface water is a reliable water source, if sufficient water rights are obtained. There are no known water quality concerns with the surface waters available to the region. Some water quality variation may be experienced due to storm water runoff. Finally, utilizing surface water reduces the area's use and dependence on the existing groundwater ,subsequently resulting in a reduction in groundwater overdraft conditions.

The most significant disadvantages to surface water treatment are the lack of existing surface water rights and location of the treatment facilities. First, the districts do not presently own any permanent or temporary rights to any quantity of surface water. Permanent rights would be required to ensure a reliable water supply. Purchasing the water for treatment represents over half of the estimated annual costs of the surface water approach. Second, a suitable location for the surface water treatment facilities has not been identified or established. Ideal locations exist, however, the availability of such locations has not been pursued.

An additional disadvantage to surface water treatment is the increased regulatory requirements associated with drinking water treatment. Increase treatment requirements, however, are addressed through the use of the membrane and UV disinfection systems. Chemical handling requirements associated with chlorination can be addressed through risk management plan measures.

CONCLUSION

If a surface water supply can be identified and secured by the districts, the surface water treatment approach represents the most economical and beneficial project. The conclusion is based upon the following:

- lowest total potential project cost;
- lowest estimate annual operations and maintenance cost;
- modular components allowed for phased implementation;
- single location;
- consistent water quality; and
- provides regional groundwater benefits.

The acquisition of surface water represents a significant issue to using surface water treatment to meet the projected water needs. The Friant-Kern Canal represents the closest surface water source for the districts. The Friant-Kern Canal is taken out of service every three years, however, which may require the use of Alta Irrigation District's (AID) water delivery canals. Since AID's canals travel through more developed areas, including the Cutler-Orosi area and receive storm water flow, increased water quality monitoring may be required.

The remaining disadvantages/obstacles to the surface water treatment approach can be addressed through detailed planning and design considerations.

Funding sources and programs have not been identified. Table 5-11 summarizes various funding scenarios for the surface water treatment approach. The funding scenarios represent common conditions of various funding programs. The funding terms directly impact the costs to the districts and their respective customers.

Table 5-11 also presents each district's respective share of overall project costs based upon water demands. CPUD's cost share is significantly greater than OPUD's cost share due to its greater water demand from the project facilities.

TABLE 5-11
FUNDING SCENARIOS - PROPORTIONAL COST SHARE PER DISTRICT (1)
WATER SUPPLY STUDY
CUTLER-OROSI AREA

AMOUNTS	SCENARIO					
	50% Grant / 50% Loan		75% Grant / 25% Loan		75% Grant / 25% Loan	
	Conditions	Amount	Conditions	Amount	Conditions	Amount
Project Cost (2)		$ 17,114,300.00		$ 17,114,300.00		$ 17,114,300.00
Grant Amount	50%	$ 8,557,150.00	75%	$ 12,835,725.00	75%	$ 12,835,725.00
Loan Amount	50%	$ 8,557,150.00	25%	$ 4,278,575.00	25%	$ 4,278,575.00
Annual Repayment Amount (rounded)		$ 465,000.00		$ 232,500.00		$ 171,100.00
Payment term (years)	40		40		25	
Interest Rate	4.50%		4.50%		0.00%	
Required Reserve Amount (Percent)	10%	$ 46,500.00	10%	$ 23,250.00	10%	$ 17,110.00
TOTAL ANNUAL REPAYMENT AMOUNT		$ 511,500.00		$ 255,750.00		$ 188,210.00
Total Monthly Amount		$ 42,625.00		$ 21,312.50		$ 15,684.17
Cutler Public Utility District	70%	$ 29,837.50		$ 14,918.75		$ 10,978.92
Cost Per Connection	1,102	$ 27.08		$ 13.54		$ 9.96
Orosi Public Utility District	30%	$ 12,787.50		$ 6,393.75		$ 4,705.25
Cost Per Connection	1,645	$ 7.77		$ 3.89		$ 2.86

Note:
(1) District share based upon water demand. Reference Table 3-5.
(2) Surface water treatment approach. See Table 5-6 for cost development.

As an alternative to funding the project cost according to each district's water demand, the potential project could be funded equally between the districts. This funding alternative is presented in Table 5-12. This approach would result in additional capacity for OPUD in the surface water treatment plant and subsequent reduce CPUD's share in the surface water treatment plant. CPUD's firm water supply would be reduced by utilizing this approach. Additional water capacity would need to be purchased from OPUD when needed by CPUD to meet projected water demands.

TABLE 5-12
FUNDING SCENARIOS - EQUAL COST SHARE PER DISTRICT (1)
WATER SUPPLY STUDY
CUTLER-OROSI AREA

AMOUNTS	SCENARIO					
	50% Grant / 50% Loan		75% Grant / 25% Loan		75% Grant / 25% Loan	
	Conditions	Amount	Conditions	Amount	Conditions	Amount
Project Cost (2)		$ 17,114,300.00		$ 17,114,300.00		$ 17,114,300.00
Grant Amount	50%	$ 8,557,150.00	75%	$ 12,835,725.00	75%	$ 12,835,725.00
Loan Amount	50%	$ 8,557,150.00	25%	$ 4,278,575.00	25%	$ 4,278,575.00
Annual Repayment Amount (rounded)		$ 465,000.00		$ 232,500.00		$ 171,100.00
Payment term (years)	40		40		25	
Interest Rate	4.50%		4.50%		0.00%	
Required Reserve Amount (Percent)	10%	$ 46,500.00	10%	$ 23,250.00	10%	$ 17,110.00
TOTAL ANNUAL REPAYMENT AMOUNT		$ 511,500.00		$ 255,750.00		$ 188,210.00
Total Monthly Amount		$ 42,625.00		$ 21,312.50		$ 15,684.17
Cutler Public Utility District	50%	$ 21,312.50		$ 10,656.25		$ 7,842.08
Cost Per Connection	1,102	$ 19.34		$ 9.67		$ 7.12
Orosi Public Utility District	50%	$ 21,312.50		$ 10,656.25		$ 7,842.08
Cost Per Connection	1,645	$ 12.96		$ 6.48		$ 4.77

Note:
(1) Project cost divided equal between district without consideration of actual water demand.
(2) Surface water treatment approach. See Table 5-6 for cost development.

TABLE 5-13
TOTAL MONTHLY COST PER CONNECTION - PROPORTIONAL COST SHARE PER DISTRICT (1)
WATER SUPPLY STUDY
CUTLER-OROSI AREA

AMOUNTS (2)	SCENARIO					
	50% Grant / 50% Loan		75% Grant / 25% Loan		75% Grant / 25% Loan	
	Conditions	Amount	Conditions	Amount	Conditions	Amount
Total Annual Debt Service Cost (3)		$ 511,500.00		$ 255,750.00		$ 188,210.00
Total Annual Operations and Maintenance Cost (4)		$ 483,740.00		$ 483,740.00		$ 483,740.00
Total Annual Cost		$ 995,240.00		$ 739,490.00		$ 671,950.00
Total Monthly Amount		$ 82,936.67		$ 61,624.17		$ 55,995.83
Cutler Public Utility District	70%	$ 58,055.67	70%	$ 43,136.92	70%	$ 39,197.08
Cost Per Connection	1,102	$ 52.68	1,102	$ 39.14	1,102	$ 35.57
Debt Service		$ 27.08		$ 13.54		$ 9.96
O&M		$ 25.61		$ 25.61		$ 25.61
Orosi Public Utility District	30%	$ 24,881.00	30%	$ 18,487.25	30%	$ 16,798.75
Cost Per Connection	1,645	$ 15.13	1,645	$ 11.24	1,645	$ 10.21
Debt Service		$ 7.77		$ 3.89		$ 2.86
O&M		$ 7.35		$ 7.35		$ 7.35

Note:
(1) District share based upon water demand. Reference Table 3-5.
(2) Surface water treatment approach.
(3) See Table 5-11 for cost development.
(4) O&M cost reflects surface water treatment approach only. See Table 5-7 for development.
Does not include existing O&M cost for groundwater well operation.

TABLE 5-14
TOTAL MONTHLY COST PER CONNECTION - PROPORTIONAL COST SHARE PER DISTRICT (1)
WATER SUPPLY STUDY
CUTLER-OROSI AREA

AMOUNTS (2)	SCENARIO					
	50% Grant / 50% Loan		75% Grant / 25% Loan		75% Grant / 25% Loan	
	Conditions	Amount	Conditions	Amount	Conditions	Amount
Total Annual Debt Service Cost (3)		$ 511,500.00		$ 255,750.00		$ 188,210.00
Total Annual Operations and Maintenance Cost (4)		$ 483,740.00		$ 483,740.00		$ 483,740.00
Total Annual Cost		$ 995,240.00		$ 739,490.00		$ 671,950.00
Total Monthly Amount		$ 82,936.67		$ 61,624.17		$ 55,995.83
Cutler Public Utility District	50%	$ 41,468.33	50%	$ 30,812.08	50%	$ 27,997.92
Cost Per Connection	1,102	$ 37.63	1,102	$ 27.96	1,102	$ 25.41
Debt Service		$ 19.34		$ 9.67		$ 7.12
O&M		$ 18.29		$ 18.29		$ 18.29
Orosi Public Utility District	50%	$ 41,468.33	50%	$ 30,812.08	50%	$ 27,997.92
Cost Per Connection	1,645	$ 25.21	1,645	$ 18.73	1,645	$ 17.02
Debt Service		$ 12.96		$ 6.48		$ 4.77
O&M		$ 12.25		$ 12.25		$ 12.25

Note:
(1) District share based upon water demand. Reference Table 3-5.
(2) Surface water treatment approach.
(3) See Table 5-12 for cost development.
(4) O&M cost reflects surface water treatment approach only. See Table 5-7 for development.
Does not include existing O&M cost for groundwater well operation.

TABLE
PROJECTED WATER CONNECTION FEES
WATER SUPPLY STUDY
CUTLER-OROSI AREA

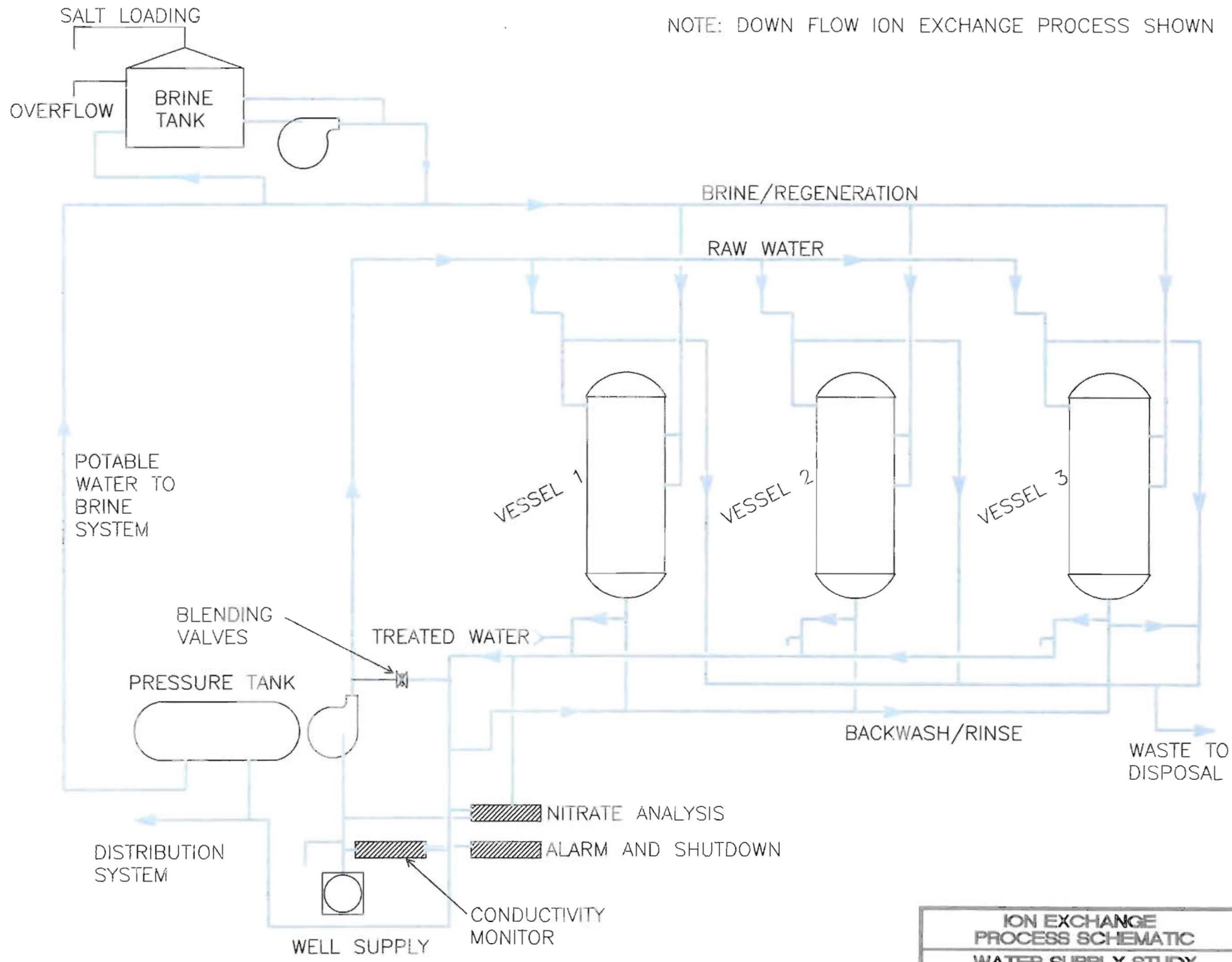
Total Project Cost $ 17,114,300.00

	CPUD	OPUD
Scenario	70%	30%
Water Capacity (MGD)	1.40	0.60
Water Use (gpcd)	205	150
Population Served by Water Capacity (persons)	6,829	2,927
Population per Existing Connection (1)	4.4	5.5
Available Connections	1,552	532
Total Project Cost Share	$ 11,980,010.00	$ 5,134,290.00
Cost per Connection (Connection Fee)	$ 7,718.55	$ 9,648.19

Note:
1. Based upon the number of connections and estimated 2007 population

	CPUD	OPUD
Number of Connections	1102	1645
Estimated Population	4815	9000
Population per Connection	4.4	5.5

FIGURE 5-1



Source: National Drinking Water Clearinghouse Ion Exchange and Demineralization fact sheet.

ION EXCHANGE PROCESS SCHEMATIC

WATER SUPPLY STUDY

CUTLER-OROSI AREA

KELLER/WEGLEY

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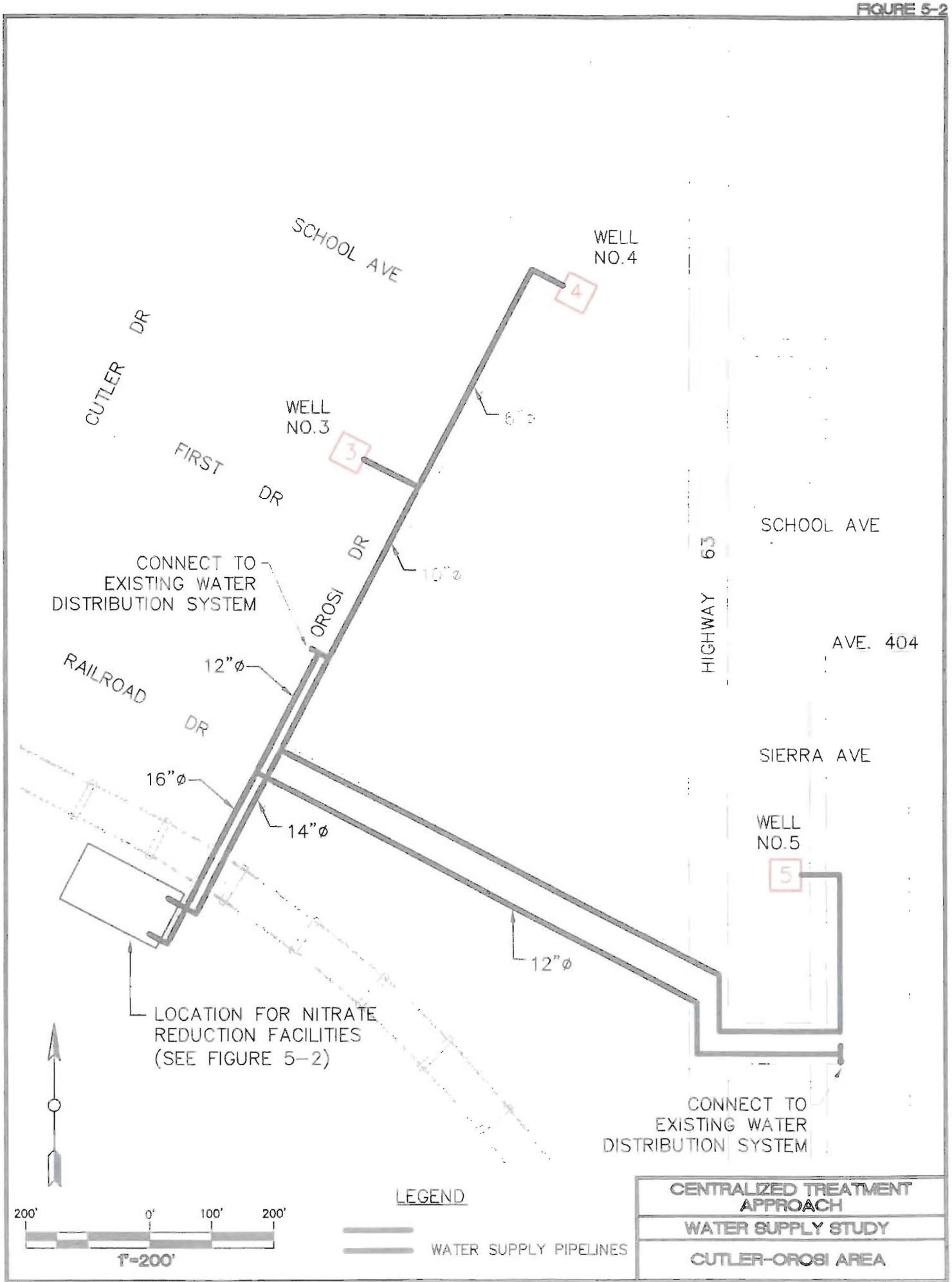
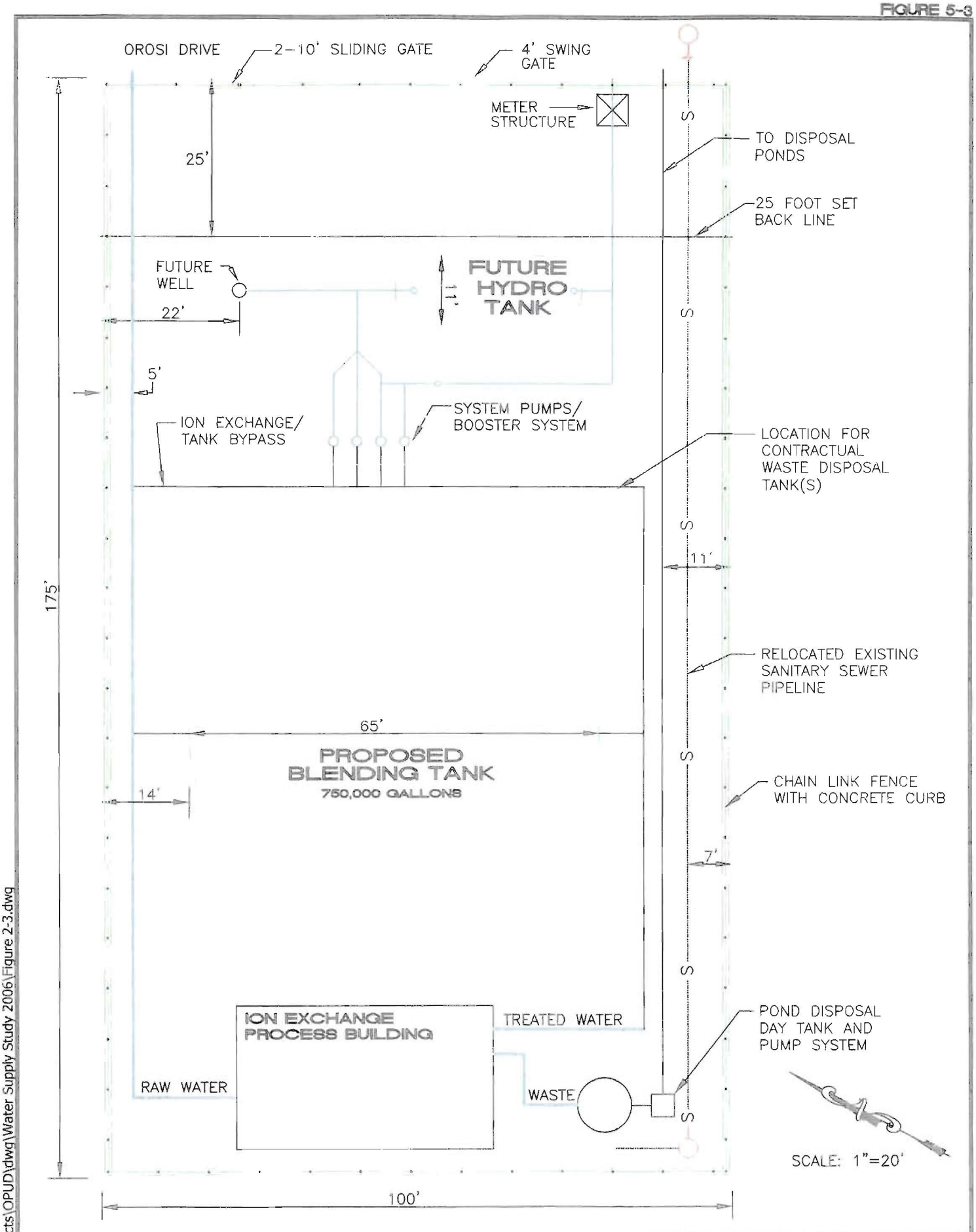
FIGURE 5-2



KELLER/WEGLEY

FIGURE 5-3



CPUD ION EXCHANGE LOCATION
WATER SUPPLY STUDY
CUTLER-OROSI AREA

KELLER/WEGLEY

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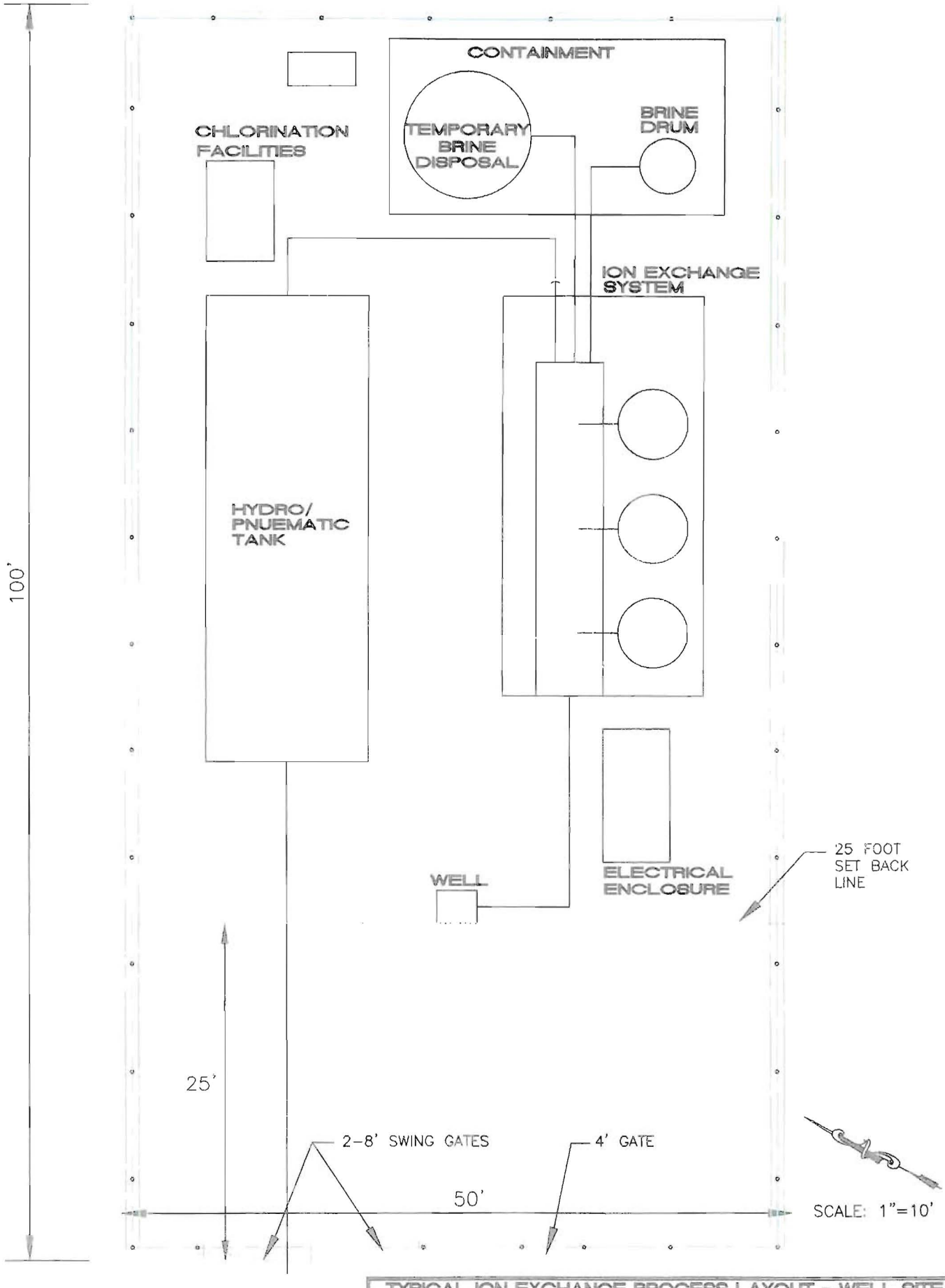
FIGURE 5-4



TYPICAL ION EXCHANGE PROCESS LAYOUT - WELL SITE
WATER SUPPLY STUDY
CUTLER-OROSI AREA

KELLER/WEGLEY

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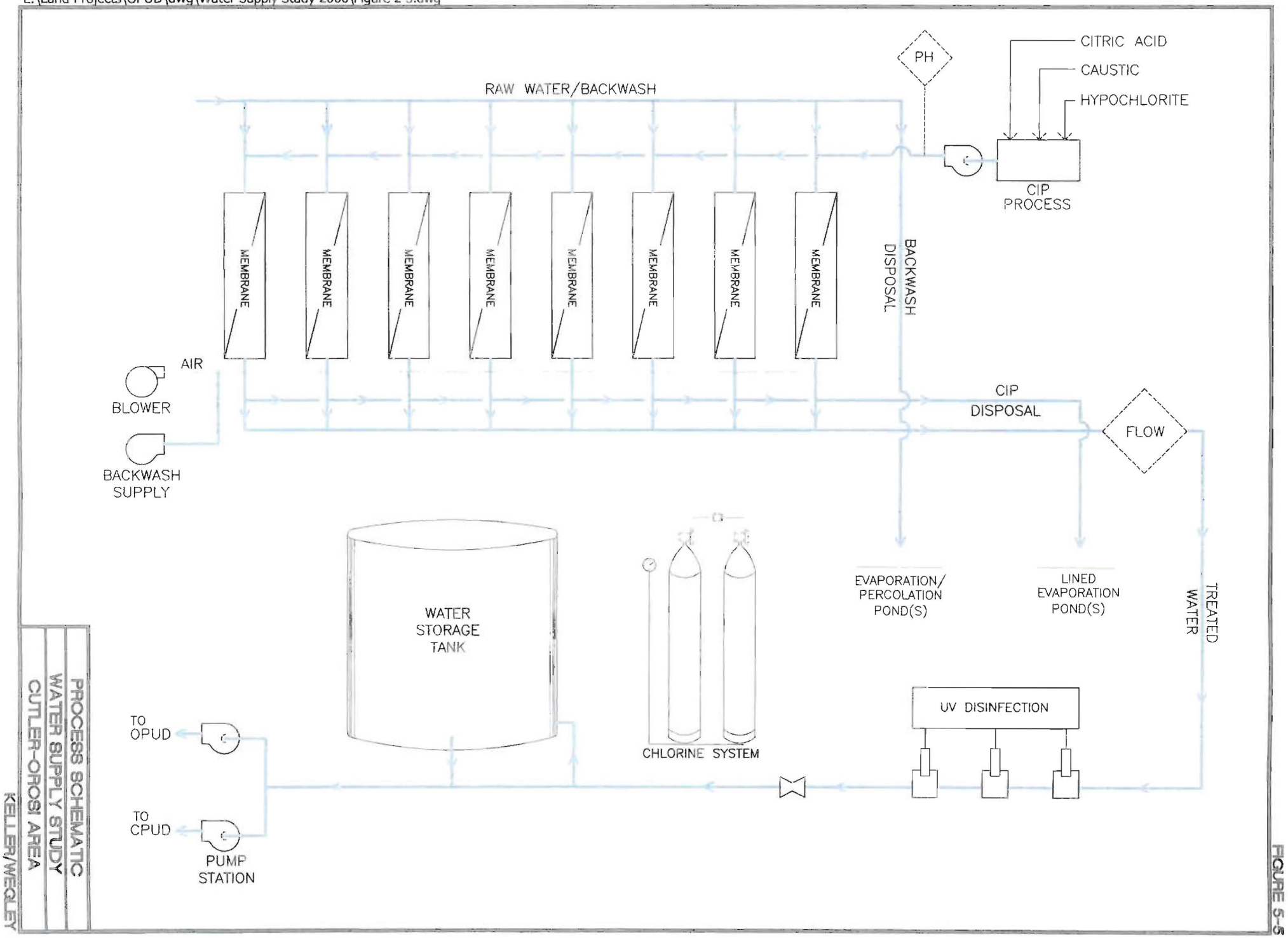
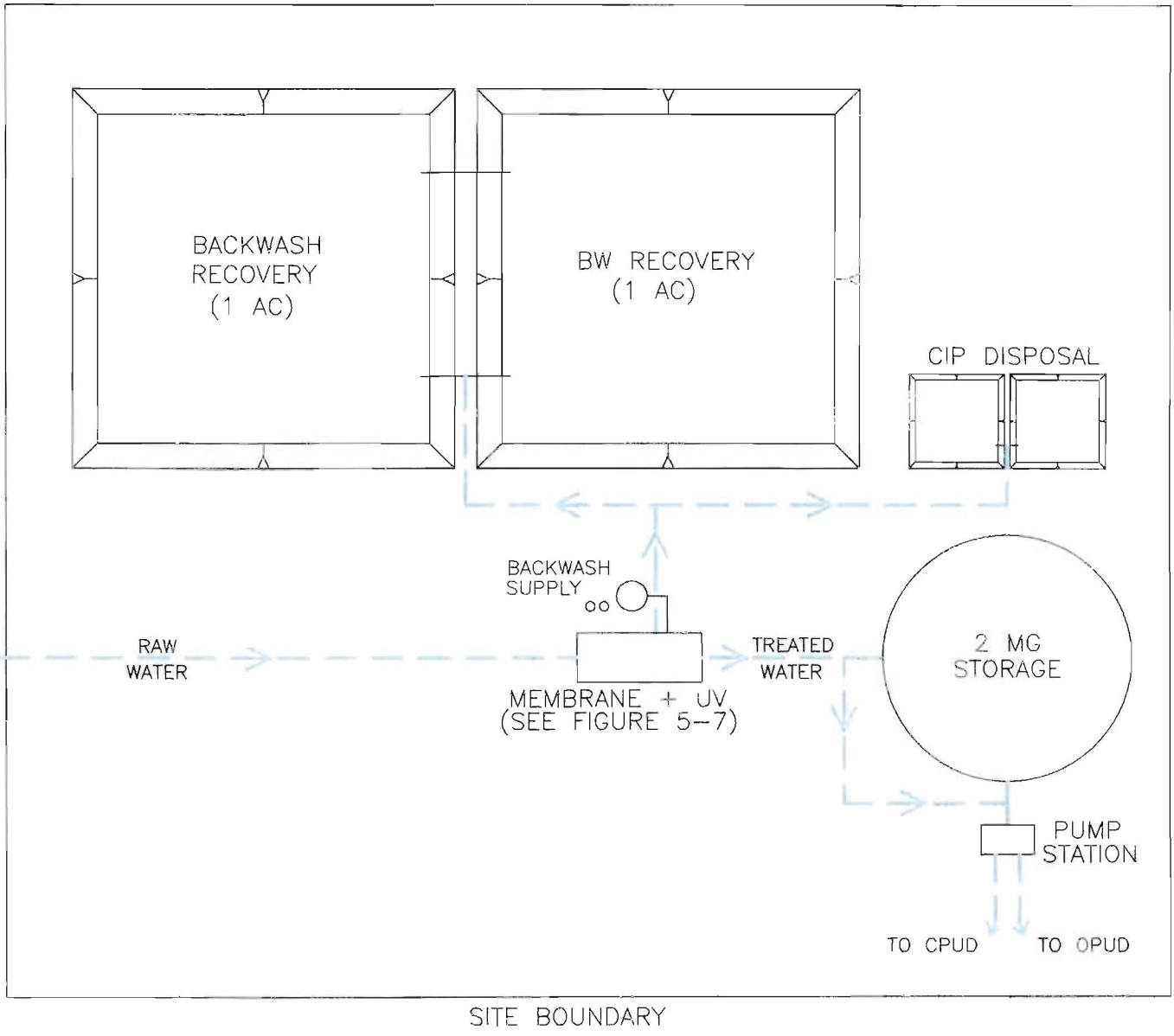


PROCESS SCHEMATIC
WATER SUPPLY STUDY
CUTLER-OROSI AREA

KELLER/WEGLEY

FIGURE 5-5

FIGURE 5-6



SCALE: 1"=100'

GENERAL SITE PLAN
WATER SUPPLY STUDY
CUTLER-OROSI AREA

KELLER/WEGLEY

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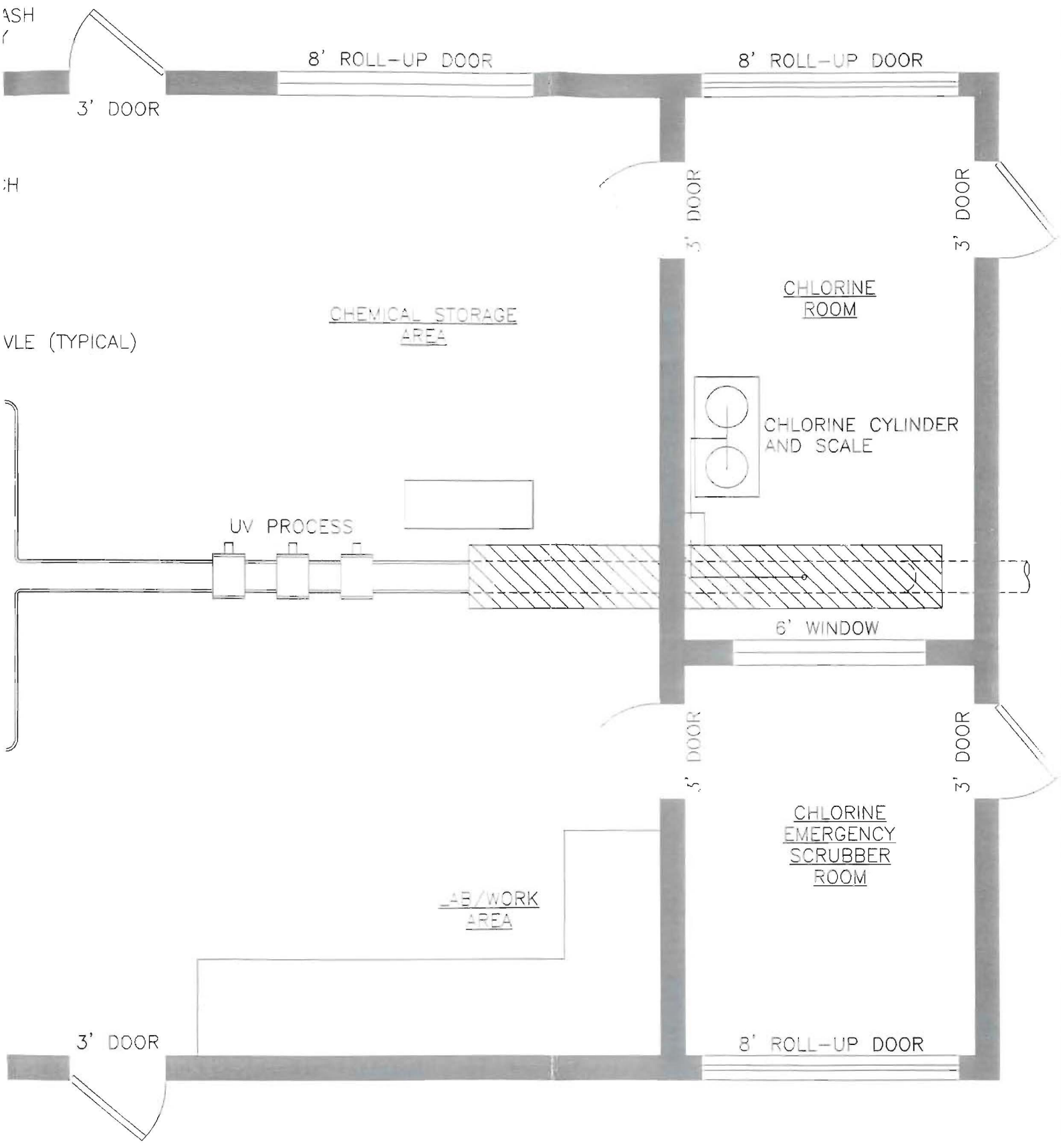
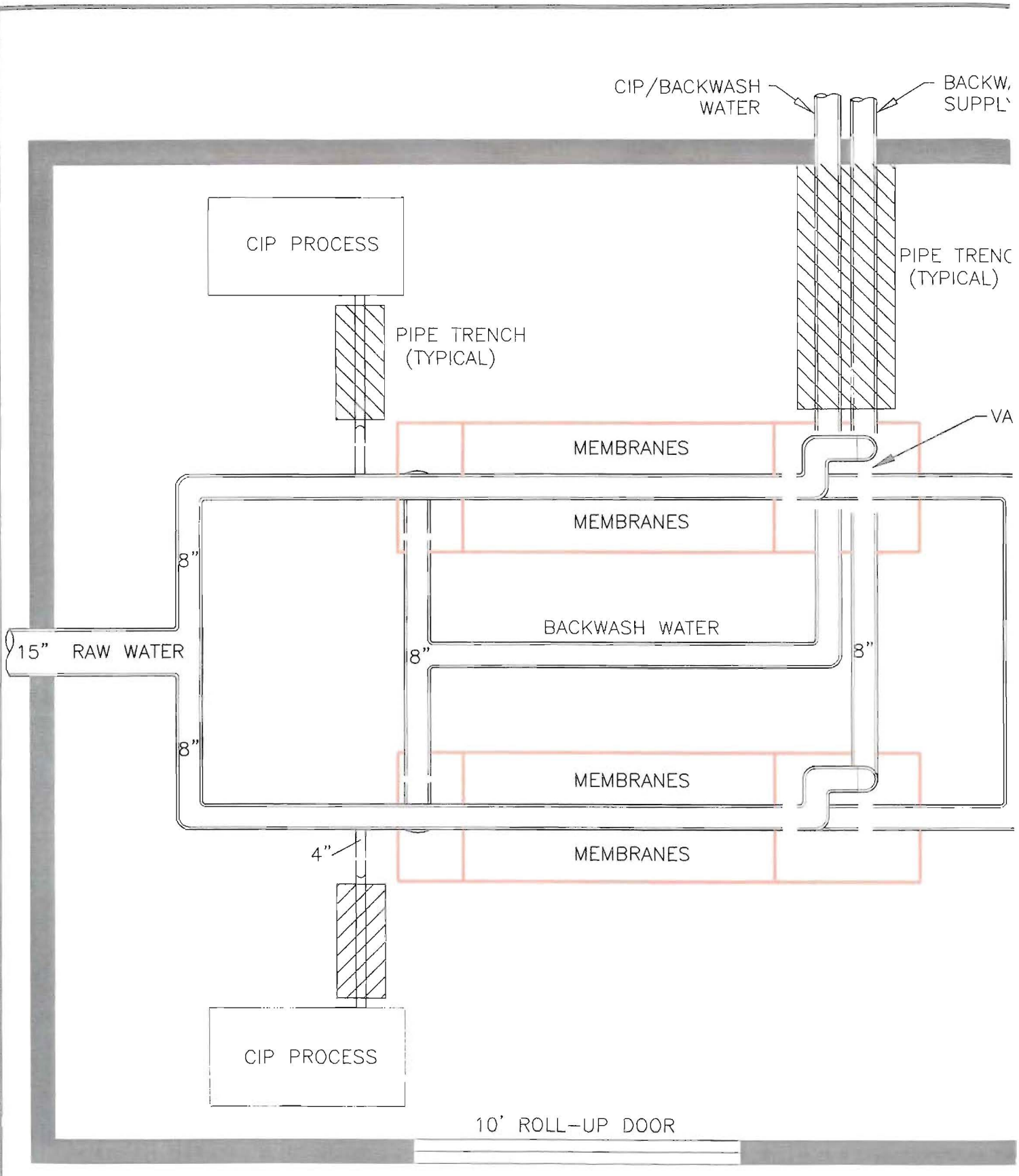
FIGURE 5-7



SCALE: 1"=4'

DETAILED EQUIPMENT LAYOUT
WATER SUPPLY STUDY
CUTLER-OROSI AREA

KELLER/WEGLEY



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G

DEPARTMENT OF HEALTH SERVICES
CALIFORNIA SAFE DRINKING WATER
STATE REVOLVING FUND

ENGINEERING REPORT SUPPLEMENT

APPLICATION NO.: 5410008-006

PRIORITY LIST CATEGORY: F

OROSI PUBLIC UTILITY DISTRICT
TULARE COUNTY

FEBRUARY 2009

Prepared By:

Dennis R. Keller / James H. Wegley
Consulting Civil Engineers

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OROSI PUBLIC UTILITY DISTRICT

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B. Problem 3

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Table 1 Water Supply Study Cross References

Figure 1 Project Schedule

Appendix A Memorandum of Understanding

ENGINEERING REPORT SUPPLEMENT
WATER SUPPLY STUDY
OROSI PUBLIC UTILITY DISTRICT

PREFACE

In February 2007, the Orosi Public Utility District (OPUD) prepared a report entitled "Water Supply Study - Cutler-Orosi Area" that consisted of many SRF engineering report elements. Table 1 cross-references the SRF engineering report elements to the Water Supply Study.

The purpose of this supplement is to document SRF report elements not covered by the Water Supply Study.

A copy of the draft Water Supply Study has been included in the SRF Application package.

TABLE 1
WATER SUPPLY STUDY CROSS REFERENCES
ENGINEERING REPORT SUPPLEMENT
OROSI PUBLIC UTILITY DISTRICT

SRF Preliminary Engineer Report Format (SRF Application Materials)	Water Supply Study
A. DESCRIPTION OF SYSTEM	Section 2
• Type of System	Section 2
• Type of Water Services	Section 2
• General location	Section 2
• Number of service connections	N/A
• Number of persons served	Section 3
B. PROBLEM	Section 1, Section 2
C. ALTERNATIVES	Section 4, Section 5
• Feasibility	Section 4
• Costs - Capital	Section 5
• Costs - O&M	Section 5
D. DESCRIPTION OF PROJECT	Section 5
• Components	Section 5
• Connections	N/A
E. ELIGIBILITY	Section 5
• Land purchase	N/A
F. PRELIMINARY DESIGN	Section 4, Section 5
• Overall design	Section 5
• Peak water demand	Section 3
• Growth and water demand methodology	Section 3
• Project phases	N/A
• Cost estimates	Section 5
• Schedule	N/A
• California Environmental Quality Act	N/A
• Average residential water rate	Section 5
• Useful life project	N/A
G. WATER RIGHTS	N/A
H. PLANNING	N/A
I. SCHEDULE	N/A

A. DESCRIPTION OF SYSTEM

The water supply study includes system descriptions for both OPUD and Cutler Public Utility District (CPUD). System descriptions are provided in Section 2.

OPUD currently has a total of 1,627 connections serving approximately 7,138 persons (Census 2000, Orosi CDP). CPUD has a total of 1,206 connections serving approximately 4,491 persons (Census 2000, Cutler CDP). The connections include commercial and other non-residential connections.

B. PROBLEM

OPUD and the CPUD provide domestic water to the residents of the unincorporated communities of Orosi and Cutler, respectively. Each district relies solely on groundwater to meet the water demands of its customers. OPUD presently utilizes four wells. CPUD has two active wells. The districts' wells experience elevated nitrate levels that approach or exceed the MCL for nitrates. In addition, the smaller surrounding communities of East Orosi and Sultana have water quality issues similar to both Orosi and Cutler. These nearby communities, while significantly smaller than Cutler and Orosi, are in need of a dependable potable water supply for their residents. Overall, the groundwater supply in the Cutler-Orosi area is high in nitrates and it is becoming increasingly difficult to locate groundwater low in nitrates. Recent wells drilled by the districts have exceeded the nitrate MCL. Nitrate levels in OPUD's four active wells range from 16 mg/l to 43 mg/l, having an average of about 25 mg/l. Nitrate levels at OPUD's inactive well sites, however, exceed the regulatory standard of 45 mg/l, having an average nitrate concentration of approximately 110 mg/l.

Each CPUD well must be in service to meet existing water demands. CPUD's existing wells, however, are currently experiencing elevated nitrate levels which are jeopardizing the long term viability of the existing water supply. Nitrate levels in CPUD's two active wells range from 25 mg/l to 49 mg/l with an average of about 35 mg/l. The active wells also have DBCP (0.03 to 0.32 ug/l). CPUD's inactive wells have an average nitrate concentration of approximately 54 mg/l. The existing water system does not meet California Department of Public Health (CDPH) waterworks standards for water supply capacity and will not be able to meet projected average or peak water demands. Additional water supply is necessary because of the contamination.

In October 2005, OPUD and CPUD were issued compliance orders (Nos. 03-12-050-007 and -008, respectively) to address water supply deficiencies. Additional water supplies are necessary to meet future water needs, to insure sufficient water supplies in the event any of the existing wells experience elevated levels of contamination over time that require the districts to remove well(s) from active status jeopardizing the districts' ability to serve potable water to their customers and obtaining compliance with CDPH waterworks standards for water supply capacity (CCR 64562). In addition, the Lovell School and the El Monte School have submitted SRF applications for funding to connect to the CPUD and OPUD water systems, respectively. In order for CPUD and OPUD to provide the schools with potable water, additional water supplies will be needed. Due to groundwater nitrate levels and subsequent groundwater treatment options, the districts have concluded that a regional surface water treatment plant represents the most feasible solution for addressing the districts' future water demands.

C. ALTERNATIVES

Section 4 and Section 5 of the Water Supply Study discuss the evaluation of alternatives. The evaluations established that a surface water treatment plant represents the most economical and feasible approach to addressing the Cutler-Orosi area's water needs.

D. DESCRIPTION OF PROJECT

Due to the local groundwater contamination, the OPUD and CPUD identified a need for additional dependable potable water supplies to continue serving the existing residents of the Districts, proposed service for Lovell and El Monte Schools and to meet projected (20-year) water demands. Both OPUD and CPUD are within the Alta Irrigation District (AID), which is local surface water purveyor in the area and is developing new projects to generate additional surface water supplies. In February 2007, the districts, in conjunction with AID, completed a preliminary study that identified surface water treatment as the most economical and feasible approach to meeting the districts' water needs. This facility would also serve East Orosi and Sultana, along with having the potential to serve additional communities or residential clusters in the area. The districts' water supply study provided a broad overview of the proposed surface water treatment approach. The surface water treatment plant would be developed as a regional facility that interties OPUD and CPUD and includes the capability to serve adjacent rural communities, such as East Orosi and Sultana. Due to the scope and magnitude of the project, further details regarding elements comprising the project and implementation of the organizational structure are necessary. The districts propose to conduct a feasibility study that will enable the detailed development and/or evaluation of numerous preconstruction items, including:

1. Complete environmental documentation (CEQA);
2. Water treatment plant site identification and possibly the securing of an option to purchase same;
3. Pipeline alignments and right-of-way issues identified and initiation of acquisition;
4. Organizational structure evaluation and determination of initial service area and potential for future expansions of the initial service area;
5. Finalize treatment plant capacity requirements for Orosi and Cutler;
6. Meet with adjacent communities, including East Orosi and Sultana, regarding water capacity requirements;
7. Identify water supply;
8. Negotiate all necessary water transfers and conveyance facility agreements;
9. File application for regional water supply permit; and
10. Prepare 20 percent design level plans.

E. ELIGIBILITY

A new surface water treatment plant will require land for its facilities. The districts have not established a location for the facilities. Identification of a location represents an important component of the OPUD's Project. The districts anticipate that all land costs associated with the proposed Project will be eligible for SRF funding.

F. PRELIMINARY DESIGN

OPUD's project being pursued under this SRF application covers the preliminary elements prior to final design and construction of the proposed water treatment plant. OPUD will prepare a feasibility study that will allow the detailed development and/or evaluation of numerous preconstruction items. Detailed design of the water treatment plan will be completed through subsequent funding efforts.

G. WATER RIGHTS

CPUD and OPUD do not have any rights to surface water. The two districts utilize groundwater for domestic water supply. In 2005, the districts entered into a memorandum of understanding with the Alta Irrigation District (AID) that evaluated options for maintaining a potable water supply. AID will develop a firm surface water supply through the recharging of groundwater supplies with uncontrolled flood and surplus waters generated in wet years. The conjunctive use of the new groundwater supply will allow AID to provide surface water to the proposed water treatment plant. A copy of the memorandum of understanding is included as Appendix A.

H. PLANNING

The Tulare County General Plan was prepared in 1981 to provide requirements and guidance for the use and development of resources within the county. The Tulare County General Plan is currently being updated. Draft versions of General Plan elements are available. The Rural Valley Lands Plan and the Cutler-Orosi Community Plan cover the project area.

Developing and maintaining reliable water supplies are considerations under the planning documents. The selected location will need to consider planning requirements (land use, zoning, etc.) to maintain consistency with current planning requirements. These considerations are to be included in the proposed project.

I. PROPOSED SCHEDULE

The proposed project consists of the preliminary efforts to construct a surface water treatment plant. The project is based upon findings of the districts' water supply study. The study did not establish a schedule for completion.

Figure 1 shows the proposed schedule for the Project.

TASK / MONTH (1)	1
WATER SUPPLY DEVELOPMENT	
1. MEET W/ ADJACENT COMMUNITIES	
2. ORGANIZATIONAL STRUCTURE	
3. PLANT CAPACITY REQUIREMENTS	
4. IDENTIFY WATER SUPPLY	
5. NEGOTIATE WATER AGREEMENTS	
6. FILE REGIONAL WATER SUPPLY PERMIT	
PRELIMINARY DESIGN	
1. WTP SITE IDENTIFICATION	
A. LAND PURCHASE OPTION	
2. PIPELINE ALIGNMENT/ROW ACQUISITION	
3. PREPARE 20% DESIGN PLANS	
CEQA PROCEDURES	
1. INITIAL STUDY	
2. NOTIFICATION AND REVIEW	
1. PUBLIC REVIEW	
2. PUBLIC HEARING	
3. ADOPTION OF FINDINGS	

NOTE: (1) MONTH FOLLOWING SRF CONTRACT AGREEMENT COMPLETI

LEGEND

- SCHEDULED TASK DURATION
- POTENTIAL TASK DURATION
- DELIVERABLE/MILESTONE
- OPTIONAL MILESTONE

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APPENDIX A

MEMORANDUM OF UNDERSTANDING

ENGINEERING REPORT SUPPLEMENT

OROSI PUBLIC UTILITY DISTRICT

MEMORANDUM OF UNDERSTANDING

THIS MEMORANDUM OF UNDERSTANDING (this "MOU") is made and entered into this 21st day of September, 2005 (the "Effective Date"), by and among ALTA IRRIGATION DISTRICT, a California Irrigation District ("Alta"), CUTLER PUBLIC UTILITY DISTRICT, a California Special District ("Cutler"), and OROSI PUBLIC UTILITY DISTRICT, a California Special District ("Orosi"). Alta, Cutler, and Orosi are collectively referred to herein as the "Participating Agencies."

RECITALS:

A. Cutler and Orosi seek stable water supplies for municipal and industrial uses. The water supplies may dilute potentially contaminated waters and restore certain wells contained within their service areas. Alta seeks to cooperate in studying water supplies for Cutler and Orosi (the "Supply").

B. The Participating Agencies seek to hire a qualified consultant to conduct a water resource study (the "Study") to examine the physical, environmental, and economic feasibility of the Supply. The Participating Agencies desire that this Study be completed within two (2) years of the Effective Date of this MOU.

C. This MOU memorializes the Participating Agencies' obligations to commission and pay for the Study.

NOW, THEREFORE, in consideration of the recitals set forth above, which are herein incorporated by this reference, and the mutual covenants and undertakings set forth herein, the mutual receipt and sufficiency of which is hereby acknowledged, the Participating Agencies agree as follows:

1. **Study Commission and Approval**. The Participating Agencies shall retain Keller-Wegley Engineering of Visalia, California (the "Consultant"), to conduct the Study. At least one (1) representative of each of the Participating Agencies shall meet, within thirty (30) days of the Effective Date, with the Consultant to discuss in some detail the parameters of the Study. No more than thirty (30) days after this meeting, the Consultant shall forward to the Committee an outline, complete with a timeline for each task, of how the Study will be conducted. Each of the Participating Agencies shall provide its written approval of this outline. Once approved by each of the Participating Agencies, the outline shall be incorporated by this reference into this MOU.

2. **Funding**. Upon execution hereof, each of the Participating Agencies shall be responsible for an equal one-third share of the Study's cost. The total cost to prepare the Study for each of the Participating Agencies shall not exceed twenty-five thousand ($25,000.00) dollars, unless each of the Participating Agencies provides their express written consent to exceed this budget.

3. **Notices**. Notices or other communications required or permitted by this MOU or by law to be served on or given to Participating Agencies shall be in writing and shall be deemed duly served and given (i) immediately when personally delivered to the party to whom it is directed, (ii) immediately when delivered by telecopier, provided the original is immediately deposited in the United States mail, first class, postage prepaid (notices received by telecopier after 5:00 p.m. or on a day other than a business day shall be deemed given as of 9:00 a.m. the following day), (iii) two (2) days after being deposited in the United States mail, first class, postage prepaid, addressed:

To ALTA at:	P.O. Box 715 Dinuba, CA 93618 (559) 591-5190
To CUTLER at:	40526 Orosi Drive Cutler, CA 93615 (559) 528-1919
To OROSI at:	12488 Avenue 416 Orosi, CA 93647 (559) 528-2770

Any party hereto may change its address and/or its telecopier number for the purpose of this Paragraph by giving written notice of such change to the other Participating Agencies in the manner provided for in this Paragraph.

4. **Legally Binding Commitment**. The Participating Agencies intend for this MOU to be a legally binding commitment enforceable in accordance with its terms by any of the Participating Agencies.

5. **Attorneys' Fees**. In the event of any controversy, claim, or dispute between any of the Participating Agencies arising out of or relating to this MOU or the breach thereof, the prevailing party shall be entitled to recover from the breaching Participating Agencies reasonable expenses, attorneys' and other professionals' fees, and costs.

6. **Effect of Headings**. The subject headings of the paragraphs and subparagraphs of this MOU are included for purposes of convenience only and shall not affect the construction or interpretation of any of its provisions.

7. **Governing Law**. This MOU shall be governed by the laws of the State of California.

///

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8. **Counterparts; Facsimile Signatures**. This MOU may be executed in any number of counterparts, each of which shall be deemed an original and all of which shall constitute one and the same MOU. This MOU shall be deemed fully-executed and legally binding when signed by all of the Participating Agencies and after such signatures have been exchanged among the Participating Agencies via mail or facsimile.

IN WITNESS WHEREOF, the Participating Agencies hereto have executed this MOU as of the day and year first above written:

"ALTA"
ALTA IRRIGATION DISTRICT

By Norman Waldner

Its President

By Chris M. Kapheim

Its Secretary

"CUTLER"
CUTLER PUBLIC UTILITY DISTRICT

By Robert Ryder

Its President

By [illegible]

Its Vice-Pres

"OROSI"
OROSI PUBLIC UTILITY DISTRICT

By [illegible]

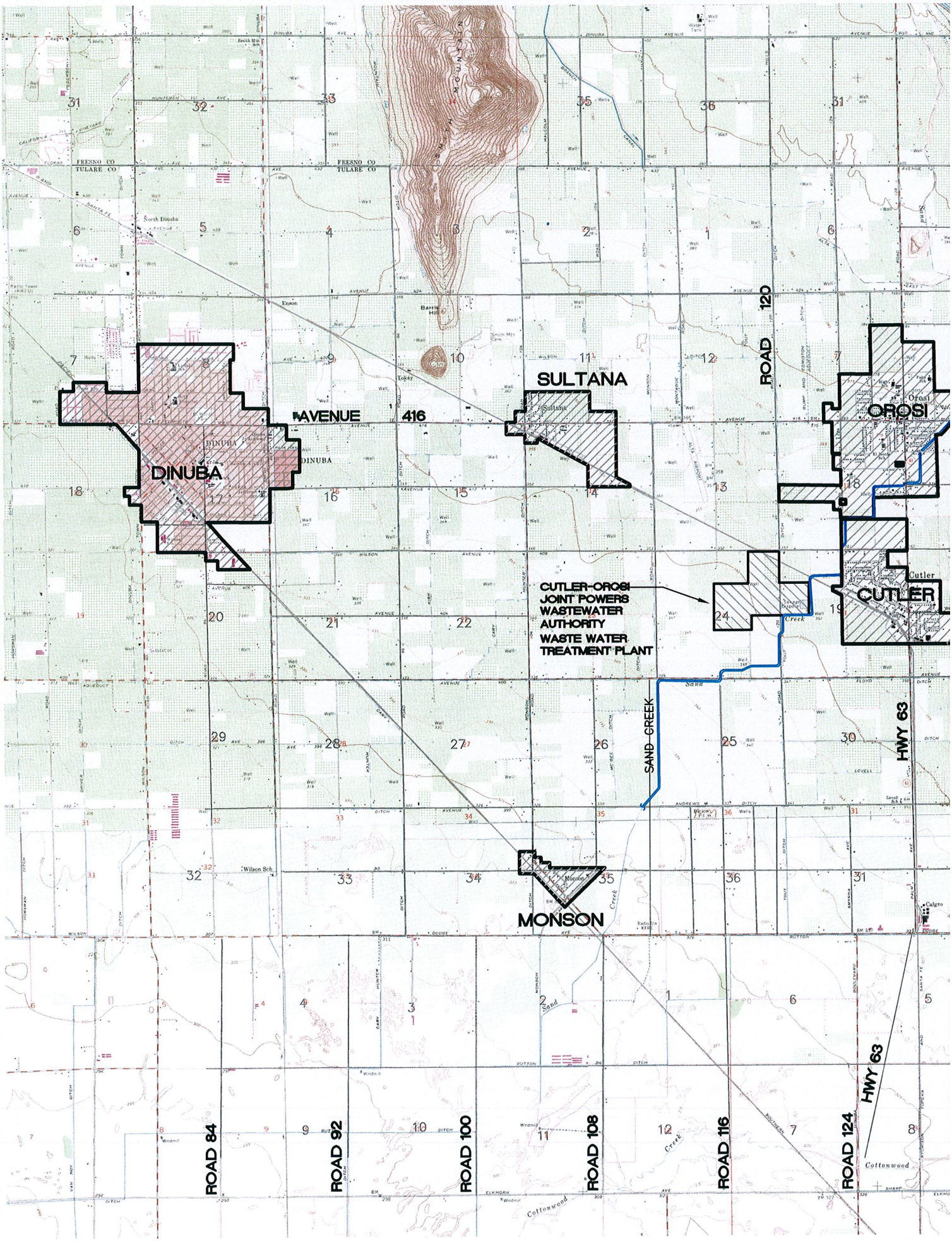
Its President

By Eileen Kirkman

Its Secretary

TABLE 5-6
PRELIMINARY COST ESTIMATE - SURFACE WATER TREATMENT
WATER SUPPLY STUDY
CUTLER - OROSI AREA

ITEM	DETAILS		AMOUNT
1.	Intake Structure and Pump Station		$ 280,000.00
	Pumps, Screens, Structure, Modifications		
2.	Transmission Pipeline		$ 1,500,000.00
	15-inch diameter, 4 miles long		
3.	Water Treatment Plant Site		
	Land Purchase - 10 acres		$ 200,000.00
	Sitework; preparation (fencing, paving, etc.)		$ 350,000.00
4.	Membrane Treatment Process		
	2 MGD, modular, clean in place process		$ 1,300,000.00
	Installation		$ 520,000.00
	Electrical and Controls		$ 400,000.00
5.	UV Disinfection System		
	2 MGD		$ 250,000.00
	Installation		$ 100,000.00
	Electrical and Controls		$ 75,000.00
6.	Chlorination System - For Distribution System		$ 100,000.00
	Additional chemical processes, treatment appurtenances		
7.	Water Treatment Plant Building		$ 720,000.00
	Equipment enclosure, lab area		
8.	Treated Water Storage Tank and Pump Station		$ 3,000,000.00
9.	Backwash Recovery Ponds		
	Ponds - (2) one acre ponds, (2) 2,200 sf ponds, piping		$ 125,000.00
10.	Standby Generator and Automatic Transfer Switch		$ 100,000.00
11.	Distribution System Piping		$ 1,000,000.00
	SUBTOTAL		$ 10,020,000.00
	Contractor Profit, Bonds and Insurance at 10 %		$ 1,002,000.00
	Contingency at 20 %		$ 2,004,000.00
	Inflation at 10 %		$ 1,002,000.00
	TOTAL CONSTRUCTION COST		$ 14,028,000.00
	Engineering	7%	$ 982,000.00
	CEQA, Permits, Preliminary Study	2%	$ 280,600.00
	Legal/Administration	2%	$ 280,600.00
	Inspection, Surveying, Testing	11%	$ 1,543,100.00
	TOTAL PROJECT COST		$ 17,114,300.00



L:\OPUD\dwg\Water Supply Study 2006\Figure 2-3.dwg

H

DINUBA POND PROJECT OPERATIONS, MAINTENANCE

AND CAPITAL REPLACEMENT AGREEMENT

By and between

THE CITY OF DINUBA AND ALTA IRRIGATION DISTRICT

November 14, 2011

THIS DINUBA POND PROJECT OPERATIONS AND MAINTENANCE AND CAPITAL REPLACEMENT AGREEMENT ("Agreement") is made effective as of Nov 14, 2011 by and between ALTA IRRIGATION DISTRICT, a California irrigation district ("District"), and CITY OF DINUBA, a California municipal corporation ("City").

RECITALS:

A. City is the owner of real property located in Dinuba and containing approximately twenty-eight (28) acres as described in Exhibit "A" attached hereto and incorporated herein by this reference (the "Property").

B. The Property has been improved by the construction thereon of storm water recharge basins, pipelines and associated appurtenances ("Facility");.

C. City and District desire to clarify and assign to each party specific obligations to maintain, operate and replace various components of the Facility.

D. City and District desire to specify which party shall pay the cost of carrying out their respective obligations.

E. District, at its sole discretion, desires to recharge surplus waters when available.

NOW THEREFORE, in consideration of the mutual covenants and condition contained herein, the parties agree as follows:

ARTICLE I

DEFINITIONS

1.1 "Engineer" shall mean the Engineer of the District, Keller/Wegley Engineers.

1.2 "General Manager" shall mean the General Manager of the District.

1.3 "City Manager" shall mean the City Manager of the City

1.4 "Project" shall mean the work associated with the storm water recharge basins or associated appurtenances that are part of the Facility.

1.5 "Work" shall mean the cost of providing materials and labor to replace components of the Project.

1.6 "Project Estimate" shall be the Engineer's estimate of the cost of the Work.

ARTICLE II

DISTRICT'S OPERATIONS AND MAINTENANCE OBLIGATIONS

2.1 Dinuba Town Pipeline Control Structure. District shall have the sole authority to regulate and direct the flow of water leaving the control structure, which is part of the Facility, located at the intersection of the Smith Mountain Pipeline and the Dinuba Town Ditch, adjacent to and west of Road 80. The District shall at its sole cost and expense maintain, but not be obligated to replace the control structure and/or appurtenances thereto.

2.2 Water Meters. District shall at its sole cost and expense maintain in good working condition, and with currently updated computer software, the two (2) meters in the Facility that record the flow of all water entering and exiting the Facility. District shall keep a copy of all records produced by those meters.

2.3 Non-City Storm Water. District may, in its sole discretion, recharge surplus waters; to wit, other than storm water directed by City to the Facility.

2.4 Weed Control. District at its sole cost and expense shall perform all necessary weed control work at the Facility. Furthermore, District shall report all such weed control work to the appropriate reporting agencies.

2.5 Levee, Structures and Gate; Maintenance and Operation of the Control Gate from Project to Horsman Ditch. District shall at its sole cost and expense maintain the levees, structures and gates associated with the Facility. District shall have the sole authority to control the timing and rate of flow of any release of water from the Facility to the Horsman Ditch or other facility of District.

2.6 Groundwater Monitoring. District shall at its sole cost and expense schedule, perform and record all groundwater monitoring associated with the Facility. District shall include such groundwater monitoring data in the District's "Water Banking Annual Report."

ARTICLE III

CITY'S OPERATIONS AND MAINTENANCE OBLIGATIONS

3.1 City Storm Drain Water and Storm Water Facilities; Storage Capacity Priorities. It is the purpose of the Facility to recharge City storm water. City shall direct all such storm water into the basin(s) that are part of the Facility. City shall have the first priority to use the storage capacity thereof, provided that when City does not need that capacity, District may

release water from its facilities into such basin(s). City at its sole cost and expense shall operate, maintain, design and replace City storm water and storm water facilities, such as storm water pipelines and associated appurtenances, through which City storm water flows to the Facility.

3.2 Soil Testing. City at its sole cost and expense shall test the soil in Basin I after the first substantial rain event of the season and semiannually test the water in the monitoring well installed near Basin 3 and dispose of heavy metals or other possible contaminants now or hereafter occurring in the Facility. Further, City shall report the results of such tests and its intent to commence such disposal to the District.

3.3 Pump Maintenance. City at its sole cost and expense shall operate, maintain and replace (a) the pump within Pond 1 of the Facility whose function is to remove water from dead storage, and (b), the City pump located adjacent to Pond 2, which was constructed as a part of the Facility to provide project benefits.

ARTICLE IV

REPLACEMENT OF CAPITAL IMPROVEMENTS

4.1 Shared Cost of Replacing Capital Improvements. Except as specifically proved otherwise in Articles II and III above, City and District shall pay in equal shares the cost of replacing capital improvements that are part of the Facility, including without limitation, the two, (2) meters referred to above, the exit pipeline, in-basin gates and control structures and basins.

4.2 Project Estimate. Engineer shall, prepare a Project Estimate. No Work described in such Project Estimate shall commence until approved in writing by the City Manager and General Manager.

ARTICLE V

INSURANCE

District and City shall each respectively maintain liability insurance, auto and workers compensation in the amount and/or terms specified.

5.1.1 General Liability. One million dollars ($1,000,000) per occurrence for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to the project/location (with the ISO CG 2503, or ISO CG 2504, or insurer's equivalent endorsement provided to the District) or the general aggregate limit shall be twice the required occurrence limit.

Automobile Liability: One million dollars ($1,000,000) for bodily injury and property damage each accident limit.

5.1.2 The general liability policy shall cover bodily injury and property damage liability, owned and non-owned equipment, blanket contractual liability, completed operations

liability, explosion, collapse, underground excavation and removal of lateral support. The automobile liability policy shall cover all owned, non-owned, and hired automobiles.

5.2 Workers' Compensation and Employer's Liability Insurance. The Landowner/Contractor shall insure (or be a qualified self-insured) under the applicable laws relating to workers' compensation insurance, all of their employees working on or about the construction site, in accordance with the "Workers' Compensation and Insurance Act," Division IV of the Labor Code of the State of California and any Acts amendatory thereof. The Landowner/Contractor shall provide employer's liability insurance in the amount of at least $1,000,000 per accident for bodily injury and disease.

5.3 Waiver of Subrogation. The insurer shall waive all rights of subrogation against the District, its directors, officers, employees, or volunteers and landowner.

ARTICLE VI

MISCELLANEOUS

6.1 Indemnification.

(a) To the fullest extent allowed by law, City ("indemnifying party") shall indemnify, hold harmless and defend District, and each of its officers, officials, directors, employees, agents contractors consultants and authorized volunteers from any and all loss, liability, fines, penalties, forfeitures, costs and damages (whether in contract, tort or strict

liability, including but not limited to personal injury, death at any time and property damage) incurred by District or any other person, and from any and all claims, demands and actions in law or equity (including attorney's fees and litigation expenses), arising or alleged to have arisen directly or indirectly from the acts, negligent or intentional, or omissions, or willful misconduct of the indemnifying party or any of its officers, officials, directors, employees, agents, contractors, consultants or authorized volunteers in the performance of this Agreement, including, but not limited to, the use, hazardous substance evaluation and soil testing of and in the Property, as well as the communication of the results of that evaluation and testing together with all expenses of remediation of any property of District required under law as a result thereof ; provided nothing herein shall constitute a waiver by the indemnifying party of governmental immunities including California Government Code Section 810 et seq. The duty to indemnify and defend shall apply to all claims and liability regardless of whether any insurance policies are applicable and the policy limits do not act as a limitation upon the amount of indemnification to be provided. This indemnification obligation shall survive termination or expiration of this Agreement.

(b) To the fullest extent allowed by law, District ("indemnifying party") shall indemnify, hold harmless and defend City, and each of its officers, officials, directors, employees, agents contractors, consultants and authorized volunteers from any and all loss, liability, fines, penalties, forfeitures, costs and damages (whether in contract, tort or strict liability, including but not limited to personal injury, death at any time and property damage) incurred by City or any other person, and from any and all claims, demands and actions in law or equity (including attorney's fees and litigation expenses), arising or alleged to have arisen

directly or indirectly from the acts, negligent or intentional, or omissions, or willful misconduct of the indemnifying party or any of its officers, officials, directors, employees, agents, contractors, consultants or authorized volunteers in the performance of this Agreement; provided nothing herein shall constitute a waiver by the indemnifying party of governmental immunities including California Government Code Section 810 et seq. The duty to indemnify and defend shall apply to all claims and liability regardless of whether any insurance policies are applicable and the policy limits do not act as a limitation upon the amount of indemnification to be provided. This indemnification obligation shall survive termination or expiration of this Agreement.

6.2 Mediation of Disputes. The parties agree to mediate any dispute between them arising out of this Agreement prior to the initiation of any court action or arbitration. The parties shall use best efforts to mutually agree upon a mediator and such mediation shall be conducted in Fresno County, California. If the parties cannot agree on a mediator, the Superior Court of the County of Fresno shall appoint a mediator. The mediator may conduct more than one session and fees shall be paid equally by both parties to the dispute. Matters within the jurisdiction of the small claims court are excluded from mediation.

6.3 Effect of Headings. The subject headings of the paragraphs and subparagraphs of this Agreement are included for purposes of convenience only and shall not affect the construction or interpretation of any of its provisions.

6.4 Entire Agreement. This Agreement constitutes the entire agreement between the parties pertaining to the subject matter contained in it and supersedes all prior and contemporaneous agreements, representations, and understandings of the parties. No supplement, modification, or amendment of this Agreement shall be binding unless executed in writing by all of the parties hereto.

6.5 Waiver. Waiver of any breach of this Agreement by any party hereto shall not constitute a continuing waiver or a waiver of any breach of the same or another provision of this Agreement.

6.6 Counterparts. This Agreement may be executed in any number of counterparts and each such counterpart shall be deemed to be an original instrument, all of which together shall constitute one and the same instrument.

6.7 Binding Effect. This Agreement shall be binding upon and inure to the benefit of the heirs, executors, administrators, assigns, and successors of the parties hereto.

6.8 Governing Law. This Agreement shall be governed by the laws of the State of California.

6.9 Construction. All words used in this Agreement, shall be construed to include the plural as well as the singular number and vice versa. Words used herein in the present tense shall include the future as well as the present, and words used in the masculine gender shall include the feminine and neuter genders.

6.10 Parties in Interest. Nothing in this Agreement, whether expressed or implied, is intended to confer any rights or remedies on any persons other than the parties hereto

and their respective successors and assigns, nor is anything in this Agreement intended to relieve or discharge the obligation or liability of any third person to any party to this Agreement, nor shall any provision give any third person any right of subrogation or action over and against any party to this Agreement.

6.11 Notices. All notices required or permitted by this Agreement or applicable law shall be in writing and may be delivered in person (by hand or by courier) or may be sent by regular, certified or registered mail or U.S. Postal Service Express Mail, with postage prepaid, or by facsimile transmission, and shall be deemed sufficiently given if served in a manner specified in this Paragraph. The addresses noted below shall be that party's address for delivery or mailing of notices. Either party may by written notice to the other specify a different address for notice. Any notice sent by registered or certified mail, return receipt requested, shall be deemed given on the date of delivery shown on the receipt card, or if no delivery date is shown, two (2) days after the postmark thereon. If sent by regular mail the notice shall be deemed given forty-eight (48) hours after the same is addressed as required herein and mailed with postage prepaid. Notices delivered by United States Express Mail or overnight courier that guarantee next day delivery shall be deemed given twenty-four (24) hours after delivery of the same to the Postal Service or courier. Notices transmitted by facsimile transmission or similar means shall be deemed delivered upon telephone confirmation of receipt (confirmation report from fax machine is sufficient), provided a copy is also delivered via delivery or mail. If notice is received after 4:30 p.m. in the time zone in which the party is located or on a Saturday, Sunday or legal holiday, it shall be deemed received on the next business day.

To District at: Alta Irrigation District

Post Office Box 715

289 North "L" Street

Dinuba, California 93618

To City at: City of Dinuba

405 E. El Monte Way,

Dinuba, CA 93618

or at such other address as either party may, by like notice, designate to the other party in writing.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the day and year first above written.

"CITY"

CITY OF DINUBA,
a California municipal corporation

By _____
J. Edward Todd, Executive Director

"DISTRICT"

ALTA IRRIGATION DISTRICT
a California irrigation district

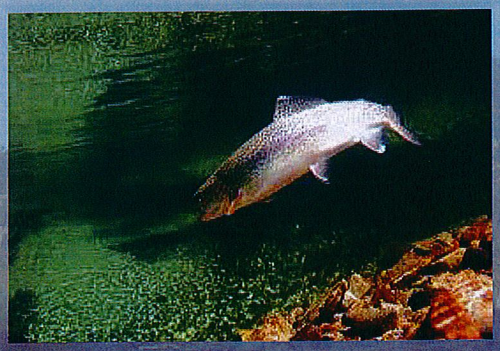
By _____
Norman Waldner, President

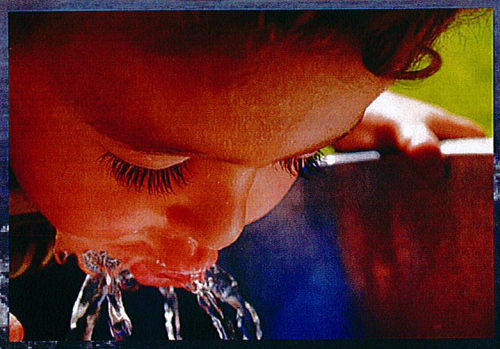
By _____
Chris M. Kapheim, Secretary

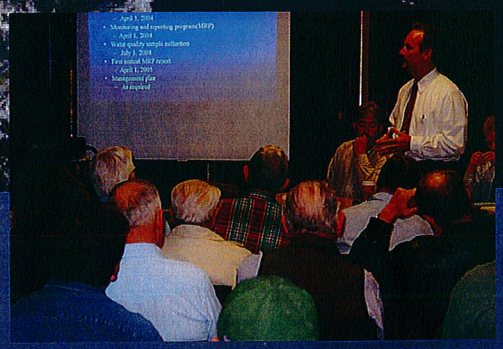
I

Kings Basin

Integrated Regional Water Management Plan







KINGS BASIN
Water Authority

Adopted October 17, 2012

17 CLIMATE CHANGE

17.1 Introduction

Climate change is a long-term alteration in global weather patterns such as precipitation, temperature, wind and severe weather events. Climate change can occur from both natural and anthropogenic effects. Scientists believe that a primary driver of climate change is greenhouse gas concentrations, including methane and carbon dioxide. Anthropogenic release of these gases is expected to accelerate the rate of natural climate change. Paleoclimatic evidence, such as ice cores, lake varves, and tree rings show a direct correlation between greenhouse gas concentrations and global temperatures (Ruddiman, 2002). There is broad scientific agreement that climate change is occurring and that emissions of heat-trapping gases are the primary cause.

Climate change impacts in the Kings Basin cannot be precisely predicted, but if they occur, they could include different precipitation patterns and river flows, higher temperatures, and earlier snowmelt. The California Department of Water Resources (DWR) recognizes that current climate change projections are not precise, but they require that climate change planning be incorporated into Integrated Regional Water Management Plans (IRWMPs). Further, due to the uncertainty in predictions, water managers should prepare for a range of future conditions.

The general strategy to plan for climate change in the Kings Region includes: 1) identify vulnerabilities 2) implement adaptation measures; and 3) monitor for climate change. This planning process is shown in **Figure 17-1**.

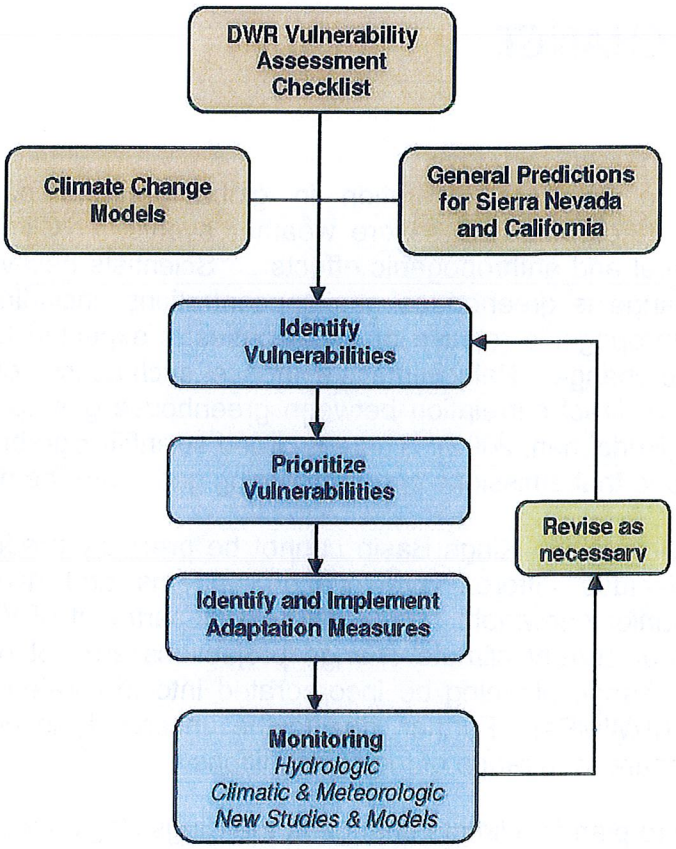


Figure 17-1: Process for Climate Change Planning

Specific topics addressed in this section include: climate change literature, general impacts from climate change, a vulnerability assessment for the Kings Basin, climate change modeling results, adaptation measures, climate change monitoring, and consideration of greenhouse gas emissions in the project review process.

17.2 Literature Review

Numerous documents were used to evaluate climate change in the Kings Basin. The primary document was the *Climate Change Handbook for Regional Water Planning*, (DWR and EPA, 2011). This handbook is the most recent, practical climate change document published by the DWR, and provides numerous tools for addressing climate change. This document is not required for preparing IRWMPs; however, DWR does recommend that it be used.

Other important climate change documents that were used include California Natural Resources Agency (2009), California State University at Fresno (2008), Conrad (2012), Climatewise (2010), DWR (October 2008), and U.S. Global Change Research Program

(2009). Lastly, several reports that describe climate change modeling results were reviewed. These are discussed in Section 17.5.

Several local water and land use plans address climate change. The climate change goals and policies in these plans are consistent with this IRWMP. For example, the General Plans for the City of Selma, Tulare County and Kings County outline numerous climate change mitigation measures such as energy efficiency requirements at new developments, compact urban development, and promoting development of renewable energy. The City of Clovis Urban Water Management Plan proposes water conservation measures to reduce energy demands and mitigate for climate change. The City of Fresno Metropolitan Water Resources Management Plan (2007) identifies a need for more flood control space to address more frequent flood flows caused by climate change. The City of Fresno also assumes a ten percent decrease in Kings River and San Joaquin River water supplies to Fresno from climate change impacts, although there is no specific basis used to determine this number. Climate change is missing from many older planning documents; however, it is being addressed in most new planning efforts.

17.3 General Impacts from Climate Change

This section discusses potential general impacts from climate change on the Kings Basin. Specific impacts are uncertain, but it is generally agreed that the climate will warm and have a variety of impacts on precipitation, hydrology, and the ecosystem. Some of the potential climate change impacts listed by DWR (Oct. 2008), California Natural Resources Agency (2009) and the U.S. Global Change Research Program (June 2009) include:

Precipitation

- Changes in the seasonality of precipitation
- Increase in frequency and intensity of droughts
- More precipitation and less snowfall, resulting in less water stored in the snowpack
- Increased frequency of rain-on-snow events
- Changes in temperatures and cloud cover that inhibit or prevent cloud seeding
- Lower overall precipitation and increased aridity

Streamflow

- Changes in the timing of spring runoff
- Increased flood risk, creating conflicts between water storage and flood control

Water Demands

- Higher temperatures leading to higher evapotranspiration rates from plants, soils and open water surfaces

- Extended growing seasons resulting in higher evapotranspiration for urban landscape and permanent crops

Water Quality

- Higher water temperatures leading to fish distress and algae growth
- Changes in erosion patterns resulting from changes in runoff and overland flow

Other

- Increased fire risk to rangeland and forests
- Potential for increase in diseases, pest invasions and weed invasions
- Heat waves and crop stress leading to lower crop yield
- Overall geographic changes in distribution of flora and fauna

The California water system is especially vulnerable to climate change due to its dependence on mountain snow accumulation and snowmelt processes. Sierra snow is the largest water reservoir in California, and is an important storage mechanism for the Kings Basin. Earlier peak runoff, more intense storms that quickly wash through the system, and lower snowpack levels could all contribute to lower water availability, and increased demand on groundwater.

Predicted changes in precipitation vary, but most predictions include a reduction in overall moisture. For example, Koopman et al. (2010) states that six climate change models described in several California Energy Commission reports showed a drier climate for Central California. On the other hand, California State University at Fresno (2008) states that global climate change models suggest near similar precipitation regimes but with a potential variation of 15-25%. Bashford et al. evaluated two climate change scenarios, including one wet scenario and one dry scenario. The purpose of listing these different predictions is not to throw doubt onto climate change science, but rather show that some uncertainty exists, and water managers should therefore plan for a range of conditions.

Climate change could also have some positive impacts including less frost damage to crops, longer agricultural growing seasons, and less demand for winter heat. However, the Kings Basin water system is designed for a specific climate, and warmer temperatures will generally be detrimental since they will increase water demands and reduce snowpack storage in a water-short area. The risks to the region from no action are clear and include a reduction in available water supply, greater groundwater overdraft, urban water shortages, higher water costs, and lower agricultural output.

17.4 Vulnerability Assessment

A local vulnerability assessment was performed using the 'Vulnerability Assessment Checklist' found in the *Climate Change Handbook for Regional Water Planning* (DWR and EPA, 2011). This checklist, provided below, evaluates vulnerabilities to water

demand, water supply, water quality, flooding, ecosystems and habitats, and hydropower from potential climate change.

1. Water Demand

1.a - Are there major industries that require cooling/process water in your planning region?

The region includes a large number of fruit, vegetable, and meat processing plants, but the temperature of the process water is not likely a major factor. The Kings River Conservation District (KRCD) operates a natural gas peaking powerplant (Malaga Peaking Plant) in the area, but cooling water is provided entirely from groundwater. No other major thermal powerplants are located in the region.

1.b - Does water use vary by more than 50% seasonally in parts of your region?

Seasonal water use varies substantially (greater than 50%) in the region. The majority of water is used in the summer for crop irrigation and some landscape irrigation. Water demands are very low in the winter when much of the farmland is idle, most permanent crops are dormant, and effective precipitation provides most of the needed moisture. Approximately one-third of urban water demands occur in the winter with the other two-thirds in the summer.

1.c - Are crops grown in your region climate-sensitive? Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, be prohibitive for some crops?

The region experiences hot dry summers, and, as a result, most of the crops grown have a relatively good resistance to heat. Changes in heat patterns would probably only impact crop yields if there is a significant increase in temperature. Changes in heat patterns could increase the demand for crop irrigation water. Although freezing temperatures do harm some crops, they are beneficial to some permanent crops that need a certain number of chilling hours below freezing for an effective dormancy. Freezing temperatures also kills some types of pests. Therefore, a reduction in the number of freezing days could negatively impact some crops.

1.d - Do groundwater supplies in your region lack resiliency after drought events?

Groundwater provides an important supplement to surface water in the Kings Basin. Groundwater is used to meet demands not met by surface water, and the demand for groundwater increases during droughts. The region has experienced several severe droughts and the groundwater supply has proven resilient, although there is generally still a steady decline in groundwater levels due to long-term overdraft.

1.e - Are water use curtailment measures effective in your region?

Surface water curtailments include urban water conservation measures and reductions in surface water allocations. Historically, water users have been able to supplement surface water supplies with groundwater, resulting in few water shortages. However, if groundwater levels continue to decline then groundwater will become less reliable as a backup supply. The area has a hardened demand due to a large number of permanent plantings, so new water conservation programs may have to be implemented in the future if less surface water is available.

1.f - Are some instream flow requirements in your region either currently insufficient to support aquatic life, or occasionally unmet?

Minimum in-stream flow requirements are almost always met. These flows have the highest priority for the surface waters, and flows would be insufficient only in an extreme drought.

2. Water Supply

2.a - Does a portion of the water supply in your region come from snowmelt?

Yes, most of the surface water comes from snowmelt in the Sierra Nevada Mountains. This surface water is used throughout the region. Therefore, the Kings Basin is vulnerable to potential climate change impacts on snow including earlier spring runoffs, less water storage as snowpack, and more frequent rain-on-snow events that could cause flood releases out of reservoirs.

2.b - Does part of your region rely on water diverted from the Delta, imported from the Colorado River, or imported from other climate-sensitive systems outside your region?

A small portion of the Kings Basin, including James Irrigation District, Tranquillity Irrigation Districts, and Fresno Slough Water District, use Delta water as a portion of their water supply. However, as part of their water contracts, these districts can receive San Joaquin River water in place of Delta water if Delta water is not available.

2.c - Does part of your region rely on coastal aquifers? Has salt intrusion been a problem in the past?

No, the region does not rely on coastal aquifers.

2.d - Would your region have difficulty in storing carryover supply surpluses from year to year?

The local reservoirs have some capacity to store carryover water from year to year without encroaching on flood control space. The space to store the water, and ability to keep it in storage, depends on the hydrology. In some years, agencies can carryover water and in other years they cannot. Additional carryover storage capacity would be welcomed by the local water agencies. The region does have very large sub-surface storage capacity. New groundwater banks are needed to further utilize this underground storage space.

2.e - Has your region faced a drought in the past during which it failed to meet local water demands?

Surface water supplies are reduced during droughts, but groundwater is generally used to meet shortfalls, in addition to some urban water conservation. As a result, almost all water demands have been met in past droughts. If groundwater levels continue to decline, then it may not be a reliable backup supply in the future and some demands may not be met.

2.f - Does your region have invasive species management issues at your facilities, along conveyance structures, or in habitat areas?

Some invasive plant species can clog natural channels and canals if they are not properly managed, so most agencies include this as part of their maintenance activities. Agencies in the area have been alerted to the potential for invasive species such as quagga mussels and how to help prevent their spread.

3. Water Quality

3.a - Are increased wildfires a threat in your region? If so, does your region include reservoirs with fire-susceptible vegetation nearby which could pose a water quality concern from increased erosion?

No reservoirs are located in the Kings Basin itself, but several reservoirs are found in the watersheds that provide surface water to the region. Vegetation surrounds these reservoirs, but it is generally sparse in the immediate vicinity of the larger reservoirs and would not pose a large water quality concern from increased erosion. Some reservoirs at higher elevations have thick forest on the reservoir rim, or are located in steeper terrain where post-fire erosion could potentially affect water quality.

3.b - Does part of your region rely on surface water bodies with current or recurrent water quality issues related to eutrophication, such as low dissolved oxygen or algal blooms? Are there other water quality constituents potentially exacerbated by climate change?

Warmer water could cause conditions that lead to eutrophication. However, the surface waters in the region, Kings River and San Joaquin River, are derived from Sierra snowmelt, and are cold and very pure. These waters have few nutrients that support algae growth and it is generally not a problem. However, algae is a problem in the canals that carry Kings River water to treatment facilities and can become a problem during very low flows at the distal end of the rivers.

3.c - Are seasonal low flows decreasing for some waterbodies in your region? If so, are the reduced low flows limiting the waterbodies' assimilative capacity?

No decreases in low flows for the local water bodies have been observed, although no detailed analysis has been performed. Changes in annual low flows from climate change would be difficult to identify since low flows already vary due to natural climate variations and management of reservoir releases.

3.d - Are there beneficial uses designated for some water bodies in your region that cannot always be met due to water quality issues?

Local surface water supplies are able to meet all beneficial uses, which include recreation, hydropower, aquatic habitat, irrigation, and municipal water use. However, operational adjustments are often made to improve water quality for fish. Groundwater quality varies throughout the region and is not suitable for municipal use in some areas. Groundwater quality may degrade further as groundwater levels continue to decline.

3.e Does part of your region currently observe water quality shifts during rain events that impact treatment facility operation?

Yes, even though surface waters in the region generally have excellent water quality, storm activity can cause very high turbidity spikes that can affect the operation of surface water treatment facilities.

4. Sea Level Rise

The Kings Basin is at an average elevation of about 300 feet above mean sea level and is approximately 100 miles from the ocean. Therefore, sea level rise is not a threat to the region.

5. Flooding

5.a - Does critical infrastructure in your region lie within the 200-year floodplain? DWR's best available floodplain maps are available at: http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/best_available_maps/.

Most of the floodplains in the Kings Basin are farmland. Some houses, roads, and water supply infrastructure (wells, canals, etc.) are also located in the floodplains. Major flooding would not likely cause serious disruptions to essential emergency-response services.

5.b - Does part of your region lie within the Sacramento-San Joaquin Drainage District?

No.

5.c - Does aging critical flood protection infrastructure exist in your region?

Major flood control facilities include Pine Flat Dam and Kings River levees. In addition, Friant Dam on the San Joaquin River impacts flooding along the San Joaquin River, on the northern boundary of the Kings Basin. These facilities are all considered to be in good condition.

5.d - Have flood control facilities (such as impoundment structures) been insufficient in the past?

Major flood control facilities including dams and levees have been sufficient in past years. Levee breaks along the Kings River would likely not cause serious problems and in most cases would only flood farmland.

5.e - Are wildfires a concern in parts of your region?

Wildfires are not generally a concern in the Kings Basin, but they are a concern in the San Joaquin River and Kings River watersheds which are largely forested. Wildfires can result in severe short-term erosion and water quality degradation of surface waters.

6. Ecosystem and Habitat Vulnerability

6.a - Does your region include inland or coastal aquatic habitats vulnerable to erosion and sedimentation issues?

No.

6.b - Does your region include estuarine habitats which rely on seasonal freshwater flow patterns?

No.

6.c - Do climate-sensitive fauna or flora populations live in your region?

A variety of flora and fauna live in the area and some are likely climate sensitive. Due to urban and agricultural development, some have limited ability to migrate as a means of adapting to climate change.

6.d - Do endangered or threatened species exist in your region? Are changes in species distribution already being observed in parts of your region?

Yes, several threatened and endangered species are found in the area. No noticeable changes in species distribution are known to have occurred since the region was developed.

6.e - Does the region rely on aquatic or water-dependent habitats for recreation or other economic activities?

Recreation is an important part of the local culture on the Kings River, San Joaquin River and in Pine Flat Reservoir. These recreational opportunities also provide a minor benefit to the local economy.

6.f - Are there rivers in your region with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life?

The San Joaquin River and Kings River both have schedules for minimum environmental flows. These flows are the highest priority water uses, and are likely to be met, except possibly in an exceptionally dry year.

6.g - Do estuaries, coastal dunes, wetlands, marshes, or exposed beaches exist in your region? If so, are coastal storms possible/frequent in your region?

No.

6.h - Does your region include one or more of the habitats described in the Endangered Species Coalition's Top 10 habitats vulnerable to climate change (http://www.itsgettinghotoutthere.org/)?

The Kings Basin is not included in the list of top 10 habitats vulnerable to climate change. However, the Kings River watershed is located in the Sierra Nevada Mountains, which is on the list.

6.i - Are there areas of fragmented estuarine, aquatic, or wetland wildlife habitat within your region? Are there movement corridors for species to naturally migrate? Are there infrastructure projects planned that might preclude species movement?

Due to the large amount of urban and agricultural development, prime wildlife habitat is generally fragmented in the valley portion of the Kings Basin. However, wildlife could feasibly travel between prime habitat areas through agricultural land, or along the Kings River corridor and its tributaries. In the foothills, and forested areas east of the basin, large un-fragmented wilderness areas are found. A high-speed rail project is proposed that could further fragment habitats in the Kings Basin.

7. Hydropower

7.a - Is hydropower a source of electricity in your region?

Yes. Hydropower is generated on the Kings River, San Joaquin River, and along the Friant-Kern Canal. The electricity is sold to the local power company and delivered to the electric grid, so it is not necessarily used directly in the Kings Basin, but is a valuable resource.

7.b - Are energy needs in your region expected to increase in the future? If so, are there future plans for hydropower generation facilities or conditions for hydropower generation in your region?

Energy demands are likely to increase in the region due to population growth, and to accommodate any climate change. No new major hydropower projects are planned for the area and are probably not likely to be pursued due to permitting difficulties. Some small hydropower projects are being considered along canals or at existing dams to utilize fish release flows. However, the energy generated from these projects would be small.

Conclusions from Vulnerability Assessment

Based on the analysis above the following vulnerabilities were identified for the Kings Basin. These vulnerabilities are listed in their order of importance.

1. **Backup Water Supplies.** The region has a reliable water supply, largely because groundwater is a dependable backup supply during droughts and the dry season. However, the groundwater level is declining and groundwater demands may increase if climate change reduces precipitation or causes earlier spring runoff that cannot be stored. If groundwater levels decline too much then the groundwater will become a less reliable supply, and groundwater quality may decline. This vulnerability can be measured with several parameters including

groundwater overdraft, groundwater level decline, groundwater remaining in storage, and changes in well yields.

2. **Inadequate Water Storage.** Storage facilities in the Kings Basin include Pine Flat reservoir, several smaller reservoirs in the upper Kings River watershed, and groundwater banks in the valley. These facilities have been successful in helping the region regulate seasonal and year-to-year flows; however, there is still demand for more storage. These facilities may be inadequate if warming reduces water storage in the form of snow. Obtaining permits to construct large dams is difficult, and, therefore, storage would have to be developed with numerous groundwater banks and off-channel reservoirs. This vulnerability can be measured by the volume of new storage developed in acre-feet.
3. **Climate Sensitive Crops.** Warmer temperatures could reduce losses for some crops from winter freezes, but other crops depend on some winter freezes to kill pests or ensure an effective dormancy. Higher temperatures could result in lower yields for these crops. No adaptation measures are available for this impact, other than changing crop types, which is expensive if permanent plantings are impacted. This vulnerability can be measured with the number of chilling hours below freezing, and impacts to crop productivity each year.
4. **Flooding.** Flooding is not currently a large problem, but increases in high flows could create future problems since it is unlikely that large flood control dams can be constructed. Therefore, proper floodplain zoning and limiting high-value development on floodplains is crucial to preventing future problems. This vulnerability can be measured by the number of essential structures constructed in the 200-year floodplain.

These vulnerabilities will be re-evaluated at least every five years to reflect changes in local cropping, water demands, water supplies, new facilities, and climate change projections.

17.5 Climate Change Models

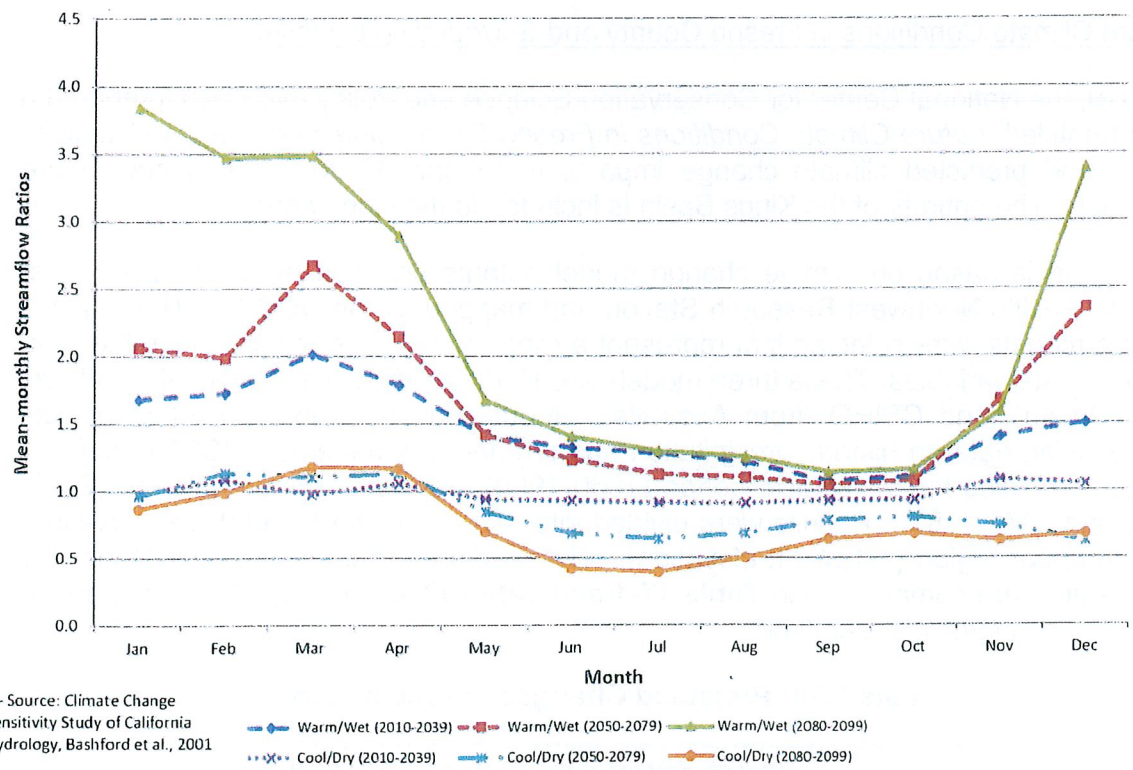
Climate change models are tools that can help identify a range of possible future climatic conditions. The Kings Basin Water Authority (Authority) did not perform model studies, primarily because several other organizations have modeled the local area. The results from each model differ, likely a result of different assumptions and differences in understanding the earth's processes and feedbacks. Taken as a group, however, climate models present a range of possible future conditions. Two models are described below followed by several general predictions for the State of California and Sierra Nevada mountain range.

Climate Change Sensitivity Study of California Hydrology

In 2001, the Lawrence Berkeley National Laboratory and National Oceanic and Atmospheric Administration published a report entitled '*Climate Change Sensitivity Study of California Hydrology*'. Six headwater basins in California were evaluated

including the Kings River Basin. Two climate change projections were used including a warm/wet scenario (HadCM2 run 1) and a cool/dry scenario (PCM run B06.06), based on projections provided by the Third Assessment Report of the Intergovernmental Panel on Climate Change. The 'cool/dry' scenario still includes increasing temperatures, but at a slower rate than the 'warm/wet' scenario. The conditions described by these global models were used to assess local conditions in specific areas of California.

The study provided estimated changes in temperature and precipitation for the two scenarios during different time periods. These impacts are ultimately reflected in changes to streamflows, which are illustrated in **Figure 17-2**. The streamflow ratios represent the ratio of projected streamflow to historical conditions (historical conditions have a ratio of 1.0).



1 - Source: Climate Change Sensitivity Study of California Hydrology, Bashford et al., 2001

Figure 17-2: Estimated Impacts to Kings River Flows
(Warm/Wet and Cool/Dry Climate Change Scenarios)

Figure 17-2 shows two vastly different scenarios, and illustrates both the uncertainty in climate change predictions and the importance of being prepared for a range of impacts.

The warm/wet scenario would provide additional water, which would be welcome in the water-short Kings Basin. However, some of this moisture would be lost to higher

evaporation and transpiration, and some would leave the basin as flood flows. This scenario could also present serious flooding problems throughout the Kings Basin, especially along the Kings River.

The cool/dry scenario would result in less overall moisture. Streamflows would be higher in the late winter and early spring due to earlier snowmelts. Late spring and summer flows would be lower, which could have serious water supply impacts.

The report also lists seven previous studies that suggested Sierra Nevada streams are likely to peak earlier in the season under global warming. In addition, a key finding was that basin elevation has the greatest influence on streamflow sensitivity to climate change. The Kings Basin watershed is at a high elevation compared to some of the other basins modeled, and was less sensitive to rising temperatures.

Future Climate Conditions in Fresno County and Surrounding Counties

In 2010, the National Center for Conservation Science and Policy (NCCSP), prepared a report entitled '*Future Climate Conditions in Fresno County and Surrounding Counties*'. The report predicted climate change impacts in Fresno, Madera, Kings and Tulare Counties. The entirety of the Kings Basin is included in the study area.

The report is based on climate change model outputs provided by the USDA Forest Service Pacific Northwest Research Station and mapped by the NCCSP. Three global climate models were selected that represent a range of projections for temperature and other climate variables. These three models are Hadley (HADCM from the UK), MIROC (from Japan), and CSIRO (from Australia). Model outputs were converted to local scales using data on historic precipitation and temperature patterns. NCCSP mapped climate variables for a historical period (1960-1990) and for two future periods (2035-2045 and 2075-2085). Results were divided into a lower region (<1,000 feet elevation) and an upper region (> 1,000 ft elevation). The predicted changes in precipitation and temperature are summarized in **Table 17-1** and **Table 17-2**. The report did not provide predicted changes in streamflow.

Table 17-1: Projected Changes in Precipitation

Time Period	Average Precipitation (% change from historic)			
	Lower Region		Upper Region	
Historic	9.4 in	-	29.9 in.	-
2035-2045	6.9 – 10.6 in.	-27% to +13%	21.7 – 33.6 in.	-28% to 12%
2075-2085	6.8 – 8.8 in.	-28% to -7%	20.5 – 28.2 in.	-32% to -6%

Note: USDA Forest Service Model

Projections for future precipitation varied among the three models, but all three agreed on drier conditions, on average, by late century, especially in the spring.

Table 17-2: Projected Increased in Temperature (F°)

Time Period	Upper Region	Lower Region
Historic	46.4	62.3
2035-2045	+2.5 – 4.8	+2.3 – 4.3
2075-2085	+5.2 – 8.9	+4.7 – 8.2

Note: USDA Forest Service Model

General Predictions for California and the Sierra Nevada Mountain Range

Several publications provide general statements on predicted climate change in California and the Sierra Nevada range. These general statements are not specific to the Kings Basin and are generally considered less reliable than local modeling results. However, they are useful for discussion and comparison purposes, and are listed in **Table 17-3**

Table 17-3: General Climate Change Predictions

Source	Prediction
Climate Change Adaptation Strategies for California's Water (DWR, 2008)	Water managers should use a drought component that assumes, until more accurate information is available, a 20 percent increase in the frequency and duration of future dry conditions.
	DWR projects that Sierra snowpack will experience a 25 to 40 percent reduction from its historic average by 2050.
Sierra Climate Change Toolkit, 2nd Edition (Sierra Nevada Alliance, 2007)	In most cases, total annual streamflow into major Sierra Nevada reservoirs is projected to drop about 10 to 20 percent before mid-century and 25 to 30 percent before the end of the century.
The Ahwannee Principles for Climate Change (Local Government Commission, 2009)	The State's largest reservoir (snowpack) is predicted to lessen by one third over the next 50 years and to half its historic size by the end of the century.

17.6 Adaptation Measures

Climate change adaptation is a response that seeks to reduce the severity of climate change impacts to human and natural systems. The adaptation measures identified below do not address a specific quantified impact, but rather focus on a range of

potential impacts. Since climate change predictions will never be perfect, flexibility and diversity in adaptation measures is fundamental. The adaptation measures will also help the region to improve resiliency, which is defined as the ability to return to original conditions after a disturbance or impact.

The DWR defines 'no-regret' strategies as actions that provide measurable benefits today while also reducing vulnerability to climate change (DWR, 2011). In other words, they are strategies that provide benefits with or without climate change. For instance, constructing a water bank would provide needed water supply benefits in the present, but could mitigate climate change impacts through floodwater capture, increasing water storage, and enhancing wetland habitat. The Water Education Foundation (2010) believes that planning for climatic uncertainty will also benefit planning for regulatory, environmental, economic, and social uncertainty.

The IRWMP Update Workgroup concluded that no-regret strategies should comprise the majority of adaptation measures. Consequently, the threat of climate change further justifies the need for many water management strategies already being used in the region. Furthermore, climate change adaptation is not in conflict with current Goals and Objectives of the region.

Most of the resource management strategies described in Section 6 would assist with climate change adaptation. However, the following strategies were deemed the most practical and effective for climate change adaptation in the Kings Basin:

- Improve urban and agricultural water efficiency
- Increase use of recycled water (where energy efficient)
- Revise land use planning policies to encourage conservation (e.g. low impact development or water efficiency standards)
- Develop groundwater recharge and banking projects
- Develop water storage projects inside and outside of the Kings Basin
- Increase ability to capture floodwater both for flood control and water supply
- Restore mountain meadows, wetlands, and riparian areas to regulate flows resulting in more summer runoff
- Change crop types to accommodate climate change

The overall theme with these strategies is to expand the extreme conditions (drought and floods) that the region can accommodate. Eliminating or reducing groundwater overdraft is considered the primary strategy for addressing water supply impacts from climate change.

17.7 Climate Change Monitoring

Climate change monitoring includes two components: 1) monitoring hydrologic and meteorologic parameters for climate change; and 2) monitoring climate change literature, legislation and modeling results.

The Kings Basin already includes a robust network for monitoring the hydrology, meteorology, water demands, water use, crop yields and wildlife. No immediate improvements are needed to monitor for climate change. The monitoring programs are periodically evaluated and upgraded, and the need for improvements to evaluate climate change will also be periodically evaluated.

Water projects were designed and are operated on the assumption that future hydrology will mimic past hydrology. Climate change will likely change future hydrology. However, the specific changes to the hydrology are uncertain, and some scientists are still undecided on whether the region will have a wetter or drier climate. Consequently, future projects will continue to be designed based on past hydrology until more definitive predictions are available. However, the potential change in hydrology is the driving force behind adaptation measures which will be pursued by the Authority.

The science of climate change, and the tools to mitigate and adapt to climate change, are still evolving. As a result, every five years as part of the California Water Plan Update process, DWR will provide revised estimates of changes to sea levels, droughts, and flooding that can be expected over the following 25 years. The Authority will also stay apprised of new studies, reports, literature, legislation, and climate change model runs that are pertinent to the area. When needed this literature will be shared with the Authority members and interested parties, and incorporated into the IRWMP updates.

17.8 Mitigation of Greenhouse Gas Emissions

Mitigation of climate change can be achieved by selecting and promoting projects that help to reduce greenhouse gas emissions (GHG) emissions. While the Authority is not responsible for air quality management, and they can only have a small impact on global emissions, it is sensible to consider emissions in project selection in view of the negative impacts climate change may have on water resources. The Authority is also dedicated to helping the State meet GHG emission reduction goals. These goals, prescribed in the California Global Warming Solutions Act of 2006 (AB 32), include reaching 2000 emission levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050.

All of the resource management strategies described in Chapter 6 can assist with climate change mitigation through reduction in energy demand, ecosystem enhancement, or carbon sequestration. For instance, water conservation can reduce energy demands to pump, convey, and treat water supplies. Another example is riparian area restoration, which can sequester carbon and create habitat for species impacted by climate change.

Projects are primarily ranked based on their water supply benefits, but GHG emissions and climate change adaptation were added as secondary considerations. Specifically, the following questions were added to the Project Review Process form:

1. Will this project result in reduced greenhouse gas emissions? If yes, explain how and quantify.
2. Will this project increase greenhouse gas emissions? If yes, explain how and quantify.
3. Will this project contribute to adaptation strategies to respond to climate change impacts?

Beginning July 1, 2012, GHG emissions for California Environmental Quality Act (CEQA) studies are required to be calculated using the California Emissions Estimator Model (CalEEMod). CalEEMod quantifies potential criteria pollutant and GHG emissions from construction and operations for a variety projects. The Authority will also require that this model be used on projects considered for funding.

17.9 Climate Change in other IRWMP Sections

Climate change is discussed in several other IRWMP sections including:

- **Chapter 5 – Goals and Objectives.** This chapter includes general goals related to climate change adaptation and mitigation.
- **Chapter 6 - Resource Management Strategies** – This chapter discusses the impacts of climate change on the efficacy of different strategies, and the ability of strategies to help adapt to climate change.
- **Chapter 7 - Project Review Process** – The project review process includes new questions related to GHG emissions (Section 17.8)
- **Chapter 12 - Relation to Local Water Planning** – This chapter summarizes the climate change adaptation and mitigation strategies from local water plans, and evaluates their consistency with the goals of this IRWMP.

J

ENGINEER'S REPORT

PROPOSITION 218 PROCEDURES

ALTA IRRIGATION DISTRICT

DECEMBER 2005

REGISTERED PROFESSIONAL ENGINEER
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REPORT SUMMARY

PROPOSITION 218

ALTA IRRIGATION DISTRICT

REPORT SUMMARY
PROPOSITION 218
ALTA IRRIGATION DISTRICT

The following is a summary of the Engineer's Report which was prepared in support of a proposed groundwater assessment increase. This report was prepared in accordance with the provisions of Section 53750 through 53753.5 of the Government Code of the State of California. These provisions were implemented as required by Proposition 218, which establishes mandatory procedures for either increasing or establishing new special benefit assessments charged to lands by special agencies.

The Engineer's Report reviewed existing District operations, budgets and projected costs. At the current rate structure, the District is running a deficit in their annual budget that is draining their reserves. Within four to five years, these reserves will be completely exhausted.

In 2000/2001, the District initiated a water surcharge. The surcharge is assessed based on the quantity of water delivered to the landowner. This rate was established to fund the actual cost of delivering surface water to the landowner. Increases in this fee structure are governed by Section 6 of Proposition 218.

The groundwater charge refelcts the groundwater benefit received by all landowners through the delivery of the District's surface water entitlement. These benefits include a reduction in pumping costs, stabilization of the groundwater, drought protection, maintaining land values and cost savings for on-farm capital improvements. These benefits are applied uniformly among all the lands within the District. The groundwater charge was instituted in 1981. The cities and unincorporated communities which obtain their water supply from the groundwater also benefit from the activities of the District. They are not included in the assessment analysis, since they currently pay an agreed upon assessment to the District.

The District is currently operating with a deficit. The estimated future increase in the costs for the Maintenance and General Budget have been developed. Funding to balance the budget will be collected by raising the present groundwater fee. This fee has not been increased for 11 years and is set at a value substantially below the value of the benefits received. During this 11 year period, the District has experienced substantial cost increases for insurance, fuel, materials, regulatory fees and environmental regulations. Many of the costs included in the budget are required whether or not water is delivered. The proposed increase is needed to maintain the District in a stable financial position, allowing them to continue properly administering their water right.

During this last 11 year period of increased costs, the District has maintained their Maintenance and General Costs at a level amount. This occurred through measures implemented by the District to contain costs. The ditchtender routes have been reduced from 22 to 11. This

has been done without any sacrifice in the level of service. Other cost savings came through the use of electronic equipment such as cellular phones and computers to provide a labor savings, organizational improvements, management structure, ditchtender vehicle usage and operational changes.

Based on the benefits and costs associated with the groundwater assessment, a maximum increase in this rate of $5.00 per acre should be established. It is recommended that the increase be applied uniformly across the District lands. This rate increase will initially be set at $3.50 per acre and gradually increased as required, to meet the obligations of the District. The Board of Directors will evaluate the costs annually and set the assessment accordingly. This maximum increase will not be evoked unless necessary to establish a rate structure sufficient to allow the District to continue providing water to the landowners in accordance with their Kings River entitlement. A maximum increase in the groundwater fee was developed instead of annual increases to reduce the structural costs associated with the Proposition 218 requirements.

The District will be holding public hearings to consider and address comments and questions from the District's landowners. The landowners will be allowed to participate and provide input regarding the District's operations and recommended assessment increases. All landowners impacted by the additional assessment will receive a ballot for voting on the recommended fee increase. The procedures in Proposition 218 regarding the holding of an election will be followed and will begin after the acceptance of the Engineer's Report by the Board of Directors.

CHAPTER I

PROPOSITION 218

ALTA IRRIGATION DISTRICT

CHAPTER I
PROPOSITION 218
ALTA IRRIGATION DISTRICT

GENERAL

In November of 1996, the California voters adopted the Proposition 218 initiative, Right to Vote on Taxes Act. Proposition 218 requires that beginning on July 1, 1997, all fees or charges shall comply with the requirements set forth in Article XIIIC and Article XIIID of the California constitution. In addition, the articles apply to any general tax imposed, extended or increased without voter approval on or after January 1, 1995. Existing assessments that were effective prior to July 1, 1997 for sidewalks, streets, sewers, water, flood control, drainage system or vector control are not subject to Proposition 218.

The act is specific regarding the procedures to be followed. This includes the requirement for conducting an election prior to establishing a new assessment or increasing an existing assessment. The election process specified in Proposition 218 requires the ballots to be weighted according to the financial obligation of the property. A new fee or an increase in fees shall not be imposed if the weighted ballots in opposition to the assessment exceed the ballots submitted in favor of the assessment.

In addition to the election requirements there are certain specific procedures that the agency must follow. These procedures are summarized below:

1. All parcels that will receive a special benefit and upon which an assessment will be imposed shall be identified;
2. The value of the benefit for each parcel shall be identified;
3. The cost shall not exceed the proportioned special benefit;
4. An engineer's report shall be prepared supporting the assessments;
5. A notice, including ballot, shall be mailed to owners of all properties impacted by the assessment;
6. A public hearing shall be conducted not less than 45 days after mailing of the notice to the record owners of each parcel; and
7. At the close of the public hearing, the ballots shall be tabulated.

Prior to the passage of Proposition 218, the District was able to set an assessment each year that was adequate to cover expenses. The District must now follow the requirements of Proposition 218 prior to raising an assessment.

ENGINEER'S REPORT

Proposition 218 requires that a detailed Engineer's Report be prepared in support of all assessments. In compliance with Proposition 218, this Engineer's Report was completed and submitted to the District. As part of the study, existing District operations and budgets were examined. The existing budget deficit was noted. Projected future revenues and costs were prepared based on anticipated activities, operations and cost factors. Historical District activities

were noted and additional regulatory requirements being placed on irrigation districts were identified. These regulatory issues have an adverse impact on the District budget.

The Engineer's Report identifies the existing fee structures within the District, water supplies, costs and revenues. The Report evaluated the relationship between the groundwater benefit received by all landowners and the increase in the groundwater assessment. This benefit was found to exceed the cost of the assessment increase. The proposed budgets are neutral, in that they only propose revenues equal to District costs.

CHAPTER II

DISTRICT BACKGROUND DATA

ALTA IRRIGATION DISTRICT

CHAPTER II

DISTRICT BACKGROUND DATA

ALTA IRRIGATION DISTRICT

GENERAL

The Alta Irrigation District (District) maintains its main office within the City of Dinuba. The District is located in the Counties of Tulare, Fresno and Kings. The District is principally rural with the only incorporated cities being Dinuba and Reedley. In addition to the two cities there are several unincorporated urban areas within the District. The District is governed by a seven member Board of Directors. The District staff provides management, collections, maintenance and operations activities.

HISTORY

The District was preceded by the "76" Land and Water Company (Company). The Company began construction of their diversion and delivery facilities in 1883. At that time the headquarters for the Company was located in Traver.

The California Legislature passed the Wright Act on March 7, 1887. This act led to the formation of irrigation districts within the State of California. On August 14, 1888, an election was held authorizing the formation of the District. The District was one of the first irrigation districts formed in the state.

There are 129,300 acres within the District. A map of the District is shown on Plate 1. Of the total acres within the District, approximately 110,000 acres are farmed.

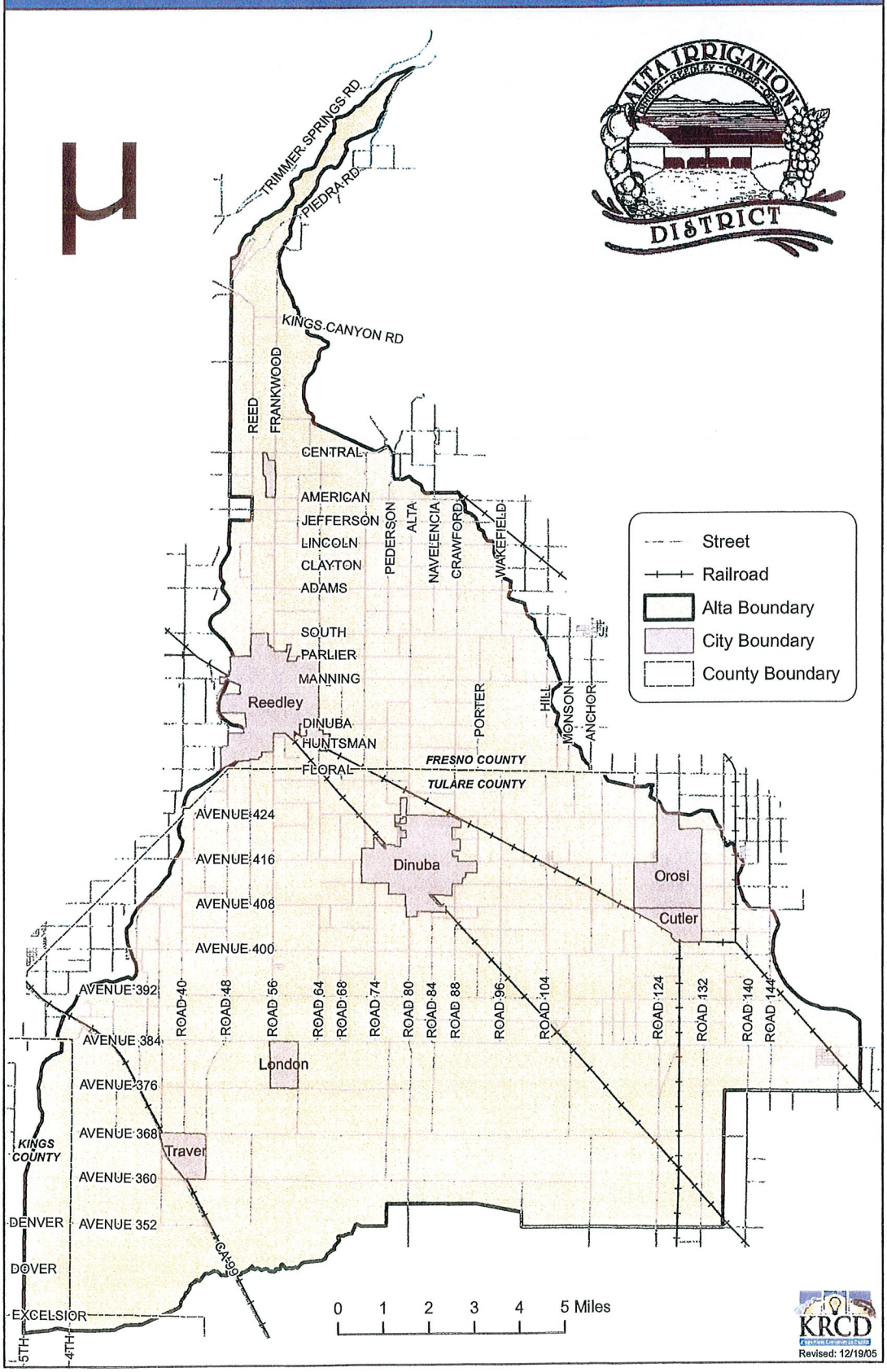
In the early years, the lands within the District were predominantly used for cattle grazing, and the growing of wheat, cotton and other row crops. Water was only available to the District when the Kings River was flowing. With the improvement of District facilities and construction of Pine Flat Dam, the water supply dependability was greatly improved. Due to these improvements, the cropping pattern has changed considerably. The District is now predominantly developed to permanent plantings. The crop survey for the District is based on county records.

Within the District there has been some conversion of agricultural lands to urban developments. This has occurred steadily over time with increased activity occurring during the last few years. This development has predominantly occurred within the cities of Reedley and Dinuba along with the unincorporated community of Orosi.

CLIMATE

The District's climate is characterized by long dry periods, hot summers and mild winters, with the rainy season lasting usually from mid-November through March. Summer temperatures of 100 degrees or higher are common. The winters are mild with some frost and Tule fog being

Alta Irrigation District Boundry



prevalent during the December through February period. The rainfall occurs during the winter months with no precipitation typically being experienced during the summer. The average annual rainfall is 12.5 inches per year.

WATER SUPPLY

The District's water supply is based on historical water diversions from the Kings River. The District is one of four districts classified as the upper districts. The District's diversion from the Kings River is the first one on the river. The District's supply is diverted at the Cobbles Weir located on the Kings River and into the "76" Channel. The water flows in the "76" Channel to the District's Headgate where it is diverted into the Main Canal. From this location water is conveyed through district facilities to individual turnouts for application to the land.

In 1954, Pine Flat Dam was completed on the Kings River. Prior to construction of the dam, deliveries were based on the run of the river. Under these conditions, water could only be diverted when water was present in the river and in accordance with the entitlement schedules for all the water right holders. This did not allow for much flexibility in the management of the District's water supply. Since the completion of the dam, water is now stored in Pine Flat Reservoir. The District purchased a storage right behind the dam. This has allowed greater flexibility in the District's water operations and improved their ability to make beneficial use of the available water supply. The ability to store entitlement has also allowed water to be carried over in the reservoir from one year to the next. Depending on storage availability, the runoff in wet years can now be stored and run the following year.

The District's water supply is comprised of pre-1914 water rights on the Kings River. The District was one of the initial water rights holders on the river. Surface water rights for each of the individual units are administered through the Kings River Water Association. Each of the 28 organizations within the association have defined Kings River water rights based on both the instantaneous natural flow within the river and the month the flow occurs. The water available annually to the District is extremely valuable. The 25-year record of District diversions is shown in Table 1. To maintain this water right, the District must continue to make beneficial use of the water supply.

During the 1977-2001 period, the average annual District diversion was 163,500 acre-feet. The actual diversion during this time period varied from a low of 38,721 acre-feet to a high of 253,269 acre-feet. The annual diversions are shown in Table 1.

The quantity of water available to the District is a function of the runoff generated within the Kings River system. This runoff is comprised of both rainfall and snow melt. An important benefit of the snowfall is the water storage provided by the snow pack.

Prior to the construction of Pine Flat Dam, water was diverted only when the rainfall and snow melt runoff were flowing in the Kings River. With the construction of the dam, the District is now able to store their entitlement and deliver it to landowners more efficiently. Instead of being subject to short water runs at high flow rates, the District can now provide a managed flow over an extended period of time. This has changed the manner in which the District operates its delivery system and has lengthened the average irrigation run for the landowners.

In addition, the large quantities of runoff developed during wet years can now be stored in the reservoir and carried over for use in the following year to the extent allowed under the Kings

TABLE 1

DISTRICT HEADGATE DIVERSION

ALTA IRRIGATION DISTRICT

YEAR	DIVERSION (acre-feet)
1977	38,721
1978	246,204
1979	181,999
1980	253,269
1981	145,581
1982	247,599
1983	205,445
1984	214,165
1985	170,826
1986	227,709
1987	121,270
1988	59,188
1989	89,983
1990	58,463
1991	107,706
1992	66,623
1993	246,415
1994	122,677
1995	236,725
1996	222,268
1997	214,341
1998	172,176
1999	147,120
2000	166,441
2001	124,620

River Water Association agreements. The construction of the dam has resulted in the District being able to better utilize their available water supply and maximize the District's irrigation run. The length of the District's water run is highly variable from one year to the next. The average water run for the 25-year period shown in Table 1 is approximately four months.

The District does not provide a full water supply to the landowners. To meet their individual water demands, the water users must pump groundwater in conjunction with the surface water supply. There are lands within the District that are groundwater only areas and pump their entire supply, except in wet years when some surface water is delivered. Conjunctive use of surface water and groundwater is practiced within the District. The wet years allow the groundwater levels to be enhanced by reducing the pumping. This provides additional groundwater storage for those years in which the surface water supply is reduced and additional pumping is required.

The District has constructed regulation reservoirs to enhance the use of the surface water supply. These reservoirs allow excess water within the distribution system to be captured by the District for delivery to the landowners at a later time to supplement the water deliveries. The District was able to reduce the cost of constructing two regulation reservoirs by entering into agreements with the counties of Fresno and Kings for the sale of the soil. A third regulation reservoir was improved with grant funds received from the Kings River Conservation District.

GROUNDWATER

Being a conjunctive use district, opportunities to enhance the groundwater supply are important to the District. Due to the soil structure within the District, there are very few sites that

are suitable for direct recharge basins. The existing groundwater supply is overdrafted and the District continues to look for ways to enhance groundwater storage.

The District has investigated potential recharge basin sites. The District is now in the process of executing a grant contract through the Proposition 13 Program to build a groundwater recharge basin on the west side of the District. With this basin the District will be able to augment their net water supply by recharging both flood waters and the additional water that is available in wet years. In addition, a joint use basin will be constructed and utilized by the City of Dinuba and District in the westerly portion of Dinuba for groundwater recharge and storm water retention.

The District maintains a network of monitoring wells that are read twice a year. These water level measurements provide information on the changes in the groundwater levels. There is a direct correlation between the years in which the District diverts large quantities of surface water and the subsequent improvement in the groundwater elevations. Likewise, during years of below normal diversions by the District, the groundwater level continues to drop.

There are three methods utilized by the District to recharge the groundwater. One method is through the direct recharge of surface water. This is done where possible, but locating suitable sites for recharge within the District is difficult. Another method is through indirect recharge from canal percolation. The third method is in lieu recharge. The latter method is accomplished by maximizing the District's surface water deliveries, which allows the landowners to reduce the quantity of groundwater that is pumped. This is the most efficient method of recharge available to the District. The groundwater pumping that is replaced by the in lieu recharge remains in the

groundwater basin for withdrawal at a later time and/or for stabilization of the groundwater levels.

The District has also prepared a Groundwater Management Plan. This plan has been endorsed by the cities and the unincorporated urban areas within the District. The Groundwater Management Plan is useful for basin-wide groundwater management and allows for cooperative projects between the agencies that can further stabilize the groundwater.

The District is also a partner in the Integrated Regional Water Management Plan. Through this program, the District is working with other local agencies to secure grant funding for projects within the District.

FACILITIES

The District operates and maintains approximately two hundred and fifty miles of open channels along with sixty-five miles of pipeline. In addition, there are thousands of structures that are operated by the District. Many of the pipelines are 50 years old with some of the structures being 100 years old. This represents a substantial investment in capital facilities that must be operated and maintained by the District. As these facilities age, they will require additional maintenance. The long term depreciation of these facilities are additional costs that the District must fund to maintain their delivery system.

The District was recipient of a Proposition 13 grant to evaluate the feasibility of piping a portion of two existing open channels in an area where there is an existing groundwater mound. The grant funding allowed the study to be completed along with a portion of the engineering

plans for the piping. With the completion of the study, the District will pursue grant funds to install the pipelines. These types of projects can provide a benefit to the District by reducing the water loss from those channels. The water gained by this project can be utilized in other locations for groundwater recharge or in lieu recharge through direct deliveries to agricultural land.

OPPORTUNITIES

The District is actively involved in securing funding through Proposition 13 and Proposition 50. Through these programs, funds are available to conserve water, upgrade facilities and improve monitoring. Proposition 13 and Proposition 50 funding will assist the District in developing programs to augment their water supply and reduce operational costs for the District. Through their participation in the Water Forum, the District is able to stay informed of the various funding opportunities. The District continues to evaluate organizational improvements, management structure, effectiveness of ditchtender runs and operational changes that will enhance their ability to beneficially deliver water at the lowest cost.

CHAPTER III

BUDGET AND ASSESSMENTS

ALTA IRRIGATION DISTRICT

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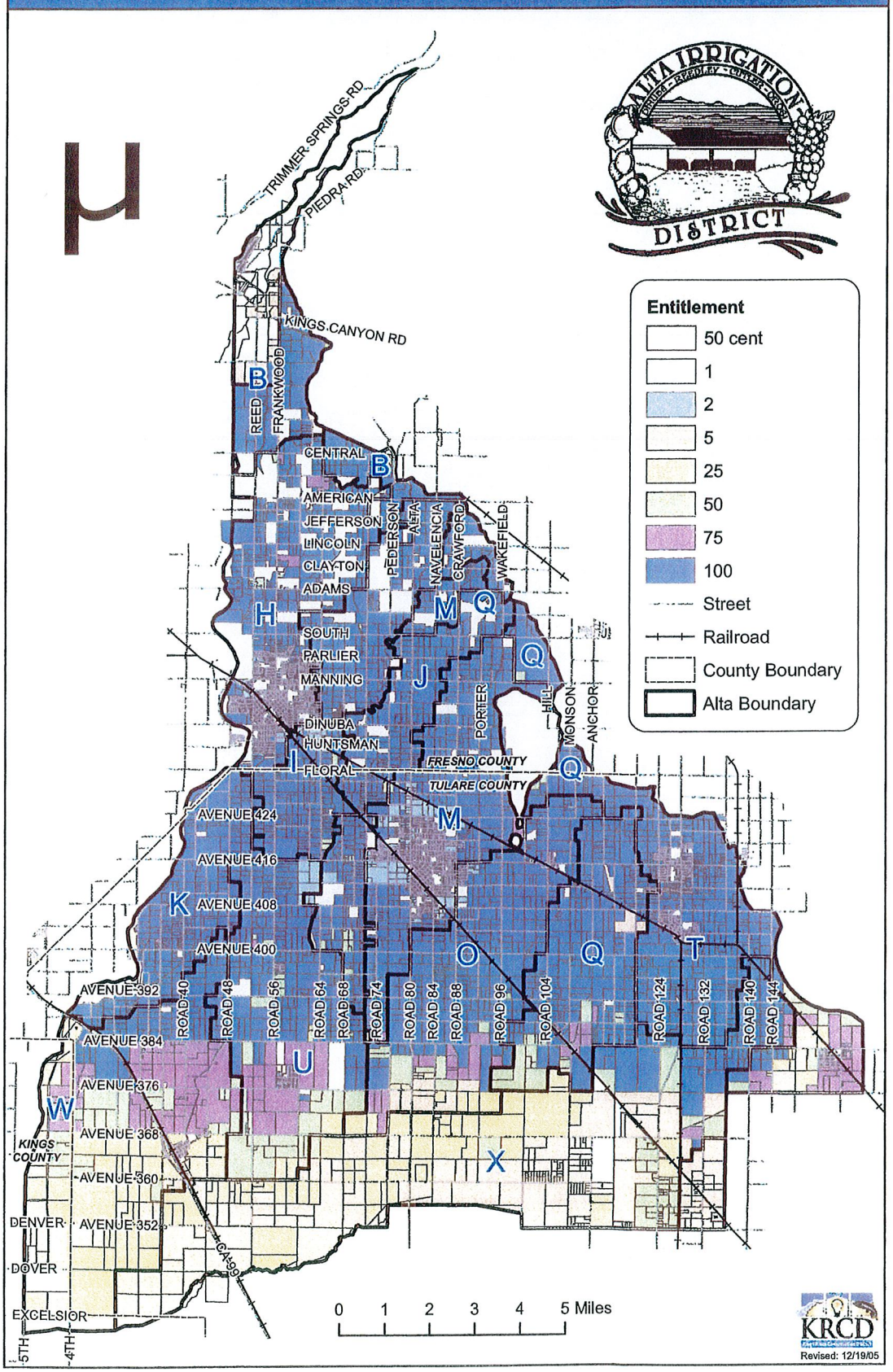
ALTA IRRIGATION DISTRICT

ENTITLEMENTS

The agricultural lands within the District are provided surface water based on the specific surface water entitlement (entitlement) for each parcel. There are currently four different surface water entitlement classifications ranging from a maximum of 100 percent down to 25 percent. Lands that are not in one of the four categories are classified as groundwater only. A map of the District showing the entitlements for all the parcels is shown as Plate 2.

Based on the entitlement category for an individual parcel, the allocated surface water allotment in a normal year is reflected by the ratio of the percentages. As an example, all lands that are designated as being within the 50 percent entitlement category will be entitled to one-half of the amount of surface water that is allocated to lands included in the 100 percent category. Approximately 60 percent of the land within the District is included in the 100 percent delivery category.

Alta Irrigation District Entitlement



Some lands are in the groundwater only entitlement category. These lands are not entitled to surface water deliveries, but receive a groundwater benefit. If the landowner has facilities to divert surface water, the groundwater only entitlement category may have an opportunity to receive entitlement water in very wet years.

The average amount of measured water delivered to turnouts during the 1999-2005 period for the four entitlement categories is 93,456 acre-feet. The total quantity of water delivered along with the average acre-foot per acre delivery made during this period for each category is shown in Table 2.

TABLE 2

ENTITLEMENT OF MEASURED WATER DELIVERIES TO TURNOUTS

CATEGORY (%)	VOLUME (AF)	DELIVERY PER ACRE (AF/AC)
100	75,901	1.02
75	7,353	0.94
50	4,570	0.57
25	4,961	0.37

Generally, the water delivered per acre follows the entitlement category percentage. There are variations from year to year based on the water availability.

Prior to the development of these four categories, there were twenty different entitlements within the District. Operating the system with twenty entitlement categories was a logistics problem for the District in trying to provide equitable management of the water supply to the individual landowners. In 1985, the District evaluated all of the existing entitlement categories.

Based on the results of that study, the twenty entitlements were reduced to the four. Those categories are currently in place at this time. This change has allowed the District to more efficiently operate their conveyance facilities and to equitably administer the water deliveries for each landowner. These changes did not place any of the lands into a lower entitlement category. In addition, the groundwater only category was maintained.

GROUNDWATER CHARGE

The groundwater charge was instituted in 1981. The Alta Irrigation District is a conjunctive use district that depends on surface water deliveries to bolster the groundwater supply. If the District did not have their present surface water right, the groundwater would rapidly be depleted and the pumping levels would increase. The impacts of surface water on the groundwater supply have previously been discussed. Due to these benefits, the District initiated a groundwater charge. This groundwater charge is paid by all agricultural lands within the District. The last increase in this rate occurred in 1994, when the rate was raised from $2.50 to $3.50 per acre.

SURCHARGE

A surcharge based on the actual quantity of surface water measured to each parcel was instituted in 2000 under Section 6 of Proposition 218. The initial rate was set at $1.71 per acre-foot. The amount of surface water delivered to each parcel is measured at the individual turnouts. The total surcharge fee is computed at the end of the water run based on the measured quantity of water and billed in the following fiscal year. Due to the increasing costs for delivery

of surface water, this rate was increased to $3.20 per acre-foot in 2004. Those parcels that cannot or elect not to take surface water, are not charged the surcharge.

URBAN AREAS

Within the District there are two cities and numerous unincorporated urban areas. These communities do not receive any surface water, but pump water from the underground to meet the demands of their customers. Even though the communities are supplied 100 percent from groundwater pumping, they receive a benefit from the District's surface water deliveries. Without the surface water provided by the District, the communities would be subject to declining groundwater levels and increased pumping costs. The District has developed an appropriate fee for all lands lying within the urban area boundary of these communities. These fees are collected by the county on behalf of the District.

HISTORICAL BUDGETS

The District has historically maintained adequate reserves to provide funding for one-half year of operational costs, potential flood related damage costs, construction of system improvements, unforeseen legal and regulatory costs and replacement of district facilities. For the last five years, the District has elected to utilize these reserves to meet the annual operation, maintenance and general costs. The District's total annual revenues and costs for the years 96/97 through 03/04 are shown in Table 3.

TABLE 3

DISTRICT REVENUES AND COSTS

FISCAL YEAR	TOTAL REVENUES	TOTAL COST
96/97	2,031,215	2,191,518
97/98	2,005,032	2,152,881
98/99	2,032,842	2,001,891
99/00	2,098,289	2,124,094
00/01	1,985,309	2,184,631
01/02	2,269,160	2,076,811
02/03	2,009,302	2,210,894
03/04	2,021,402	2,197,572

During this period, the District has experienced significant increases for the cost of liability insurance, health insurance, workmen's compensation insurance, pensions, materials, fuel and new regulatory compliance requirements. Even with all of these increases in cost, the District has been able to maintain the level of service provided to the landowners by using reserves to cover the short fall. The revenues to the District during this period of time have been constant and have not reflected the increasing costs of operations. The deficit amount occurring each year is shown in Table 4.

The additional funding required to balance the budget during the 96/97 -03/04 period has been taken from reserves. Without taking from the reserves, the District would not have been able to meet their financial obligation. The year 01/02 shows a surplus of $192,349. The surplus for the year was due to the income received by the District for selling a portion of the District

TABLE 4

DISTRICT BUDGET DEFICIT

FISCAL YEAR	DEFICIT AMOUNT
96/97	-160,303
97/98	-147,849
98/99	+30,951
99/00	-25,805
00/01	-199,322
01/02	+192,349 /1
02/03	-201,592
03/04	-176,170

/1 $200,000 deficit without property sale.

property to the City of Dinuba. If it was not for the sale of this property, the District would have experienced a $200,000 deficit for the year. The 98/99 year showed a slight surplus of $30,951.

The District has been able to reduce spending by instituting more efficient operating procedures, which included the use of cellular phones, computers, reduction in the number of personnel, revisions to ditchtender assignments and the delaying of maintenance and capital improvements on the distribution system. The practice of using reserves cannot continue or the District will soon be in a position where they do not have sufficient funds to meet their annual obligations. The capital improvement program for the District cannot be continually deferred. These improvements eventually need to be completed to maintain the integrity of the system. Replacement of old equipment is necessary for the District to stay efficient in completing the

maintenance and capital improvement projects. The District is able to complete these improvements at a lower cost by utilizing their personnel. The total cash reserves held by the District are shown in Table 5. The anticipated reserve for the 4/05 year is $897,876.

TABLE 5

DISTRICT CASH RESERVES

FISCAL YEAR	AMOUNT
96/97	$2,106,023
97/98	$2,368,476
98/99	$2,256,286
99/00	$2,007,697
00/01	$1,767,890
01/02	$1,734,104
02/03	$1,519,147
03/04	$1,276,892

WATER SURCHARGE

Due to the recurring deficit in the District's annual budget, a water surcharge was instituted during the fiscal year 99/00. Since this is a volumetric charge based on the actual water measured at a landowner's turnout, a public hearing was conducted in accordance with Section 6 of Proposition 218. Based on the results of that hearing, the water surcharge was instituted. Prior to adopting the water surcharge rate, an evaluation was conducted of the operational costs involved in delivering the District's water supply. The charge per acre-foot was established to provide sufficient funding to cover the costs for delivering water to the landowners. Without the

implementation of the water surcharge, the District's average deficit would have increased by $188,000 per year. This would have amounted to $938,690 over a five-year period. From a review of Table 5, it can be seen that this additional deficit would have eliminated the District's reserves.

The District's Operational Budgets for the fiscal years 96/97 through 03/04 are shown in Table 6. The revenue side of this budget is principally comprised of the water surcharge (acre-foot delivery charge) along with 50 percent of the District's share of the power revenue generated at Pine Flat Dam. The water surcharge is billed at the end of the year and is actually collected in the water year following delivery. For the purpose of this report, we have shown these revenues in the year that the water was delivered. This allows actual costs and revenues to be compared.

This Operational Budget represents only the costs involved with the delivery of water to the landowners. To compute the actual cost, the District's budget was evaluated by staff and the engineer to determine the actual cost for water delivery. The estimated employee time involved with the delivery of water was included in the Operations Budget. This cost includes direct labor along with the associated benefits and payroll taxes. Other costs in the budget are for items such as maintenance and fuel for ditchtender trucks, cell phones and chemicals for algae control in the water supply.

An initial surcharge rate was previously set at $1.71 per acre-foot. This rate has significantly reduced the deficit in the Operations Budget, but it has not been completely eliminated. Due to the continuing deficit, a hearing regarding a rate increase was held during fiscal year 03/04. The rate was adjusted to $3.20 per acre-foot at that time.

TABLE 6
DISTRICT OPERATIONAL HISTORICAL REVENUES AND COSTS

Volumetric Water Surcharge	$0.00	$0.00	$0.00	$0.00	$1.71	$1.71	$1.71	$3.20
Fiscal Year	**96/97**	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**
Water Run Revenues								
Water Surcharge *	$ -	$ -	$ -	$ 178,894	$ 130,446	$ 132,351	$ 262,594	$ 234,406
Water Surcharge Penalty	-	-	-	1,043	412	465	1,503	1,756
Pine Flat Power Income 50%	169,282	134,076	117,644	91,298	78,999	64,778	55,515	67,796
Total Water Run Revenues	$ 169,282	$ 134,076	$ 117,644	$ 271,234	$ 209,856	$ 197,595	$ 319,611	$ 303,957
Water Run Costs								
Maintenance Ditchtender Trucks	$ -	$ -	$ 5,559	$ 4,348	$ 3,301	$ 3,716	$ 8,224	$ 4,462
Fuel - Ditchtender trucks	22,792	24,097	14,910	21,307	14,979	12,831	15,244	18,016
Cell Phone - Ditchtenders	-	-	7,918	10,050	8,062	6,037	3,919	3,803
Answering Service	-	-	149	223	185	206	170	282
Car Hire	41,513	34,985	-	-	-	-	-	-
Algicide	-	-	-	-	9,416	8,258	8,180	6,036
Operational Payroll	203,869	240,671	209,916	248,492	159,654	182,124	183,459	166,232
Payroll Tax/Benefits	65,694	77,553	67,643	80,073	51,446	58,687	59,117	53,566
Drop Boards	8,708	5,452	5,782	4,776	4,394	3,858	3,818	4,426
Total Water Run Costs	$ 342,576	$ 382,758	$ 311,877	$ 369,269	$ 251,437	$ 275,717	$ 282,131	$ 256,823
Net Operational Cash Flow	$ (173,295)	$ (248,682)	$ (194,233)	$ (98,035)	$ (41,581)	$ (78,122)	$ 37,480	$ 47,134

* Water Revenues Are Shown In The Year Generated For Budget Purposes.
These Revenues Are Actually Received In The Following Year.

The total annual operational cost for delivery of water to the landowners is highly variable and depends on the runoff. In wet years when there is an adequate water supply on the Kings River, the water run for the District is lengthened and results in a corresponding increase in operational costs. With an adequate surcharge rate, the revenue from the sale of the additional water will increase sufficiently to cover the additional operational costs associated with the longer water run.

MAINTENANCE AND GENERAL COSTS

As with the Operational Budget, a similar approach was utilized in determining the actual cost for maintenance and general purposes. The items included in this budget represent the costs incurred by the District whether they run water or not. The District is required to pay fees associated with maintaining their water rights. These fees include maintenance of the dam, Kings River Water Association operational costs and a newly invoked water diversion fee charged by the State Board. In addition, the District has ongoing costs for insurance, payment on financing packages, normal system maintenance, maintaining the District office, collections, associated charges and new regulatory requirements. These costs continue even in dry years when limited surface water supplies are available. The Maintenance and General Budget is shown in Table 7. The District has completed the repayment for their share of the Pine Flat Dam construction and this cost is no longer included in the budget. The last payment, as noted in Table 7, was made in 02/03.

The income for the Maintenance and General Budget is generated primarily from assessment revenues. The assessment revenues include the various entitlement categories,

TABLE 7

DISTRICT MAINTENANACE & GENERAL HISTORICAL REVENUES AND COSTS

Fiscal Year	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04
Maint & General Revenues								
Assessment Revenues	$ 1,503,970	$ 1,505,871	$ 1,504,005	$ 1,501,432	$ 1,498,439	$ 1,505,096	$ 1,502,142	$ 1,561,387
Pine Flat Power 50%	169,282	134,076	117,644	91,298	78,999	64,778	55,515	67,796
PGE Evaporation	-	-	-	-	12,982	10,467	28,058	10,958
Interest Income	116,656	180,638	146,954	160,590	152,824	79,781	50,942	44,536
Penalties and Cost	8,902	9,899	9,408	9,525	12,634	4,347	9,841	9,815
Equipment Lease/Rents	5,550	6,542	6,000	6,180	6,430	6,410	10,030	7,320
Administrative Fee	-	-	9,052	377	640	1,590	26,173	2,597
London Pond Soil Sales	3,530	10,700	3,600	6,350	-	-	-	-
Misc Income	52,036	65,687	134,463	51,011	3,428	9,096	6,990	13,036
Gain/(Loss) Sale of Equipment	2,007	(42,457)	(15,928)	292	9,077	390,000	-	-
Total Maint & General Revenues	**$ 1,861,933**	**$ 1,870,956**	**$ 1,915,198**	**$ 1,827,055**	**$ 1,775,453**	**$ 2,071,565**	**$ 1,689,691**	**$ 1,717,445**
Maint & General Costs								
Pine Flat Dam M&O	$ 45,228	$ 46,039	$ 95,000	$ 65,000	$ 67,569	$ 70,116	$ 66,623	$ 61,411
KRWA M&O / Water Fees	62,192	71,513	72,849	88,092	77,854	109,666	86,486	93,278
Maintenance (+ Maint payroll)	532,549	538,040	438,494	451,530	480,340	432,247	502,164	585,169
General	1,079,773	1,027,848	970,614	938,550	1,004,531	920,914	1,023,138	1,047,205
Interest Expense			20,056	17,512	33,768	38,339	30,526	25,149
Total Maint & General Costs	**$ 1,719,742**	**$ 1,683,440**	**$ 1,597,013**	**$ 1,560,684**	**$ 1,664,062**	**$ 1,571,282**	**$ 1,708,937**	**$ 1,812,212**
Maint & Admin General Costs								
BUDGET Maint - Capital	$ 93,700	$ 15,183	$ 22,564	$ 13,863	$ 86,506	$ 7,042	$ 60,149	$ 26,118
BUDGET Office - Capital	-	36,000	6,955	37,275	1,858	2,950	5,600	30,450
BUDGET Finance Packages *(principal only)*	-	-	-	61,675	99,440	138,597	99,587	71,969
BUDGET Pine Flat Repayment	35,500	35,500	35,500	35,500	35,500	35,395	35,395	-
Ditchtender Trucks - finance package	-	-	27,982	45,828	45,828	45,828	19,095	-
Capital purchases and financial packages	**$ 129,200**	**$ 86,683**	**$ 93,001**	**$ 194,141**	**$ 269,132**	**$ 229,812**	**$ 219,826**	**$ 128,537**
Total Maint & General Costs	$ 1,848,942	$ 1,770,123	$ 1,690,014	$ 1,754,825	$ 1,933,194	$ 1,801,094	$ 1,928,763	$ 1,940,749
Net Maint & General Cash Flow	$ 12,991	$ 100,833	$ 225,184	$ 72,230	$ (157,741)	$ 270,471	$ (239,072)	$ (223,304)

groundwater charge and urban area assessments. Fifty percent of the District's share of the revenue generated from the Pine Flat Power Plant is included in the revenue section of this budget. At various times, the District also receives money for the sale of soil from their ponding basins. This can vary from minimal to significant amounts based on construction activity in the area. Recently with the large number of homes being constructed, soil sales have been a significant source of income.

Since fiscal year 00/01, the District has operated with a deficit in the Maintenance and General Budget. The annual deficit/surplus for fiscal years 96/97 through 03/04 are shown in Table 8.

TABLE 8

MAINTENANCE AND GENERAL BUDGET DEFICIT

FISCAL YEAR	CASH FLOW
96/97	+$12,991
97/98	+$100,833
98/99	+$225,184
99/00	+$72,230
00/01	-$157,741
01/02	+$270,471 /1
02/03	-$239,072
03/04	-$223,304

/1 $200,000 deficit without property sale.

As previously discussed, the surplus shown for fiscal year 01/02 reflects the sale of District property to the City of Dinuba.

The per acre assessment has not been increased for eleven years causing the District to use reserve funds to supplement the Maintenance and General Budget. As noted in Table 7, the District costs for the 8-year period shown in the table have remained constant due to prudent management strategies. As previously discussed in the Water Surcharge Section, there have been substantial cost increases during this same period. In addition, there are new fees and costs imposed by the state for water rights and water quality testing. Currently, the District is operating with a $220,000 annual deficit in their Maintenance and General Budget and are continuing to draw down their reserves.

POWER REVENUE

The power revenue is comprised of two components. One component is developed from the water flowing through the turbines. The other component of the power revenue is based on the head developed on the turbines. The head is a function of the storage behind Pine Flat Dam. The District's share of the Pine Flat power revenues are divided between the Operational Budget and the Maintenance and General Budget. The power component which is derived from the actual water flow through the turbines is included in the Operational Budget, since it is generated through the delivery of water. The power revenue from the head generation component is included in the Maintenance and General Budget, since it is credited to the District based on the water stored behind the dam and does not require release of water through the turbines.

SUMMARY

In the section on Maintenance and General Costs, the revenues and expenses associated

with that portion of the District's budget have been presented. As shown in Table 8, the District is operating in a negative cash flow situation. This has dramatically reduced the District's reserves and if continued unabated, will reduce them to zero in a few years. This has occurred even though the District has implemented numerous cost saving measures to reduce their expenses. These measures have included the deferment of capital improvements, maintenance and purchases. The District has also instituted measures to better utilize all personnel. At the same time the District has maintained or improved their service to the landowners.

Personnel costs have been and always will represent the largest portion of the District's budget. By consolidating service areas, the District has reduced the number of ditchtenders. These changes have reduced the annual deficit that would have otherwise occurred.

The District has implemented the use of computer and cellular phones to improve the efficiency of their staff and provide better access to the ditchtenders. The cellular phones have a walkie-talkie component that allows the landowners to talk directly with the ditchtenders. The implementation of this procedure has saved considerable time for both the District's staff and the landowners, while at the same time providing better service.

The District has changed their operations from the use of private automobiles by the ditchtenders to using District vehicles. Under the old method, the ditchtenders were reimbursed for the use of their vehicles according to a rate structure based on the price of gas. With the rising fuel prices, this change has been very cost effective. This practice also makes the ditchtenders more visible in the field which improves security along District canals.

Even with the tight fiscal constraints instituted by the District, the deficit continues to increase. The costs are increasing in items that the District has no control over. This includes

fuel charges, health insurance, liability insurance, workmen's compensation insurance and regulatory fees the District is now required to pay. Pine Flat Dam is 50 years old and the operation and maintenance costs will continue to increase over the historical levels. Water quality testing costs were previously not included in the budget, but are now required. The deferring of necessary maintenance and capital improvements cannot continue forever. In order to maintain an efficient District, these works will need to be undertaken. All of these issues impact the budget for the District

The District's water supply is too valuable to consider reducing the level of service. Any reduction in the existing level of service would lead to a less efficient use of their water supply. The overall impact would be detrimental to the landowners. The District strives to enhance the management of the water supply to maximize the benefit available to all landowners. Consideration must be given to the raising of rates to continue the beneficial use of the Kings River water supply. An increase in rates should reflect the benefits that are derived from the water supply.

CHAPTER IV

BENEFIT DETERMINATION

ALTA IRRIGATION DISTRICT

CHAPTER IV

BENEFIT DETERMINATION

ALTA IRRIGATION DISTRICT

GENERAL

Being a conjunctive use district, the total water supply available to the landowners is comprised of both surface deliveries and groundwater pumping. The lands within the District receive benefits from the direct delivery of surface water, groundwater recharge through both incidental and direct recharge and the in lieu recharge achieved by supplying surface water instead of pumping groundwater. The District's water rights on the Kings River support all three methods. To continue providing these benefits to the landowners, the District must maintain a stable financial position. As discussed in Chapter III, the District cannot continue to spend reserves to meet their annual financial obligations. The District must consider an increase in their existing funding sources to insure they can meet the financial obligations required to continue the beneficial use of their water supply. Additional fees should reflect the benefit received by an individual landowner.

DISTRICT CHARGES

The District collects revenue from the landowners through three different methods. Each component of revenue is determined based on the benefits received. The major revenue source is through the entitlement category for the land. The entitlement charge per acre is assessed based on the water allocation for each parcel. Those landowners that divert surface water for irrigation purposes also pay a surcharge that is based on the measured quantity of water delivered to the parcel. This rate is established according to the cost of delivering water to the land. The surcharge has been in effect since the 2000/2001 fiscal year and is periodically increased to reflect the additional cost for making water deliveries. The projected Operational Budgets through fiscal years 2009 - 2010 are shown in Table 9. The various line items in the budget have been increased to reflect projected future costs. In addition, a pipeline reserve has also been added.

The District has a substantial investment in existing pipelines and a pipeline depreciation account, which is a restricted reserve to utilize in funding pipeline replacement and/or as a District contribution towards a project funded through state and federal programs or by the issuance of bonds, has been added. The reserve amount included in the budget for each year is $25,000.

The proposed increase per acre-foot of water delivered would range from $0.45 in the first year to just under a dollar in the last year of the budget. The requirements set forth in Section 6 of Proposition 218 will need to be followed prior to instituting an increase in this surcharge rate.

TABLE 9
FUTURE DISTRICT OPERATIONAL BUDGETS

Volumetric Water Surcharge	**$3.65**	**$3.76**	**$3.90**	**$4.10**
Fiscal Year	**06/07**	**07/08**	**08/09**	**09/10**
Water Run Revenues				
Water Surcharge	$ 365,000	$ 376,000	$ 390,000	$ 410,000
Water Surcharge Penalty	500	500	500	500
Pine Flat Power Income 50%	84,476	84,476	84,476	84,476
Total Water Run Revenues	$ 449,976	$ 460,976	$ 474,976	$ 494,976
Water Run Costs				
Maintenance Ditchtender Trucks	$ 8,000	$ 8,400	$ 8,800	$ 9,200
Fuel - Ditchtender trucks	30,000	33,000	36,000	39,000
Cell Phone - Ditchtenders	6,000	6,000	6,000	6,000
Answering Service	400	400	400	400
Algicide	24,000	24,000	24,000	24,000
Operational Payroll	263,423	270,535	277,840	285,342
Payroll Tax/Benefits	84,885	87,177	89,531	91,948
Drop Boards	6,100	6,400	6,800	7,200
Total Water Run Costs	$ 422,808	$ 435,913	$ 449,371	$ 463,090
Add reserves for maintenance of pipelines	$ 25,000	$ 25,000	$ 25,000	$ 25,000
Net Operational Cash Flow	$ 2,168	$ 63	$ 605	$ 6,886

The groundwater charge is applied to all agricultural land within the District. This charge is for the groundwater benefit that the District's surface water supply provides. This benefit is available to all agricultural lands within the District. The fee is assessed whether or not surface water is delivered, (for those landowners who utilize surface water, this fee is in addition to their entitlement fees).

All of the cities and unincorporated urban communities within the District pump groundwater to meet the water demands of their customers. They benefit from the District's water rights and the continued use of these rights through deliveries to the landowners. The urban areas do not pay the groundwater fee, but each parcel within the urban area boundary is assessed a fee for the benefits received. These fees are collected by the County on behalf of the District.

The growth occurring in these urban communities requires the installation of pipelines along with other modifications to the District's system. The District has instituted a fee based on the value of these improvements. A portion of the fee is used to cover District costs with the remaining funds being held in a separate account to be utilized for projects and studies related to urban impacts.

BENEFIT ALLOCATION

The deficits in the annual Maintenance and General Budgets were previously shown in Chapter III. The reduction in the District's reserve is also shown in the same chapter. The purpose of this Engineer's Report is to address these issues and determine a financing plan that will adequately fund these costs based on the benefits received.

The benefits to all landowners, as a result of the District's water rights in stabilizing groundwater supply and the value of the physical improvements are all identifiable. Another benefit is the increase in land values due to the water rights. Without the surface and groundwater supplies, the land values within the District would be substantially reduced. The premium the lands within the District enjoy is in the hundreds of millions of dollars.

Without the surface water supply provided by the District, the landowners would meet their water demands by pumping additional groundwater. This would have a severe impact on the groundwater levels and result in additional pumping costs for all landowners. The additional pumping will increase the summer electrical load and reduce the reliability of the existing electrical grid serving the area.

The District's average annual diversion from the Kings River for the period 1977 - 2001 was 163,500 acre-feet. These diversions were previously shown in Table 1 (Chapter II). In many years the diversions are considerably higher than average and in other years they are much lower.

Based on the average specific yield for the upper soils in the aquifer and the average diversion, the current District-wide water depth of 40 feet would drop another 8.4 feet per year without this surface supply. In a single year this would amount to an additional $1.50 per acre-foot in pumping costs. Utilizing a water demand of 3 acre-feet per acre, this represents a cost to the landowners of $4.50 per acre. At the end of five years, this additional annual cost for pumping would increase to $22.50 per acre. This analysis does not include the other costs that accompany the lowering of the groundwater including the replacement of pumps and motors and the deepening of the wells.

The calculated depth for the lowering of the groundwater level is conservative, since the upper 50 feet of the aquifer has the highest specific yield. As the groundwater drops, the materials in the aquifer become finer and the specific yield is reduced. The lower specific yields would accentuate the estimated 8.4 feet annual drop in the groundwater levels.

There are other major issues that will occur with the lowering of the groundwater level. Land values will decline and the viability of farming, industrial, commercial and urban uses will be severely impacted. It will only take a few years before these existing land uses will no longer be sustainable in the area. Through the conjunctive use practices currently being implemented, the surface water supply allows the groundwater to be stabilized and provides a bank for meeting water demands during periods of drought, which are part of the normal hydrological cycle.

The fees assessed by the District should be proportional to the benefits derived. The existing groundwater fee of $3.50 per acre has not been increased for eleven years. As detailed in the previous paragraphs, the existing rate is less than the pumping benefit received in a single year from the District's average surface water diversion. The total benefits to the landowners include the reduction in pumping costs, stabilization of the groundwater, drought protection, land values and the cost savings from not having to replace wells and pumps. Since these benefits apply equally to all lands within the District, the additional fee should be assessed on a per acre basis.

CHAPTER V

IMPLEMENTATION PROCEDURES

ALTA IRRIGATION DISTRICT

CHAPTER V

IMPLEMENTATION PROCEDURES

ALTA IRRIGATION DISTRICT

PROCEDURAL BASIS

In Chapter IV the groundwater benefits for all the lands within the District were evaluated. These benefits were shown to be far greater than the fees currently being assessed by the District. Due to the difference between the benefits received and the groundwater fees, the District should raise the existing fee.

Since the most equitable procedure is to increase this land based charge, the District must comply with the provisions of Article 13 D of the California Constitution. These procedures require that an Engineer's Report be prepared to distribute the cost fairly among all lands; a public hearing must be held to inform the landowners of the District's proposed actions; and a duly noticed and promptly held election is to be conducted in conformance with Section 4 of Proposition 218 (Article 13 D of the California Constitution). These procedural requirements are further detailed in Chapter I.

RATE CALCULATION

With the implementation of Proposition 218, the District can no longer develop an annual budget and enact rates sufficient to meet their financial obligations. The procedures contained in Proposition 218 must now be followed. The new requirements of preparing an Engineer's Report and conducting an election will increase the District's cost.

To reduce the impact of this additional cost on the budget, the District has developed future budgets of anticipated costs with matching revenues. This will allow the District to set a maximum rate increase that will take effect over a number of years instead of incurring the procedural costs associated with Proposition 218 on an annual basis. The projected future Maintenance and General Budgets for fiscal years 06/07 through 09/10 are shown in Table 10. These budgets were developed from the previous budgets shown in Chapter III for historical District operations. The various items included within the existing budget were adjusted to reflect additional/reduction in costs. This includes items such as Pine Flat Dam M&O which is anticipated to increase in the future because of the age of the dam. Additional costs for water rights fees were also added along with inflationary costs for various line items. The repayment of Pine Flat Dam was completed in fiscal year 02/03 and is, therefore, not included in the budget projections. The revenue from London Pond soil sales for fiscal year 06/07 is shown to be $51,500. The revenue for this item is based on projects currently planned and which are expected to be done. In the following fiscal years, this item has been reduced due to the uncertainty regarding future developments. This will also affect the anticipated revenues for the administrative fee on urban projects, which is a separate account and is used for specific purposes as previously discussed. The administrative fee shown in Table 10 is for specific District costs in administering the urban projects.

TABLE 10

FUTURE DISTRICT MAINTENANACE & GENERAL BUDGETS

Ground Water Charge Increase	**$3.50**	**$4.25**	**$4.60**	**$4.95**
Fiscal Year	**06/07**	**07/08**	**08/09**	**09/10**
Maint & General Revenues				
Assessment Revenues	$ 1,931,519	$ 2,042,755	$ 2,062,408	$ 2,126,051
Pine Flat Power 50%	84,476	84,476	84,476	84,476
PGE Evaporation	16,200	16,200	16,200	16,200
Interest Income	63,500	65,550	65,550	65,600
Penalties and Cost	-	-	-	-
Equipment Lease/Rents	6,800	6,800	6,800	6,800
Generalistrative Fee	19,500	10,000	10,000	10,000
London Pond Soil Sales	51,500	1,500	1,500	1,500
Misc Income	-	-	-	-
Gain/(Loss) Sale of Equipment	3,500	5,000	6,000	1,500
Total Maint & General Revenues	**$ 2,176,995**	**$ 2,232,281**	**$ 2,252,934**	**$ 2,312,127**
Maint & General Costs				
Pine Flat Dam M&O	$ 60,000	$ 85,000	$ 60,000	$ 60,000
Water Quality Fee (New Fee) or testing	15,000	20,000	20,000	20,000
KRWA M&O / Water Fees	114,775	114,775	114,775	114,775
Maintenance (+ Maint payroll)	650,055	657,866	670,302	682,953
General	1,124,476	1,140,349	1,145,117	1,173,292
Interest Expense	19,419	15,228	10,843	6,239
Total Maint & General Costs	**$ 1,983,725**	**$ 2,033,218**	**$ 2,021,037**	**$ 2,057,259**
Maint & General Capital Costs				
Special Job Projects	$ 32,500	$ 32,500	$ 62,500	$ 62,500
BUDGET Maint - Capital Items	-	19,382	32,532	35,532
BUDGET Office - Capital Items	-	18,500	500	20,500
BUDGET Finance Packages *(principal only)*	90,712	91,007	95,392	99,996
Hand Held recorders	10,000	-	-	-
Headgate Computer and Controls	50,000	-	-	-
Office Computer Server	10,000	-	-	-
Equipment Shed	-	35,000	35,000	30,000
Capital purchases and financial packages	**$ 193,212**	**$ 196,389**	**$ 225,924**	**$ 248,528**
Total Maint & General Costs	$ 2,176,937	$ 2,229,607	$ 2,246,961	$ 2,305,787
Net Maint & General Cash Flow	$ 58	$ 2,674	$ 5,973	$ 6,340

Due to a lack of funding, maintenance and improvement projects have been deferred. Three of these projects have been added into the proposed budgets. The headgate computer and controls must be undertaken to properly operate the water diversion into the District's system. The existing headgate controls were installed in 1999. An equipment shed is needed at the District shop. This item has continually been deferred in previous budgets, but the District needs to proceed with the construction. A computer server will need to be replaced at the District office. New items to be included in the finance package line item include the replacement of a dump truck, spray rig and maintenance trucks. In addition, a backhoe will be purchased. The District will also purchase two handheld recorders for use in the field for managing water deliveries to increase efficiency and reduce errors. They will be evaluated to determine if this is a cost effective method that should be extended to all the ditchtenders.

Based on this analysis, the groundwater rate should be increased up to a maximum of five dollars per acre over the next four years. The District will evaluate the budget each year and establish a rate sufficient to meet the financial demands. The maximum increase will not be implemented unless it is necessary to provide sufficient funds for meeting budget obligations. It is recommended that the District proceed with seeking approval to increase the groundwater fee.

All water districts are currently feeling the effects of increased costs. Fresno Irrigation District and Consolidated Irrigation District have recently gone through Proposition 218 hearings and have increased their rates up to $13.38 per acre and $6.00 per acre, respectively. Even with the proposed increase, the Alta Irrigation District will still be one of the lowest cost providers of irrigation water.

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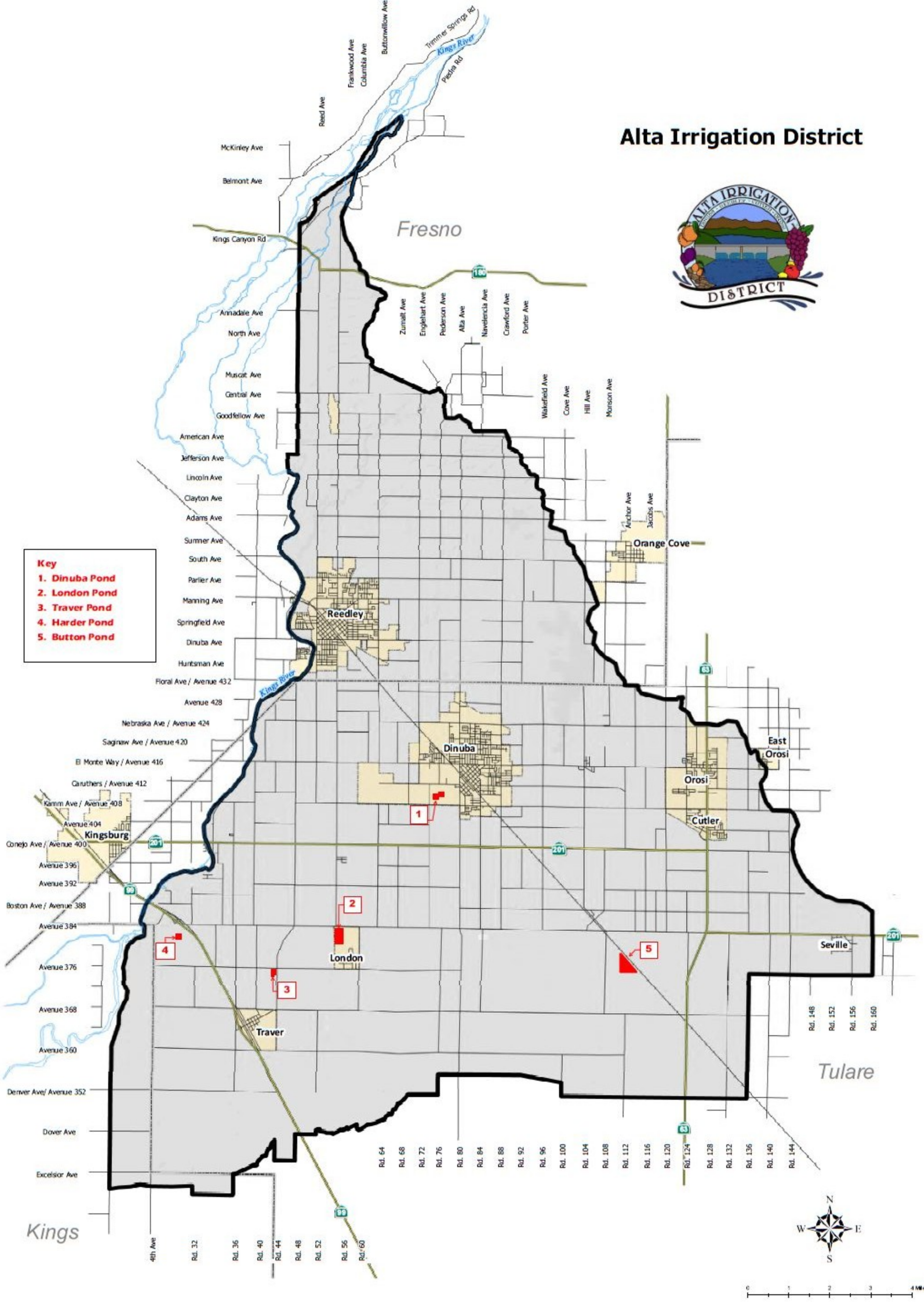
Alta Irrigation District



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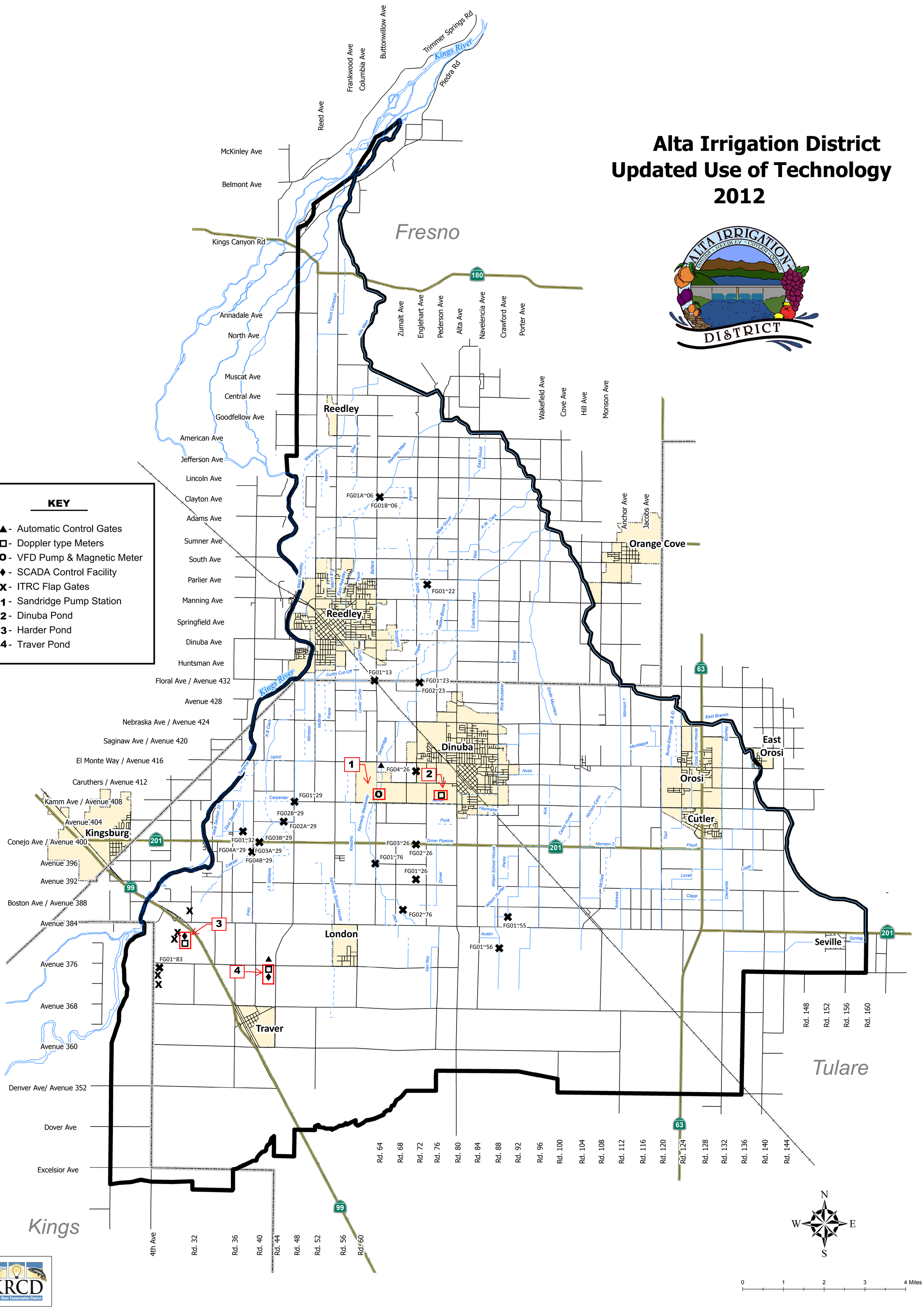
Alta Irrigation District
Updated Use of Technology
2012



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moving water in new directions

IRRIGATION TRAINING & RESEARCH CENTER

SBx7 Flow Rate Measurement Compliance for Agricultural Irrigation Districts

SBx7 Compliance

Aug 26, 2012

IRRIGATION TRAINING & RESEARCH CENTER

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Irrigation Training & Research Center
Updated October 2012

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GROUPED DELIVERIES

Senate Bill x7-7 (SBx7-7) requires documented volumetric accounting to individual turnouts for water deliveries. Section 597.3 of the bill lists two very different requirements for devices (***bold, underlined, italics*** have been added for emphasis):

- Section 597.3(a) discusses measurement devices that must be used at points where there is a reasonable degree of flow rate control.
- Section 597.3(b) states that "An agricultural water supplier may measure water delivered at a location upstream of the delivery points or farm-gates of multiple customers using one of the measurement options described in §597.3(a) if the downstream individual customer's delivery points meet ***either*** of the following conditions:

  A. The agricultural water supplier does not have legal access to the delivery points of individual customers or group of customers to install, measure, maintain, operate, and monitor a measurement device.

  Or,

  B. An engineer determines that due to small differentials in water level ***or*** large fluctuations in flow rate or velocity that occur during the delivery ***season*** at a single farm-gate, accuracy standards of the measurement options in §597.3(a) cannot be met by installing a measurement device or devices (manufactured or on site built or in-house built devices) with or without additional components (such as gauging rod, water level control structure at the farm-gate, etc.).

This last section (B) in essence defines the most downstream point of measurement to be located at the "hand-off point".

The "hand-off point" can be defined as the location, moving downstream in the branching hydraulic network, below which the irrigation district no longer has good control over the flow rates that go to individual farm-gates.

For example, one might consider using a ditch or pipeline with a rotation delivery schedule, with one "head" or delivery at a time. That single "head" or flow rate is rotated among users, one at a time. There is no control over flow rates at individual turnouts (along that ditch or pipeline); the flow rate is controlled at the head of the ditch or pipeline.

This is also true of ditches or pipelines with a rotation delivery schedule, with two or three "heads" or deliveries. These systems typically have little or no precise flow control downstream of the heading. In some districts, the delivery points are not even to a field; the distribution pipelines have alfalfa valves for each border strip that is irrigated. When there is an internal splitting of two "heads", it is done without the benefit of the structures that provide good water level or pressure control.

While it may be possible in many cases to install flow measurement devices within these pipelines or canals, the measurement would be of uncontrolled flows unless the pipelines or canals were substantially modified. In other words, "additional components" besides the flow measurement devices would be required.

Rice systems are a special category, as good water management of rice irrigation is premised on maintaining a target water level in the fields, rather than on delivering a specific volume to a specific field.

That said, with traditional rice laterals, or with traditional rotation laterals, it is entirely reasonable to require farmers with new pressurized systems on such ditches/pipelines to install magnetic meters or propeller meters on their systems. Such flow measurement installations are rather typical and do not represent technical or fiscal challenges for implementation.

Conclusions

1. The wording of SBx7 appears to clearly indicate that the proper, most downstream flow measurement location would be at the head of any "community ditches". "Community ditches" (sometimes called "improvement districts") are defined as privately owned distribution systems that receive water from the irrigation district. The distribution, partitioning, and scheduling of water deliveries within the "community ditch" is not done by irrigation district personnel.
2. Irrigation district ditches and pipelines that are operated on a rotation schedule need an accurate flow measurement device at the head of the ditch or pipeline, but not at individual delivery points within/along the ditch or pipeline that receives water on a rotation schedule. This pertains to ditches and pipelines that are owned either by improvement districts or by irrigation districts.
3. Individual delivery points with pressurized irrigation systems that receive water from an irrigation district ditch or pipeline that is primarily a "rotation" system must be individually metered.

Note: The phrase "irrigation district" encompasses a wide range of district types including reclamation districts (e.g., RD108), water districts (e.g., Coachella WD), irrigation districts (e.g., Modesto ID), and Water Storage Districts (e.g., Buena Vista WSD).

FLOW RATE VS. VOLUMETRIC ACCURACY

SBx7 requires the verification of the accuracy of annual volumes provided at delivery points.

- For devices **with** totalizers, it can be assumed that:

  Flow rate accuracy = Volumetric accuracy

- For devices such as meter gates and orifice plates that do **not** have totalizers, the flow rate accuracy may only be part of the total desired 12% volumetric accuracy. The annual volumetric accuracy of any such single turnout depends upon errors due to:
  - IFR – Instantaneous flow rate error
  - CWLF – Canal water level fluctuations, or pipeline pressure fluctuations over time. The impact of these fluctuations are mostly self-canceling over the course of an irrigation season. This is discussed later in this report.
  - CBP – Changes in "backpressure". Backpressure is the pressure on the downstream side of the flow measurement device.
  - ARD – Accuracy of the recording of durations. For example, if an actual delivery lasts for a total of 25 hours but it is recorded and billed as a 24-hour delivery, this would be an error of one hour, or 4.2%

These inaccuracies must be mathematically combined to determine the total volumetric accuracy.

$$Volumetric\ accuracy = 100\ \times \left[\ 1 - \sqrt{(IFR)^2 + (CWLF)^2 + (CBP)^2 + (ARD)^2}\right]$$

For example, assume the following errors expressed as decimals rather than as percentages. These are plus/minus errors ("within 5%" means "within +/- 5%"):

IFR is within 5% (IFR =.05)	CBP = .03
CWLF = .02	ARD = .04

Then,

$$Volumetric\ accuracy\ (VA) = 100\ \times \left[1 - \sqrt{(.05)^2 + (.02)^2 + (.03)^2 + (.04)^2}\right]$$

VA = 92.7 = 93%

The errors are independent of each other. Therefore, the total error does ***not*** equal the sum of the errors (14%), which would incorrectly indicate an 86% accuracy.

The maximum acceptable flow rate measurement error (expressed as a decimal) equals:

$$\text{Max. acceptable device flow rate error} = \sqrt{(1 - \frac{VA}{100})^2\ -\ ARD^2 - CBP^2 - CWLF^2}$$

For example, if the required volumetric accuracy (VA) = 88% (88) (i.e., within 12%) and:

ARD = .04 CBP = .03 CWLF = .02

Then, the maximum acceptable device flow rate accuracy error = 0.107 = 10.7%

That is, this specific device, when tested at a specific representative flow rate, must be within 89.3% accuracy.

IMPACT OF CANAL WATER LEVEL CHANGES ON ANNUAL VOLUMETRIC ACCURACY

Background

The volume delivered through flow measurement devices without totalizers is computed as:

$$\text{Volume} = (\text{Flow Rate}) \times \text{Time}$$

The flow rate is typically checked once per day, and a new flow rate is either noted on the records, or the flow rate control device is re-adjusted to provide the target flow rate.

During any 24-hour period, the canal water levels will fluctuate, resulting in a delivery of more or less flow rate than was originally set.

The question addressed in this section is: Over the course of an irrigation season with ten, twenty, or thirty 24-hour irrigation events, do these minute-to-minute fluctuations cancel out? If they do, this will remove the "CWLF" (discussed in the previous section) from consideration.

To examine this, ITRC obtained water level data from multiple locations throughout San Luis Canal Company, over a time period from June 8 to July 11, 2012. Canal levels were recorded automatically on an hourly basis. The total change in water level across the turnout [(water surface in the canal) - (water surface in the downstream ditch)] was also recorded at the start of each datalogging session. The irrigation district has typical flashboard check structures to maintain water levels in the majority of its locations.

A series of 22 sites were analyzed for 48-72 hours. It is believed that these sites are representative of the range of conditions throughout the district. No special management of the check structures was involved; the canal operators were unaware that the levels were being recorded.

Error Analysis

Water Level Error Model

In order to assess the error of volumetric flow rate measurement in the canal system, first the fluctuations in water level must be computed. A model was constructed to measure the percent error of the water level over a 24-hour period from a given starting point in the sample set.

The raw data was normalized so that canal fluctuations would be represented as a percentage of the head difference. In this way, all the data points could be accumulated to create a contiguous set of hourly fluctuations for the model data set. The resulting model contains a total of 5500 hourly data points.

Sample Set

A sample set was generated from the model. The sample set contained three different blocks. Each block had 30 different seasons with varying numbers of irrigations events per season. Block 1 had 30 seasons of ten 24-hour irrigations, Block 2 had 30 seasons of twenty 24-hour irrigations, and block 3 had 30 seasons of thirty 24-hour irrigations.

The starting points for the irrigation events in each season were selected by a random number generator. The error was recorded for each hour from the starting point for a total 24 hours. Thus, each irrigation event consisted of 24 data points, resulting in a total of 21,600 data points sampled for all of the seasons in all 3 blocks.

Results

If the present water level for a moment during an irrigation event in the model is equal to the starting water level for that event, then the percent error at that moment is zero. The percent error at each recorded time during an irrigation is calculated by the following equation:

$$\%\ Error\ at\ a\ moment = \frac{Present\ Water\ Level - Initial\ Water\ Level}{Initial\ Change\ in\ Head} \times 100$$

Where "Initial Water Level" is the water level when the 24-hour irrigation began.

The characteristics of the population of "errors" in water level are shown in the figure below.

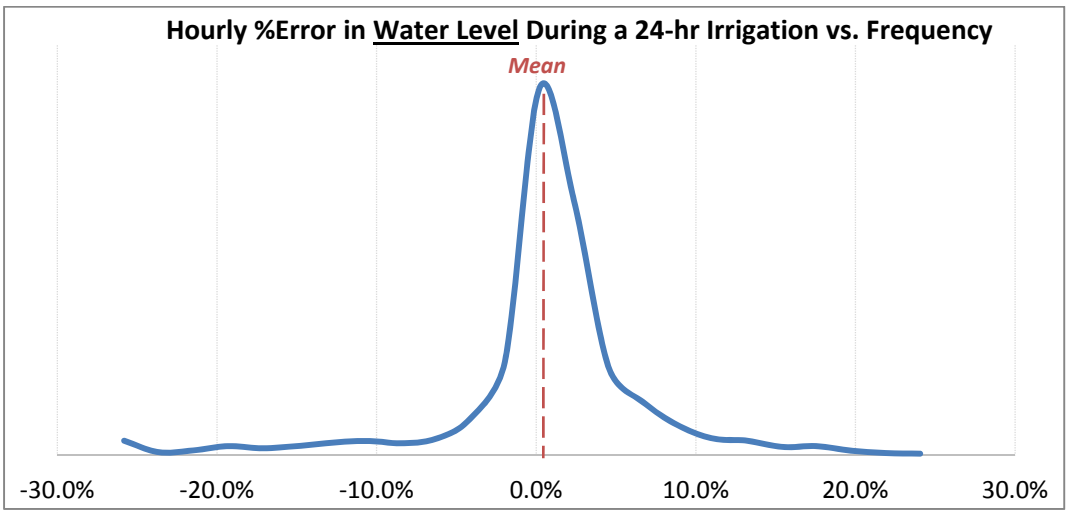


Figure 1. Sample distribution for hourly % error in water level vs. frequency

The variation in relative water levels over time is interesting, but of more interest is the impact on turnout flow rates. There are two possible situations, described below:

1. The flow measurement device is operated under "free flow". That is, the water jets out from it, and the flow rate through the orifice device is not affected by changing downstream water levels. The variation in flow rate over time can be computed, based solely on the upstream water level change. In this case, the sensitivity of the turnout flows to canal water levels is computed as:

$$Free\ Flow\ Error = (1 + Level\ Error)^{0.5} - 1$$

2. The flow measurement device operates under a "submerged" condition. In this case, what happens is that if the canal water level changes, the flow through the measurement device increases. But that also results in a rise in the downstream water level. This provides a "pressure compensating" effect. The total head change is less than the change in the canal water level. ITRC has examined a number of possible downstream channel conditions, and uses the following equation to estimate the effect of a change in canal water level:

$$Submerged\ Flow\ Error = (1 + Level\ Error)^{0.38} - 1$$

For each block (group of 30 randomly selected seasonal irrigation cycles), the mean and standard deviation of the error were computed. **Figure 2** shows the results of the analysis. The mean error is plotted for each block along with the standard deviations. The red bars are 1 standard deviation above the mean, and the green bars are 1 standard deviation below the mean.

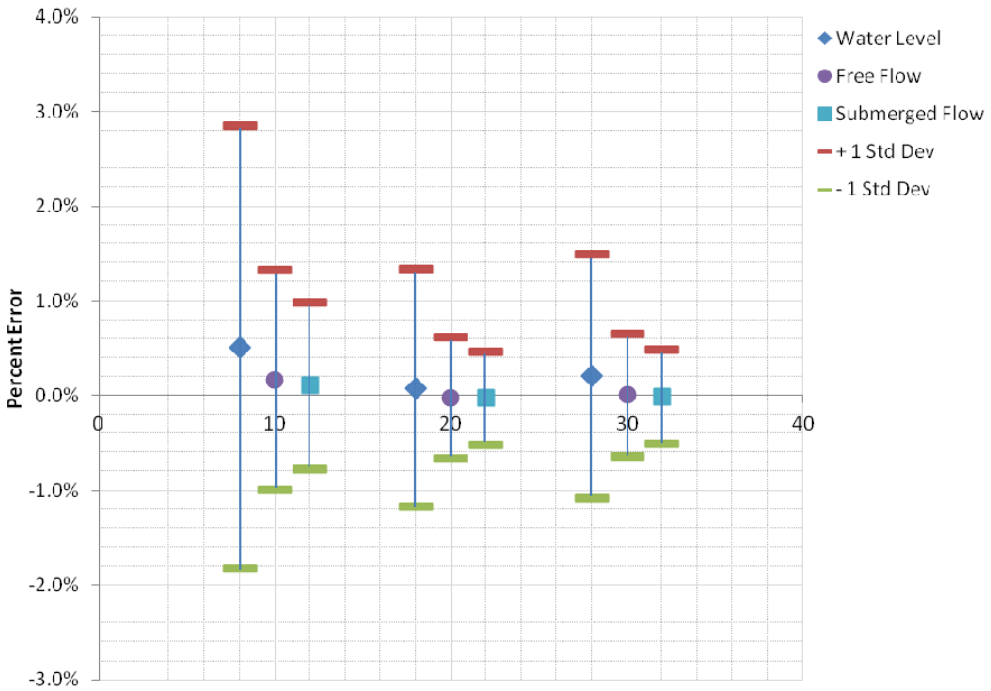


Figure 2. Means and standard deviations for each block

Conclusion

For the condition of 10 irrigations per season, the seasonal flow rate error due to fluctuating canal water levels averages less than 0.2%, regardless of whether the turnout is free flow or submerged flow. The average seasonal error for 20-30 irrigations per season is almost 0.0%.

Because most irrigation districts deliver more than 10 irrigations per season, it appears that a reasonable estimate of the annual volumetric error due to a fluctuating canal water level is about +/- 0.5%, when one considers one standard deviation from the mean.

While this data originated in a single district, ITRC believes that the conditions are representative of "typical" canal districts, based on experiences in about 150 irrigation districts in the western U.S. The exception would be the few irrigation districts that have a very extensive distribution of long-crested weirs or ITRC flap gates throughout the canals. An extreme example would be Modesto ID, in which case almost every check structure is a long-crested weir. In that case, the seasonal impact of fluctuating canal water levels is likely 0.0%, for all practical purposes.

SELECTION OF A REPRESENTATIVE SAMPLE FOR VERIFICATION OF ACCURACY

California Legislature SBx7 requires flow measurement devices to be within a required level of accuracy. For existing flow measurement devices, the acceptable error for volumetric flow measurement is ±12% as stated in §597.3(a)(1). Initial certification of existing devices requires a random and statistically representative sample set or an accepted statistical methodology as described in §597.4(a)(1) and §597.4(b)(1). This document defines a statistical methodology that can be used to provide good information that meets both the intent of SBx7 and the needs of the irrigation districts.

Background

Representative Sample

Irrigation districts have turnouts with flow measurement devices that supply water to areas with correspondingly varying annual delivered volumes. The selection process defined below is intended to define how to select a representative sample set of flow measurement devices for verification of volumetric measurement quality in the district as whole.

In an irrigation district with a wide range of acreages downstream of flow measurement devices, a simple random selection of measurement devices would statistically over-emphasize the importance of small delivery points. The sampling may only represent a very small percentage of all the water delivered in the district. The volume delivered through a turnout is related to the size of the area irrigated. Therefore, it is better to weigh the importance of each measurement device according to the area it services, rather than weighing all turnouts equally. Thus, the sample of flow measurement devices to be tested will be constructed using a ***probability-proportional-to-size (PPS)*** sampling method so that the likelihood of inspection for a given flow measurement device will be proportional to the acreage served by that device.

Considerations for Availability

Ideally, all the devices would be randomly selected by the PPS sampling process mentioned above, and then the selected devices would be evaluated for accuracy. However, only some percentage of the turnouts will be operating at a given time. Therefore, if a turnout is selected in a purely random manner, the customer served by that turnout may not be ready to irrigate, prohibiting evaluation of the flow measurement device at that turnout. It is also clear that even if farmers are scheduled to receive water from a turnout on a specific date/time, they do not always irrigate on that schedule; this makes advance and careful scheduling of field evaluations problematic.

A solution to this is to use ***opportunity sampling*** in combination with ***sampling quotas***. An opportunity sample is composed of samples taken as they are available or convenient. Since device availability will be an issue, devices should be inspected when they are available.

Point #1: To ensure that the data set is representative of the district's overall volumetric flow measurement, a minimum of 10% of the district's service area (or volume) should be represented by the combined service acreage for the turnouts in the sample set.

Point #2: To meet the SBx7 requirements, the minimum sample size of 5 and maximum of 100 for a particular device type should be evaluated.

Point #3: Two scenarios for sampling are described in this document:
- Advance Probability-Proportional-To-Size (PPS) Sampling
- Opportunity Sampling with a consideration of PPS

Scenario 1: Acreage-Based Sampling Using Probability-Proportional-to-Size (PPS)

Scenario 1 is the ideal situation, where at any given time all turnouts will be available for inspection.

Background

Representative Sample Selection

Flow measurement devices in a district will be assigned a number ***range*** based on the acreage (or known annual volume) that the devices serve (e.g., a turnout servicing 10 acres may be assigned 10 numbers such as 61-70). This numbering will have a logical sequencing that is appropriate for the given district. A random number generator will then be used to select a device from the developed sequence. In this way each device will be weighted in selection by the acreage it serves. Specifically, the sample will be skewed favoring devices that measure greater volumes of water. This will ensure that the random sample will be statistically representative of the overall accuracy of flow measurement within the district.

Random Selection Process

A random number generator will be used to select a device to be tested. If the number produced by the random number generator is within the range assigned to a device, then that device will be tested. Once a device has been tested, its range will no longer be considered in the selection process, and numbers randomly generated in its range will be ignored. This procedure will be improved from the example given in §597.4(b)(1), in that devices providing at least 10% of the district volume or acreage (rather 10% of the devices) will be tested, with a minimum of 5 devices, and not to exceed 100 individual devices of a certain type.

Device Types

It is important to take note of device types for this legislation. If 25% of existing devices (as estimated from the properly selected sample) of a particular type are not in compliance with ±12% accuracy requirements, the district must develop a plan to test another sample of measurement devices of this type as stated in §597.4(b)(2). This document interprets the intent of the legislation as applying to 25% of water delivered, rather than 25% of existing devices. For illustration, in the extreme case of a district with the following:

- 100 garden plots of 0.25 acres each, each with a measurement device (25 acres total)
- 50 larger fields of 80 acres each, each with a measurement device (4000 acres total)

Certainly, careful irrigation water management would not focus on the large number of very small plots that represent less than 1% of the total acreage. This document therefore assumes that the proper interpretation is to focus on reasonable measurement of at least 25% of sample water volume, rather than 25% of the sample devices.

Step 1: Assign Sequence Range Numbers to Each Turnout

Table 1 describes a sample scenario and shows a sequence range of number assignments for each turnout. The district in the sample scenario has one lateral with 10 turnouts serving a varying array of acreage.

Table 1. Example of assigning sequence range numbers

Turnout #	Acreage Served	Sequence Range From	Sequence Range To
1	10	**1**	**10**
2	10	**11**	**20**
3	15	**21**	**35**
4	15	**36**	**50**
5	2	**51**	**52**
6	2	**53**	**54**
7	5	**55**	**59**
8	5	**60**	**64**
9	50	**65**	**114**
10	50	**115**	**164**
Total	**164**		

Note that the final sequence number should be equal to the total acreage

Each turnout is assigned sequence range numbers based on their acreage. Turnout 1 is assigned the sequence range from 1 to 10 because it has 10 acres, and Turnout 2 is similarly assigned 11 to 20. Turnout 3 is assigned a longer sequence range, from 21 to 35, because it has 15 acres. Turnouts are continued to be assigned sequence range numbers in this fashion. As a result of this sequence range numbering, each turnout will represent a portion of the total 164 acres.

Step 2: Use a Random Number Generator to Select Turnouts

Use a random number generator to choose a number between 1 and the total acreage of the district. A random number generator can be a software program or simply pulling numbers out of a hat. In the example above the random number generator would pick a number between 1 and 164. If the number produced by the random number generator is between the sequence range numbers assigned to a device, then that device will be tested.

Repeat this process until devices representing 10% of the acreage served (or volume delivered) have been selected with a minimum of 5 and a maximum of 100 per device type.

Continuing with the example data set above, assume that the first numbers selected by the random number generator were: 17, 24, 157, 156, 53, 42, 41, 36, 2, 12, and 52.

Eliminate duplicate turnouts, starting from the first random number.

With this random selection of numbers, the following turnouts are selected:

2 (selected by number 17; 12 is a duplicate)
3 (selected by number 24)
10 (selected by number 157; 156 is a duplicate)
6 (selected by number 53)
4 (selected by number 41; 41 and 36 are duplicates)

This provides the minimum number of 5 turnouts. Now, the acreage must be checked to verify that the selection represents more than 10% of the acreage (or volume).

Table 2. Example of randomly selected sample set

Green rows indicate the selected devices for the sample set

Turnout	Acreage Served		Sequence Range	
#	Acres	% of Total	From	To
1	10	6%	**1**	**10**
2	10	6%	**11**	**20**
3	15	9%	**21**	**35**
4	15	9%	**36**	**50**
5	2	1%	**51**	**52**
6	2	1%	**53**	**54**
7	5	3%	**55**	**59**
8	5	3%	**60**	**64**
9	50	30%	**65**	**114**
10	50	30%	**115**	**164**
Total	**164**	**100%**		

The five turnout samples represent 55% of the total acreage.

Therefore, this sample set meets the criteria of:
- greater than or equal to 10% of the acreage, and
- a minimum of 5 turnouts of a particular type - assuming all are the same device.

Note: If there is more than one device, this process would be repeated ***by device***. The final criteria to be met are:
- Including all device sample sets, at least 10% of the district acreage (or volume) must be accounted for.
- A minimum of 5 turnouts of a particular device, for each device.
- No more than 100 of any particular device.

Step 3: Evaluate Selected Turnouts and Record Data

Once the turnouts have been selected, evaluate each flow measurement device for accuracy. Record gate type, total acreage serviced by the device, and measured accuracy. This data will need to be retained for ten years or two Agricultural Water Management Plan Cycles as per 597.4(c).

To continue the example, **Table 3** shows how data should be recorded for the example district. For simplicity, it is assumed that all devices are meter gates.

Table 3. Sample data collection for selected turnouts

Red rows indicate devices that do not meet the required standard

Turnout #	Device Type	Acreage Served	Flow Accuracy Error, %
2	Meter Gate	10	15%
3	Meter Gate	15	9%
4	Meter Gate	15	6%
6	Meter Gate	2	8%
10	Meter Gate	50	4%
	Total acreage sampled:	***92***	

Step 4: Determination of Compliance

SBx7 requires an annual volumetric accuracy of within 12% on existing devices. Table 3 addresses flow rate accuracy, not volumetric accuracy.

If 25% or more of the sampled area for a particular device type exceeds the 12% annual volumetric allowable error, then a second round of testing must be conducted. This second round of testing should be conducted in the same manner as the first, but only for the device type(s) that did not meet the required accuracy standard.

Compliance of this particular example. Table 3 is repeated below for illustration.

Table 3. Sample data collection for selected turnouts

Red rows indicate devices that do not meet the required standard

Turnout #	Device Type	Acreage Served	Flow Accuracy error, %
2	Meter Gate	10	15%
3	Meter Gate	15	9%
4	Meter Gate	15	6%
6	Meter Gate	2	8%
10	Meter Gate	50	4%
	Total acreage sampled:	***92***	

Assuming that the minimum required flow rate accuracy is 10.7% (using the example), then only one turnout measurement device does not meet the requirement. No re-testing is needed, because:

1. Ninety-two acres were tested out of the total 164 acres. This is much greater than the 10% sample size required.
2. Five devices were sampled, which meets the minimum because all devices are of the same basic design.
3. The one device with greater than 10.7% error only represents 10 acres, which is 11% of the acreage sampled. This is below the allowable 25%.

Scenario 2: Limited Availability of Turnouts and Opportunity Sampling

Turnouts may not be available for inspection due to fluctuations in irrigation scheduling. Therefore, opportunity sample can be used to select devices to be evaluated. As opposed to the PPS random sample set, this sample will be based on availability and service size rather than a weighted random sampling.

Background

Representative Sample Selection

To ensure the sample is representative of the district as a whole, evaluators need to ensure that the area serviced by the devices evaluated is at least 10% of the district's entire area. Furthermore, when given a choice between devices of equal convenience, devices servicing a larger acreage should be given priority for inspection. Additionally, a minimum of 5 devices must be inspected. In this way each device will be weighted in selection by the acreage it serves. Specifically, the sample will be skewed favoring devices that measure greater volumes of water. This will ensure that the opportunity sample will be statistically representative of the overall accuracy of flow measurement within the district.

Selection Process

Devices will be selected as they are available to be tested. Priority for evaluation will be given to devices that service greater acreage. Once a device has been tested, it will no longer be considered in the selection process. A minimum of 5 devices will be tested, and all evaluated devices (summation of all types) will service a combined 10% of the district's total area (or delivered volume), not to exceed 100 individual devices of a certain type.

Step 1: Choose a Currently Available Turnout

Select a turnout that is available for testing based on the size of the turnout, giving priority to turnouts that serve greater acreage. Do not test the same device more than once. **Table 4** shows an example of the selection process for two days. On the first day Turnout 10 serves the largest acreage out of the available turnouts. On day two, Turnout 5 is chosen because it serves the largest area and has not yet been tested. The district in this example has one canal lateral with 10 turnouts, and the turnouts have limited availability for testing.

Table 4. Device selection on two separate days

Green rows indicate the selected turnout. Grey rows indicate a turnout that has been tested.

Day 1

Turnout #	Currently Available	Acreage Served
1	yes	10
2	yes	10
3	no	9
4	yes	7
5	no	30
6	no	1
7	yes	1
8	yes	2
9	no	50
10	yes	50

Day 2

Turnout #	Currently Available	Acreage Served
1	no	10
2	yes	10
3	no	9
4	yes	7
5	yes	30
6	no	1
7	yes	1
8	yes	2
9	no	50
10	*yes*	*50*

Continue testing devices until the following criteria have been met:

- *At least 10% of the total district acreage is serviced by the devices tested*
- *At least 5 devices have been tested*
- *Test no more than 100 devices of a particular type*

Steps 2-4 : Follow the Previous Scenario Instructions

FLOW MEASUREMENT DEVICES

Background

This section is intended to provide useful information on several common flow measurement devices that might be considered for traditional, non-pressurized turnouts. Often, the problems with some of the devices (meter gates, orifice plates, and propeller meters) are largely associated with improper measurement, or improper installation or maintenance. If properly designed and maintained, all three of these measurement devices will generally fall well within required SBx7 requirements.

Meter Gates

Meter gates are one of the most common devices used in California irrigation districts to both measure and control flow rates. There is no doubt that many of these devices provide accurate results. However, as with all devices, certain rules must be followed. Typical physical inaccuracies associated with meter gates include:

1. *Incorrect "zero" measurement of gate opening*, as determined by the vertical movement of the threaded shaft.
   a. There are four primary reasons operators might measure the opening from an incorrect "zero" mark on the threaded shaft:
      i. The zero point is affected by "slop" in the connection between the shaft and the gate plate.
      ii. Wedges are used to force the plate against the gate frame during gate closure. These wedges are often adjusted in the field, so there is no standard stopping distance (vertically) for the plate.
      iii. When the plate begins to move, it may overlap the opening (by 0.5 - 2"). Although water may begin to leak as the plate moves out of the wedge constraint, the true zero is the opening at which the bottom of the plate is exactly at the bottom of the frame opening.
      iv. The "zero" point should always be determined while the gate is being raised.
   b. Once the zero point is known, a notch should be scribed into the shaft to note the location of the zero mark. Then the gate opening should always be measured as the gate is being opened, rather than being closed.

2. *Incorrect downstream water level measurement*.
   a. The stilling well must be placed over a full pipe, at a specific distance downstream of the meter gate.
   b. Many existing stilling wells were actually designed to be air vents, and have such a small diameter that there is constant surging. A large diameter stilling well, fed by a relatively small access hole at its bottom (about 1/6th the diameter of the stilling well), is needed to "still" the water surface so it can be measured downstream of the gate. The problem with a small access hole is that it can plug up easily. A good combination is a 2" access hole (connecting the stilling well to the top of the pipe) and a 12" stilling well.
   c. The pipe must be full at all flow rates. This may require the placement of a small obstruction downstream, in the pipe, similar to what is done with well pump discharges to keep propeller meters full. Various entities, including ITRC, have successfully designed side contractions in pipes to create "Replogle flumes" that have very little loss, and that pass bottom loads of silt. Something similar could be used downstream of the meter gates.

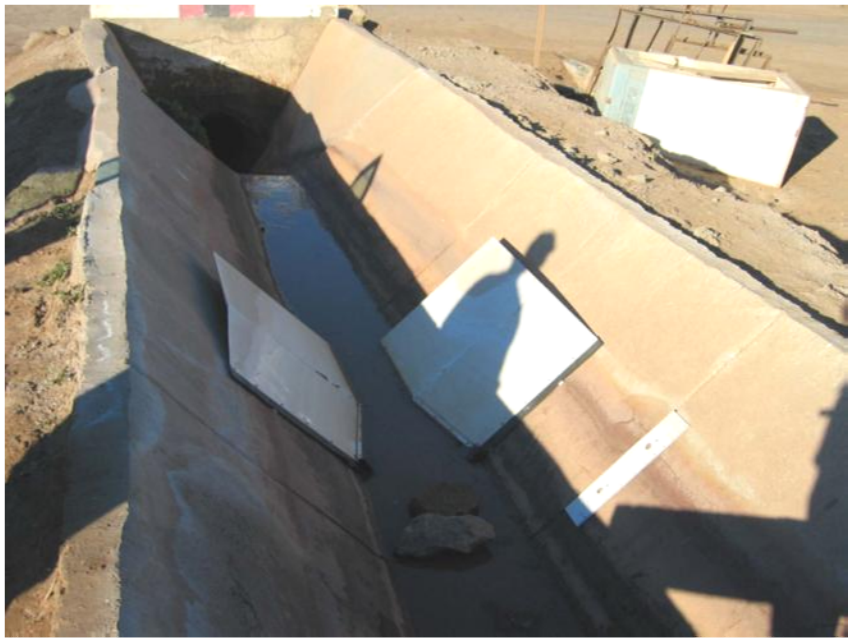


Figure 3. Side contractions rather than a traditional "Replogle Flume". Designed by USBR, Yuma. The rocks are not part of the design.

Another technique used in some districts to maintain a submerged condition on a gate is to install "bumps" in the bottom of a canal or ditch downstream of the turnout. These should be permanent "bumps" which, at low flows, will keep the water level high. The rule for building these "bumps" is:

> Build up the restriction from the bottom of the ditch/canal so that at high flow rates, the upstream water surface (relative to the bump) is only raised by about 0.1' or less. In other words, its presence will hardly be noticeable.

If farmers move downstream in their canal, setting siphons at a different place, this "bump" will keep the backpressure on the meter gate almost constant, and minimize the flow rate change that would normally occur.

3. *Incorrect gate opening geometry*. Since the plate has a larger outside diameter than the inside diameter of the pipe, the ratio of the open area between the two openings must be taken into account. Almost everyone uses tables that were developed decades ago. ITRC is not certain if the gate dimensions have changed since then, or if different manufacturers use different gate dimensions. ITRC is planning to verify this in the future.

4. *Non-standard entrance and exit conditions.* The flow rate is associated with a measured opening and head loss. The head loss will be different (at the same flow rate) with different entrance conditions. Various manuals, such as the USBR Flow Measurement Manual, provide recommended dimensions.

Orifice Plates

The following is an explanation of the characteristics of a submerged (on both sides) rectangular orifice plate.

According to the U.S. Bureau of Reclamation *Water Measurement Manual*, conditions for achieving accurate flow measurement of ± 2% for a fully contracted submerged rectangular orifice are:

- The upstream edges of the orifice should be straight, sharp, and smooth.
- The upstream face and the sides of the orifice opening need to be vertical.
- The top and bottom edges of the orifice opening need to be level.
- Any fasteners present on the upstream side of the orifice plate and the bulkhead must be countersunk.
- The face of the orifice plate must be clean of grease and oil.
- The thickness of the orifice plate perimeter should be between 0.03 and 0.08 inches. Thicker plates would need to have the downstream side edge chamfered at an angle of at least 45 degrees.
- Flow edges of the plate require machining or filing perpendicular to the upstream face to remove burrs or scratches and should not be smoothed off with abrasives.
- For submerged flow, the differential in head should be at least 0.2 feet.
- Using the dimensions depicted in **Figure 4** below, P > 2Y, Z > 2Y, and M > 2Y

The equation for determining the flow through a submerged orifice plate is:

$$Q = C_d A\sqrt{2g\Delta h}$$

Where:

Q = Flow Rate, CFS
C_d = Coefficient of Discharge, 0.61
A = Area of the orifice, ft^2
A = W x Y
W = Orifice opening width, ft
Y = Orifice opening height, ft
g = Acceleration due to gravity, 32.2 ft/s^2
Δh = Change in head, ft

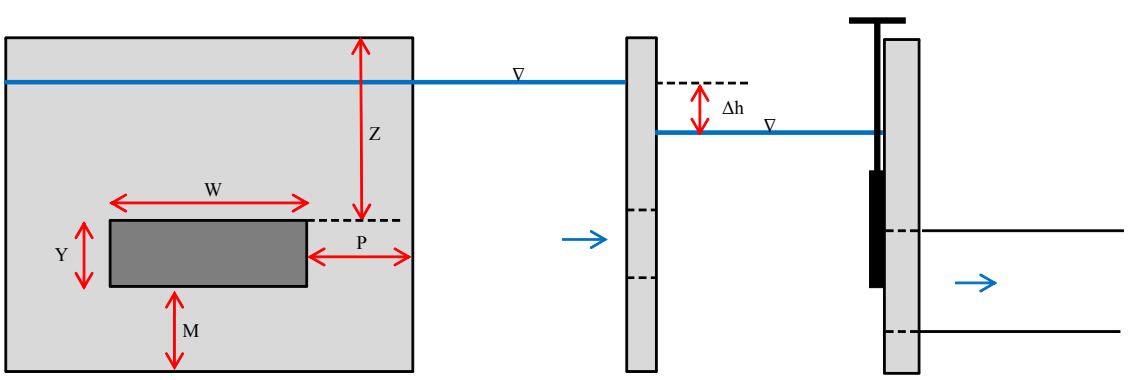


Figure 4. Flow through a submerged orifice plate

For a sharp-edged rectangular orifice where full contraction occurs from every side of the orifice, the coefficient of discharge is 0.61.

It is recommended that "Y" be smaller than "W", so that a good depth "Z" can be maintained. This helps keep the orifice entrance submerged all the time regardless of upstream water level fluctuations, and also provides for the proper entrance conditions.

It is assumed that the flow control gate will be located downstream of the orifice plate. The particular dimensions of that gate would rarely influence the performance of an orifice plate.

Typical problems include:

1. Inaccurate measurement of the difference in head.
   Solution:
   a. Careful relative calibration of pressure transducers, if used. They do not need to read a correct "elevation", but at zero flow rate must read the same "elevation".
   b. Install a horizontal reference steel plate on a bulkhead wall, so operators use the same reference elevation for both measurements if they manually measure the head difference.
2. The distances P, Z, or M are not greater than 2 times the smallest opening dimension (usually "Y"). In reality, it is rare that this "2 times" criteria is met in irrigation districts, except with very small flows.
   Solution:
   a. If only one side is suppressed (typically the bottom entrance, which might have no convergence), adjust the discharge coefficient, C_d as follows:

W/Y	1	2	4
Cd	0.63	0.64	0.65

   b. We do not know exactly how much to adjust the C_d if the distances P, Z, or M are less than two times the smallest opening dimension. Therefore, it is recommended that the orifice be installed in a plate that is wide enough and tall enough to approximately meet those required distances – even if the plate must be extended beyond the inlet to the turnout. See the figure below.

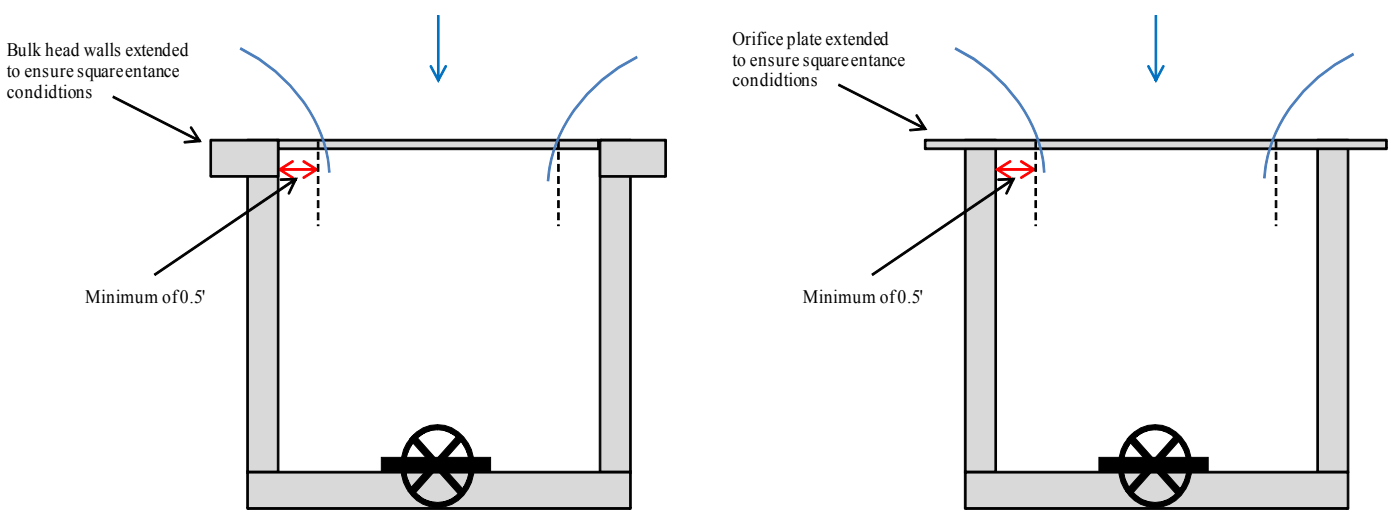


Figure 5. Installation of orifice

3. A single orifice size has a limited flow rate range. This is illustrated in the tables below. At too low a flow rate, the measured head difference is very small, often resulting in major errors in head difference. At too high a flow rate, the measured head difference is excessive, and may well exceed the available head. For this reason, *it is common to have a moveable plate that can be adjusted up and down,* varying the "Y" dimension.

   The addition of the moveable plate (often a rectangular sluice gate) creates the commonly known "CHO" or "constant head orifice". The device certainly does not create a "constant head", but it does provide an adjustable orifice. It provides the flexibility needed for a turnout to supply different flows at different times, with reasonably accurate head measurements. The opening should be adjusted so that the minimum head difference is greater than 0.2'. A 1' head loss across the orifice plate is more than what is attainable in many California irrigation district turnouts.

Table 5. Orifice size values

	Width of Orifice Opening, ft							
	1.0							
	Height of Orifice Opening, ft							
	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Flow Rate, CFS	Change in Head, ft							
5.0								1.0
4.5							1.0	0.8
4.0						1.0	0.8	0.7
3.5					1.0	0.8	0.6	0.5
3.0				1.0	0.8	0.6	0.5	0.4
2.5			1.0	0.7	0.5	0.4	0.3	0.3
2.0		1.0	0.7	0.5	0.3	0.3	0.2	0.2
1.5	1.0	0.6	0.4	0.3	0.2	0.1	0.1	
1.0	0.5	0.3	0.2	0.1				

	Width of Orifice Opening, ft						
	1.5						
	Height of Orifice Opening, ft						
	0.5	0.6	0.8	1.0	1.2	1.4	1.5
Flow Rate, CFS	Change in Head, ft						
11.0						1.1	1.0
10.0						0.9	0.8
9.0					1.0	0.8	0.7
8.0				1.2	0.8	0.6	0.5
7.0				0.9	0.6	0.5	0.4
6.0			1.0	0.7	0.5	0.3	0.3
5.0			0.7	0.5	0.3	0.2	0.2
4.5		1.0	0.6	0.4	0.3	0.2	0.2
4.0	1.2	0.8	0.5	0.3	0.2	0.2	0.1
3.5	0.9	0.6	0.4	0.2	0.2	0.1	0.1
3.0	0.7	0.5	0.3	0.2	0.1		
2.5	0.5	0.3	0.2	0.1			
2.0	0.3	0.2	0.1				
1.5	0.2	0.1					

Table 5 (continued). Orifice size values

	Width of Orifice Opening, ft								
	2.0								
	Height of Orifice Opening, ft								
	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
Flow Rate, CFS	Change in Head, ft								
20.0									1.0
19.0								1.2	0.9
16.0							1.0	0.8	0.7
13.0						0.9	0.7	0.5	0.4
10.0				1.0	0.7	0.5	0.4	0.3	0.3
9.0				0.8	0.6	0.4	0.3	0.3	0.2
8.0			1.0	0.7	0.5	0.3	0.3	0.2	0.2
7.0			0.8	0.5	0.4	0.3	0.2	0.2	0.1
6.0		1.0	0.6	0.4	0.3	0.2	0.1	0.1	
5.0	1.0	0.7	0.4	0.3	0.2	0.1	0.1		
4.5	0.8	0.6	0.3	0.2	0.1	0.1			
4.0	0.7	0.5	0.3	0.2	0.1				
3.5	0.5	0.4	0.2	0.1					
3.0	0.4	0.3	0.1						
2.5	0.3	0.2	0.1						
2.0	0.2	0.1							

	Width of Orifice Opening, ft											
	2.5											
	Height of Orifice Opening, ft											
	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.5
Flow Rate, CFS	Change in Head, ft											
30.0											1.0	1.0
25.0									1.0	0.9	0.7	0.7
20.0							1.0	0.8	0.7	0.6	0.5	0.4
15.0					1.0	0.8	0.6	0.5	0.4	0.3	0.3	0.2
10.0			1.0	0.7	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1
9.0			0.8	0.5	0.4	0.3	0.2	0.2	0.1	0.1		
8.0		1.2	0.7	0.4	0.3	0.2	0.2	0.1	0.1			
7.0		0.9	0.5	0.3	0.2	0.2	0.1	0.1				
6.0	1.0	0.7	0.4	0.2	0.2	0.1						
5.0	0.7	0.5	0.3	0.2	0.1							
4.5	0.5	0.4	0.2	0.1								
4.0	0.4	0.3	0.2	0.1								
3.5	0.3	0.2	0.1									
3.0	0.2	0.2										

	Width of Orifice Opening, ft													
	3.0													
	Height of Orifice Opening, ft													
	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
Flow Rate, CFS	Change in Head, ft													
45.0													1.2	1.0
40.0												1.1	0.9	0.8
35.0										1.2	1.0	0.8	0.7	0.6
30.0									1.0	0.9	0.7	0.6	0.5	0.5
25.0							1.1	0.9	0.7	0.6	0.5	0.4	0.4	0.3
20.0						0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.2
15.0				1.0	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1
10.0			0.7	0.5	0.3	0.2	0.2	0.1	0.1					
5.0	0.5	0.3	0.2	0.1										

If steel theft is a concern, a marine plywood frame could be used to support a steel orifice opening frame. Fasteners used to connect the steel orifice to the plywood frame would need to be countersunk to minimize debris getting caught on them.

Trash Shedding Propeller Meters

For several decades there has been interest in "trash shedding propeller meters". ITRC examined the "cloggability" of an early design about 20 years ago. Boat propellers are sold with "weed shedding" features, which include specially designed propellers as well as fixed vanes upstream of the propeller that are intended to pass the weeds below or to the side of the boat propeller. McCrometer sells a saddle meter with the trash shedding options.

MC® Propeller

CONFIGURATION SHEET

MODEL M0300SW

REVERSE BOLT-ON SADDLE SURFACE WATER FLOWMETER

DESCRIPTION

The M0300SW is a bolt-on reverse-helix* propeller meter designed to shed debris often associated with surface water applications. The M0300SW is designed with the meter body turned 180 degrees from normal, a propeller installed nose-first on the bearing shaft, and a reverse flow style bearing assembly. This configuration allows the ell to curve with the flow, allowing grass or other debris to shed off with ease. The assembly design also reduces the ability of sand and silt to accumulate in the bearing.

The M0300SW features a fabricated stainless steel saddle with McCrometer's unique drive and register design. The stainless steel saddle eliminates the fatigue-related breakage common to cast iron and aluminum saddles and provides unsurpassed corrosion protection. Fabricated stainless steel construction offers the additional advantage of being flexible enough to conform to out-of-true pipe. The Model M0300SW is manufactured to comply with applicable provisions of American Water Works Association Standard No. C704-02 for propeller-type flowmeters. As with all McCrometer propeller flowmeters, standard features include a magnetically coupled drive, instantaneous flowrate indicator and straight reading, six-digit totalizer.

The impellers are manufactured of high-impact plastic, capable of retaining their shape and accuracy over the life of the meter. Each impeller is individually calibrated at the factory to accommodate the use of any standard McCrometer register, and since no change gears are used, the M0300SW can be field-serviced without the need for factory recalibration. Factory lubricated, stainless steel bearings are used to support the impeller shaft. The shielded bearing design limits the entry of materials and fluids into the bearing chamber providing maximum bearing protection.

The instantaneous flowrate indicator is standard and available in gallons per minute, cubic feet per second, liters per second and other units. The register is driven by a flexible steel cable encased within a protective vinyl liner. The register housing protects both the register and cable drive system from moisture while allowing clear reading of the flowrate indicator and totalizer.

INSTALLATION

Standard installation is horizontal mount. If the meter is to be mounted in the vertical position, please advise the factory. A straight run of full pipe the length of eight pipe diameters upstream and five diameters downstream of the meter is recommended for meters without straightening vanes. Meters with optional straightening vanes require at least three pipe diameters upstream and two diameters downstream of the meter.

* 4" meters use a forward helix propeller with a reverse register.

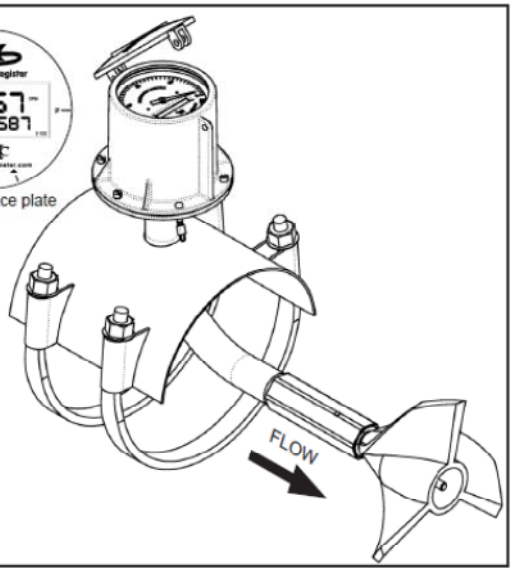
Typical face plate

The McCrometer Propeller flowmeter comes with a standard instantaneous flowrate indicator and straight-reading totalizer. An optional FlowCom register is also available.

Typical face plate

APPLICATIONS

- **Surface Water**
- **Water Containing Trash**
- **Sand Producing Wells**
- **Irrigation District Turnouts**



McCrometer will also mount a reverse-facing propeller on a standard open flow meter, which can be mounted on stands above low pressure pipelines.

Propeller

CONFIGURATION SHEET

MODEL M1700

OPEN FLOWMETER

DESCRIPTION

Model M1700 Open Flowmeters are designed to measure the flow in canal outlets, discharge and inlet pipes, irrigation turnouts and other similar installations. The M1700 series meets or exceeds the American Water Works Association Standard C704-02. Constructed of stainless steel, the meter incorporates bronze mounting brackets that permit simple installation and removal. As with all McCrometer propeller flowmeters, standard features include a magnetically coupled drive, instantaneous flowrate indicator and straight reading, six-digit totalizer.

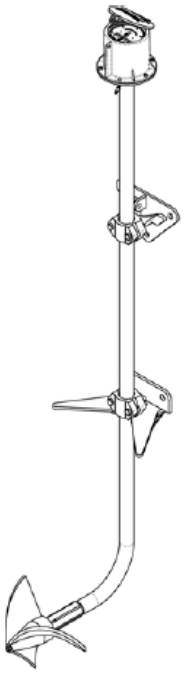
Impellers are manufactured of high-impact plastic, designed to retain both shape and accuracy over the life of the meter. Each impeller is individually calibrated at the factory to accommodate the use of standard McCrometer registers, and since no change gears are necessary, the M1700 can be field-serviced without the need for factory recalibration. Factory lubricated, stainless steel bearings are used to support the impeller shaft. The sealed bearing design limits the entry of materials and fluids into the bearing chamber providing maximum bearing protection.

An instantaneous flowrate indicator is standard and available in gallons per minute, cubic feet per second, liters per second and other units. The register is driven by a flexible steel cable encased within a protective, self-lubricating vinyl liner. The die-cast aluminum register housing protects both the register and cable drive system from moisture while allowing clear reading of the flowrate indicator and totalizer.

INSTALLATION

The M1700 must be mounted on a headwall, standpipe or other suitable structure so that the propeller is located in the center of the discharge or inlet pipe. A straight run of full pipe the length of ten pipe diameters upstream and two diameters downstream of the meter is recommended for meters without straightening vanes. Meters with optional straightening vanes require at least five pipe diameters upstream of the meter. Please specify the inside diameter of the pipe when ordering.

The McCrometer Propeller flowmeter comes with a standard instantaneous flowrate indicator and straight-reading totalizer. An optional FlowCom register is also available. *Typical face plates.*



APPLICATIONS

The McCrometer propeller meter is the most widely used flowmeter for municipal water and wastewater applications as well as agricultural and turf irrigation measurements. Typical applications include:

- Water and wastewater management
- Canal laterals
- Gravity turnouts from underground pipelines
- Sprinkler irrigation systems
- Golf course and park water management

A commercially available package that includes a reverse propeller meter and trash-shedding fixed vane, plus flow straighteners, is available from RSA.

Rubicon Transit Time Flow Meter

The Rubicon Sonaray flow meter is an interesting addition for larger turnouts with a canal supply, in that it also has a totalizer. The Rubicon literature cites a flow test in California, but it is unclear if the magmeter used for flow rate verification was recently calibrated. ITRC has found that new magmeters with guaranteed accuracies can be off by several percentage points. The device appears to be new, without substantial field testing in the USA.

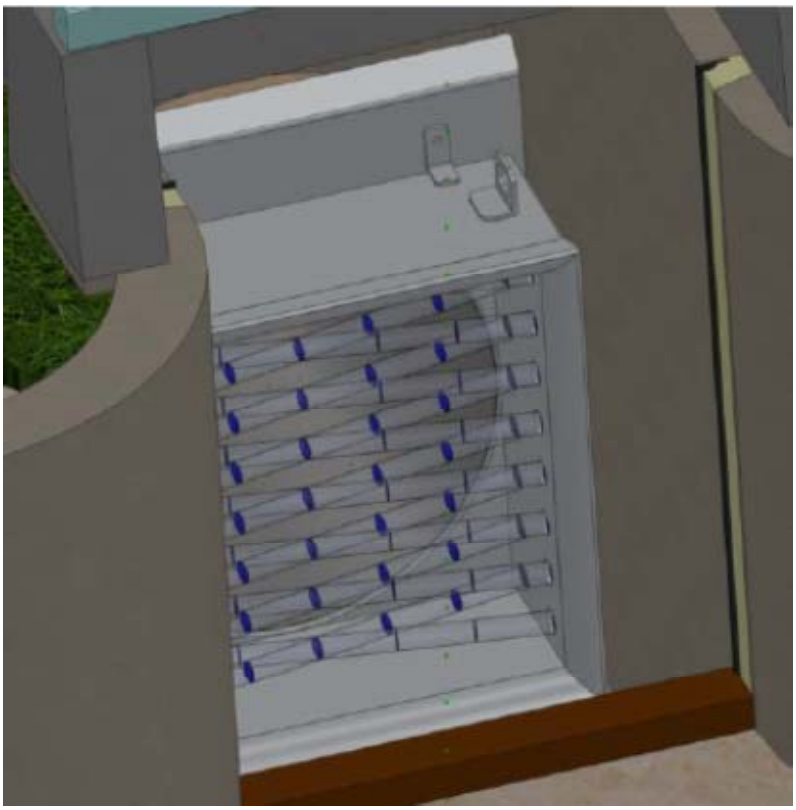


Figure 6. Rubicon Sonaray flow meter

N

Alta Irrigation District *active in last 3 years; serving 10 acres or more*

budgeting $2000 @ turnout, $9000 annual average

List of Inadequate Turnout Locations as of 11/1/2012

	Turnout	Acres	MeasurementType	Booster	LastDelivery
1	X89.21-03	318.49	Estimated Flow		5/23/2010 17:00
2	X88.19-03	160.89	Estimated Flow		5/17/2012 7:00
3	X89.30-01	160.00	Estimated Flow	YES	8/15/2012 23:00
4	X90.01-02	156.74	Estimated Flow	YES	8/8/2012 7:00
5	X90.02-02	156.74	Estimated Flow		8/9/2012 7:00
6	X89.19-01	144.46	Estimated Flow		8/15/2012 23:00
7	W83.13-01	80.00	Estimated Flow	YES	8/1/2012 7:00
8	W80.05-02	80.00	Estimated Flow	YES	8/2/2012 7:00
9	T68.09-04	77.91	Estimated Flow	YES	8/13/2012 12:00
10	M53.06-02	76.06	Estimated Flow	YES	8/10/2012 7:00
11	H06.07-08	58.65	Estimated Flow	YES	8/15/2012
12	J24.04-01	49.08	Estimated Flow		8/15/2012 14:00
13	O55.08-01	47.75	Estimated Flow		8/12/2012
14	K33.02-02	46.97	Estimated Flow		9/25/2010 16:00
15	K33.05-01	40.66	Estimated Flow		8/14/2012 10:00
16	X88.15-01	40.00	Estimated Flow	YES	7/13/2012
17	X90.00-01	40.00	Estimated Flow	YES	8/1/2012 15:00
18	W80.04-01	40.00	Estimated Flow	YES	8/15/2012 23:45
19	K33.01-01	39.24	Estimated Flow		8/15/2012 23:45
20	H07.03-03	39.00	Estimated Flow		8/8/2012 12:00
21	I38.10-02	38.81	Estimated Flow		8/15/2012 12:00
22	M54.30-02	37.62	Estimated Flow	YES	8/15/2012 17:30
23	J27.09-01	37.32	Estimated Flow		8/16/2010 7:00
24	J27.09-02	37.32	Estimated Flow		5/23/2012 7:00
25	J27.09-03	37.32	Estimated Flow		8/15/2012 1:00
26	O46.01-02	35.00	Estimated Flow		8/2/2012 23:00
27	K33.05-03	34.82	Estimated Flow		7/11/2012
28	T72.13-01	32.62	Estimated Flow	YES	5/28/2012 14:00
29	H05.01-01	28.75	Estimated Flow		9/9/2011 7:00
30	I38.06-02	24.00	Estimated Flow		8/15/2012 6:00
31	O47.15-01	23.19	Estimated Flow	YES	8/29/2011 12:00
32	K33.04-01	23.11	Estimated Flow		6/21/2011 15:00
33	H03.17-01	22.49	Estimated Flow		8/15/2012
34	J24.12-01	19.72	Estimated Flow		8/11/2010 17:00
35	T62.03-01	19.70	Estimated Flow		8/12/2012 7:00
36	K33.01-02	19.63	Estimated Flow		9/9/2011 10:00
37	H04.07-02	19.46	Estimated Flow		8/14/2012 7:00
38	H07.03-01	19.36	Estimated Flow		8/10/2012 12:00
39	J23.16-01.5	18.90	Estimated Flow		8/4/2012 5:00
40	J76.07-01	18.00	Estimated Flow	YES	8/15/2012
41	J24.08-01	15.27	Estimated Flow		7/30/2012
42	J24.12-02	14.00	Estimated Flow		5/3/2010 6:00
43	O52.04-01	14.00	Estimated Flow		8/7/2012 8:00
44	I38.07-01	13.88	Estimated Flow		8/7/2012 7:00
45	I16.05-01	11.00	Estimated Flow		6/9/2012 7:00
46	H04.07-01	10.52	Estimated Flow		8/9/2012 10:00
47	M48.00-01	10.00	Estimated Flow		8/14/2012 7:00