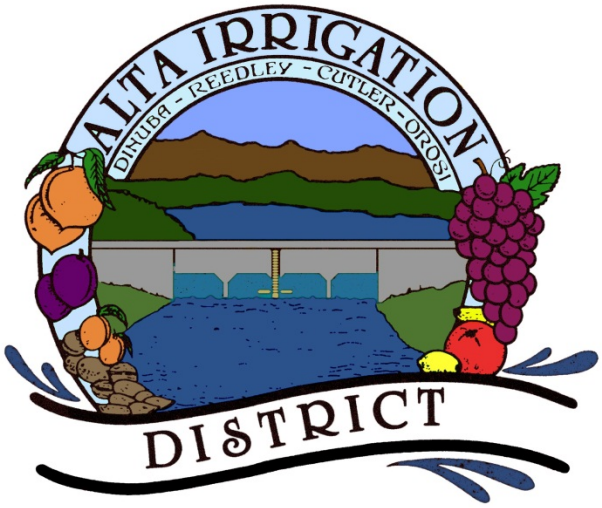
WATER MANAGEMENT PLAN

FOR

ALTA IRRIGATION DISTRICT



For Submission to

California Department of Water Resources

Regarding compliance with SB x7-7

Volume 2 of 3

June 1999

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4. Alta Irrigation District (Alta). 1981. Methods and Devices.

5. Kings River Conservation District (KRCD). 1999. Artificial Groundwater Recharge in the Kings River Service Area.

6. Kings River Conservation District (KRCD). 1997. Kings River Service Area Annual Groundwater Report.

7. Kings River Conservation District (KRCD). 1992. Alta Irrigation District Groundwater Study.

8. Kings River Conservation District (KRCD). 1991. Alta Irrigation District Surface Water Study.

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ALTA IRRIGATION DISTRICT

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

revised 8/14/98

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

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

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 for the purpose of maintaining, operating, inspecting or examining the canals, ditches, conduits, pipelines headgates, and other structures owned 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 turnouts from District owned facilities shall be measured by means of an approved flow meter, submerged orifice or other means of measurement with approval of District. Water delivery to a water turnout may be denied upon inadequate means of measurement, as determined by District.

CONTINUOUS USE OF WATER

Rule 10. Water deliveries shall be made on the basis of continuous and steady use of water during all days and nights, including weekends and holidays. No additional time shall be allowed to landowners who fail, neglect or refuse to use water continuously, when available, during the allotted cycle. Landowners who fail, neglect or refuse to use water during the cycle when water has been scheduled shall not claim the 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

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.

REQUESTS FOR DELIVERIES

Rule 11. Requests for turning on, turning off, increasing or decreasing water deliveries shall be made to the ditchtender. Requests shall be made at least 24 hours prior to the day scheduled for turning on or turning off water. Reasonable efforts will be made to comply with all such requests.

DURATION OF DELIVERIES

Rule 12. After water service has started, the water will run continuously for the scheduled delivery, or as otherwise requested by a landowner, if approved by Ditchtender. The 24-hour notice for stopping water service may be waived in case of an emergency. The Ditchtender shall determine the water-use time based upon a reasonable assessment of actual water use.

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, ditch or other conduit or from the water flowing therein. The responsibility of the District shall cease and terminate when water is delivered into the private canal, ditch or other conduit in accordance with these Rules and Regulations. The Ditchtender shall have access to private canals, ditches or conduits and to the land irrigated by them to enable him to schedule the water delivery to the headgate of such facilities and to inspect the condition of these facilities. The same authority and jurisdiction granted to Ditchtenders in the operation of canals, ditches, and conduits owned by the District, however, is not applicable to those that are privately owned. Cleaning, maintaining, and repairing of private canals, ditches, and conduits is the responsibility of landowners.

The District will not knowingly, and a Ditchtender is not authorized to, deliver water to a private canal, 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. It shall be incumbent on the landowners to control the actions of person taking water from private canals, ditches or conduits. Said landowners shall be responsible for water delivery from such private canals, 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 therefrom.

TRASH OR DEBRIS

Rule 23. No tires, trash, debris, litter, garbage, prunings, 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 therefor 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 August 14, 1998.

_____

Chris M. Kapheim, Secretary

COMPUTATION OF WATER ENTITLEMENT

Computation of water entitlement for each irrigation period is determined by the Board of Directors and is based on 4 days per 20 acres, flowing 1 cubic foot per second (cfs), multiplied by the parcel's entitlement. If the flow is not 1 cfs, the hours of entitlement are divided by the actual cfs to get the adjusted hours of entitlement.

FORMULA: Acres multiplied by the factor, divided by the cfs equals hours of entitlement

ENTITLEMENT PER ACRE	VALUATION FACTOR
100%	4.80
75%	3.60
50%	2.40
25%	1.20
5%	.24

EXAMPLES:

(1) 20 acres: 100% Entitlement. Flow 1.00 cfs
20 x 4.80 (factor) divided by 1.00 (flow) = 96 hours or 4 days.

(2) 20 acres: 100 % Entitlement. Flow, .80 cfs
20 x 4.80 (factor) divided by .80 (flow) = 120 hours or 5 days.

(3) 20 acres: 100% Entitlement. Flow, 1.20 cfs
20 x 4.80 (factor) divided by 1.20 (flow) = 80 hours or 3 days & 8 hours.

(4) 20 acres: 75% Entitlement. Flow, 1.00 cfs
20 x 3.60 (factor) divided by 1.00 (flow) = 72 hours or 3 days.

(5) 20 acres: 50% Entitlement. Flow, 1.00 cfs
20 x 2.40 (factor) divided by 1.00 (flow) = 48 hours or 2 days.

(6) 20 acres: 25% Entitlement. Flow, 1.00 cfs
20 x 1.20 (factor) divided by 1.00 (flow) = 24 hours or 1 day.

(7) 20 acres: 5% Entitlement. Flow, 1.00 cfs
20 x .24 (factor) divided by 1.00 (flow) = 4.80 hours.

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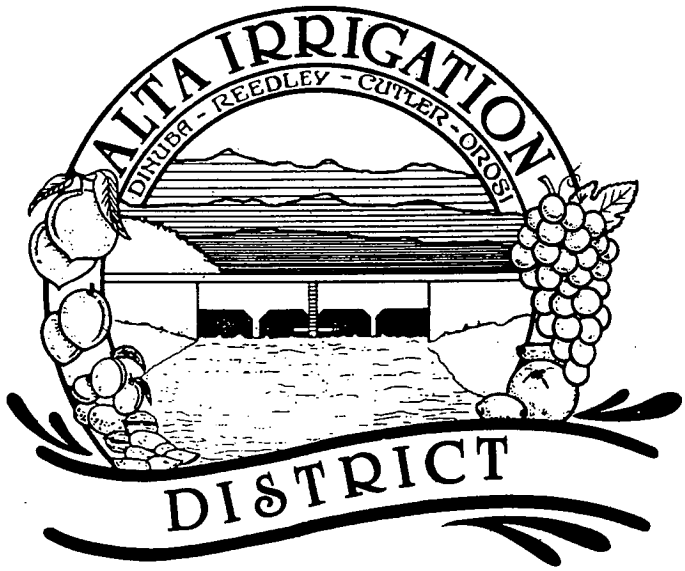
ALTA IRRIGATION DISTRICT



1995

ANNUAL REPORT

ALTA
IRRIGATION
DISTRICT

289 NORTH L STREET
P.O. BOX 715
DINUBA, CA 93618
(209) 591-0800
FAX (209) 591-5190

BOARD OF DIRECTORS

NORMAN B. WALDNER
PRESIDENT

BEN AGRIFOGLIO
SCOTT BELKNAP
TOM MARSHALL
DAVID POWELL
ROGER WARKENTIN
LEONARD WILEMAN

CHRIS M. KAPHEIM
GENERAL MANAGER

JANELLE M. COCHRAN
SECRETARY TREASURER

DARLENE F. STEWART
COLLECTOR

May 13, 1996

Honorable Board of Directors
Alta Irrigation District
P. O. Box 715
Dinuba, CA 93618

Re: 1995 Annual Report

Gentlemen:

Transmitted herewith is the 1994/95 fiscal year end annual report of the Alta Irrigation District for the period from October 1, 1994 through September 30, 1995.

Also, a part of this report are various schedules showing the expenditures for additions to permanent assets; for maintenance and operation for general expense; income and expenses and other data pertinent to the financial operation of the District.

Also, enclosed in this report, is the crop & pump survey, charts showing the twenty-year rainfall, groundwater levels, diversions and dates of water run and a history of the District.

Respectfully submitted,

ALTA IRRIGATION DISTRICT

Chris M. Kapheim
General Manager

CMK:jmc

Encl.

ALTA IRRIGATION DISTRICT
1995 ANNUAL REPORT

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ALTA IRRIGATION DISTRICT

ANNUAL REPORT

BOARD OF DIRECTORS

Norman Waldner
Division No. 4

Ben Agrifoglio
Division No. 1

Roger Warkentin
Division No. 2

Leonard Wileman
Division No. 3

Tom Marshall
Division No. 5

OFFICERS

Norman Waldner.....President
Ben Agrifoglio.....Vice-President
Janelle M. Cochran.....Secretary-Treasurer

MANAGEMENT STAFF

Chris M. Kapheim.....General Manager
Jeff Heringer.....Superintendent
Janelle M. Cochran.....Office Manager
Darlene F. Stewart.....Collector

CONSULTANTS

James H. Wegley.....Engineer
Douglas B. Jensen.....Attorney
Blankenship & Schultz.....Auditors

REGULAR BOARD MEETING
SECOND FRIDAY OF EACH MONTH
9:00 A.M.

ALTA IRRIGATION DISTRICT HISTORY

HISTORY OF EARLY IRRIGATION IN THE KINGS RIVER AREA

The Alta Irrigation District was originally a dry and arid area capable of sustaining dry land crops and cattle. The area in 1825 resembled a desert. The reason is simple, with the average rainfall in the District for the 50 year period to 1956 being only 11.39 inches. Furthermore, virtually none of the annual rainfall occurs during the months of June, July and August which are the hottest, and also the period during which the greatest plant growth takes place.

The Kings River, which supplies water to the Alta District, is one of the largest streams entering the San Joaquin Valley. The river drains from the mountain and foothill area of 1,742 square miles, ranging in elevation from 500 to 14,000 feet above sea level. More than half 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 high stage until the middle of May or first of June. However, the average runoff does not guarantee this amount 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.

Irrigation in the Kings River area was practiced in a limited way in the river bottoms beginning in the early 1850's. To make this irrigation possible, the early settlers built dams of cobblestones, and built ditches with the aid of horses and mules, scrapers, or by hand. The efforts of these early pioneers were to secure water on lands not bordering streams, or to irrigate lands for a second crop of corn and pumpkins after hay had been cut. Irrigation at that time was used only for small operations. Any large scale farmer depended on dry farming to raise wheat or grazed cattle on the grass of the plains.

Two important factors were of value with the early diversion of water from the Kings River. First, the growing of fruits and vegetables were made possible, and secondly, the establishment of water rights for these lands were secured.

During this time period, cattle grazing was more important in the Kings River area than agriculture. There were frequent conflicts between the cattlemen and the owners of crops. More and more crops were planted because of the availability of water, yet cattle roamed at will, often ruining crops. Also, during this time period, a "No Fence" bill was introduced, and after much controversy, it was eventually passed. This law required all cattle owners to prevent their stock from trespassing upon the land of others, and held them responsible for any damage done by their

cattle. Because of this new law, it was economically impossible to continue the same type of ranching as had been carried on in this area previously. Therefore, many thousand head of cattle were driven over the mountains into the wilds of Nevada, where large tracts of wild range were now protected by the new state law. The farmer-irrigator had won a major battle. As a result of this victory, many more farmers were attracted to the Kings River area, including the Alta Irrigation District.

The other factor during this time was the problem of water rights. As more farmers arrived, the demand for diverted water increased until there seemed to be a shortage and litigation naturally ensued. Litigation between claimants or water priority and litigation over water rights was the general rule and not the exception. This was the state of affairs along the Kings River and along other California streams until the final settlement in the California Supreme Court in 1886. The judgment in this case stated that doctrine of appropriation was the common law and as a result of this law, all irrigation units on the Kings River were enjoined from diverting its water.

One of the companies, which had serious problems as a result of the Riparian Rights Case, was the "76" Land and Water Company, the forerunner of the Alta Irrigation District.

"76" LAND AND WATER COMPANY

In 1856, a large tract of land in the Kings River bottom was being used by owners Andrew Darwin and E. C. Ferguson for their cattle operation. The brand they used, and so recorded in Fresno County, was the "76". Their cattle roamed throughout the present Alta District and was soon to be known as "76" Country. In 1865, Darwin and Ferguson sold all their holdings to Thomas Fowler and Richard Carmen and continued to graze their cattle throughout the area. Around 1875, Fowler bought out Carmen and it was around this time the struggle between farmer and cattle rancher was being waged.

The idea to build an irrigation system in the "76" country was conceived in the mind of P. Y. Baker, a civil engineer, and D. K. Zumwalt in 1881. Their plan was to acquire a large tract of land, build an irrigation system, and then subdivide the land and either sell or lease the land in small plots to settlers attracted by the advertising of the proposed company. At this time, Fowler had ceased to be very optimistic concerning the future operation of the "76" land and Baker sold him on the idea of an irrigation company. As a result, Fowler turned all his land over to the company which Baker had organized in exchange for a large block of stock in the company. Six other capitalists were also interested in the project and on May 15, 1882, Baker posted a sign on the south bank of the Kings River saying the water was to be diverted. This was

necessary to establish water rights. The articles of incorporation of the "76" Land and Water Company were filed in the Fresno County Clerk's office on May 29, 1882.

The first office of the "76" Land and Water Company was in Visalia. The capital stock of the corporation was $280,000, which was divided into fourteen shares of $20,000 each. The land owned by the company totaled 30,000 acres. The first preliminary survey for the "76" Canal was run through Dunnigan Gap, following closely the line now used by the Friant-Kern Canal, with construction beginning in 1882.

The original point of diversion from the main channel of the Kings River was at the mouth of Dennis Slough. Shortly, however, this was changed to the present point of diversion just below the town of Piedra. This point is known as "The Cobbles". It is about fourteen miles northeast of Reedley and is four miles above the point of diversion of any other canal on the Kings River. The canal follows a southwesterly course through a channel that is partly natural and partly man made. The canal, near the diversion point, is one hundred feet wide and in that area has a drop of four feet to the mile. It is capable of carrying one thousand three hundred cubic feet of water per second.

The headgate, or point of control of the "76" Canal, was located several miles down the main canal. The headgate was built in 1883 of redwood timbers. Since the canal at that point was still one hundred feet wide at the bottom, the headgate was also one hundred feet wide. It was claimed that this headgate was larger than that of any other irrigation system in the western United States at that time. It is also interesting to note that even in the early days the system served as a bridge for a county road, as it stills does to this day.

The construction of the system continued until December of 1883. At this time, the main canal and several lateral canals were completed, and the decision to turn some water into the ditches was made. When the water reached the Wahtoke Dam, constructed by the "76" Company, a serious break occurred resulting in closure of the headgate. Continued construction on the system was made until they had reached the Central Pacific Railroad (now Southern Pacific) in Tulare County, a few miles south of where the railroad crossed the Kings River. At this point, the company decided to survey a townsite. The surveying was complete by March, 1884, and the town was named Traver, in honor of Charles Traver, member of the Board of Directors of the "76" Land and Water Company. At this time the company moved its office from Visalia to Traver.

The first sale of the "76" Land and Water Company was made on December 31, 1883. In April of 1884, the headgates were opened allowing a moderate head of water to flow into the main canal. That same month, an auction was held to sell town lots. The sales at the end of the two day auction totaled $65,000. The only building in the townsite at this time was a partially completed

railroad depot. By September, however, it was a thriving town with stores, hotels, grain warehouses and other places of business, including a few saloons.

Over the next few years, between poor management on the part of the "76" Land and Water Company, the breaking of the faith with the tenants of the "76" Company, and the years of litigation that followed, a succession of short crops and low prices, and the financial depression bringing a decline in the prices of real estate, not only delayed the progress of the "76" Company, but brought financial ruin to some of its pioneers. Undoubtedly, there were many reasons for this decline in land value and financial ruin of the pioneers, but there can be no doubt that the practices of the "76" Land and Water Company were an important factor.

THE FORMATION OF ALTA IRRIGATION DISTRICT

Since irrigation works were very expensive and because of increased demands for water distribution systems by small farmers who could not afford to build these systems themselves, the California legislature passed the Wright Act on March 7, 1887. This act sought to confer on farming communities powers of municipalities in the purchase or construction and operation of irrigation works. These powers included the right of eminent domain, the right to issue bonds against all the real property within any area organized into an irrigation district, and the right to tax that property for the purpose of building or operating irrigation works. Provision was made for conducting district elections, for meeting of board of directors and for the management of district business.

There were questions in regards to the legality of the Wright Act, but the State Supreme Court ruled that the Act complied with the various provisions of the state constitution. This judgment apparently encouraged the people who were served by the "76" Land and Water Company to proceed with plans to form an irrigation district.

In complying with the provisions of the Wright Act, a petition calling for an election to form an irrigation district and bearing the signatures of sixty-six landowners within the proposed district, was presented to the Tulare County Clerk on July 7, 1888. When the committee registered the papers for the new district, it was suggested that a new name be adopted. It was decided that since the diversion point off the Kings River was higher in elevation than any other point of diversion, the title "Alta Irrigation District" (Alta is Spanish means high) would be an appropriate name. And was so recorded. The area included within the boundaries of the District was approximately 130,000 acres. The District included parts of Tulare, Fresno and Kings Counties. The present communities of Dinuba, Reedley, Traver, Cutler, and Orosi lie within these boundaries.

On August 14, 1888, the election was held with 326 in favor of the formation of an irrigation district and 19 against the formation of such a district. Thus, the Alta Irrigation District was formed to become the third irrigation district in California. The election was also used to elect a Board of Directors to serve the new District. The area was divided into five divisions, with one director to be elected from each of these divisions. On September 10, 1888, the first Board of Directors meeting was held and P. Y. Baker was elected President and William J. Applegate was appointed Secretary.

On October 12, 1888, the Board of Directors appointed James Sibley as engineer for the District. It was his assignment to determine the amount of bonds that would be necessary to cover the cost of needed construction. At this time, the board also began negotiating with the "76" Land and Water Company for the purchase of their existing irrigation system. On December 4, 1888, the Board of Directors voted to transfer the District office from Traver to Dinuba. This move was viewed by the citizens of Traver as a serious blow to the already dying community.

On February 15, 1889, a successful bond election was held and according to the Wright Act, all the real estate within the district boundaries was to be used as security to back the bonds.

During all of this time that the District was a legal entity, no property had been purchased. Negotiations with the "76" Company was on-going and it was not until July 1, 1890 that an agreement had been reached. The "76" Company agreed to take 820 bonds of the District, each with a value of $500, or a total of $410,000, in exchange for its canals and water rights. At the time of transfer of the irrigation system to Alta, the "76" Company was furnishing water to only about 1,900 acres. Many more canals and ditches would need to be constructed if all 129,300 acres were to be irrigated. After a bond sale of $100,000, a great deal of construction of canals, ditches, drops and headgates were instigated. By January, 1895, the necessary system of ditches were nearly completed.

In the next few years, in spite of the low cost of the water and the continuity of water delivery, there were groups who wanted to do away with the irrigation district system. One of these groups was composed of city dwellers who attacked the Wright Act on the grounds that the irrigation system was for the benefit of the farmer, not the city resident. In 1891, the State Supreme Court left no doubt that the Wright Act was legal and binding. The other dissatisfied group were owners of large tracts of land who pooled their resources and employed an attorney to lobby the state legislature to repeal the Wright Act. The Board of Directors of Alta Irrigation District persuaded William P. Boone to run for the state assembly to counteract the efforts of any groups that were interested in repealing the Wright Act. Mr. Boone was elected and he joined the legislature for the 1895 session. In the next two

years, Mr. Boone tried to preserve the Wright Act. In 1897, Boone achieved at least partial success in his mission with a compromise. This compromise, known as the "Bridgeford Act", stated that no new irrigation district could be organized. The Act was so severe for organizing districts in incurring indebtedness, that irrigation district development in California remained dormant for twelve years, with no new projects being initiated between 1897 and 1909.

On Mr. Boone's return to his position as Secretary of the Board of Directors of the Alta District, he found the situation still serious. The Tulare Superior Court handed down a decision which stated that the bonds of the District were illegal and that the Board of Directors could not force the people of the District to pay taxes for the purpose of making any kind of payment on the bonds. The court made a distinction, as did many of the landowners, between taxes for bond payment and taxes for operating expenses. The courts ruled the District could assess the property owners to pay operating expenses, but could not assess for bond payments. During this entire period the people of the District voted overwhelmingly in favor of the special assessments requested by the Board of Directors for operating expenses.

During this three year period, the landowners, not knowing exactly what they could be forced to pay, and the Board of Directors not knowing exactly what they could legally collect, consequently resulted in default in bond payments. With the refusal of most landowners to pay taxes or assessments, the Board of Directors had to contrive a plan to raise money to pay the necessary labor. The water users were canvassed for loans or contributions to raise funds with a promise that such contributions would apply on their taxes.

Two legislative acts were passed during the time period in which all of these problems occurred in the Alta District. The first, entitled "An Act to provide for the issue and sale or exchange of funding bonds of Irrigation Districts organized under and in accordance with the Wright Act", was passed by the California Legislature on April 1, 1897. The second act was an "Amendment of the 1897 Act", and was designed to aid the irrigation districts in exchanging or refunding their bonds. This act was passed in Sacramento on March 16, 1901. W. P. Boone, on behalf of the Board of Directors, was to settle with the landowners means of repayment. Finally, a committee representing the landowner's group and a like representation of the bond holders, agreed upon a basis of compromise, calling for a vote of refunding bonds and cancellation of all outstanding bonds with a reduction of 25% of the debt at a reduced rate. Boone, too, was to obtain written agreement from every landowner in the district, which bound each landowner not to question the validity of such refunding bonds. After Boone had successfully obtained all property owners agreements, the Board of Directors called for a meeting of the landowners to consider the proposal from the bondholders

representatives. Five landowners were elected to travel to San Francisco to deal with the bondholders.

On October 10, 1901, a petition was presented to the Board of Directors which proposed the funding of such outstanding bonds and coupons and that the payment thereof may be provided for by the issuance of new bonds. On this same day, the Board of Directors called for a special election to decide whether $500,000 in new bonds should be issued and sold to pay off the old bonds. The election was held and approved by the voters. With the refunding of this debt, the most critical period in the financial development of the District had ended.

One of the other problems that existed during the early formation of the district were the battles between the water districts. Over 100 lawsuits were tried between the turn of the century and 1918 at a tremendous cost to the water districts and landowners.

Thus, in the early part of 1914, a large mass meeting was called to address the situation. The meeting resulted in the formation of a committee of five men to begin searching for solutions through negotiation instead of litigation. By 1916, it became apparent that public sentiment was in favor of a negotiated peace between water interests. Meetings were held between feuding companies and districts in order to begin to work on a compromise solution. By 1917, nearly all of the companies had begun submitting schedules for diversions for consideration by the whole.

FORMATION OF THE KINGS RIVER WATER ASSOCIATION

The State Water Commission selected engineer Charles Kaupke to clean up the problem that was facing the water districts on the Kings River. The commission thought it would require about two months to complete. Having gone through a number of temporary schedules, the 19 water agencies, covering approximately 940,000 acres at that time and operating on the Kings River, finally came to a long-overdue negotiated settlement. On January 1, 1928, the Kings River Water Association was borne with Charles Kaupke as the designated watermaster of the river.

The new Association finally had brought an end to the painful and expensive litigation that existed for over fifty years on the Kings River. An organization had been borne to see that the most beneficial use was made of the limited water supply for all users on the river.

Today, the Alta Irrigation District remains as one of the charter members of the Kings River Water Association, with Director William P. Boone serving as its President from its inception until his death in 1944. With 28 member water agencies, the Association continues to represent and manage water distribution for over 1.1 million acres of irrigated agriculture and urban areas throughout the Kings River service area.

PINE FLAT DAM PROJECT

From the first years of irrigation practice in the region, it became apparent that some type of storage facility and flood control project needed to be established. Heavy rains and snowpack in the watershed high in the Sierras would send torrential, destructive flood waters jumping the banks of the Kings River. In alternating drought years, the river would be reduced to a fraction of its normal flow.

As early as 1902, land developer Thomas L. Reed traveled to Washington D. C. to drum up support of the building of a dam on the river, but he returned unsuccessful in his attempt. Four years later, with his own funds, he commissioned a study to survey the river for a dam site. The site chosen was roughly the same location as where Pine Flat Dam would eventually be built, some 48 years later.

In 1914, a group of Kings River water interest landholders, called the "Committee of Thirty", began meeting and concurred that funds should be sought for a reservoir site. William P. Boone, a man closely associated with Alta Irrigation District from its beginning, headed the formal campaign to build the project. He traveled to Sacramento to secure support from the legislature, but once again the trip was not forthcoming. The main problems were with the water users themselves and their inability to negotiate a permanent agreement on Kings River Water Rights. By 1928, when the Depression was at its peak, unemployment was at a record high, and the crop prices had collapsed, federal money for such a project such as Pine Flat Dam was nearly hopeless. It was not until 1944 that a contract was signed with the Army Corps of Engineers to begin construction on the dam, with completion in 1954.

The most recent technological enhancement of the district's operation is the power plant at Pine Flat Dam, completed in 1985. The hydroelectric facility, with its 55 megawatt generators, provides power to the Department of Water Resources to run pumping stations.

GROUNDWATER OVERDRAFT PROBLEMS

In its earliest years, Alta Irrigation District's most difficult problems were fought in the court room. Today, however, the battle is being waged under the ground and is a war against the already severe overdraft that exists in the previous groundwater tables.

The groundwater overdraft problem that the District is now faced with would be hard to fathom 100 years ago. For hundreds of years, the underground tables had been filled and were nearly overflowing with water. In recent years, with the heavy reliance by agriculture on pumping (especially drought years) has resulted in a severe groundwater overdraft. For those with no ready access

to surface water supplies, the cost in electricity bills alone becomes worse each year, as more energy is required to pump from ever deepening levels beneath the ground.

The hope for solutions to these problems through increased water conservation within the District itself and throughout the San Joaquin Valley is disheartening. The decisions we are faced with today are consequences our region must endure in the future. Whether we decide to decrease the demand for water or increase the supply. Or do we opt for agricultural land and businesses to go out of production. Or is the solution to build more water storage projects on the river, which politically means unpopular dams. The choice is a difficult one and it will be the Alta Irrigation District and the small family farmer who will either win or lose.

BALANCE SHEET - SEPTEMBER 30, 1995

ASSETS	
Current Assets:	
Cash and investments	$2,075,211
Receivables:	
Unredeemed assessment sales	62,553
Collector's deeds	498
Note receivable, current portion	9,550
Inventory	32,987
Prepaid expenses	95,955
Deposits	33,746
TOTAL CURRENT ASSETS	**2,310,500**
Utility, plant, net of accumulated depreciation	**4,457,911**
Other assets:	
Note receivable	57,300
Accounts receivable	125,394
Deposits	22,931
TOTAL OTHER ASSETS	**205,625**
TOTAL ASSETS	**$6,974,036**
LIABILITIES & FUND EQUITY	
Current liabilities:	
Current maturities of long-term debt	$ 35,395
Accounts payable	117,809
Accrued expenses	154,167
Deferred income	28,904
Delinquent assessment sales trust fund	55,268
TOTAL CURRENT LIABILITIES	**$ 391,543**
Long-term debt	**247,763**
Fund equity:	
Contributed capital	610,834
Retained earnings:	
Appropriated	5,575,069
Unappropriated	148,827
TOTAL FUND EQUITY	**6,334,730**
TOTAL LIABILITIES & FUND EQUITY	**$6,974,036**

STATEMENT OF INCOME - SEPTEMBER 30, 1995

OPERATING REVENUE	
Assessments:	
Current charges	$1,471,121
City of Reedley	13,902
City of Dinuba	20,238
Pine Flat Power	208,471
TOTAL ASSESSMENTS	**1,713,732**
OPERATING EXPENSES	
Depreciation	165,378
Maintenance	586,836
Operations	432,690
General and administrative	769,821
Pine Flat Dam - Maintenance & Operation	46,039
TOTAL OPERATING EXPENSES	**2,000,764**
OPERATING INCOME (LOSS)	**(287,032)**
NON-OPERATING REVENUE (EXPENSES)	
Interest income	139,449
Penalties and costs	9,089
Interest on assessments	4,275
Work for others	2,888
Miscellaneous	147,937
Equipment lease and rents	4,826
Gain (loss) on sale of assets	421
Refunds	10,349
TOTAL NON-OPERATING REVENUE (EXPENSES)	**320,234**
NET INCOME	**$ 33,202**

STATEMENT OF CASH FLOWS - SEPTEMBER 30, 1995

CASH FLOWS FROM OPERATING ACTIVITIES:	
Net income	$ 33,202
Adjustments to reconcile net income to net cash, provided by operating activities:	
Depreciation	165,378
Gain on sale of assets	(421)
Changes in assets & liabilities:	
(Increase) in accounts receivable	(82,761)
(Increase) in unredeemed assessment sales	(1,748)
Decrease in collector's deed receivable	3,715
Increase in prepaid expenses	(13,984)
(Increase) in inventory	(1,924)
Decrease in deposits	949
(Decrease) in accounts payable	(26,745)
Increase in accrued liabilities	31,182
Increase in deferred income	28,904
Increase in delinquent assessment sales trust fund	55,268
TOTAL ADJUSTMENTS	**161,661**
NET CASH (USED) PROVIDED BY OPERATIONS	**194,863**
CASH FLOWS FROM CAPITAL & RELATED FINANCING ACTIVITIES:	
Principal payments on notes	(35,395)
Capital contributions	43,681
Capital expenditures	(207,111)
Proceeds from sale of assets	1,720
Proceeds from construction in progress	20,664
NET CASH USED FROM CAPITAL & RELATED FINANCING ACTIVITIES	**(217,769)**
CASH FLOWS FROM INVESTING ACTIVITIES:	
Proceeds from note receivable	9,550
NET CASH PROVIDED FROM INVESTING ACTIVITIES	**9,550**
NET INCREASE IN CASH & CASH EQUIVALENTS	**(13,356)**
CASH & CASH EQUIVALENTS AT BEGINNING OF YEAR	**2,088,567**
CASH & CASH EQUIVALENTS AT END OF YEAR	**$2,075,211**

NOTES TO FINANCIAL STATEMENTS
YEAR ENDED SEPTEMBER 30, 1995

SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Organization and Operation - The Alta Irrigation District (the District) was organized under the Wright Act in 1887 and operates under the provision of the California Water Code. The District covers an area of approximately 130,000 acres and distributes water to the agricultural lands in Tulare, Fresno & Kings counties.

The District has the authority to fix rates and charges for commodities and services furnished; it may also, with prior voter approval, incur indebtedness and issue bonds. The District is exempt from payment of federal and state taxes.

Basis of Accounting - Alta Irrigation District uses the accounting system prescribed by the State of California for Special Districts. The accounting records are maintained on the accrual basis of accounting.

Cash and Cash Equivalents - The District invests its funds in various financial instruments with limited interest rate risk. Investments with a maturity of three months or less when purchased are classified as cash and equivalents.

Accounts Receivable - Accounts receivable arise from billings to landowners for water charges and certain improvements made to the landowner's property. Substantially all of the District's sales are to landowners located within the District's boundaries. Uncollectible amounts from individual landowners do not exist because the District obtains a lien upon all assessed property once the assessment becomes delinquent. After a five year period, the District can sell the property to recover all prior assessments, cost, penalties and interest due the District.

Inventory - Inventories are stated at the lower of cost or market. Cost is determined by the first in, first out method.

Property, Plant and Equipment - Property, plant and equipment (including major renewals and improvements) are recorded at cost. Depreciation is provided over the useful lives of the assets using the straight-line method. When properties are disposed of, the related costs and accumulated depreciation are removed from the respective accounts. Any gains or losses on the disposition by sale or retirement are recognized currently in net income. Maintenance and repairs which do not improve or extend the life of the respective assets are expensed currently.

Long-Term Debt - Long-term debt is recorded at the stated principal amount of the obligation.

Revenue Recognition - Irrigation revenues are recognized on the basis of cycle billings and are recorded when landowners are billed.

Deferred Compensation Plan - The District offers its employees a deferred compensation plan created in accordance with the Internal Revenue Code Section 457. Until paid or made available to the employee or other beneficiary, all amounts of deferred compensation, all property and rights purchased with those amounts, all income attributable to those amounts, and property or rights, are subject to the claims of the District's general creditors. Participants' rights under the plan are equal to those of a general creditor. The District has the duty of reasonable care in the selection of investment alternatives, but neither the District nor its directors or officers have any liability for losses under the plan.

Retirement - Alta Irrigation District is a member of the Public Employees' Retirement System for Local Miscellaneous Members, a contributory pension plan covering qualified employees.

Oversight Responsibility - Alta Irrigation District is administered by a board separate from and independent of, the Tulare County Board of Supervisors. The Tulare County Board of Supervisors does not select the board or management of Alta Irrigation District nor significantly influence its operation. As a result, the activities of Alta irrigation District are not included in the financial statements of the County of Tulare.

CASH

The District has monies on deposit with the Local Agency Investment Fund, a special fund of the California State Treasury. The fund invests in government securities and commercial paper. The District may withdraw monies upon one day notice. At September 30, 1995 the funds were earning interest at an annual percentage rate of 5.89%.

Cash Balances Consisted of the Following:

Treasurer's General Account:	
Money market account	$ 110,062
Checking account	17,468
TOTAL	**$ 127,530**

Secretary's Payroll Account (checking)	**95,437**
Secretary's Imprest Account (checking)	**45,000**
Collector's Office Petty Cash	**200**
TOTAL CASH BALANCE	**$2,075,211**

At September 30, 1995, the book balance of the District's deposits was $268,167 and the bank balance was $203,776 which was collateralized with pools of securities held by the pledging financial institutions's trust department or agent, but not in the District's name.

The collateral for the District's deposits is categorized, in accordance with GASB Statement No. 3, to give an indication of the level of risk assumed by the District at year end. Category 1 includes deposits that are insured or collateralized with securities held by the District or its agent in the District's name. Category 2 includes deposits collateralized with securities held by the pledging financial institutions's trust department or agent in the District's name. Category 3 includes uncollateralized deposits, including deposits that are collateralized with securities held by the pledging financial institution or by its' trust department or agent, but not in the District's name.

	1995 CATEGORY		
	1	2	3
Checking			$ 77,804
Savings and money market			125,972
TOTAL	**$ -0-**	**$ -0-**	**$ 203,776**

The market value of the securities pledged by the financial institution holding District funds exceeded 110 percent of the amount on deposit as of September 30, 1995.

The District invests with the State of California Local Agency Investment Fund, which is an uncollateralized special fund of the California State Treasury, however, per California Government Code Section 16429.2, these funds cannot be seized or impounded by any government official or agency. The balance at September 30, 1995 was $1,807,044 which approximates market value. The investment pool is managed by another government and is not required to be categorized in accordance with GASB Statement No. 3.

NOTE RECEIVABLE

A note receivable arose from the sale of approximately 30 acres of land which the District no longer needed. The note balance is $66,850 as of September 30, 1995, and accrues interest at 9% annum. The note is payable beginning July 31, 1993 in the amount of $9,550 per year plus interest. The final payment is due July 31, 2002.

Total principal payments due on the note receivable for each of the fives subsequent to September 30, 1995 are as follows:

1996	**$ 9,550**
1997	**9,550**
1998	**9,550**
1999	**9,550**
2000	**9,550**
Thereafter	**19,100**
TOTAL	**$66,850**
Less: current portion	**(9,550)**
	$57,300

PROPERTY, PLANT AND EQUIPMENT

Property, plant and equipment are summarized by major classifications as follows:

		Estimated Useful Lives
Land	**$ 240,467**	
Pine Flat Reservoir	**1,489,143**	
Transmission & distribution plant	**4,026,790**	**50 years**
General Plant	**1,398,624**	**5 - 20 years**
Construction-in-progress	**(6,201)**	
TOTAL	**$7,161,025**	
LESS: ACCUMULATED DEPRECIATION	**(2,703,114)**	
TOTAL PROPERTY, PLANT & EQUIPMENT	**$4,457,911**	

Depreciation is computed using the straight-line method for financial reporting purposes and amounted to $165,378 in 1995.

ACCRUED VACATION, SICK AND COMPENSATION TIME

District employees have accumulated unpaid vacation of $43,178 as of September 30, 1995, which they may elect to receive in cash upon termination. Earned vacation varies with the length of employment.

In addition, all employees, after completing five years of full-

time employment with the District, shall be compensated in time off at the end of the term of employment, or in money for 50% of their sick leave to a maximum of 240 hours.

Vacation	$ 43,178
Sick time	50,823
Compensation time	5,488
TOTAL	$ 56,311

ACCRUED EXPENSES

Accrued expenses consist of the following:

Wages	$ 30,047
Vacation	43,178
Sick leave	50,823
Compensation time	5,488
Payroll taxes on comp absences	6,864
Payroll taxes	11,767
TOTAL ACCRUED EXPENSES	$ 154,167

LONG-TERM DEBT

Long-term debt consists of the following:

U. S. Bureau Reclamation, non-interest bearing, installments of $35,395 due annually	$ 283,158
Less: current portion	(35,395)
TOTAL	$ 247,763

Total principal payments due on long-term debt for each of the five years subsequent to September 30, 1995 are as follows:

1996	$ 35,395
1997	35,395
1998	35,395
1999	35,395
2000	35,395
Thereafter	106,183
	$ 283,158

APPROPRIATED RETAINED EARNINGS

Appropriated retained earnings consists of the following:

Utility plant	**4,457,911**
Pine Flat debt repayment	**283,158**
Capital fund	**434,000**
Appropriated	**300,000**
Contingency fund	**100,000**
TOTAL	**$5,575,069**

The Board of Directors has authorized the above appropriations of retained earnings.

DEFINED BENEFIT PENSION PLAN

Plan Description - The District contributes to the California Public Employees' Retirement System (PERS), an agent, multiple employer, public employee retirement system which acts as a common investment and administrative agent for participating public entities within the State of California. The payroll for employees covered by the System for the year ended September 30, 1995 was $777,535; District's payroll was $883,018.

All full-time employees are eligible to participate in the System. Employees who retire at or after age fifty (50) with five (5) years of credited service are entitled to a retirement benefit. The benefit will generally be based on the average salary over the last three years of credited service. Benefits fully vest on reaching five years of service. The system also provides death and disability benefits.

Both employees and the employer contribute to the plan. The employee contribution rate is specified in the contract with PERS and does not change. The employee rate is 7% of gross compensation excluding overtime minus $133.33, while the employer rate as of September 30, 1995 is 10.931%. Employer contribution rates are recalculated annually, effective each September 1, as a part of the PERS annual actuarial evaluation. The employer contribution rates have two components; the employer normal cost contribution rate and the employer contribution rate required to amortize the unfunded actuarial liabilities over a specified period, each expressed as a percent of payroll. The District is required to contribute the remaining amounts necessary to fund the benefits for its members, using the actuarial basis recommended by the PERS actuaries and actuarial consultants and adopted by the Board of Administration.

Funding Status and Progress - The amount shown below as the "pension benefit obligation" is a standardized disclosure measure of the present value of pension benefits, adjusted for the effects

of projected salary increases and step-rate benefits, estimated to be payable in the future as a result of employee service to date. The measure is intended to help users assess the funding status of the System on a going-concern basis, assess progress made in accumulating sufficient assets to pay benefits when due, and make comparisons among employers. The measure is the actuarial present value of credited projected benefits and is independent of the funding method used to determine contributions to the System.

The pension benefit obligation was computed as part of an actuarial valuation performed as of June 30, 1994. Significant actuarial assumptions used in the valuation include (a) a rate of return on the investment of present and future assets of 8.5% a year compounded annually, (b) projected salary increases of 4.5% a year compounded annually, attributable to inflation, (c) across the board real salary increases of .00%, (d) additional projected salary increases of .00% a year, attributable to seniority/merit, and (e) no post retirement benefit increases.

Total (funded) pension benefit obligation applicable to the District's employees was $211,638 at June 30, 1994, as follows:

PENSION BENEFIT OBLIGATION:

Retirees and beneficiaries currently receiving benefits and terminated employees not yet receiving benefits	**$1,696,050**
CURRENT EMPLOYEES:	
Accumulated employee contributions including allocated investment earnings	**538,287**
Employer financed vested	**450,168**
Employer financed nonvested	**27,846**
TOTAL PENSION BENEFIT OBLIGATION	**2,712,351**
Actuarial value of assets (market value is $2,915,217)	**2,923,989**
(FUNDED) PENSION BENEFIT OBLIGATION	**($ 211,638)**

Changes in the pension benefit obligation from 1993 to 1994 due to changes in actuarial assumptions are ($34,346).

Actuarially Determined Contribution Requirements and Contribution Made - PERS uses the Entry Age Normal Actuarial Cost Method which is a projected benefit cost method. That is, it takes into account those benefits that are expected to be earned in the future as well

as those already accrued. According to this cost method, the normal cost for an employee is the level amount which would fund the projected benefit if it were paid annually from date of employment until retirement. PERS uses a modification of the Entry Age Cost Method in which the employer's total normal cost is expressed as a level percentage of payroll. PERS also uses the level percentage of payroll method to amortize any unfunded actuarial liabilities. The amortization period of the unfunded actuarial liability ends on June 30, 2000.

The significant actuarial assumptions used to compute the actuarially determined contribution requirement are the same as those used to compute the pension benefit obligation as described above.

The contribution to the System for the 1994-1995 year of $128,682 was made in accordance with actuarially determined requirements computed through an actuarial valuation performed as of June 30, 1994. The contribution by the employer consisted of (a) $48,455 normal cost (6.539% of current covered payroll) and (b) $32,841 amortization of the unfunded actuarial accrued liability (4.392% of current covered payroll). The District contributed $81,296 (10.4556% of current covered payroll); employees contributed $47,386 (6.094% of current covered payroll).

The contribution to the System for the 1993-1994 year of $154,055 was made in accordance with actuarially determined requirements computed through an actuarial valuation performed as of June 30, 1993. The contribution by the employer consisted of (a) $52,391 normal cost (6.539% of current covered payroll) and (b) $46,333 amortization of the unfunded actuarial accrued liability (4.392% of current covered payroll). The District contributed $98,724 (14.005% of current covered payroll); employees contributed $55,331 (7.85% of current covered payroll).

POST EMPLOYMENT BENEFIT

The District provides its retirees who retire under provisions of a regular service retirement and who have twelve years of service the opportunity to continue enrollment in the District's health insurance program until age sixty-five. the District accounts for the program on a pay-as-you-go basis. The retired employees may also have the District pay for 60% of their spouses health insurance for a maximum of 36 months upon date of retirement. The District had $6,683.58 of benefits expended net of participants contributions. There are four retirees participating in the health insurance plan and three spouses of the retirees participating in the 60% plan.

CONTINGENCIES

A fuel tank, which was underground, leaked fuel into the ground. The tank and the contaminated ground will probably have to be removed. The extent of the contamination and the method in which the contaminants will be removed have not yet been determined, so it is not possible to estimate the expenditure required to solve the contamination problem. Because no estimate is available, no loss contingency will be accrued.

The District is the defendant in a number of lawsuits arising principally in the normal course of operations. In the opinion of the administration, the outcome of these lawsuits will not have a material adverse effect on the accompanying combined financial statements and accordingly, no provision for losses has been recorded.

RESTATEMENTS

A. Effective October 1, 1993, the District retroactively changed its method of accounting for compensated absences to conform with Statement No. 16 of the Government Accounting Standards Board. The statement requires the compensated absences liability generally to be measured using the pay rates in effect at the balance sheet date. It also requires additional amounts to be accrued for certain salary related payments associated with the payment of compensated absences. As a result of the retroactive change, the financial statements for the year ended September 30, 1993 have been restated as follows:

	As Originally Reported	As Restated
Accrued expenses	**$119,328**	**$124,858**
Retained earnings:		
Unappropriated, 10/1/92	**392,231**	**387,747**
Unappropriated, 09/30/93	**79,750**	**74,993**
Operating income (loss)	**(505,977)**	**(507,023)**
Net income (loss)	**(242,476)**	**(243,522)**

B. The amount of depreciation on the contributed capital was understated. The original depreciation was calculated to be $5,339 when it should have been $6,112.

Prior depreciation contributed capital	**$ 5,339**
Corrected depreciation contributed capital	**(6,112)**
Adjustment to contributed capital	**($ 773)**

PERCENTAGE OF CHARGES COLLECTED

YEAR	AT 12/20/94
1985	89.66%
1986	90.13%
1987	91.17%
1988	93.82%
1989	91.25%
1990	94.55%
1991	93.06%
1992	94.70%
1993	93.91%
1994	94.01%
1995	94.03%

All charges are collected the preceding year of water delivery. All charges are due on November 20 and delinquent on December 20 of each and every year. After December 20, as required by law, penalties and costs are automatically charged immediately upon delinquency.

SCHEDULE OF PROPERTY, PLANT & EQUIPMENT - SEPTEMBER 30, 1995

	COST 10/1/93	NET ADDITIONS TO DATE	ACCUMULATED DEPRECIATION TO DATE	BOOK VALUE 9/30/95
Irrigation system	$3,859,032	$167,558	$1,643,395	$2,383,195
Real Estate & bldgs.	160,146	0	136,624	23,522
Roadways	300			300
Drainage wells	600			600
Piping & tanks	14,520		3,675	10,845
Shop equipment & machinery	144,899	1,145	123,531	22,513
Autos, trucks & tractors	820,270	22,288	621,643	220,915
Garage equipment	50			50
Engineer's equipment	2,247		763	1,484
Furniture & office equip.	126,767	4,729	90,743	40,753
Ground water wells	150			150
Ditch signs	100			100
Dropboards & temp. gates	350			350
Dragline	24,399		24,399	
Radio equipment	57,054	248	48,570	8,732
Rental equipment	1,700		1,700	
Other land	240,467			240,467
Pine Flat Reservoir	1,489,143			1,489,143
Pipeline-Special Assessment Fund	10,715		7,750	2,965
Safety Equipment		5,947	321	5,626
Construction-in-Progress	(14,463)	20,664		6,201
TOTALS	**$6,938,466**	**$222,579**	**$2,703,114**	**$4,457,911**

SCHEDULE OF DIVERSIONS & WATER RUN, 1975-1995

DIVERSIONS FROM HEADGATE		WATER RUN	
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
1993	246,415 Acre Feet	04/02-10/02	184 Days
1994	122,677 Acre Feet	05/17-08/18	93 Days
1995	236,725 Acre Feet	04/09-09/30	174 Days
AVERAGE	**163,396 Acre Feet**	**AVERAGE**	**121 Days**
MOST	**253,269 Acre Feet**	**LONGEST**	**195 Days**
LEAST	**38,721 Acre Feet**	**SHORTEST**	**28 Days**

AVERAGE COST OF WATER FOR 1995

PROPERTY CATEGORY PERCENTAGE	CHARGE PER ACRE	ACRES IRRIGATED IN EACH CATEGORY	ACRE FEET DELIVERED	AVERAGE ACRE FOOT PER ACRE IRRIGATED	COST PER FOOT DELIVERED
100	$15.00	61,965.35	114,867.04	1.85	$ 8.09
75	$12.13	6,563.23	12,036.82	1.83	$ 6.61
50	$ 9.25	5,483.25	7,666.74	1.39	$ 6.62
25	$ 6.38	10,022.34	12,737.98	1.27	$ 5.02
5	$ 3.50	7,325.10	5,267.38	.71	$ 4.87
TOTALS		**91,359.27**	**152,575.96**		
AVERAGES				**1.41**	**$ 6.24**

RECAPITULATION OF CROP SURVEYS - YEARS 1993 & 1995

CROP NAME	1993 ACRES	%	1995 ACRES	%	DRIP OR SPRINKLER ACRES	PERCENTAGE OF 1995 ACRES
Alfalfa	7,620	5.9	7,895	6.1		
Apples	851	.7	946	.7	131	13.8
Apricots	644	.5	681	.5	48	7.0
Citrus	8,436	6.5	8,816	6.8	2,811	31.9
Corn	4,562	3.5	4,230	3.3		
Cotton	7,358	5.7	6,599	5.1	15	.2
Grains	756	.6	1,370	1.1		
Grapes	20,670	16.0	20,652	16.0	1,261	6.1
Idle Land	8,048	6.2	9,930	7.7	38	.4
Melons	280	.2	156	.1	6	3.8
Misc. Crops	3,314	2.6	3,233	2.5	231	7.1
Nectarines	16,262	12.6	15,872	12.3	1,702	10.7
Nuts	1,501	1.2	1,433	1.1	76	5.3
Peaches	11,073	8.6	10,665	8.2	376	3.5
Perm. Pasture	2,626	2.0	2,526	2.0	21	.8
Plums	12,031	9.3	11,602	9.0	1,002	8.6
Pomegranates	495	.4	373	.3	37	9.9
Olives	799	.6	1,025	.8	338	33.0
Vegetables	928	.7	1,747	1.4	5	.3
IRRIGABLE ACRES	**108,254**	**83.8**	**109,751**	**85.0**	**8,098**	**7.4**
BLDG. SITES	**5,929**	**4.6**	**5,842**	**4.5**	**14**	**.2**
DRY PASTURE	**2,197**	**1.7**	**376**	**.3**		
TOWNS & ROADS	**12,920**	**9.9**	**13,331**	**10.2**		
TOTAL ACRES	**129,300**	**100.0**	**129,300**	**100.0**		

WATER RECAP

Total Acre Feet of Water Delivered	152,575.96
Headgate Diversions	236,725.00
Percentage Delivered	.64
Total Acre Feet Not Delivered	84,149.04
1 Percent Evaporative Losses	2,367.25
5 Percent Operational Losses	11,836.25
Recharge	69,945.54
TOTAL HEADGATE DIVERSIONS	**236,725.00**

SCHEDULE OF RAINFALL & AVERAGE GROUND WATER LEVELS, 1976-1995

RAINFALL		AVERAGE GROUND WATER LEVELS	
1975-76	9.05 Inches	1976	46.08 Feet
1976-77	7.55 Inches	1977	59.60 Feet
1977-78	21.28 Inches	1978	40.43 Feet
1978-79	10.06 Inches	1979	40.65 Feet
1979-80	12.51 Inches	1980	35.48 Feet
1980-81	8.99 Inches	1981	37.95 Feet
1981-82	15.52 Inches	1982	33.86 Feet
1982-83	20.92 Inches	1983	21.53 Feet
1983-84	8.87 Inches	1984	20.17 Feet
1984-85	8.96 Inches	1985	22.77 Feet
1985-86	14.12 Inches	1986	24.33 Feet
1986-87	9.71 Inches	1987	26.55 Feet
1987-88	10.92 Inches	1988	37.40 Feet
1988-89	8.90 Inches	1989	45.77 Feet
1989-90	8.57 Inches	1990	51.79 Feet
1990-91	9.95 Inches	1991	58.47 Feet
1991-92	11.07 Inches	1992	59.28 Feet
1992-93	16.45 Inches	1993	56.01 Feet
1993-94	9.78 Inches	1994	54.92 Feet
1994-95	19.70 Inches	1995	48.23 Feet
AVERAGE	**12.14 Inches**	**AVERAGE**	**41.06 Feet**
HIGHEST	**21.28 Inches**	**HIGHEST**	**20.17 Feet**
LOWEST	**7.55 Inches**	**LOWEST**	**59.60 Feet**

PUMPS OPERATING IN DISTRICT

KIND	1988	1991	1993	1995
CENTRIFUGAL	182	119	135	79
SUBMERSIBLE	465	541	733	787
TURBINE	2,933	3,093	2,840	2,992
MISC.	13	28	47	72
TOTAL PUMPS	**3,593**	**3,781**	**3,755**	**3,930**
TOTAL HORSEPOWER	**49,540**	**46,689**	**51,214**	**53,155**

SCHEDULE OF GENERAL & ADMINISTRATIVE EXPENSES - SEPTEMBER 30, 1995

AdministrationPayroll	$207,012
Vacations, Holidays, Sick Leave & Other Payroll	104,742
Assessments & Dues	73,539
Bank Charges	25
Cellular Phone Expense	2,765
Collector's Office Supplies	3,388
Collector's Deed Foreclosures	11,281
Collector's Expense	87
Collection Agreement - Dinuba	11,228
Computer Supplies	3,173
Convention Expense	6,653
Damage Claims	1,048
Dental Insurance	3,113
Director's Fees	7,900
Fish & Game Expense	366
Health Insurance	39,673
Insurance & Bonds	110,290
Lease Agreement	300
Legislation	9,586
Life Insurance	819
Litigation	5,655
Manager's Expense	379
Medical Supplies	681
Meetings	827
Miscellaneous	3,555
Office Supplies	4,353
Officer's Expense	2,169
Postage	3,787
Publication & Advertisement	907
Rental Equipment	3,594
Retirement Contribution	24,529
Reorganization Expenses	27,197
Secretary's Expense	62
Services:	
Audit	13,075
Computer Programmer	2,720
Engineer	12,405
Janitorial	2,629
Legal	24,191
Personnel	582
Rug & Coverall	4,197
Yard Maintenance	900
Social Security Taxes	17,920
Telephone	3,244
Unemployment Insurance	2,268
Utilities	6,794
Vision Care Plan	2,079
Water Management Plan	1,243
Xerox	891
TOTAL GENERAL & ADMINISTRATIVE EXPENSES	$769,821

SCHEDULE OF MAINTENANCE & OPERATION EXPENSES - SEPTEMBER, 1995

MAINTENANCE

Labor	$ 221,194
Dental Insurance	3,239
Diesel	3,557
Gasoline	23,697
Health Insurance	28,592
Life Insurance	950
Maintenance supplies	8,410
Material & supplies	166,323
Miscellaneous	833
Oil	4,086
Radio System	1,920
Rental Equipment	457
Repairs & maintenance	64,313
Retirement contribution	32,353
Safety equipment	1,176
Shop equipment & supplies	7,151
Social security taxes	27,086
Unemployment insurance	9,012
Utilities	12,745
Vision care plan	2,109
TOTAL MAINTENANCE	**$ 619,203**

OPERATION

Labor	284,289
Car Hire	46,006
Dental Insurance	2,332
Health Insurance	18,530
Life insurance	760
Retirement contribution	22,637
Social security taxes	21,710
Unemployment insurance	2,476
Vision care plan	1,530
Water recorders	53
TOTAL OPERATION	**$ 400,323**

PINE FLAT DAM

Maintenance & Operation	46,039
TOTAL PINE FLAT DAM	**$ 46,039**

TOTAL MAINTENANCE, OPERATION & PINE FLAT DAM	**$1,065,565**

MANAGER'S REPORT

Alta Irrigation District manages and maintains 400 miles of open canal system and pipelines. The District utilizes a variety of management concepts and equipment to keep the open canals free of weeds and debris and to repair leaks in existing pipelines. The following is an overview of the District's maintenance program.

PRE-EMERGENCE SPRAY PROGRAM - The District's maintenance program consists of a pre-emergence spray program normally initiated in November using Direx (Diuron) at a rate of five to seven pounds per sprayed acre. This program keeps the weed seed from germinating for seven to eight months, depending upon the rainfall after spraying.

SELECTIVE SPRAY PROGRAM - During the spring and summer months, a selective spray program is initiated using such materials as Rodeo or Roundup. The materials primarily work on troublesome weeds such as bermuda grass that Direx has trouble eliminating during the pre-emergence spray program. The last several years numerous counties have initiated "Pest Management Zones" which will not allow Direx applications on non-crop areas such as ditch banks. As a result, 15 ditches are not treated with Direx and are selectively treated with Rodeo or Roundup.

GENERAL MAINTENANCE - After the operation season and before the pre-emergence spray program, selective ditches are side-bladed, meaning deposited earthen material is cleaned out of the ditch. Washouts and low areas, where the ditch bank has eroded away with time, are reinforced with cement, hardpan or other earthen materials.

CONSTRUCTION PERIOD - After the pre-emergence spray program is concluded, cement pipelines are installed, pipeline patching and structures to be built are constructed. Gates are checked for leakage; broken parts and stems are replaced.

SHOP - The District is fortunate to have a fully equipped shop which enables personnel to fabricate control gates and other necessary measuring devices along with equipment maintenance. Equipment repair has been reduced with the decision several years ago to upgrade the district vehicles and equipment, thus reducing the maintenance budget and increasing the performance and reliability.

PONDING BASINS

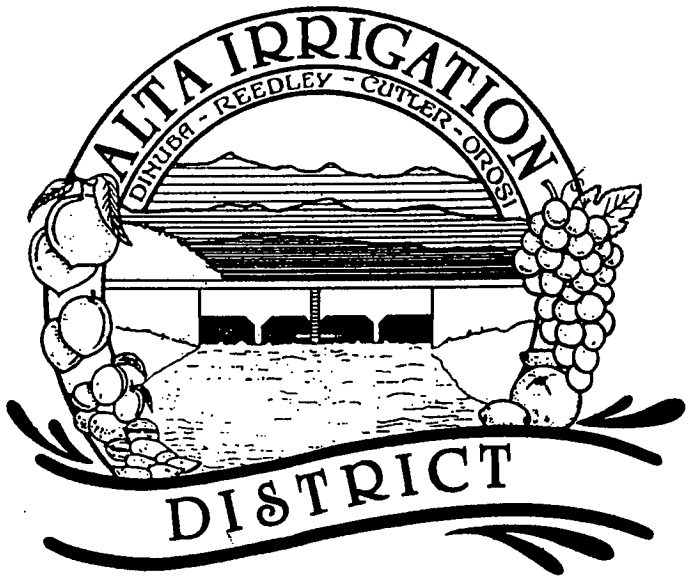
Water regulation, conservation, groundwater recharge and

maintenance of existing District facilities to better serve the constituents has been an on-going concern of the Board of Directors. Current and future water development projects seem to be at a standstill due to political and environmental concerns. As a result, the District has determined that it must maximize its existing water resources to their fullest extent possible. Maintenance of existing concrete linings, installation of new water regulation basins and improved measuring stations are examples of water conservation efforts currently utilized by the District.

In the last several years, the District has planned and instigated two additional ponding basins besides the London Pond located on Ave. 384 and Road 56. The new ponds that have been constructed in the District are the Traver, located in Kings County comprising five acres; and the Button Pond, located south of Avenue 384 and west of Road 108 which will eventually comprise an area of 57 acres.

The District is in the process of utilizing London Pond as a water regulating basin. On years when we serve the entire district, there are fluctuations due to the distance that the water must travel to serve property south of Ave. 384. If water was stored during peak flows and utilized in times of need, canal deliveries could be substantially improved.

ALTA IRRIGATION DISTRICT



1996

ANNUAL REPORT

ALTA
IRRIGATION
DISTRICT

289 NORTH L STREET
P.O. BOX 715
DINUBA, CA 93618
(209) 591-0800
FAX (209) 591-5190

BOARD OF DIRECTORS

NORMAN B. WALDNER
PRESIDENT

BEN AGRIFOGLIO
SCOTT BELKNAP
TOM MARSHALL
DAVID POWELL
ROGER WARKENTIN
LEONARD WILEMAN

CHRIS M. KAPHEIM
GENERAL MANAGER / SECRETARY

IRMA PANTOJA FARIA
OFFICE MANAGER / TREASURER

DARLENE F. STEWART
COLLECTOR

May 12, 1997

Honorable Board of Directors
Alta Irrigation District
P.O. Box 715
Dinuba, CA 93618

Re: 1996 Annual Report

Gentlemen:

Transmitted herewith is the 1995/96 fiscal year end annual report of the Alta Irrigation District for the period from October 1, 1995 through September 30, 1996.

Also, as part of this report are various schedules showing the expenditures for additions to permanent assets; for maintenance and operation and for general expense; income and expenses and other data pertinent to the financial operation of the District.

Also, included in this report, is a crop & pump survey, charts showing the twenty-year rainfall, groundwater levels, diversion amounts and water run history as well as a history of the District.

Respectfully submitted,

ALTA IRRIGATION DISTRICT

Chris M. Kapheim
General Manager

CMK:ipf

ALTA IRRIGATION DISTRICT

ANNUAL REPORT

BOARD OF DIRECTORS

	Norman Waldner Division No. 4	
Ben Agrifoglio Division 1	Roger Warkentin Division 2	Leonard Wileman Division 3
Tom Marshall Division 5	David Powell Division 6	Scott Belknap Division 7

OFFICERS

Norman Waldner .....President
Ben Agrifoglio .....Vice-President
Chris M Kapheim .....Secretary
Janelle M Cochran .....Secretary-Treasurer

MANAGEMENT STAFF

Chris M Kapheim.....General Manager
Jeff Heringer .....Superintendent
Janelle M Cochran .....Office Manager
Darlene F. Stewart .....Collector

CONSULTANTS

James H Wegley.....Engineer
Douglas B. Jensen.....Attorney
Blankenship & Schultz.....Auditors

REGULAR BOARD MEETING
SECOND FRIDAY OF EACH MONTH
9:00 A.M.

ALTA IRRIGATION DISTRICT
1996 ANNUAL REPORT

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ALTA IRRIGATION DISTRICT HISTORY

HISTORY OF EARLY IRRIGATION IN THE KINGS RIVER AREA

The Alta Irrigation District was originally a dry and arid area capable of sustaining dry land crops and cattle. The area in 1825 resembled a desert. The reason is simple, the rainfall in the District for the 50 year period prior to 1956 had averaged only 11.39 inches. Furthermore, virtually none of the annual rainfall occurs during June, July or August, the hottest months and also the period during which the greatest plant growth takes place.

The Kings River, which supplies water to the Alta District, is one of the largest streams entering the San Joaquin Valley. The river drains from the mountain and foothill area of 1,742 square miles, ranging in elevation from 500 to 14,000 feet above sea level. More than half 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 high stage until the middle of May or first of June. However, the average runoff does not guarantee this amount 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.

Irrigation in the Kings River area was practiced in a limited way in the river bottoms beginning in the early 1950's. To make this irrigation possible, the early settlers built dams of cobblestones, and built ditches with the aid of horses and mules, scrapers, or by hand. The efforts of these early pioneers were to secure water on lands not bordering streams, or to irrigate lands for a second crop of corn and pumpkins after hay had been cut. Irrigation at that time was used only for small operations. Any large scale farmer depended on dry farming to raise wheat or grazed cattle on the grass of the plains.

Two important factors were of value with the early diversion of water from the Kings River. First, the growing of fruits and vegetables were made possible, and secondly, the establishment of water rights for these lands were secured.

During this time period, cattle grazing was more important in the Kings River area than agriculture. There were frequent conflicts between the cattlemen and the owners of crops. More and more crops were planted because of the availability of water, yet cattle roamed at will, often ruining crops. Also, during this time period, a "No Fence" bill was introduced, and after much controversy, it was eventually passed. This law required all cattle owners to prevent their stock from trespassing upon the land of others, and held them responsible for any damage done by their

cattle. Because of this new law, it was economically impossible to continue the same type of ranching as had been carried on in this area previously. Therefore, many thousand head of cattle were driven over the mountains into the wilds of Nevada, where large tracts of wild range were now protected by the new state law. The farmer-irrigator had won a major battle. As a result of this victory, many more farmers were attracted to the Kings River area, including the Alta Irrigation District.

The other factor during this time was the problem of water rights. As more farmers arrived, the demand for diverted water increased until there seemed to be a shortage and litigation naturally ensued. Litigation between claimants or water priority and litigation over water rights was the general rule and not the exception. This was the state of affairs along the Kings River and along other California streams until the final settlement in the California Supreme Court in 1886. The judgment in this case stated that doctrine of appropriation was the common law and as a result of this law, all irrigation units on the Kings River were enjoined from diverting its water.

One of the companies, which had serious problems as a result of the Riparian Rights Case, was the "76" Land and Water Company, the forerunner of the Alta Irrigation District.

"76" LAND AND WATER COMPANY

In 1856, a large tract of land in the Kings River bottom was being used by owners Andrew Darwin and E. C. Ferguson for their cattle operation. The brand they used, and so recorded in Fresno County, was the "76". Their cattle roamed throughout the present Alta District and was soon to be known as "76" Country. In 1865, Darwin and Ferguson sold all their holdings to Thomas Fowler and Richard Carmen and continued to graze their cattle throughout the area. Around 1875, Fowler bought out Carmen and it was around this time the struggle between farmer and cattle rancher was being waged.

The idea to build an irrigation system in the "76" country was conceived in the mind of P. Y. Baker, a civil engineer, and D. K. Zumwalt in 1881. Their plan was to acquire a large tract of land, build an irrigation system, and then subdivide the land and either sell or lease the land in small plots to settlers attracted by the advertising of the proposed company. At this time, Fowler had ceased to be very optimistic concerning the future operation of the "76" land and Baker sold him on the idea of an irrigation company. As a result, Fowler turned all his land over to the company which Baker had organized in exchange for a large block of stock in the company. Six other capitalists were also interested in the project and on May 15, 1882, Baker posted a sign on the south bank of the Kings River saying the water was to be diverted. This was

necessary to establish water rights. The articles of incorporation of the "76" Land and Water Company were filed in the Fresno County Clerk's office on May 29, 1882.

The first office of the "76" Land and Water Company was in Visalia. The capital stock of the corporation was $280,000, which was divided into fourteen shares of $20,000 each. The land owned by the company totaled 30,000 acres. The first preliminary survey for the "76" Canal was run through Dunnigan Gap, following closely the line now used by the Friant-Kern Canal, with construction beginning in 1852.

The original point of diversion from the Main Channel of the Kings River was at the mouth of Dennis Slough. Shortly, however, this was changed to the present point of diversion just below the town of Piedra. This point is known as "The Cobbles." It is about fourteen miles northeast of Reedley and is four miles above the point of diversion of any other canal on the Kings River. The canal follows a southwesterly course through a channel that is partly natural and partly man-made. The canal, near the diversion point, is one hundred feet wide and in that area has a drop of four feet to the mile. It is capable of carrying one thousand three hundred cubic feet of water per second.

The point of control otherwise known as the "Headgate" was located several miles down stream from the Main Canal. The Headgate was built in 1883 of redwood timbers. Since the canal at that point was still one hundred feet wide at the bottom, the Headgate was also one hundred feet wide. It was claimed that this Headgate was larger than that of any other irrigation system in the western United States at that time. It is also interesting to note that even in the early days the system served as a bridge for a county road, as it still does to this day.

The construction of the system continued until December of 1883. At this time, the Main Canal and several lateral canals were completed, and the decision to turn some water into the ditches was made. When the water reached the Wahtoke Dam, constructed by the "76" Company, a serious break occurred resulting in closure of the Headgate. Continued construction on the system was made until it had reached the Central Pacific Railroad (now Southern Pacific) in Tulare County, a few miles south of where the railroad crossed the Kings River. At this point, the company decided to survey a townsite. The surveying was complete by March, 1884, and the town was named Traver, in honor of Charles Traver, member of the Board of Directors of the "76" Land and Water Company. At this time the company moved its office from Visalia to Traver.

The first sale of the "76" Land and Water Company was made on December 31, 1883. In April of 1884, the Headgate was opened allowing a moderate head of water to flow into the Main Canal. That same month, an auction was held to sell town lots. The sales at the end of the two day auction totaled $65,000. The only building in the townsite at this time was a partially competed

railroad depot. By September, however, it was a thriving town with stores, hotels, grain warehouses and other places of business, including a few saloons.

Over the next few years, between poor management on the part of the "76" Land and Water Company, the breaking of the faith with the tenants of the "76" Company, and the years of litigation that followed, a succession of short crops and low prices, and the financial depression bringing a decline in the prices of real estate, not only delayed the progress of the "76" Company, but brought financial ruin to some of its pioneers. Undoubtedly, there were many reasons for this decline in land value and financial ruin of the pioneers, but there can be no doubt that the practices of the "76" Land and Water Company were an important factor.

THE FORMATION OF ALTA IRRIGATION DISTRICT

Since irrigation works were very expensive and because of increased demands for water distribution systems by small farmers who could not afford to build these systems themselves, the California legislature passed the Wright Act on March 7, 1887. This act sought to confer on farming communities powers of municipalities in the purchase or construction and operation of irrigation works. These powers included the right of eminent domain, the right to issue bonds against all the real property within any area organized into an irrigation district, and the right to tax that property for the purpose of building or operating irrigation works. Provision was made for conducting district elections, for meeting of board of directors and for the management of district business.

There were questions in regards to the legality of the Wright Act, but the State Supreme Court ruled that the Act complied with the various provisions of the state constitution. This judgment apparently encouraged the people who were served by the "76" Land and Water Company to proceed with plans to form an irrigation district.

In complying with the provisions of the Wright Act, a petition calling for an election to form an irrigation district and bearing the signatures of sixty-six landowners within the proposed district, was presented to the Tulare County Clerk on July 7, 1888. When the committee registered the papers for the new district, it was suggested that a new name be adopted. It was decided that since the diversion point off the Kings River was higher in elevation than any other point of diversion, the title "Alta Irrigation District" (Alta is Spanish means high) would be an appropriate name; And was so recorded. The area included within the boundaries of the District was approximately 130,000 acres. The District included parts of Tulare, Fresno and Kings Counties. The present communities of Dinuba, Reedley, Traver, Cutler, and Orosi lie within these boundaries.

On August 14, 1888, the election was held with 326 in favor of the formation of an irrigation district and 19 against the formation of such a district. Thus, the Alta Irrigation District was formed to become the third irrigation district in California. The election was also used to elect a Board of Directors to serve the new District. The area was divided into five divisions, with one director to be elected from each of these divisions. On September 10, 1888, the first Board of Directors meeting was held and P. Y. Baker was elected President and William J. Applegate was appointed Secretary.

On October 12, 1888, the Board of Directors appointed James Sibley as engineer for the District. It was his assignment to determine the amount of bonds that would be necessary to cover the cost of needed construction. At this time, the board also began negotiating with the "76" Land and Water Company for the purchase of their existing irrigation system. On December 4, 1888, the Board of Directors voted to transfer the District office from Traver to Dinuba. This move was viewed by the citizens of Traver as a serious blow to the already dying community.

On February 15, 1889, a successful bond election was held and according to the Wright Act, all the real estate within the district boundaries was to be used as security to back the bonds.

During all of this time that the District was a legal entity, no property had been purchased. Negotiations with the "76" Company was on-going and it was not until July 1, 1890 that an agreement had been reached. The "76" Company agreed to take 820 bonds of the District, each with a value of $500, or a total of $410,000, in exchange for its canals and water rights. At the time of transfer of the irrigation system to Alta, the "76" Company was furnishing water to only about 1,900 acres. Many more canals and ditches would need to be constructed if all 129,300 acres were to be irrigated. After a bond sale of $100,000, a great deal of construction of canals, ditches, drops and headgates were instigated. By January, 1895, the necessary system of ditches were nearly completed.

In the next few years, in spite of the low cost of the water and the continuity of water delivery, there were groups who wanted to do away with the irrigation district system. One of these groups was composed of city dwellers who attacked the Wright Act on the grounds that the irrigation system was for the benefit of the farmer, not the city resident. In 1891, the State Supreme Court left no doubt that the Wright Act was legal and binding. The other dissatisfied group were owners of large tracts of land who pooled their resources and employed an attorney to lobby the state legislature to repeal the Wright Act. The Board of Directors of Alta Irrigation District persuaded William P. Boone to run for the state assembly to counteract the efforts of any groups that were interested in repealing the Wright Act. Mr. Boone was elected and he joined the legislature for the 1895 session. In the next two

years, Mr. Boone tried to preserve the Wright Act. In 1897, Boone achieved at least partial success in his mission with a compromise. This compromise, known as the "Bridgeford Act," stated that no new irrigation district could be organized. The Act was so severe for organizing districts in incurring indebtedness, that irrigation district development in California remained dormant for twelve years, with no new projects being initiated between 1897 and 1909.

On Mr. Boone's return to his position as Secretary of the Board of Directors of the Alta District, he found the situation still serious. The Tulare Superior Court handed down a decision which stated that the bonds of the District were illegal and that the Board of Directors could not force the people of the District to pay taxes for the purpose of making any kind of payment on the bonds. The court made a distinction, as did many of the landowners, between taxes for bond payment and taxes for operating expenses. The courts ruled the District could assess the property owners to pay operating expenses, but could not assess for bond payments. During this entire period the people of the District voted overwhelmingly in favor of the special assessments requested by the Board of Directors for operating expenses.

During this three year period, the landowners, not knowing exactly what they could be forced to pay, and the Board of Directors not knowing exactly what they could legally collect, consequently resulted in default in bond payments. With the refusal of most landowners to pay taxes or assessments, the Board of Directors had to contrive a plan to raise money to pay the necessary labor. The water users were canvassed for loans or contributions to raise funds with a promise that such contributions would apply on their taxes.

Two legislative acts were passed during the time period in which all of these problems occurred in the Alta District. The first, entitled "An Act to provide for the issue and sale or exchange of funding bonds of Irrigation Districts organized under and in accordance with the Wright Act", was passed by the California Legislature on April 1, 1897. The second act was an "Amendment of the 1897 Act," and was designed to aid the irrigation districts in exchanging or refunding their bonds. This act was passed in Sacramento on March 16, 1901. W. P. Boone, on behalf of the Board of Directors, was to settle with the landowners means of repayment. Finally, a committee representing the landowner's group and a like representation of the bond holders, agreed upon a basis of compromise, calling for a vote of refunding bonds and cancellation of all outstanding bonds with a reduction of 25% of the debt at a reduced rate. Boone, too, was to obtain written agreement from every landowner in the District, which bound each landowner not to question the validity of such refunding bonds. After Boone had successfully obtained all property owners agreements, the Board of Directors called for a meeting of the landowners to consider the proposal from the bondholders

representatives. Five landowners were elected to travel to San Francisco to deal with the bondholders.

On October 10, 1901, a petition was presented to the Board of Directors which proposed the funding of such outstanding bonds and coupons and that the payment thereof may be provided for by the issuance of new bonds. On this same day, the Board of Directors called for a special election to decide whether $500,000 in new bonds should be issued and sold to pay off the old bonds. The election was held and approved by the voters. With the refunding of this debt, the most critical period in the financial development of the District had ended.

Lawsuits between different water districts and landowners were common during the early formation of the District. Over 100 lawsuits were tried between the turn of the century and 1918 at a tremendous cost to the water districts and landowners.

Thus, in the early part of 1914, a large mass meeting was called to address the situation. The meeting resulted in the formation of a committee of five men to begin searching for solutions through negotiation instead of litigation. By 1916, it became apparent that public sentiment was in favor of a negotiated peace between water interests. Meetings were held between feuding companies and districts in order to begin to work on a compromise solution. By 1917, nearly all of the companies had begun submitting schedules for diversion for consideration by the whole.

FORMATION OF THE KINGS RIVER WATER ASSOCIATION

The State Water Commission selected engineer Charles Kaupke to clean up the problem that was facing the water districts on the Kings River. The commission thought it would require about two months to compete. Having gone through a number of temporary schedules, the 19 water agencies, covering approximately 940,000 acres at that time and operating on the Kings River, finally came to a long-overdue negotiated settlement. On January 1, 1928, the Kings River Water Association was borne with Charles Kaupke as the designated watermaster for the river.

The new Association finally had brought an end to the painful and expensive litigation that existed for over fifty years on the Kings River. An organization had been borne to see that the most beneficial use was made of the limited water supply for all users on the river.

Today, the Alta Irrigation District remains as one of the charter members of the Kings River Water Association, with Director William P. Boone serving as its President from its inception until his death in 1944. With 28 member water agencies, the Association continues to represent and manage water distribution for over 1.1 million acres of irrigated agricultural and urban areas throughout the Kings River service area.

PINE FLAT DAM PROJECT

From the first years of irrigation practice in the region, it became apparent that some type of storage facility and flood control project needed to be established. Heavy rains and snowpack in the watershed high in the Sierras would send torrential destructive flood waters jumping the banks of the Kings River. In alternating drought years, the river would be reduced to a fraction of its normal flow.

As early as 1902, land developer Thomas L. Reed traveled to Washington D. C. to drum up support for the building of a dam on the river, but he returned unsuccessful in his attempt. Four years later, with his own funds, he commissioned a study to survey the river for a dam site. The site chosen was roughly the same location as where Pine Flat Dam would eventually be built, some 48 year later.

In 1914, a group of Kings River water interest landholders, called the "Committee of Thirty," began meeting and concurred that funds should be sought for a reservoir site. William P. Boone, a man closely associated with Alta Irrigation District from its conception, headed the formal campaign to build the project. he traveled to Sacramento to secure support for the legislature, but once again the trip was not forthcoming. The main problems were with the water users themselves and their inability to negotiate a permanent agreement on Kings River Water Rights. By 1928, when the Depression was at its peak, unemployment was at a record high, and the crop prices had collapsed; federal money for a project such as Pine Flat Dam was nearly hopeless. It was not until 1944 that a contract was signed with the Army Corps of Engineers to begin construction on the dam, with completion in 1954.

The most recent technological enhancement of the District's operation is the power plant at Pine Flat Dam, completed in 1985. The hydroelectric facility, with its 55 megawatt generators, provides power to the Department of Water Resources to run pumping stations.

GROUNDWATER OVERDRAFT PROBLEMS

In its earliest years, ALta Irrigation District's most difficult problems were fought in the court room. Today, however, the battle is being waged under the ground and is a war against the already sever overdraft that exists in the previous groundwater tables.

The groundwater overdraft problem that the District is now faced with would be hard to fathom 100 years ago For hundreds of years, the underground tables had been filled and were nearly overflowing with water. In recent years, with the heavy reliance by agriculture on groundwater pumping (especially during drought years) has resulted in a severe groundwater overdraft. For those with no ready access to surface water supplies, the cost in

in electricity bills alone becomes worse each year, as more energy is required to pump from ever deepening levels beneath the ground.

The hope for solutions to these problems through increased water conservation within the District itself and throughout the San Joaquin Valley is disheartening. The decisions we are faced with today are consequences our region must endure in the future: Whether we decide to decrease the demand for water or increase the supply; or do we opt for agricultural land and businesses to go out of production; or is the solution to build more water storage projects on the river, which politically means unpopular dams. The choice is a difficult one and it will be the Alta Irrigation District together with the small family farmer who will either win or lose.

ALTA IRRIGATION DISTRICT

BALANCE SHEET

September 30, 1996 and 1995

ASSETS

	1996	1995
CURRENT ASSETS:		
Cash and investments	$2,227,502	$2,075,211
Receivables:		
Unredeemed assessment sales	71,491	62,553
Collector's deeds	69	498
Note receivable, current portion	9,550	9,550
Inventory	40,895	32,987
Prepaid expenses	84,929	95,955
Deposits	1,054	33,746
Total current assets	2,435,490	2,310,500
Utility plant, and equipment, net of accumulated depreciation	4,610,605	4,457,911
OTHER ASSETS:		
Note receivable	47,750	57,300
Accounts receivable	30,062	125,394
Deposits	31,026	22,931
	108,838	205,625
	$7,154,933	$6,974,036

LIABILITIES AND FUND EQUITY

CURRENT LIABILITIES:		
Current maturities of long-term debt	$ 35,395	$ 35,395
Accounts payable	107,013	117,809
Accrued expenses	153,734	154,167
Deferred income		28,904
Delinquent assessment sales trust fund	39,872	55,268
Total current liabilities	336,014	391,543
Long-term debt	212,368	247,763
FUND EQUITY:		
Contributed capital	746,640	610,834
Retained earnings:		
Appropriated	5,692,368	5,575,069
Unappropriated	167,543	148,827
Total fund equity	6,606,551	6,334,730
	$7,154,933	$6,974,036

ALTA IRRIGATION DISTRICT

STATEMENT OF INCOME & EXPENSES

Years Ended September 30, 1996 and 1995

	1996	1995
OPERATING REVENUE:		
Assessments:		
Current charges	$1,467,192	$1,471,121
City of Reedley	13,902	13,902
City of Dinuba	20,509	20,238
Pine Flat Power Revenue	317,788	208,471
Total operating revenues	1,819,391	1,713,732
OPERATING EXPENSES:		
Depreciation	159,298	165,378
Maintenance	589,289	586,836
Operations	381,084	432,690
General and administrative	761,864	769,821
Pine Flat Dam - maintenance and operation	48,303	46,039
Total operating expenses	1,939,838	2,000,764
OPERATING INCOME (LOSS)	(120,447)	(287,032)
NON-OPERATING REVENUE (EXPENSES):		
Interest income	143,121	139,449
Penalties and costs	9,071	9,089
Interest on assessments	2,573	5,275
Work for others	904	2,888
Miscellaneous	68,766	147,937
Equipment lease and rents	4,749	4,826
Gain (loss) on sale of assets		421
Refunds	13,221	10,349
	242,405	320,234
NET INCOME	$ 121,958	$ 33,202

ALTA IRRIGATION DISTRICT

STATEMENT OF CHANGES IN FUND EQUITY

Years Ended September 30, 1996 and 1995

				Appropriated				
	Total	Unappropriated	Contributed Capital	Utility Plant	Pine Flat Debt	Capital	Appropriated	Contingency
Balance, October 1, 1994	$6,257,847	$ 28,488	$579,546	$4,396,813	$315,000	$538,000	$300,000	$100,000
Net income	33,202	33,202						
Capital contributions	43,681		43,681					
Net increase in utility plant		(222,578)		222,578				
Net increase in accumulated depreciation		173,873	(12,393)	(161,480)				
Transfers		135,842			(31,842)	(104,000)		
Balance, September 30, 1995	$6,334,730	$148,827	$610,834	$4,457,911	$283,158	$434,000	$300,000	$100,000
Balance, October 1, 1995	$6,334,730	$148,827	$610,834	$4,457,911	$283,158	$434,000	$300,000	$100,000
Net income	121,958	121,958						
Capital contributions	149,863		149,863					
Net increase in utility plant		(311,989)		311,989				
Net increase in accumulated depreciation		173,352	(14,057)	(159,295)				
Transfers		35,395			(35,395)			
Balance, September 30, 1996	$6,606,551	$167,543	$746,640	$4,610,605	$247,763	$434,000	$300,000	$100,000

ALTA IRRIGATION DISTRICT

STATEMENT OF CASH FLOWS

Years Ended September 30, 1996 and 1995

	1996	1995
CASH FLOWS FROM OPERATING ACTIVITIES:		
Net income	$ 121,958	$ 33,202
Adjustments to reconcile net income to net cash, provided by operating activities:		
Depreciation	159,298	165,378
Gain on the sale of assets		(421)
Changes in assets and liabilities:		
Decrease (increase) in accounts receivable	95,332	(82,761)
(Increase) in unredeemed assessment sales	(8,938)	(1,748)
Decrease in collector's deed receivable	429	3,715
Decrease (increase) in prepaid expenses	11,026	(13,984)
(Increase) decrease in inventory	(7,908)	1,924
Decrease in deposits	24,597	949
(Decrease) in accounts payable	(10,796)	(26,745)
(Decrease) increase in accrued liabilities	(433)	31,182
(Decrease) increase in deferred income	(28,904)	28,904
(Decrease) increase in delinquent assessment sales trust fund	(15,396)	55,268
Total adjustments	218,307	161,661
Net cash provided by operations	340,265	194,863
CASH FLOWS FROM CAPITAL AND RELATED FINANCING ACTIVITIES:		
Principal payments on notes	(35,395)	(35,395)
Capital contributions	149,863	43,681
Capital expenditures	(274,952)	(207,111)
Proceeds from sale of assets		1,720
Construction in progress	(37,040)	(20,664)
Net cash used by capital and related financing activities	(197,524)	(217,769)
CASH FLOWS FROM INVESTING ACTIVITIES:		
Proceeds from note receivable	9,550	9,550
Net cash provided from investing activities	9,550	9,550
Net increase (decrease) in cash and cash equivalents	152,291	(13,356)
Cash and cash equivalents at beginning of year	2,075,211	2,088,567
Cash and cash equivalents at end of year	$2,227,502	$2,075,211

ALTA IRRIGATION DISTRICT

NOTES TO FINANCIAL STATEMENTS

Years Ended September 30, 1996 and 1995

1 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Organization and Operation - The Alta Irrigation District (the District) was organized under the Wright Act in 1887 and operates under the provision of the California Water Code. The District covers an area of approximately 130,000 acres and distributes water to the agricultural lands in Tulare, Fresno and Kings counties.

The District has the authority to fix rates and charges for commodities and services furnished; it may also, with prior voter approval, incur indebtedness and issue bonds. The District is exempt from payment of federal and state taxes.

Basis of Accounting - Alta Irrigation District uses the accounting system prescribed by the State of California Controller's Office. The accounting records are maintained on the accrual basis of accounting.

Cash and Cash Equivalents - The District invests its funds in various financial instruments with limited interest rate risk. For purposes of the statement of cash flows, highly liquid investments with a maturity of three months or less when purchased are classified as cash and cash equivalents.

Accounts Receivable - Accounts receivable arise from billings to landowners for water services charged and certain improvements made to the landowner's property. Substantially all of the District's sales are to landowners located within the District's boundaries. Uncollectible amounts from individual landowners do not exist because the District obtains a lien upon all assessed property once the assessment becomes delinquent. After a five year period, the District can sell the property to recover all prior assessments, cost, penalties and interest due the District.

Inventory - Inventories are stated at the lower of cost or market on a first in, first out method.

Property, Plant and Equipment - Property, plant and equipment (including major renewals and improvements) are recorded at cost. Depreciation is provided over the useful lives of the assets using the straight-line method. When properties are disposed of, the related costs and accumulated depreciation are removed from the respective accounts. Any gains or losses on the disposition by sale or retirement are recognized currentiy in net income. Maintenance and repairs which do not improve or extend the life of the respective assets are expensed currently.

Long-Term Debt - Long-term debt is recorded at the stated principal amount of the obligation.

Revenue Recognition - Irrigation revenues are recognized on the basis of cycle billings and are recorded when landowners are billed.

Estimates - The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reported period. Actual results could differ from these estimates.

Bad Debts - The District utilizes the direct write-off method for bad debs. No allowance for bad debts has been provided as no material write offs are expected for receivables at September 30, 1996.

(Continued)

1 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Deferred Compensation Plan - The District offers its employees a deferred compensation plan created in accordance with the Internal Revenue Code Section 457. Until paid or made available to the employee or other beneficiary, all amounts of deferred compensation, all property and rights purchased with those amounts, all income attributable to those amounts, and property or rights, are subject to the claims of the District's general creditors. Participants' rights under the plan are equal to those of a general creditor. The District has the duty of reasonable care in the selection of investment alternatives, but neither the District nor its directors or officers have any liability for losses under the plan.

Retirement - Alta Irrigation District is a member of the Public Employees' Retirement System for Local Miscellaneous Members, a contributory pension plan covering qualified employees.

Oversight Responsibility - Alta Irrigation District is administered by a board separate from and independent of, the Tulare County Board of Supervisors. The Tulare County Board of Supervisors does not select the board or management of Alta Irrigation District nor significantly influence its operation. As a result, the activities of Alta Irrigation District are not included in the financial statements of the County of Tulare.

2 - CASH AND INVESTMENTS

The District has monies on deposit with the Local Agency Investment Fund, a special fund of the California State Treasury. The fund invests in government securities and commercial paper. The District may withdraw monies upon one day notice. At September 30, 1996 and 1995 the funds were earning interest at an annual percentage rate of 5.57% and 5.89%, respectively.

Cash balances consisted of the following:

	1996	1995
Treasurer's General Account:		
Money market account	$ 28,852	$ 110,062
Checking account	4,062	17,468
Time deposit	16,586	
	49,500	127,530
Secretary's Payroll Account (checking)	81,222	95,437
Secretary's Imprest Account (checking)	45,000	45,000
Collector's Office Petty Cash	200	200
Investments:		
Local Agency Investment Fund	2,051,580	1,807,044
	$2,227,502	$2,075,211

2 - CASH AND INVESTMENTS (CONTINUED)

At September 30, 1996, the book balance of the District's deposits was $175,923 and the bank balance was $117,446 which was collateralized with pools of securities held by the pledging financial institution's trust department or agent, but not in the District's name.

The collateral for the District's deposits is categorized, in accordance with GASB Statement No. 3, to give an indication of the level of risk assumed by the District at year end. Category 1 includes deposits that are insured or collateralized with securities held by the District or its' agent in the District's name. Category 2 includes deposits collateralized with securities held by the pledging financial institution's trust department or agent in the District's name. Category 3 includes uncollateralized deposits, including deposits that are collateralized with securities held by the pledging financial institution, or by its' trust department or agent, but not in the District's name.

	1996 Category		
	1	2	3
Checking			$ 38,650
Savings and money market			78,796
	$-0-	$-0-	$117,446

The market value of the securities pledged by the financial institution holding District funds exceeded 110 percent of the amount on deposit as September 30, 1996 and 1995.

The District invests with the State of California Local Agency Investment Fund, which is an uncollateralized special fund of the California State Treasury, however, per California Government Code Section 16429.2 these funds cannot be seized or impounded by any government official or agency. The balance at September 30, 1996 was $2,051,580 which approximates market value. The investment pool is managed by another government and is not required to be categorized in accordance with GASB Statement No. 3.

(Continued)

3 - NOTE RECEIVABLE

A note receivable arose from the sale of approximately 30 acres of land which the District no longer needed. The note balance is $57,300 and $66,850 as of September 30, 1996 and 1995, respectively, and accrues interest at 9% per annum. The note is payable beginning July 31, 1993 in the amount of $9,550 per year plus interest. The final payment is due July 31, 2002.

Total principal payments due on the note receivable for each of the five years subsequent to September 30, 1996 are as follows:

1997	$ 9,550
1998	9,550
1999	9,550
2000	9,550
2001	9,550
Thereafter	9,550
	57,300
Less: current portion	(9,550)
	$47,750

4 - PROPERTY, PLANT AND EQUIPMENT

Property, plant and equipment are summarized by major classifications as follows:

	1996	1995	Estimated Useful Lives
Land	$ 240,467	$ 240,467	
Pine Flat Reservoir	1,489,143	1,489,143	
Transmission and distribution plant	4,267,501	4,026,590	50 years
General plant	1,432,667	1,398,624	5 - 20 years
Construction-in-progress	43,237	6,201	
	7,473,015	7,161,025	
Less: accumulated depreciation	(2,862,410)	(2,703,114)	
	$4,610,605	$4,457,911	

Depreciation is computed using the straight-line method for financial reporting purposes and amounted to $159,298 and $165,378 in 1996 and 1995, respectively.

(Continued)

5 - ACCRUED VACATION AND ACCRUED SICK TIME AND COMPENSATION TIME

District employees have accumulated unpaid vacation of $41,471 and $43,178 as of September 30, 1996 and 1995, respectively, which they may elect to receive in cash upon termination. Earned vacation varies with the length of employment.

In addition, all employees, after completing five years of full-time employment with the District, shall be compensated in time off at the end of the term of employment, or in money for 50% of their sick leave to a maximum of 240 hours.

	1996	1995
Vacation	$41,471	$43,178
Sick time	$52,858	$50,823
Compensation time	5,919	5,488
	$58,777	$56,311

6 - ACCRUED EXPENSES

Accrued expenses consist of the following:

	1996	1995
Wages	$ 35,195	$ 36,047
Vacation	41,471	43,178
Sick leave	52,858	50,823
Compensation time	5,919	5,488
Payroll taxes on comp absences	6,866	6,864
Payroll taxes	11,425	11,767
	$153,734	$154,167

(Continued)

7 - LONG-TERM DEBT

Long-term debt consists of the following:

	1996	1995
U. S. Bureau Reclamation, non-interest bearing, installments of $35,395 due annually	$247,763	$283,158
Less: current portion	(35,395)	(35,395)
	$212,368	$247,763

Total principal payments due on long-term debt for each of the five years subsequent to September 30, 1996 are as follows:

1997	$ 35,395
1998	35,395
1999	35,395
2000	35,395
2001	35,395
Thereafter	70,788
	$247,763

8 - APPROPRIATED RETAINED EARNINGS

Appropriated retained earnings consists of the following:

	1996	1995
Utility plant	$4,610,605	$4,457,911
Pine Flat debt repayment	247,763	283,158
Capital fund	434,000	434,000
Appropriated	300,000	300,000
Contingency fund	100,000	100,000
	$5,692,368	$5,575,069

The Board of Directors has authorized the above appropriations of retained earnings.

9 - DEFINED BENEFIT PENSION PLAN

Plan Description - The District contributes to the California Public Employees' Retirement System (PERS), an agent, multiple employer public employee retirement system that acts as a common investment and administrative agent for participating public entities within the State of California. The payroll for employees covered by the System for the year ended September 30, 1996 and 1995 was $784,658 and $743,714; District's total payroll was $868,293 and $883,018, respectively.

All full-time employees are eligible to participate in the System. Employees who retire at or after age fifty with five years of credited service are entitled to a retirement benefit. The benefit will generally be based on the average salary over the last three years of credited service. Benefits fully vest on reaching five years of service. The system also provides death and disability benefits.

Both employees and the employer contribute to the plan. The employee contribution rate is specified in the contract with PERS and does not change. The employee rate is 7% of gross compensation excluding overtime minus $133.33, while the rate as of September 30, 1996 and 1995 for the employer is 9.586 and 10.931%. Employer contribution rates are recalculated annually, effective each September 1, as a part of the PERS annual actuarial evaluation. The employer contribution rates have two components; the employer normal cost contribution rate and the employer contribution rate required to amortize the unfunded actuarial liabilities over a specified period, each expressed as a percent of payroll. The District is required to contribute the remaining amounts necessary to fund the benefits for its members, using the actuarial basis recommended by the PERS actuaries and actuarial consultants and adopted by the Board of Administration.

Funding Status and Progress - The amount shown below as the "pension benefit obligation" is a standardized disclosure measure of the present value of pension benefits, adjusted for the effects of projected salary increases and step-rate benefits, estimated to be payable in the future as a result of employee service to date. The measure is intended to help users assess the funding status of the System on a going-concern basis, assess progress made in accumulating sufficient assets to pay benefits when due, and make comparisons among employers. The measure is the actuarial present value of credited projected benefits and is independent of the funding method used to determine contributions to the System.

(Continued)

9 - DEFINED BENEFIT PENSION PLAN (CONTINUED)

The pension benefit obligation was computed as part of an actuarial valuation performed as of June 30, 1995 and 1994. Significant actuarial assumptions used in the valuation include (a) a rate of return on the investment of present and future assets of 8.5 percent a year compounded annually, (b) projected salary increases of 4.5 percent a year compounded annually, attributable to inflation, (c) across the board real salary increases of .00 percent, (d) additional projected salary increases of .00 percent a year, attributable to seniority/merit, and (e) no postretirement benefit increases.

Total (funded)/unfunded pension benefit obligation applicable to the District's employees was ($186,326) and ($211,638) at June 30, 1995 and 1994, as follows:

	1995	1994
PENSION BENEFIT OBLIGATION:		
Retirees and beneficiaries currently receiving benefits and terminated employees not yet receiving benefits	$1,731,024	$1,696,050
CURRENT EMPLOYEES:		
Accumulated employee contributions including allocated investment earnings	621,552	538,287
Employer financed vested	534,166	450,168
Employer financed nonvested	34,900	27,846
Total pension benefit obligation	2,921,642	2,712,351
Actuarial value of assets (market value is $2,915,217 and $2,630,176)	3,107,967	2,923,989
(Funded)/unfunded pension benefit obligation	($ 186,325)	($ 211,638)

Actuarially Determined Contribution Requirements and Contribution Made - PERS uses the Entry Age Normal Actuarial Cost Method which is a projected benefit cost method. That is, it takes into account those benefits that are expected to be earned in the future as well as those already accrued. According to this cost method, the normal cost for an employee is the level amount which would fund the projected benefit if it were paid annually from date of employment until retirement. PERS uses a modification of the Entry Age Cost Method in which the employer's total normal cost is expressed as a level percentage of payroll. PERS also uses the level percentage of payroll method to amortize any unfunded actuarial liabilities. The amortization period of the unfunded actuarial liability ends on June 30, 2000.

(Continued)

9 - DEFINED BENEFIT PENSION PLAN (CONTINUED)

Actuarially Determined Contribution Requirements and Contribution Made (Continued) - The significant actuarial assumptions used to compute the actuarially determined contribution requirement are the same as those used to compute the pension benefit obligation as described above.

The contribution to the system for the 1995-1996 year of $134,956 was made in accordance with actuarially determined requirements computed through an actuarial valuation performed as of June 30, 1995 and 1996. The contribution by the employer consisted of $37,652 normal cost (6.539 percent of the current covered payroll for October, 1995 through June, 1996), $13,315 normal cost (6.375 percent of the current covered payroll for July, 1996 through September, 1996), $25,289 amortization of the unfunded actuarial accrued liability (4.392 percent of current covered payroll for October, 1995 through June, 1996), and $6,706 amortization of the unfunded actuarial accrued liability (3.211 percent of current covered payroll for July, 1996 through September, 1996). The District contributed $82,962 (10.573 percent of the current covered payroll); employees contributed $51,994 (6.62 percent of covered payroll.)

The contribution to the system for the 1994-1995 year of $128,682 was made in accordance with actuarially determined requirements computed through an actuarial valuation performed as of June 30, 1994. The contribution by the employer consisted of $48,455 normal cost (6.539 percent of the current covered payroll) and $32,841 amortization of the unfunded actuarial accrued liability (4.392 percent of current covered payroll. The District contributed $81,296 (10.391 percent of the current covered payroll); employees contributed $47,386 (6.372 percent of covered payroll.)

(Continued)

10 - POST EMPLOYMENT BENEFIT

The District provides its retirees who retire under provisions of a regular service retirement and who have twelve years of service the opportunity to continue enrollment in the District's health insurance program until age sixty-five. The District accounts for the program on a pay-as-you-go basis. The retired employees may also have the District pay for 60% of their spouses health insurance for a maximum of 36 months upon date of retirement. The District had $12,764.44 of benefits expended net of participants contributions. There are eight retirees participating in the health insurance plan and three spouses of the retirees participating in the 60% plan.

11 - CONTINGENCIES AND COMMITMENTS

A fuel tank which was underground leaked fuel into the ground. The tank and the contaminated ground will probably have to be removed. The extent of the contamination and the method in which the contaminants will be removed has not yet been determined, so it is not possible to estimate the expenditure required to solve the contamination problem. Because no estimate is available, no loss contingency will be accrued.

The District is the defendant in a number of lawsuits arising principally in the normal course of operations. In the opinion of the administration, the outcome of these lawsuits will not have a material adverse effect on the accompanying combined financial statements and accordingly, no provision for losses has been recorded.

ALTA IRRIGATION DISTRICT

SCHEDULE OF PROPERTY, PLANT AND EQUIPMENT

Year Ended September 30, 1996

	Cost October 1, 1995	Net Additions to Date	Accumulated Depreciation to Date	Book Value September 30, 1996
Irrigation system	$4,026,590	$240,911	$1,725,509	$2,541,992
Real estate and buildings	160,146		138,845	21,301
Roadways	300			300
Drainage wells	600			600
Piping and tanks	14,520		4,287	10,233
Shop equipment and machinery	146,044	607	128,851	17,800
Autos, trucks and tractors	842,558	21,771	681,530	182,799
Garage equipment	50			50
Engineer's equipment	2,247		898	1,349
Furniture and office equipment	131,496	9,592	97,077	44,011
Ground water wells	150			150
Ditch signs	100			100
Dropboards and temporary gates	350			350
Dragline	24,399		24,399	
Radio equipment	57,303	2,072	50,220	9,155
Rental equipment	1,700		1,700	
Other land	240,467			240,467
Pine Flat Reservoir	1,489,143			1,489,143
Pipeline-special assessment fund	10,715		8,179	2,536
Safety equipment	5,947		915	5,032
Construction-in-progress	6,201	37,036		43,237
	$7,161,026	$311,989	$2,862,410	$4,610,605

Percentage of Charges Collected

Year	By December 20
1986	90.13%
1987	91.17%
1988	93.82%
1989	91.25%
1990	94.55%
1991	93.06%
1992	94.70%
1993	93.91%
1994	94.01%
1995	94.03%
1996	94.60%

All charges are collected the preceding year of water delivery. All charges are due on November 20, and delinquent December 20, of each and every year. After December 20, as required by law, penalties and costs are automatically charged immediately upon delinquency.

Schedule of Diversions & Water Run for 1977-1996

	Diversion from Headgate	Water Run Season	
1977	38,721 Acre Feet	07/01 - 07/28	28 Days
1978	246,204 Acre Feet	05/11 - 10/31& 5 days in Sep	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
1993	246,415 Acre Feet	04/02 - 10/02	184 Days
1994	122,677 Acre Feet	05/17 - 08/18	93 Days
1995	236,725 Acre Feet	04/09 - 09/30	174 Days
1996	222,268 Acre Feet	04/02 - 09/01	153 Days
Average	163,139 Acre Feet	Average	121 Days
Most	253,269 Acre Feet	Longest	195 Days
Least	38,721 Acre Feet	Shortest	28 Days

Average Water Cost Per Property Category For 1996

Property Category Percentage	Charge Per Acre	Acres Irrigated In Each Category	Acre Feet Delivered	Average Acre Foot Per Acre Irrigated	Cost Per Acre Foot Delivered
100	$15.00	60,008	111,760	1.86	$8.05
75	$12.13	6,610	11,590	1.75	$6.92
50	$9.25	5,477	7,115	1.30	$7.12
25	$6.38	9,170	11,356	1.24	$5.15
5	$3.50	5,157	2,423	0.47	$7.45
Totals		86,421	144,243	1.67	

Recapitulation of Crop Surveys - Year 1993 & 1995

Crop Name	1993 Acres	%	1995 Acres	%	Drip or Sprinkler Acres	Percentage Of 1995 Acres
Alfalfa	7,620	5.9%	7,895	6.1%		
Apples	851	0.7%	946	0.7%	131	13.8%
Apricots	644	0.5%	681	0.5%	48	7.0%
Citrus	8,436	6.5%	8,816	6.8%	2,811	31.9%
Corn	4,562	3.5%	4,230	3.3%		
Cotton	7,358	5.7%	6,599	5.1%	15	0.2%
Grains	756	0.6%	1,370	1.1%		
Grapes	20,670	16.0%	20,652	16.0%	1,261	6.1%
Idle Land	8,048	6.2%	9,930	7.7%	38	0.4%
Melons	280	0.2%	156	0.1%	6	3.8%
Misc. Crops	3,314	2.6%	3,233	2.5%	231	7.1%
Nectarines	16,262	12.6%	15,872	12.3%	1,702	10.7%
Nuts	1,501	1.2%	1,433	1.1%	76	5.3%
Peaches	11,073	8.6%	10,665	8.2%	376	3.5%
Perm. Pasture	2,626	2.0%	2,526	2.0%	21	0.8%
Plums	12,031	9.3%	11,602	9.0%	1,002	8.6%
Pomegranates	495	0.4%	373	0.3%	37	9.9%
Olives	799	0.6%	1,025	0.8%	338	33.0%
Vegetables	928	0.7%	1,747	1.4%	5	0.3%
	108,254	83.7%	109,751	84.9%	8,098	7.4%
Irrigable Acres	108,254	83.7%	109,751	84.9%	8,098	7.4%
Bldg. Sites	5,929	4.6%	5,842	4.5%	14	0.2%
Dry Pasture	2,197	1.7%	376	0.3%		
Towns & Roads	12,920	10.0%	13,331	10.3%		
Total Acres	129,300	100.0%	129,300	100.0%	8,112	6.3%

Water Recap

Head Gate Diversions:

Delivered	144,243	65%
Recharge	64,688	29%
Operation Loss	11,113	5%
Evaporation Loss	2,223	1%
Total Head Gate Diversions	222,268	100%

Schedule of Rainfall & Average Ground Water Levels, 1977-1996

Rainfall		Average Ground Water Levels	
1976 -77	7.55 inches	1977	59.60 feet
1977 -78	21.28 inches	1978	40.43 feet
1978 -79	10.06 inches	1979	40.65 feet
1979 -80	12.51 inches	1980	35.48 feet
1980 -81	8.99 inches	1981	37.95 feet
1981 -82	15.52 inches	1982	33.86 feet
1982 -83	20.92 inches	1983	21.53 feet
1983 -84	8.87 inches	1984	20.17 feet
1984 -85	8.96 inches	1985	22.77 feet
1985 -86	14.12 inches	1986	24.33 feet
1986 -87	9.71 inches	1987	26.55 feet
1987 -88	10.92 inches	1988	37.40 feet
1988 -89	8.90 inches	1989	45.77 feet
1989 -90	8.57 inches	1990	51.79 feet
1990 -91	9.95 inches	1991	58.47 feet
1991 -92	11.07 inches	1992	59.28 feet
1992 -93	16.45 inches	1993	56.01 feet
1993 -94	9.78 inches	1994	54.92 feet
1994 -95	19.70 inches	1995	48.23 feet
1995 -96	11.52 inches	1996	41.80 feet
Average	12.27 inches	Average	40.85 feet
Highest	21.28 inches	Highest	59.28 feet
Lowest	7.55 inches	Lowest	20.17 feet

Pumps operating in the District:

Kind	1991	1993	1995
Centrifugal	119	135	79
Submersible	541	733	787
Turbine	3,093	2,840	2,992
Misc.	28	47	72
Total Pumps	3,781	3,755	3,930
Total Horsepower	46,689	51,214	53,155

SCHEDULE OF GENERAL & ADMINISTRATIVE EXPENSES
SEPTEMBER 30, 1996 & 1995

GENERAL & ADMINISTRATIVE:	1996	1995
Administration Payroll	$209,425	$204,911
Other Payroll Expenses		
Vacation, Sick Leave, Holidays	124,442	107,597
Payroll Taxes	24,860	22,289
Benefit Package	78,659	70,213
Personnel Supplies/Programs/Auto Allow	756	(1,592)
Auto Lease	4,589	
Bank Charges	20	25
Collection Agreement - Dinuba	6,773	11,228
Collector's Deed Foreclosures	(1,798)	11,281
Collector's Expense	212	87
Convention Expense	8,913	6,653
Damage Claims	0	1,048
Director's Fees & Expenses	12,555	10,069
Dues & Assessments	77,985	73,539
Elections	4,336	0
Fish & Game Expense	1,037	366
Insurance & Bonds	92,815	110,290
Janitorial/Maintenance	8,430	7,726
Lease Agreement	300	300
Legislation	9,644	9,586
Litigation	3,582	5,655
Manager's Expense	1,068	379
Meetings	721	827
Miscellaneous	2,941	3,555
Office & Computer Supplies/Postage	19,949	18,312
Publication & Advertisement	2,444	907
Rental Equipment	3,626	3,594
Reorganization Expense	0	27,197
Secretary's Expense	156	62
Services:		
Audit	17,700	13,075
Engineer	5,886	12,405
Legal	18,117	24,191
Telephone/Cellular/Radios	7,325	6,009
Utilites	6,491	6,794
Water Banking	3,014	0
Water Management Plan	4,891	1,243
TOTAL GENERAL & ADMIN EXPENSES	$761,864	$769,821

SCHEDULE OF MAINTENANCE, OPERATION EXPENSES
& PINE FLAT OPERATIONS - SEPTEMBER 30, 1996 & 1995

	1996	1995
MAINTENANCE:		
Payroll	$235,410	$221,194
Other Payroll Expense		
Payroll Taxes	38,235	36,098
Benefit Package	77,888	67,243
Diesel	3,211	3,557
Equipment Rental		457
Gasoline	21,901	23,697
Maintenance Supplies	9,983	8,410
Materials & Supplies	147,805	166,323
Miscellaneous	125	833
Oil	16,885	4,086
Radio System		1,920
Repairs & Maintenance	34,909	64,313
Safety Equipment	1,439	1,176
Shop Equipment & Supplies	6,040	7,151
Utilities	11,548	12,745
TOTAL MAINTENANCE	$605,379	$619,203
OPERATION:		
Payroll	$251,647	$284,289
Other Payroll Expense		
Payroll Taxes	20,356	24,186
Benefit Package	40,385	45,789
Car Hire	46,795	46,006
Drop Boards	4,651	
Disposal Hazardous Waste	1,160	
Water Recorders		53
TOTAL OPERATION	$364,994	$400,323
PINE FLAT DAM:		
Maintenance & Operation	$48,303	$46,039
TOTAL PINE FLAT DAM	$48,303	$46,039
TOTAL MAINT, OPER, & PINE FLAT DAM	$1,018,676	$1,065,565

MANAGER'S REPORT

Alta Irrigation District manages and maintains 400 miles of open canal system and pipelines. The District utilizes a variety of management concepts and equipment to keep the open canals free of weeds, debris and to repair leads in existing pipelines. The following is an overview of the District's maintenance program.

PREEMERGENCE SPRAY PROGRAM - The District's maintenance program consists of a preemergence spray program normally initiated in November using Direx (Diuron) at a rate of five to seven pounds per sprayed acre. This program keeps the weed seed from germinating for seven to eight months, depending on the rainfall after spraying.

SELECTIVE SPRAY PROGRAM - During the spring and summer months, a selective spray program is initiated using such materials as Rodeo or Roundup. The materials primarily work on troublesome weeds such as bermuda grass that Direx has trouble eliminating during the preemergence spray program. The last several years numerous counties have initiated "Pest Management Zones" which will not allow Direx application on non-crop areas such as ditch banks. As a result, 15 ditches are not treated with Direx and are selectively treated with Rodeo or Roundup.

GENERAL MAINTENANCE - After the operation season and before the preemergence spray program, selective ditches are side-bladed, meaning deposited earthen material is cleaned out of the ditch. Washouts and low areas, where the ditch bank has eroded away with time, are reinforced with cement, hardpan or other earthen materials.

CONSTRUCTION PERIOD - After the preemergence spray program is concluded, cement pipelines are installed, pipeline patching and structures to be built are constructed. Gates are checked for leakage; broken parts and stems are replaced.

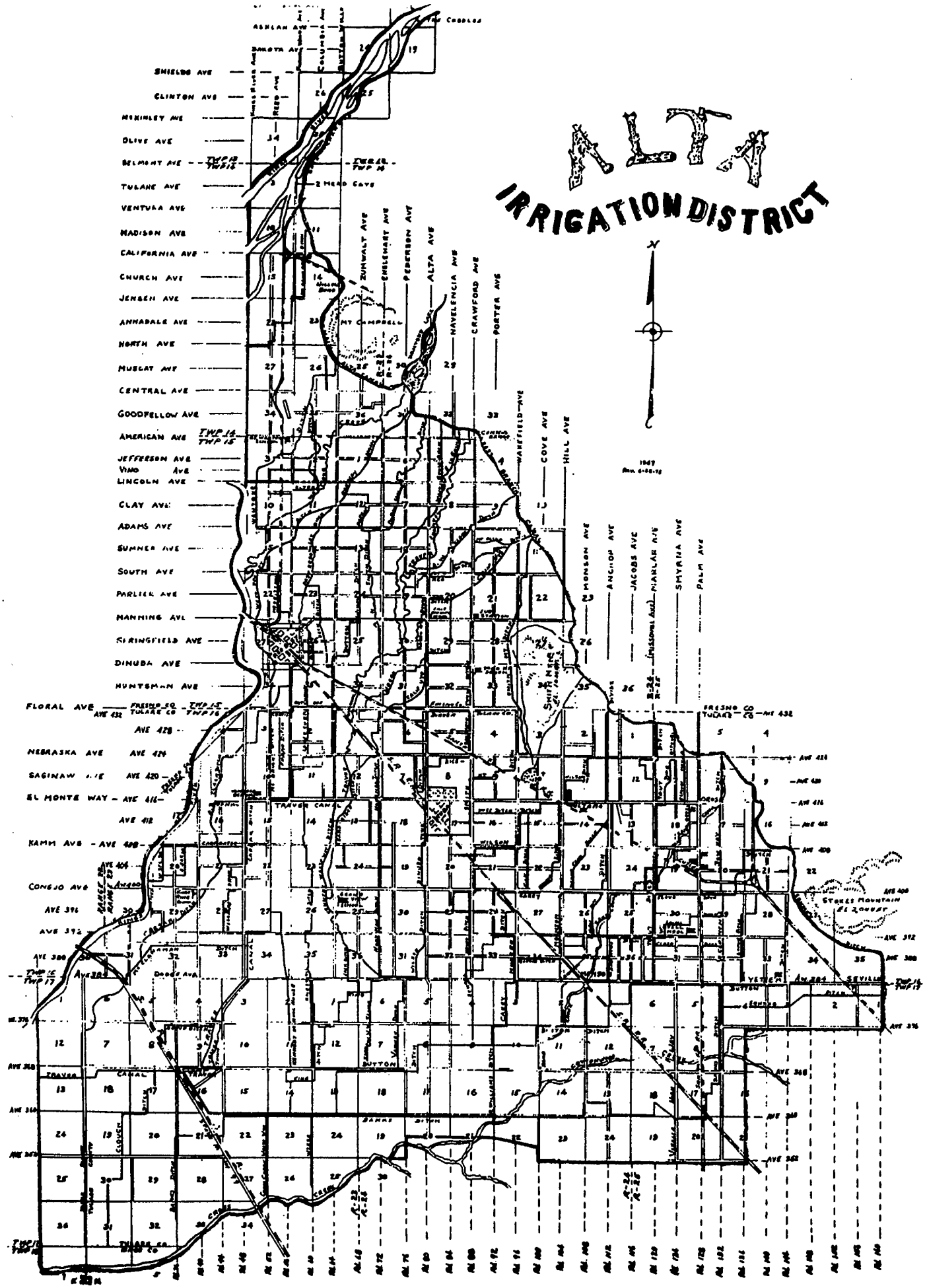
SHOP - The District is fortunate to have a fully equipped shop which enables personnel to fabricate control gates and other necessary measuring devices along with equipment maintenance. Equipment repair has been reduced with the decision several years ago to upgrade the District vehicles and equipment, thus reducing the maintenance budget and increasing the performance and reliability.

PONDING BASINS

Water regulation, conservation, groundwater recharge and maintenance of existing District facilities to better serve the constituents has been an on-going concern of the Board of Directors. Current and future water development projects seem to be at a standstill due to political and environmental concerns.

As a result, the Distinct has determined that is must maximize its existing water resources to their fullest extent possible. Maintenance of existing concrete linings, installation of new water regulation basins and improved measuring stations are examples of water conservation efforts currently utilized by the District.

In the last several years, the District has planned and constructed two reregulating reservoirs: The London Pond located on Ave 384 and Road 56, and the Button Pond located on Ave. 384 and Road 108. The service area of each reregulating reservoir is approximately 6,000 acres, thus, both projects will provide enhanced service to 12,000 acres.


ALTA
IRRIGATION DISTRICT
SHIELDS AVE
CLINTON AVE
MCKINLEY AVE
OLIVE AVE
BELMONT AVE
TULARE AVE
VENTURA AVE
MADISON AVE
CALIFORNIA AVE
CHURCH AVE
JENSEN AVE
ANNADALE AVE
NORTH AVE
MUSCAT AVE
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GOODFELLOW AVE
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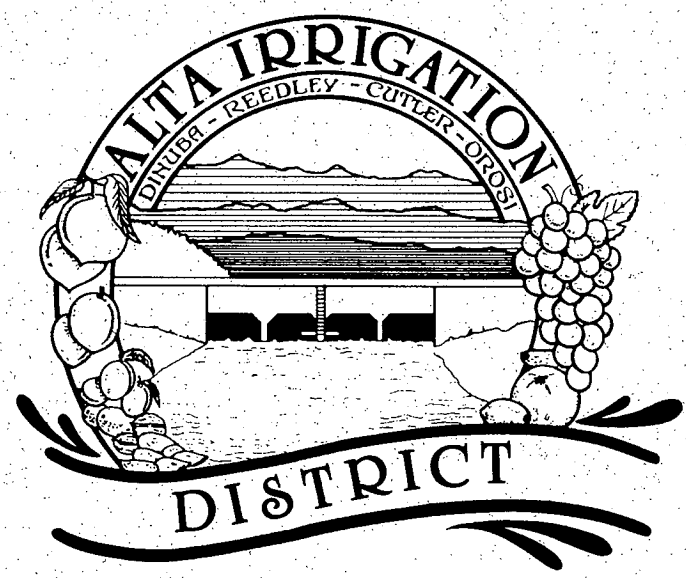
MARLAR AVE
SMYRNA AVE
PALM AVE
MT CAMPBELL
TRAVER CANAL
BUTTON
BANKS DITCH
STOKES MOUNTAIN
SEVILLE
FRESNO CO
TULARE CO

ALTA IRRIGATION DISTRICT



1997

ANNUAL REPORT

ALTA IRRIGATION DISTRICT

289 NORTH L STREET
P.O. BOX 715
DINUBA, CA 93618
(209) 591-0800
FAX (209) 591-5190

BOARD OF DIRECTORS

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PRESIDENT

BEN AGRIFOGLIO
SCOTT BELKNAP
TOM MARSHALL
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ROGER WARKENTIN
LEONARD WILEMAN

CHRIS M. KAPHEIM
GENERAL MANAGER / SECRETARY

IRMA PANTOJA FARIA
OFFICE MANAGER / TREASURER

DARLENE F. STEWART
COLLECTOR

July 10, 1997

Honorable Board of Directors
Alta Irrigation District
P.O. Box 715
Dinuba, CA 93618

Re: 1997 Annual Report

Gentlemen:

Transmitted herewith is the 1996/97 fiscal year end annual report of the Alta Irrigation District for the period from October 1, 1996 through September 30, 1997.

As part of this report are the audited financial statements with accompanying information for the same period.

Also, included in this report, is a crop & pump survey, charts showing the rainfall history, groundwater levels, diversion amounts and water run history as well as a history of the District.

Respectfully submitted,

ALTA IRRIGATION DISTRICT

Chris M. Kapheim

Chris M. Kapheim
General Manager

CMK:ipf

ALTA IRRIGATION DISTRICT
ANNUAL REPORT

BOARD OF DIRECTORS

Norman Waldner
Division No. 4

Ben Agrifoglio Division 1	Roger Warkentin Division 2	Leonard Wileman Division 3
Tom Marshall Division 5	David Powell Division 6	Scott Belknap Division 7

OFFICERS

Norman Waldner .....President
Ben Agrifoglio .....Vice-President
Chris M Kapheim .....Secretary
Irma Pantoja Faria .....Treasurer

MANAGEMENT STAFF

Chris M Kapheim.....General Manager
Jeff Heringer .....Superintendent
Irma Pantoja Faria .....Office Manager
Darlene F. Stewart .....Collector

CONSULTANTS

James H Wegley, Kellar and Wegley, Visalia.....Engineer
Douglas B. Jensen, Baker, Manock & Jensen, Fresno.....Attorney
Mike Blankenship, Blankenship & Schultz, Madera.....Auditor

REGULAR BOARD MEETING SECOND FRIDAY OF EACH MONTH

9:00 A.M.

ALTA IRRIGATION DISTRICT
1997 ANNUAL REPORT

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ALTA IRRIGATION DISTRICT HISTORY

HISTORY OF EARLY IRRIGATION IN THE KINGS RIVER AREA

The Alta Irrigation District was originally a dry and arid area capable of sustaining dry land crops and cattle. The area in 1825 resembled a desert. The reason is simple, the rainfall in the District for the 50 year period prior to 1956 had averaged only 11.39 inches. Furthermore, virtually none of the annual rainfall occurs during June, July or August, the hottest months and also the period during which the greatest plant growth takes place.

The Kings River, which supplies water to the Alta Irrigation District, is one of the largest streams entering the San Joaquin Valley. The river drains from the mountain and foothill area of 1,742 square miles, ranging in elevation from 500 to 14,000 feet above sea level. More than half 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 high stage until the middle of May or first of June. However, the average runoff does not guarantee this amount 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.

Irrigation in the Kings River area was practiced in a limited way in the river bottoms beginning in the early 1950's. To make this irrigation possible, the early settlers built dams of cobblestones, and built ditches with the aid of horses and mules, scrapers, or by hand. The efforts of these early pioneers were to secure water on lands not bordering streams, or to irrigate lands for a second crop of corn and pumpkins after hay had been cut. Irrigation at that time was used only for small operations. Any large scale farmer depended on dry farming to raise wheat or grazed cattle on the grass of the plains.

Two important factors were of value with the early diversion of water from the Kings River. First, the growing of fruits and vegetables were made possible, and secondly, the establishment of water rights for these lands were secured.

During this time period, cattle grazing was more important in the Kings River area than agriculture. There were frequent conflicts between the cattlemen and the owners of crops. More and more crops were planted because of the availability of water, yet cattle roamed at will, often ruining crops. Also, during this time period, a "No Fence" bill was introduced, and after much controversy, it was eventually passed. This law required all cattle owners to prevent their stock from trespassing upon the land of others, and held them responsible for any damage done by their cattle. Because of this new law, it was economically impossible to continue the same type of ranching as had been carried on in this area previously. Therefore, many thousand head of cattle were driven over the mountain into the wilds of Nevada, where large tracts of wild range were now protected by the new state law. The farmer-irrigation had won a major battle. As a result of this victory, many more farmers were attracted to the Kings River area, including the Alta Irrigation District.

The other factor during this time was the problem of water rights. As more farmers arrived, the demand for diverted water increased until there seemed to be a shortage and litigation naturally ensued. Litigation between claimants or water priority and litigation over water rights was the general rule and not the exception. This was the state of affairs along the Kings River and along other California streams until the final settlement in the California Supreme Court in 1886. The judgement in this case stated that the doctrine of appropriation was the common law and as a result of this law, all irrigation units on the Kings River were enjoined from diverting its water.

One of the companies, which had serious problems as a result of the Riparian Rights Case, was the "76" Land and Water Company, the forerunner of the Alta Irrigation District.

"76" LAND AND WATER COMPANY

In 1856, a large tract of land in the Kings River bottom was being used by owners Andrew Darwin and E.C. Ferguson for their cattle operation. The brand they used, and so recorded in Fresno County, was the "76". Their cattle roamed throughout the present Alta Irrigation District and was soon to be known as "76" Country. In 1865, Darwin and Ferguson sold all their holdings to Thomas Fowler and Richard Carmen and continued to graze their cattle throughout the area. Around 1875, Fowler brought out Carmen and it was around this time the struggle between farmer and cattle rancher was being waged.

The idea to build an irrigation system in the "76" Country was conceived in the mind of P.Y. Baker, a civil engineer, and D.K. Zumwalt in 1881. Their plan was to acquire a large tract of land, build an irrigation system, and then subdivide the land and either sell or lease the land in small plots to settlers attracted by the advertising of the proposed company. At this time, Fowler had ceased to be very optimistic concerning the future operation of the "76" land and Baker sold him on the idea of an irrigation company. As a result, Fowler turned all his land over to the company which Baker had organized in exchange for a large block of stock in the company. Six other capitalists were also interested in the project and on May 15, 1882, Baker posted a sign on the south bank of the Kings River saying the water was to be diverted. This was necessary to establish water rights. The articles of incorporation of the "76" Land and Water Company were filed in the Fresno County Clerk's office on May 29, 1882.

The first office of the "76" Land and Water Company was in Visalia. The capital stock of the corporation was $280,000, which was divided into fourteen shares of $20,000 each. The land owned by the company totaled 30,000 acres. The first preliminary survey for the "76" Canal was run through Dunnigan Gap, following closely the line now used by the Friant-Kern Canal, with construction beginning in 1852.

The original point of diversion from the Main Channel of the Kings River was at the mouth of Dennis Slough. Shortly, however, this was changed to the present point of diversion just below the town of Piedra. This point is known as "The Cobbles." It is about fourteen miles northeast of Reedley and is four miles above the point of diversion of any other canal on the Kings River. The canal follows a southwesterly course through a channel that is partly natural and partly man-made. The canal, near the diversion point, is one hundred feet wide and in that area has a drop of four feet to the mile. It is capable of carrying one thousand three hundred cubic feet of water per second.

The point of control otherwise known as the "Headgate" was located several miles down stream from the Main Canal. The Headgate was built in 1883 of redwood timbers. Since the canal at that point was still one hundred feet wide at the bottom, the Headgate was also one hundred feet wide. It was claimed that this Headgate was larger than that of any other irrigation system in the western United States at that time. It is also interesting to note that even in the early days the system served as a bridge for a county road, as it still does to this day.

The construction of the system continued until December of 1883. At this time, the Main Canal and several lateral canals were completed, and the decision to turn some water into the ditches was made. When the water reached the Wahtoke Dam, constructed by the "76" Company, a serious break occurred resulting in closure of the Headgate. Continued construction on the system was made until it had reached the Central Pacific Railroad (now Southern Pacific) in Tulare County, a few miles south of where the railroad crossed the Kings River. At this point, the company decided to survey a townsite. The surveying was complete by March, 1884, and the town was named Traver, in honor of Charles

The surveying was complete by March, 1884, and the town was named Traver, in honor of Charles Traver, member of the Board of Directors of the "76" Land and Water Company. At this time the company moved its office from Visalia to Traver.

The first sale of the "76" Land and Water Company was made on December 31, 1883. In April of 1884, the Headgate was opened allowing a moderate head of water to flow into the Main Canal. That same month, an auction was held to sell town lots. The sales at the end of the two day auction totaled $65,000. The only building in the townsite at this time was a partially competed railroad depot. By September, however, it was a thriving town with stores, hotels, grain warehouses and other places of business, including a few salons.

Over the next few years, between poor management on the part of the "76" Land and Water Company, the breaking of the faith with the tenants of the "76" Company, and the years of litigation that followed, a succession of short crops and low prices, and the financial depression bringing a decline in the priced of real estate, not only delayed the progress of the "76" Company, but brought financial ruin to some of its pioneers. Undoubtedly, there were many reasons for this decline in land value and financial ruin of the pioneers, but there can be no doubt that the practices of the "76" Land and Water Company were an important factor.

THE FORMATION OF ALTA IRRIGATION DISTRICT

Since irrigation works were very expensive and because of increased demands for water distribution systems by small farmers who could not afford to build these systems by themselves, the California Legislature passed the Wright Act on March 7, 1887. This act sought to confer on farming communities powers of municipalities in the purchase or construction and operation of irrigation works. These powers included the right of eminent domain, the right to issue bonds against all the real property within any area organized into an irrigation district, and the right to tax that property for the purpose of building or operating irrigation works. Provision was made for conducting district elections, for meeting of board of directors and for the management of district business.

There were questions in regards to the legality of the Wright Act, but the State Supreme Court ruled that the Act complied with the various provisions of the state constitution. This judgement apparently encouraged the people who were served by the "76" Land and Water Company to proceed with plans to form an irrigation district.

In complying with the provisions of the Wright Act, a pertition calling for an election to form an irrigation district and bearing the signatures of sixty-six landowners within the proposed district, was presented to the Tulare County Clerk on July 7, 1888, When the committee registered the papers for the new district, it was suggested that a new name be adopted. It was decided that since the diversion point off the Kings River was higher in elevation than any other point of diversion, the title "Alta Irrigation District" (Alta in Spanish means high) would be an appropriate name; And was so recorded. The area included within the boundaries of the District was approximately 130,000 acres. The District included parts of Tulare, Fresno and Kings Counties. The present communities of Dinuba, Reedley, Traver, Culter and Orosi lie within these boundaries.

On August 14, 1888, the election was held with 326 in favor of the formation of an irrigation district and 19 against the formation of such a district. Thus, the Alta Irrigation District was formed to become the third irrigation district in California. The election was also used to elect a Board of Directors to serve the new District. The area was divided into five divisions, with one director to be elected from each of these

districts. On September 10, 1988, the first Board of Directors meeting was held and P.Y. Baker was elected President and William J. Applegate was appointed Secretary.

On October 12, 1888, the Board of Directors appointed James Sibley as engineer for the District. It was his assignment to determine the amount of bonds that would be necessary to cover the cost of construction. At this time, the Board also began negotiating with the "76" Land and Water Company for the purchase of their existing irrigation system. On December 4, 1988, the Board of Directors voted to transfer the District office from Traver to Dinuba. This move was viewed by the citizens of Traver as a serious blow to the already dying community.
On February 15, 1889, a successful bond election was held and according to the Wright Act, all the real estate within the district boundaries was to be used as security to back the bonds.

During all of this time that the District was a legal entity, no property had been purchased. Negotiation with the "76" Company was on-going and it was not until July 1, 1890 that an agreement had been reached. The "76" Company agreed to take 820 bonds of the District, each with a value of $500.00, or a total of $410,000.00, in exchange for its canals and water rights. At the time of transfer of the irrigation system to Alta, the "76" Company was furnishing water to only about 1,900 acres. Many more canals and ditches would need to be constructed if all 129,300 acres were to be irrigated. After a bond sale of $100,000.00, a great deal of construction of canals, ditches, drops and headgates were instigated. By January, 1895, the necessary system of ditches were nearly completed.

In the next few years, in spite of the low cost of the water and the continuity of water delivery, there were groups who wanted to do away the irrigation district system. One of these groups was composed of city dwellers who attacked the Wright Act on the grounds that the irrigation system was for the benefit of the farmer, not the city resident. In 1891, the State Supreme Court left no doubt that the Wright Act was legal and binding. The other dissatisfied group were owners of large tracts of land who pooled their resources and employed an attorney to lobby the state legislature to repeal the Wright Act. The Board of Directors of Alta Irrigation District persuaded William P. Boone to run for the state assembly to counteract the efforts of any groups that were interested in repealing the Wright Act. Mr. Boone was elected and he joined the legislature for the 1895 session. In the next two years, Mr. Boone tried to preserve the Wright Act. In 1897, Boone achieved at least partial success in his mission with a compromise. This compromise, known as the "Bridgeford Act," stated that no new irrigation district could be organized. The Act was so severe for organizing districts in incurring indebtness, that irrigation district development in California remained dormant for twelve years, with no new projects being initiated between 1897 and 1909.

On Mr. Boone's return to his position as Secretary of the Board of Directors of the Alta Irrigation District, he found the situation still serious. The Tulare Superior Court handed down a decision which stated that the bonds of the District were illegal and that the Board of Directors could not force the people of the District to pay taxes for the purpose of making any kind of payment on the bonds. The court made a distinction, as did many of the landowners, between taxes for bond payment and taxes for operating expenses. The courts ruled the District could assess the property owners to pay operating expenses, but could not assess for bond payments. During this entire period the people of the District voted overwhelmingly in favor of the special assessments requested by the Board of Directors for operating expenses.

During this three year period, the landowners, not knowing exactly what they could be forced to pay, and the Board of Directors not knowing exactly what they could legally collect, consequently resulted in default in bond payments. With the refusal of most landowners to pay taxes or assessments, the Board of

Directors had to contrive a plan to raise money to pay the necessary labor. The water users were canvassed for loans or contribution to raise funds with a promise that such contributions would apply on their taxes.

Two legislative acts were passed during the time period in which all of these problems occurred in the Alta Irrigation District. The first, entitled "An Act to provide for the issue and sale or exchange of funding bonds to Irrigation Districts organized under and in accordance with the "Wright Act", was passed by the California Legislature on April 1, 1897. The second act was an "Amendment of the 1897 Act," and was designed to aid the irrigation districts in exchanging or refunding their bonds. This act was passed in Sacramento on March 16, 1901. W.P. Boone, on behalf of the Board of Directors, was to settle with the landowners means of repayment. Finally, a committee representing the landowner's group and a like representation of the bond holders, agreed upon a basis of compromise, calling for a vote of refunding bonds and cancellation of all outstanding bonds with a reduction of 25% of the debt at a reduced rate. Boone, too, was to obtain written agreement for every landowner in the District, which bound each landowner not to question the validity of such refunding bonds. After Boone had successfully obtained all property owner's agreements, the Board of Directors called for a meeting of the landowners to consider the proposal from the bondholders representatives. Five landowners were elected to travel to San Francisco to deal with the bondholders.

On October 10, 1901, a petition was presented to the Board of Directors which proposed the funding of such outstanding bonds and coupons and that the payment thereof may be provided for by the issuance of new bonds. On this same day, the Board of Directors called for a special election to decide whether $500,000 in new bonds should be issued and sold to pay off the old bonds. The election was held and approved by the voters. With the refunding of this debt, the most critical period in the financial development of the District had ended.

Lawsuits between different water districts and landowners were common during the early formation of the District. Over 100 lawsuits were tried between the turn of the century and 1918 at a tremendous cost to the water districts and landowners.

Thus, in the early part of 1914, a large mass meeting was called to address the situation. The meeting resulted in the formation of a committee of five men to begin searching for solutions through negotiation instead of litigation. By 1916, it became apparent that public sentiment was in favor of a negotiated peace between water interests. Meetings were held between feuding companies and districts in order to begin to work on a compromise solution. By 1917, nearly all of the companies had begun submitting schedules for diversion for consideration by the whole.

FORMATION OF THE KINGS RIVER WATER ASSOCIATION

The State Water Commission selected engineer Charles Kaupke to clean up the problem that was facing the water districts on the Kings River. The commission thought it would require about two months to compete. Having gone through a number of temporary schedules, the 19 water agencies, covering approximately 940,000 acres at that time and operating on the Kings River, finally came to a long-overdue negotiated settlement. On January 1, 1928, the Kings River Water Association was borne with Charles Kaupke as the designated watermaster for the river.

The new Association finally had brought an end to the painful and expensive litigation that existed for over fifty years on the Kings River. An organization had been borne to see that the most beneficial use was made of the limited water supply for all users on the river.
Today, the Alta Irrigation District remains as one of the charter members of the Kings River Water Association, with Director William P. Boone serving as its President from its inception until his death

in 1944. With 28 member water agencies, the Association continues to represent and manage water distribution for over 1.1 million acres of irrigated agricultural and urban areas throughout the Kings River service area.

PINE FLAT DAM PROJECT

From the first years of irrigation practice in the region, it became apparent that some type of storage facility and flood control project needed to be established. Heavy rains and snowpack in the watershed high in the Sierras would send torrential destructive flood waters jumping the banks of the Kings River. In alternating drought years, the river would be reduced to a fraction of its normal flow.

As early as 1902, land developer Thomas L. Reed traveled to Washington D. C. to drum up support for the building of a dam on the river, but he returned unsuccessful in his attempt. Four years later, with his own funds, he commissioned a study to survey the river for a dam site. The site chosen was roughly the same location as where Pine Flat Dam would eventually be built, some 48 year later.
In 1914, a group of Kings River water interest landholders, called the "Committee of Thirty," began meeting and concurred that funds should be sought for a reservoir site. William P. Boone, a man closely associated with Alta Irrigation District from its conception, headed the formal campaign to build the project. He traveled to Sacramento to secure support for the legislature, but once again the trip was not forthcoming. The main problems were with the water users themselves and their inability to negotiate a permanent agreement on Kings River Water Rights. By 1928, when the Depression was at its peak, unemployment was at a record high, and the crop prices had collapsed; federal money for a project such as Pine Flat Dam was nearly hopeless. It was not until 1944 that a contract was signed with the Army Corps of Engineers to begin construction on the dam, with completion in 1954.

The most recent technological enhancement of the District's operation is the power plant at Pine Flat Dam, completed in 1985. The hydroelectric facility, with its 55 megawatt generators, provides power to the Department of Water Resources to run pumping stations.

GROUNDWATER OVERDRAFT PROBLEMS

In its earliest years, Alta Irrigation District's most difficult problems were fought in the court room. Today, however, the battle is being waged under the ground and is a war against the already sever overdraft that exists in the previous groundwater tables.

The groundwater overdraft problem that the District is now faced with would be hard to fathom 100 years ago For hundreds of years, the underground tables had been filled and were nearly overflowing with water. In recent years, with the heavy reliance by agriculture on groundwater pumping (especially during drought years) has resulted in a severe groundwater overdraft. For those with no ready access to surface water supplies, the cost in electricity bills alone becomes worse each year, as more energy is required to pump from ever deepening levels beneath the ground.

The hope for solutions to these problems through increased water conservation within the District itself and throughout the San Joaquin Valley is disheartening. The decisions we are faced with today are consequences our region must endure in the future: Whether we decide to decrease the demand for water or increase the supply; or do we opt for agricultural land and businesses to go out of production; or is the solution to build more water storage projects on the river, which politically means unpopular dams. The choice is a difficult one and it will be the Alta Irrigation District together with the small family farmer who will either win or lose.

ALTA IRRIGATION DISTRICT'S MISSION STATEMENT

adopted January 9, 1998

MISSION: To deliver surface water to agriculture

OBJECTIVE: EFFICIENT AND EFFECTIVE WATER MANAGEMENT

STRATEGY: AB 3616 process - water conservation
Volumetric pricing - revenue enhancement
Reregulation basins
Revised operation system

MISSION: To address groundwater quality and quantity concerns pertaining to urban and agricultural interests.

OBJECTIVE: TO GATHER, REVIEW AND SELECTIVELY DISSEMINATE GROUNDWATER INFORMATION

STRATEGY: AB 3030 Groundwater Management Plan
Broaden AB 3030 to all public agencies which are water purveyors under Alta's Groundwater Management Plan
Nitrate awareness

MISSION: To address storm water issues as they relate to the protection of District pipelines and open canals

OBJECTIVE: TO PRESERVE AND PROTECT ALTA'S DISTRIBUTION SYSTEM

STRATEGY: Standardize Emergency Management System (SEMS)
Mutual Aid Agreement with Fresno and Tulare Counties (flooding)

MISSION: To educate and inform the general public on the importance of water

OBJECTIVE: TO ENHANCE THE GENERAL PUBLIC'S KNOWLEDGE OF WATER

STRATEGY: Biannual newsletter to the public
Quarterly internal newsletter to the Alta employee
Community involvement: Rotary, Tulare County Planning Commission appointment, Agricultural Education Foundation, Farm Bureau membership
Articles in newspapers and/or television coverage

Blankenship
& Schultz

CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT AUDITORS' REPORT

The Board of Directors
Alta Irrigation District

We have audited the accompanying balance sheets of Alta Irrigation District as of September 30, 1997 and 1996, and the related statements of income, changes in fund equity and cash flows for the years then ended. These financial statements are the responsibility of the District's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards, and the State Controller's Minimum Audit Requirements for California Special Districts. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the Alta Irrigation District as of September 30, 1997 and 1996, and the results of its operations, changes in fund equity, and its cash flows for the years then ended in conformity with generally accepted accounting principles, as well as accounting systems prescribed by the State Controller's office and state regulations governing special districts.

Blankenship & Schultz

October 31, 1997

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ALTA IRRIGATION DISTRICT

BALANCE SHEET

September 30, 1997 and 1996

ASSETS

	1997	1996
CURRENT ASSETS:		
Cash and investments	$2,106,023	$2,227,502
Receivables:		
Unredeemed assessment sales	68,101	71,491
Collector's deeds	277	69
Note receivable, current portion	9,550	9,550
Inventory	33,156	40,895
Prepaid expenses	109,206	84,929
Deposits		1,054
Total current assets	2,326,313	2,435,490
Utility plant, and equipment, net of accumulated depreciation	4,604,360	4,610,605
OTHER ASSETS:		
Note receivable	38,200	47,750
Accounts receivable	42,975	30,062
Deposits	27,576	31,026
	108,751	108,838
	$7,039,424	$7,154,933

LIABILITIES AND FUND EQUITY

CURRENT LIABILITIES:		
Current maturities of long-term debt	$ 35,395	$ 35,395
Accounts payable	199,428	107,013
Accrued expenses	143,325	153,734
Delinquent assessment sales trust fund		39,872
Total current liabilities	378,148	336,014
Long-term debt	176,973	212,368
FUND EQUITY:		
Contributed capital	730,834	746,640
Retained earnings:		
Appropriated	5,650,728	5,692,368
Unappropriated	102,741	167,543
Total fund equity	6,484,303	6,606,551
	$7,039,424	$7,154,933

The accompanying notes are an integral part of these financial statements.

ALTA IRRIGATION DISTRICT

STATEMENT OF INCOME

Years Ended September 30, 1997 and 1996

	1997	1996
OPERATING REVENUE:		
Assessments:		
Current charges	$1,467,181	$1,467,192
City of Reedley	13,902	13,902
City of Dinuba	22,887	20,509
Pine Flat Power Revenue	338,563	317,788
Total operating revenues	1,842,533	1,819,391
OPERATING EXPENSES:		
Depreciation	153,336	159,298
Maintenance	667,491	589,289
Operations	384,845	381,084
General and administrative	902,562	761,864
Pine Flat Dam - maintenance and operation	45,228	48,303
Total operating expenses	2,153,462	1,939,838
OPERATING INCOME (LOSS)	(310,929)	(120,447)
NON-OPERATING REVENUE (EXPENSES):		
Interest income	110,616	143,121
Penalties and costs	8,902	9,071
Interest on assessments	6,040	2,573
Work for others	1,010	904
Miscellaneous	32,641	68,766
Equipment lease and rents	5,550	4,749
Gain (loss) on sale of assets	2,007	
Refunds	17,346	13,221
Well testing	1,039	
Soil purchase	3,530	
	188,681	242,405
NET INCOME	($ 122,248)	$ 121,958

The accompanying notes are an integral part of these financial statements.

ALTA IRRIGATION DISTRICT

STATEMENT OF CHANGES IN FUND EQUITY

Years Ended September 30, 1997 and 1996

					Appropriated				
	Total	Unappropriated	Contributed Capital	Utility Plant	Pine Flat Debt	Corporation Yard	Capital	Appropriated	Contingency
Balance, October 1, 1995	$6,334,730	$148,827	$610,834	$4,457,911	$283,158		$434,000	$300,000	$100,000
Net income	121,958	121,958							
Capital contributions	149,863		149,863						
Net increase in utility plant		(311,989)		311,989					
Net increase in accumulated depreciation		173,352	(14,057)	(159,295)					
Transfers		35,395			(35,395)				
Balance, September 30, 1996	$6,606,551	$167,543	$746,640	$4,610,605	$247,763	$ -0-	$434,000	$300,000	$100,000
Balance, October 1, 1996	$6,606,551	$167,543	$746,640	$4,610,605	$247,763	$ -0-	$434,000	$300,000	$100,000
Net income	(122,248)	(122,248)							
Capital contributions	-0-		-0-						
Net increase in utility plant		(121,067)		121,067					
Net increase in accumulated depreciation		143,118	(15,806)	(127,312)					
Transfers		35,395			(35,395)	180,000	(107,000)	27,000	(100,000)
Balance, September 30, 1997	$6,484,303	$102,741	$730,834	$4,604,360	$212,368	$180,000	$327,000	$327,000	$ -0-

The accompanying notes are an integral part of these financial statements.

ALTA IRRIGATION DISTRICT

STATEMENT OF CASH FLOWS

Years Ended September 30, 1997 and 1996

	1997	1996
CASH FLOWS FROM OPERATING ACTIVITIES:		
Net (loss) income	($ 122,248)	$ 121,958
Adjustments to reconcile net income to net cash, provided by operating activities:		
Depreciation	153,336	159,298
Gain on the sale of assets	(2,007)	
Changes in assets and liabilities:		
(Increase) decrease in accounts receivable	(12,913)	95,332
Decrease (increase) in unredeemed assessment sales	3,390	(8,938)
(Increase) decrease in collector's deed receivable	(208)	429
(Increase) decrease in prepaid expenses	(24,277)	11,026
Decrease (increase) in inventory	7,739	(7,908)
Decrease in deposits	4,504	24,597
Increase (decrease) in accounts payable	92,418	(10,796)
(Decrease) in accrued liabilities	(10,409)	(433)
(Decrease) in deferred income		(28,904)
(Decrease) delinquent assessment sales trust fund	(39,872)	(15,396)
Total adjustments	171,701	218,307
Net cash provided by operations	49,453	340,265
CASH FLOWS FROM CAPITAL AND RELATED FINANCING ACTIVITIES:		
Principal payments on notes	(35,395)	(35,395)
Capital contributions		149,863
Capital expenditures	(183,067)	(274,952)
Proceeds from sale of assets	5,905	
Construction in progress	32,075	(37,040)
Net cash used by capital and related financing activities	(180,482)	(197,524)
CASH FLOWS FROM INVESTING ACTIVITIES:		
Proceeds from note receivable	9,550	9,550
Net cash provided from investing activities	9,550	9,550
Net (decrease) increase in cash and cash equivalents	(121,479)	152,291
Cash and cash equivalents at beginning of year	2,227,502	2,075,211
Cash and cash equivalents at end of year	$2,106,023	$2,227,502

The accompanying notes are an integral part of these financial statements.

ALTA IRRIGATION DISTRICT

NOTES TO FINANCIAL STATEMENTS

Years Ended September 30, 1997 and 1996

1 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Organization and Operation - The Alta Irrigation District (the District) was organized under the Wright Act in 1887 and operates under the provision of the California Water Code. The District covers an area of approximately 130,000 acres and distributes water to the agricultural lands in Tulare, Fresno and Kings counties.

The District has the authority to fix rates and charges for commodities and services furnished; it may also, with prior voter approval, incur indebtedness and issue bonds. The District is exempt from payment of federal and state taxes.

Basis of Accounting - Alta Irrigation District uses the accounting system prescribed by the State of California Controller's Office. The accounting records are maintained on the accrual basis of accounting. The accrual basis of accounting recognizes revenues when earned. Expenses are recorded when incurred.

Cash and Cash Equivalents - The District invests its funds in various financial instruments with limited interest rate risk. For purposes of the statement of cash flows, highly liquid investments with a maturity of three months or less when purchased are classified as cash and cash equivalents.

Accounts Receivable - Accounts receivable arise from billings to landowners for water services charged and certain improvements made to the landowner's property. Substantially all of the District's sales are to landowners located within the District's boundaries. Uncollectible amounts from individual landowners do not exist because the District obtains a lien upon all assessed property once the assessment becomes delinquent. After a five year period, the District can sell the property to recover all prior assessments, cost, penalties and interest due the District.

Inventory - Inventories are stated at the lower of cost or market on a first in, first out method.

Property, Plant and Equipment - Property, plant and equipment (including major renewals and improvements) are recorded at cost. Depreciation is provided over the useful lives of the assets using the straight-line method. When properties are disposed of, the related costs and accumulated depreciation are removed from the respective accounts. Any gains or losses on the disposition by sale or retirement are recognized currently in net income. Maintenance and repairs which do not improve or extend the life of the respective assets are expensed currently.

Long-Term Debt - Long-term debt is recorded at the stated principal amount of the obligation.

Revenue Recognition - Irrigation revenues are recognized on the basis of cycle billings and are recorded when landowners are billed.

Estimates - The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reported period. Actual results could differ from these estimates.

Bad Debts - The District utilizes the direct write-off method for bad debs. No allowance for bad debts has been provided as no material write offs are expected for receivables at September 30, 1997 and 1996.

(Continued)

1 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Budget - The District's budget is prepared on the cash and expenditure basis. Revenues are budgeted in the year that the applicable purchase orders are expected to be issued. The budgets are approved by the board annually and used as an internal control for management. The budget is presented in the supplemental information of these financial statements.

Billing - The bills are sent out in late October. The bills become delinquent on December 20. However, if December 20 falls on a weekend the subsequent Monday at 5:00pm becomes the deadline. The District publicizes the delinquencies and they become unredeemed assessments upon the passing of three weeks from the date of the first publication. Unredeemed assessments may be sold to the District and the District will be issued a collector's deed on the property after five years. The District may retain the property or dispose of it at a public auction to redeem delinquencies owed on it.

Deferred Compensation Plan - The District offers its employees a deferred compensation plan created in accordance with the Internal Revenue Code Section 457. Until paid or made available to the employee or other beneficiary, all amounts of deferred compensation, all property and rights purchased with those amounts, all income attributable to those amounts, and property or rights, are subject to the claims of the District's general creditors. Participants' rights under the plan are equal to those of a general creditor. The District has the duty of reasonable care in the selection of investment alternatives, but neither the District nor its directors or officers have any liability for losses under the plan.

Retirement - Alta Irrigation District is a member of the Public Employees' Retirement System for Local Miscellaneous Members, a contributory pension plan covering qualified employees.

Oversight Responsibility - Alta Irrigation District is administered by a board separate from and independent of, the Tulare County Board of Supervisors. The Tulare County Board of Supervisors does not select the board or management of Alta Irrigation District nor significantly influence its operation. As a result, the activities of Alta Irrigation District are not included in the financial statements of the County of Tulare.

(Continued)

2 - CASH AND INVESTMENTS

The District has monies on deposit with the Local Agency Investment Fund, a special fund of the California State Treasury. The fund invests in government securities and commercial paper. The District may withdraw monies upon one day notice. At September 30, 1997 and 1996 the funds were earning interest at an annual percentage rate of 5.71% and 5.57%, respectively.

Cash balances consisted of the following:

	1997	1996
Treasurer's General Account:		
Money market account	$ 31,265	$ 28,852
Checking account	2,653	4,062
Time deposit	17,483	16,586
	51,401	49,500
Secretary's Payroll Account (checking)	84,310	81,222
Secretary's Imprest Account (checking)	64,971	45,000
Collector's Office Petty Cash	200	200
Investments:		
Local Agency Investment Fund	1,905,141	2,051,580
	$2,106,023	$2,227,502

At September 30, 1997, the book balance of the District's deposits was $200,882 and the bank balance was $131,336 which was collateralized with pools of securities held by the pledging financial institution's trust department or agent, but not in the District's name.

The collateral for the District's deposits is categorized, in accordance with GASB Statement No. 3, to give an indication of the level of risk assumed by the District at year end. Category 1 includes deposits that are insured or collateralized with securities held by the District or its' agent in the District's name. Category 2 includes deposits collateralized with securities held by the pledging financial institution's trust department or agent in the District's name. Category 3 includes uncollateralized deposits, including deposits that are collateralized with securities held by the pledging financial institution, or by its' trust department or agent, but not in the District's name.

	1996 Category		
	1	2	3
Checking			$ 2,729
Savings and money market			128,607
	$-0-	$-0-	$131,336

(Continued)

2 - CASH AND INVESTMENTS (CONTINUED)

The market value of the securities pledged by the financial institution holding District funds exceeded 110 percent of the amount on deposit as September 30, 1997 and 1996.

The District invests with the State of California Local Agency Investment Fund, which is an uncollateralized special fund of the California State Treasury, however, per California Government Code Section 16429.2 these funds cannot be seized or impounded by any government official or agency. The balance at September 30, 1997 was $1,905,141 which approximates market value. The investment pool is managed by another government and is not required to be categorized in accordance with GASB Statement No. 3.

The District had funds in various accounts with Kings River State Bank at September 30, 1997 in excess of the FDIC insured amount of $100,000. The total amount at risk at September 30 1997 was $13,685.

3 - NOTE RECEIVABLE

A note receivable arose from the sale of approximately 30 acres of land which the District no longer needed. The note balance is $47,750 and $57,300 as of September 30, 1997 and 1996, respectively, and accrues interest at 9% per annum. The note is payable beginning July 31, 1993 in the amount of $9,550 per year plus interest. The final payment is due July 31, 2002.

Total principal payments due on the note receivable for each of the five years subsequent to September 30, 1997 are as follows:

1998	$ 9,550
1999	9,550
2000	9,550
2001	9,550
2002	9,550
	47,750
Less: current portion	(9,550)
	$38,200

(Continued)

4 - PROPERTY, PLANT AND EQUIPMENT

Property, plant and equipment are summarized by major classifications as follows:

	1997	1996	Estimated Useful Lives
Land	$ 240,467	$ 240,467	
Pine Flat Reservoir	1,489,143	1,489,143	
Transmission and distribution plant	4,403,010	4,267,501	50 years
General plant	1,450,300	1,432,667	5 - 20 years
Construction-in-progress	11,162	43,237	
	7,594,082	7,473,015	
Less: accumulated depreciation	(2,989,722)	(2,862,410)	
	$4,604,360	$4,610,605	

Depreciation is computed using the straight-line method for financial reporting purposes and amounted to $153,336 and $159,298 in 1997 and 1996, respectively.

5 - LEASES

The District has a lease contract for a postage meter to expire in 1998.

The District also has two auto leases which will both expire in the fiscal year ending September 30, 1999. There is an option on both contracts to purchase at their estimated fair market values. The lease expenditures are $11,654 and $3,831 for the years ending September 30, 1997 and 1996.

The remaining balance to be paid is as follows:

1998	$ 8,916
1999	5,384
2000	-0-
2001	-0-
2002	-0-
	$14,300

(Continued)

6 - ACCRUED VACATION AND ACCRUED SICK TIME AND COMPENSATION TIME

District employees have accumulated unpaid vacation of $35,975 and $41,471 as of September 30, 1997 and 1996, respectively, which they may elect to receive in cash upon termination. Earned vacation varies with the length of employment.

In addition, all employees, after completing five years of full-time employment with the District, shall be compensated in time off at the end of the term of employment, or in money for 50% of their sick leave to a maximum of 240 hours.

	1997	1996
Vacation	$35,975	$41,471
Sick time	$54,126	$52,858
Compensation time	7,337	5,919
	$61,463	$58,777

7 - ACCRUED EXPENSES

Accrued expenses consist of the following:

	1997	1996
Wages	$ 39,000	$ 35,195
Vacation	35,975	41,471
Sick leave	54,126	52,858
Compensation time	7,337	5,919
Payroll taxes on comp absences	6,887	6,866
Payroll taxes		11,425
	$143,325	$153,734

(Continued)

8 - LONG-TERM DEBT

Long-term debt consists of the following:

	1997	1996
U. S. Bureau Reclamation, non-interest bearing, installments of $35,395 due annually	$212,368	$247,763
Less: current portion	(35,395)	(35,395)
	$176,973	$212,368

Total principal payments due on long-term debt for each of the five years subsequent to September 30, 1997 are as follows:

1998	$ 35,395
1999	35,395
2000	35,395
2001	35,395
2002	35,395
Thereafter	35,393
	$212,368

9 - APPROPRIATED RETAINED EARNINGS

Appropriated retained earnings consists of the following:

	1997	1996
Utility plant	$4,604,360	$4,610,605
Pine Flat debt repayment	212,368	247,763
Capital fund	434,000	434,000
Appropriated	300,000	300,000
Contingency fund	100,000	100,000
	$5,650,728	$5,692,368

The Board of Directors has authorized the above appropriations of retained earnings.

(Continued)

10 - DEFINED BENEFIT PENSION PLAN

Plan Description - The District contributes to the California Public Employees' Retirement System (PERS), an agent, multiple employer public employee retirement system that acts as a common investment and administrative agent for participating public entities within the State of California. The payroll for employees covered by the System for the year ended September 30, 1997 and 1996 was $821,960 and $784,658; District's total payroll was $912,102 and $868,293, respectively.

All full-time employees are eligible to participate in the System. Employees who retire at or after age fifty with five years of credited service are entitled to a retirement benefit. The benefit will generally be based on the average salary over the last three years of credited service. Benefits fully vest on reaching five years of service. The system also provides death and disability benefits.

Both employees and the employer contribute to the plan. The employee contribution rate is specified in the contract with PERS and does not change. The employee rate is 7% of gross compensation excluding overtime minus $133.33, while the rate as of September 30, 1997 and 1996 for the employer is 7.429% and 9.586%. Employer contribution rates are recalculated annually, effective each September 1, as a part of the PERS annual actuarial evaluation. The employer contribution rates have two components; the employer normal cost contribution rate and the employer contribution rate required to amortize the unfunded actuarial liabilities over a specified period, each expressed as a percent of payroll. The District is required to contribute the remaining amounts necessary to fund the benefits for its members, using the actuarial basis recommended by the PERS actuaries and actuarial consultants and adopted by the Board of Administration.

Funding Status and Progress - The amount shown below as the "pension benefit obligation" is a standardized disclosure measure of the present value of pension benefits, adjusted for the effects of projected salary increases and step-rate benefits, estimated to be payable in the future as a result of employee service to date. The measure is intended to help users assess the funding status of the System on a going-concern basis, assess progress made in accumulating sufficient assets to pay benefits when due, and make comparisons among employers. The measure is the actuarial present value of credited projected benefits and is independent of the funding method used to determine contributions to the System.

(Continued)

10- DEFINED BENEFIT PENSION PLAN (CONTINUED)

The pension benefit obligation was computed as part of an actuarial valuation performed as of June 30, 1996 and 1995. Significant actuarial assumptions used in the valuation include (a) a rate of return on the investment of present and future assets of 8.5 percent a year compounded annually, (b) projected salary increases of 4.5 percent a year compounded annually, attributable to inflation, (c) across the board real salary increases of .00 percent, (d) additional projected salary increases of .00 percent a year, attributable to seniority/merit, and (e) no postretirement benefit increases.

Total (funded)/unfunded pension benefit obligation applicable to the District's employees was ($289,352) and ($186,326) at June 30, 1996 and 1995, as follows:

	1996	1995
PENSION BENEFIT OBLIGATION:		
Retirees and beneficiaries currently receiving benefits and terminated employees not yet receiving benefits	$1,707,609	$1,731,024
CURRENT EMPLOYEES:		
Accumulated employee contributions including allocated investment earnings	711,217	621,552
Employer financed vested	734,473	534,166
Employer financed nonvested	38,208	34,900
Total pension benefit obligation	3,191,507	2,921,642
Actuarial value of assets (market value is $3,738,094 and $2,915,217)	3,480,859	3,107,967
(Funded)/unfunded pension benefit obligation	($ 289,352)	($ 186,325)

Actuarially Determined Contribution Requirements and Contribution Made - PERS uses the Entry Age Normal Actuarial Cost Method which is a projected benefit cost method. That is, it takes into account those benefits that are expected to be earned in the future as well as those already accrued. According to this cost method, the normal cost for an employee is the level amount which would fund the projected benefit if it were paid annually from date of employment until retirement. PERS uses a modification of the Entry Age Cost Method in which the employer's total normal cost is expressed as a level percentage of payroll. PERS also uses the level percentage of payroll method to amortize any unfunded actuarial liabilities. The amortization period of the unfunded actuarial liability ends on June 30, 2000.

(Continued)

10 - DEFINED BENEFIT PENSION PLAN (CONTINUED)

Actuarially Determined Contribution Requirements and Contribution Made (Continued) - The significant actuarial assumptions used to compute the actuarially determined contribution requirement are the same as those used to compute the pension benefit obligation as described above.

The contribution to the system for the 1996-1997 year of $128,881 was made in accordance with actuarially determined requirements computed through an actuarial valuation performed as of June 30, 1996 and 1997. The contribution by the employer consisted of $39,226 normal cost (6.375 percent of the current covered payroll for October, 1996 through June, 1997), $13,174 normal cost (6.374 percent of the current covered payroll for July, 1997 through September, 1997), $19,755 amortization of the unfunded actuarial accrued liability (3.211 percent of current covered payroll for October, 1996 through June, 1997), and $2,180 amortization of the unfunded actuarial accrued liability (1.055 percent of current covered payroll for July, 1997 through September, 1997). The District contributed $74,335 (9.04 percent of the current covered payroll); employees contributed $54,546 (6.64 percent of covered payroll.)

The contribution to the system for the 1995-1996 year of $134,956 was made in accordance with actuarially determined requirements computed through an actuarial valuation performed as of June 30, 1995 and 1996. The contribution by the employer consisted of $37,652 normal cost (6.539 percent of the current covered payroll for October, 1995 through June, 1996), $13,315 normal cost (6.375 percent of the current covered payroll for July, 1996 through September, 1996), $25,289 amortization of the unfunded actuarial accrued liability (4.392 percent of current covered payroll for October, 1995 through June, 1996), and $6,706 amortization of the unfunded actuarial accrued liability (3.211 percent of current covered payroll for July, 1996 through September, 1996). The District contributed $82,962 (10.573 percent of the current covered payroll); employees contributed $51,994 (6.62 percent of covered payroll.)

(Continued)

10 - **DEFINED BENEFIT PENSION PLAN (CONTINUED)**

Trend Information - Trend information gives an indication of the progress made in accumulating sufficient assets to pay benefits when due. Certain historical trend information is summarized as follows:

Year End June 30	Net Assets Available For Benefits	Pension Benefits Obligation	Percentage Funded	Unfunded (Funded) Pension Benefit Obligation	Unfunded (Funded) Pension Benefit Obligation As a Percentage of Covered Payroll
1987	$1,421,400	$1,876,200	75.8%	$454,800	64.9%
1988	1,596,400	2,042,400	78.2	446,000	64.8
1989	1,827,300	2,140,400	85.4	313,100	43.0
1990	2,041,200	2,355,200	86.7	314,000	45.1
1991	2,197,200	2,434,000	90.3	236,800	32.9
1992	2,331,700	2,638,800	88.4	307,100	43.3
1993	2,505,800	2,729,400	91.8	223,500	29.3
1994	2,924,000	2,712,400	107.8	(211,600)	(27.5)
1995	3,107,900	2,921,600	106.4	(186,300)	(23.1)
1996	3,480,800	3,191,500	109.1	(289,300)	(30.4)

Showing unfunded (funded) pension benefit obligation as a percentage of annual covered payroll approximately adjusts for the effects of inflation for analysis purposes. Prior to 1994, assets were shown at book value. Beginning 1994, the assets are shown at actuarial value (smoothed market value).

(Continued)

11 - POST EMPLOYMENT BENEFIT

The District provides its retirees who retire under provisions of a regular service retirement and who have twelve years of service the opportunity to continue enrollment in the District's health insurance program until age sixty-five. The District accounts for the program on a pay-as-you-go basis. The retired employees may also have the District pay for 60% of their spouses health insurance for a maximum of 36 months upon date of retirement. The District had $12,052.20 of benefits expended net of participants contributions. There are ten retirees participating in the health insurance plan and three spouses of the retirees participating in the 60% plan.

12 - CONTINGENCIES AND COMMITMENTS

A fuel tank which was underground leaked fuel into the ground. The tank and the contaminated ground will probably have to be removed. The extent of the contamination and the method in which the contaminants will be removed has not yet been determined, so it is not possible to estimate the expenditure required to solve the contamination problem. Because no estimate is available, no loss contingency will be accrued.

13 - LITIGATION

The District has accrued a loss of $100,000 for a court issued "Writ of Mandate" ordering Al Irrigation District to comply with the drainage provisions stated in California Water Code Sectio 22098. This decision is currently under appeal.

Percentage of Charges Collected

Year	By December 20
1986	90.13%
1987	91.17%
1988	93.82%
1989	91.25%
1990	94.56%
1991	93.06%
1992	94.70%
1993	93.91%
1994	94.01%
1995	94.03%
1996	94.60%
1997	94.03%

All charges are collected the preceding year of water delivery. All charges are due November 20, and delinquent December 20, of each and every year. After December 20, as require by law, penalties and costs are automatically charged immediately upon delinquency.

Schedule of Rainfall & Average Water Levels, 1977-1997

Rainfall season July to June

Season	Inches	
1976-77	7.55	<-----
1977-78	21.28	
1978-79	10.06	
1979-80	12.51	
1980-81	8.99	
1981-82	15.52	
1982-83	20.92	
1983-84	8.87	
1984-85	8.96	
1985-86	14.12	
1986-87	9.71	
1987-88	10.92	
1988-89	8.90	
1989-90	8.57	
1990-91	9.95	
1991-92	11.07	
1992-93	16.45	
1993-94	9.78	
1994-95	19.70	
1995-96	11.52	
1996-97	21.71	<-----
AVERAGE	12.14	
HIGHEST	21.71	
LOWEST	7.55	

Average Ground Water Levels

Year		
1977	59.60	<-----
1978	40.43	
1979	40.65	
1980	35.48	
1981	37.95	
1982	33.86	
1983	21.53	
1984	20.17	<-----
1985	22.77	
1986	24.33	
1987	26.55	
1988	37.40	
1989	45.77	
1990	51.79	
1991	58.47	
1992	59.28	
1993	56.01	
1994	54.92	
1995	48.23	
1996	41.80	
1997	39.13	
AVERAGE	40.77	
HIGHEST	20.17	
LOWEST	59.60	

Schedule of Diversion & Water Run for 1977-1997

Diversion from Headgate

Year	Acre Feet		Water Run Season	Days	
1977	38,721	<-----	Jul 1 - Jul 28	28	<-----
1978	246,204		May 11-Oct 31	169	
1979	181,999		May 1 - Aug 31	123	
1980	253,269	<-----	Apr 1 - Sep 13	166	
1981	145,581		May 4 - Aug 14	103	
1982	247,599		Apr 20 - Oct 31	195	<-----
1983	205,445		Apr 28 - Oct 14	167	
1984	214,165		Mar 31 - Sep 7	161	
1985	170,826		Apr 28 - Aug 26	121	
1986	227,709		Apr 7 -Sep 30	177	
1987	121,270		May 4 - Aug 4	93	
1988	59,188		Jun 13 - Aug 1	50	
1989	89,983		May 28 - Aug 4	69	
1990	58,463		Jun 21 - Aug 7	48	
1991	107,706		May 21 - Aug 10	82	
1992	66,623		May 28 - Jul 26	59	
1993	246,415		Apr 2 - Oct 2	184	
1994	122,677		May 17 - Aug 18	93	
1995	236,725		Apr 9 - Sep 30	174	
1996	222,268		Apr 2 - Sep 1	153	
1997	214,341		Mar 24 - Aug 26	156	
AVERAGE	165,580		AVERAGE	122	
MOST	253,269		MOST	195	
LEAST	38,721		LEAST	28	

Average Water Cost Per Property Category for 1997

Property Category Percentage	Charge Per Acre	Acres Irrigated in each Category	Acre Feet Delivered	Average Acre Foot Per Acre Irrigated	Cost per Acre Foot Delivered
5.00%	$3.50	5,883.35	2,400.26	0.41	$8.58
25.00%	$6.38	9,768.18	10,347.18	1.06	$6.02
50.00%	$9.25	5,410.21	7,022.96	1.30	$7.13
75.00%	$12.13	6,748.27	11,560.06	1.71	$7.08
100.00%	$15.00	59,290.17	120,156.48	2.03	$7.40
TOTALS		87,100.18	151,486.94		
SIMPLE AVERAGE				**1.30**	**$7.24**
WEIGHTED AVERAGE				**1.74**	**$7.29**

Water Recap

Headgate Diversions:	Acre Feet
Delivered	151,486.94
Recharge	49,993.60
Operation Loss 5%	10,717.05
Evaporation Loss 1%	2,143.41
Total Headgate Diversions	**214,341.00**

ALTA IRRIGATION DISTRICT

RECAPITULATION OF CROP SURVEYS - YEAR 1995 & 1997

CROP NAME	1995 ACRES	%	1997 ACRES	%	DRIP OR SPRINKLER ACRES	PERCENTAGE OF 1997 ACRES
ALFALFA	7,895	6.1%	7,823	6.1%	0	0.0%
APPLES	946	0.7%	1,028	0.8%	137	13.3%
APRICOTS	681	0.5%	718	0.6%	92	12.7%
CHERRIES	0	0.0%	287	0.2%	32	11.3%
CITRUS	8,816	6.8%	8,811	6.8%	3,027	34.4%
CORN	4,230	3.3%	6,250	4.8%	0	0.0%
COTTON	6,599	5.1%	4,645	3.6%	251	5.4%
GRAINS	1,370	1.1%	1,078	0.8%	0	0.0%
GRAPES	20,652	16.0%	19,365	15.0%	1,384	7.1%
IDLE LAND	9,930	7.7%	8,900	6.9%	28	0.3%
MELONS	156	0.1%	310	0.2%	26	8.4%
MISC CROPS	3,233	2.5%	3,770	2.9%	155	4.1%
NECTARINES	15,872	12.3%	16,381	12.7%	1,170	7.1%
NUTS	1,433	1.1%	1,671	1.3%	131	7.8%
OLIVES	1,025	0.8%	1,000	0.8%	295	29.5%
PEACHES	10,665	8.2%	12,498	9.7%	549	4.4%
PERM PASTURE	2,526	2.0%	2,253	1.7%	0	0.0%
PLUMS	11,602	9.0%	11,343	8.8%	1,114	9.8%
POMEGRANITES	373	0.3%	419	0.3%	12	2.9%
VEGETABLES	1,747	1.4%	1,328	1.0%	10	0.7%
	109,751	84.9%	109,879	85.0%	8,410	7.7%
IRRIGABLE ACRES	109,751	84.9%	109,879	85.0%		
BLDG SITES	5,842	4.5%	5,680	4.4%		
DRY PASTURE	376	0.3%	302	0.2%		
TOWNS & ROADS	13,331	10.3%	13,439	10.4%		
TOTAL ACRES	129,300	100%	129,300	100%		

PUMPS OPERATING IN THE DISTRICT:

KIND	1993	1995	1997
CENTRIFUGAL	135	79	58
SUBMERSIBLE	733	787	999
TURBINE	2,840	2,992	3,249
MISC.	47	72	183
TOTAL PUMPS	3,755	3,930	4,489

MANAGER'S REPORT

Alta Irrigation District manages and maintains 400 miles of open canal system and pipelines. The District utilizes a variety of management concepts and equipment to keep the open canals free of weeds, debris and to repair leads in existing pipelines. The following is an overview of the District's maintenance program.

PREEMERGENCE SPRAY PROGRAM - The District's maintenance program consists of a preemergence spray program normally initiated in November using Direx (Diuron) at a rate of five to seven pounds per sprayed acre. This program keeps the weed seed from germinating, depending on the rainfall after spraying.

SELECTIVE SPRAY PROGRAM - During the spring and summer months, a selective spray program is initiated using such materials as Rodeo or Roundup. The materials primarily work on troublesome perennial weeds such as bermuda grass that Direx has trouble eliminating during the preemergence spray program. The last several years numerous counties have initiated "Pest Management Zones" which will not allow Direx application on non-crop areas such as ditch banks. As a result, 15 ditches are not treated with Direx and are selectively treated with Rodeo or Roundup.

GENERAL MAINTENANCE - After the operation season and before the preemergence spray program, selective ditches are side-bladed, meaning deposited earthen material is cleaned out of the ditch. Washouts and low areas, where the ditch bank has eroded away with time, are reinforced with cement, hardpan or other earthen materials.

CONSTRUCTION PERIOD - After the preemergence spray program is concluded, cement pipelines are installed, pipeline patching and structures are constructed. Gates are checked for leakage; broken parts and stems are replaced.

SHOP - The District is fortunate to have a fully equipped shop which enables personnel to fabricate control gates, inlet grates, metal covers and other items as required.

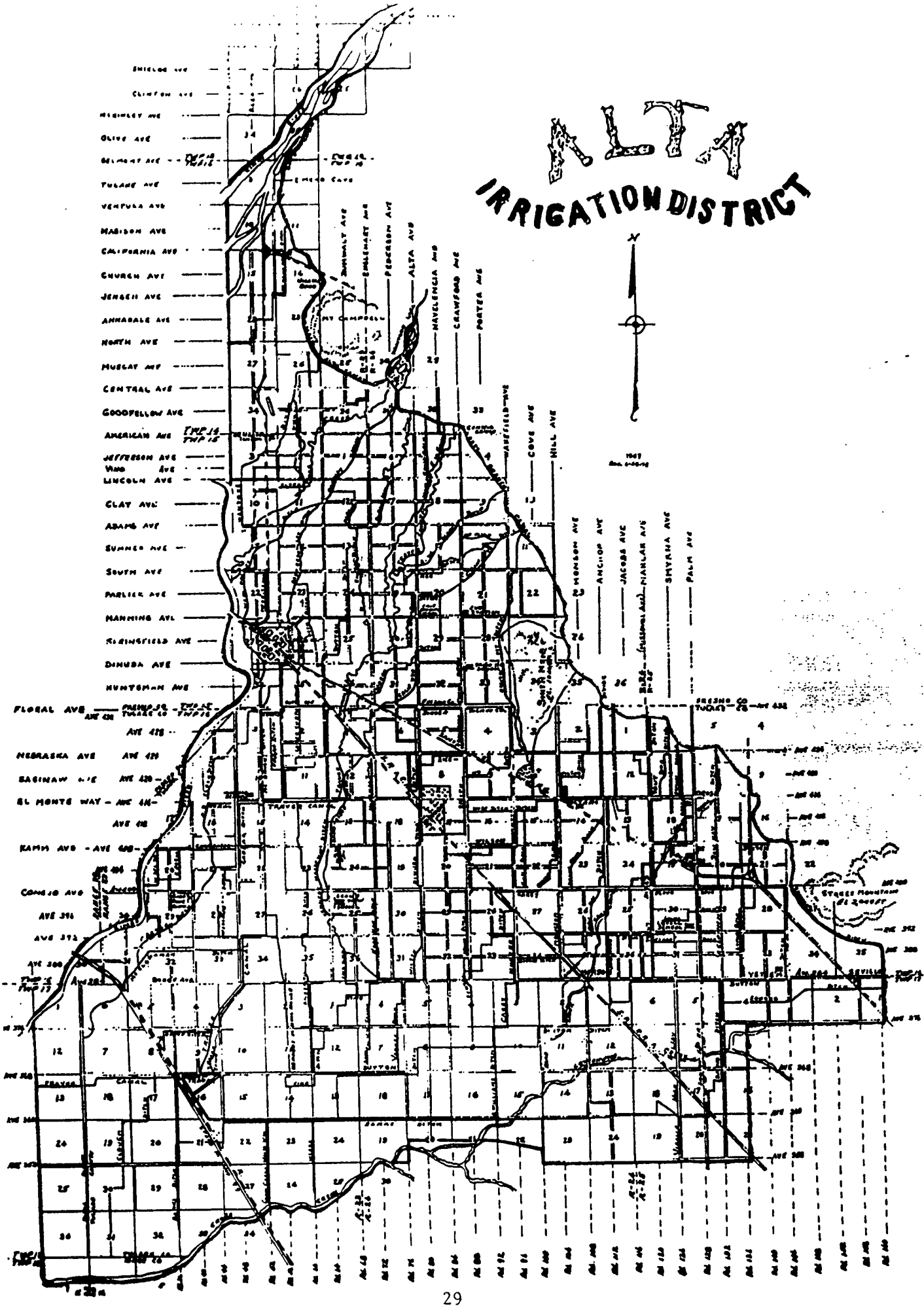
Equipment repair has been reduced with leasing programs and the turnover of purchased equipment to upgrade the District vehicles and equipment; reducing the maintenance budget and increasing the performance and reliability.

PONDING BASINS

Water regulation, conservation, groundwater recharge and maintenance of existing District facilities to better serve the constituents has been an on-going concern of the Board of Directors. Current and future water development projects seem to be at a standstill due to political and environmental concerns.

As a result, the Distinct has determined that is must maximize its existing water resources to their fullest extent possible. Maintenance of existing concrete linings, installation of new water regulation basins and improved measuring stations are examples of water conservation efforts currently utilized by the District.

In the last several years, the District has planned and constructed two reregulating reservoirs: The London Pond located on Ave 384 and Road 56, and the Button Pond located on Ave. 384 and Road 108. The service area of each reregulating reservoir is approximately 6,000 acres, thus, both projects will provide enhanced service to 12,000 acres.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BUTTON
STOKES MOUNTAIN
SEVILLE

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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 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 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 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 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 weekends additional water is stored in the basin; and on week days, 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 an 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. GROUNDWATER 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 effective 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 "F"), 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 any one 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 Managment Plan as of **October 14, 1994.**

"DISTRICT"

ALTA IRRIGATION DISTRICT, a
California Irrigation District

BY _____
Norman Waldner, President

BY _____
Janelle M. Cochran, Secretary

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 of 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

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.

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 - RECOGNITION

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 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 District shall pay one-third of the cost and expense of water quality testing, 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_____

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METHODS

and

DEVICES

Used in the Measurement and Regulation of Flow to Alta Laterals, Service Ditches and Pipe Lines, together with Tables for Field Use.

1981

ALTA IRRIGATION DISTRICT

Dinuba, California

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

1-Foot Width—

Gordon Ditch
Merrett No. 2
Mt. Olive
Parenti

2-Foot Width—

Andrews Ditch
Ballard
Banks
Barlow
Bump & Edmiston
Clark A. W.
Clapp
Curtis Upper
Curtis Lower
Driver
Dunn Madison
Elter
Floyd
Frane
Fray
Gould East
George W. D.
Grove
Haden & Boone
Haymaker
Horsman
Jack
Kirk
Kennedy waste way slough
Lovell
Loper
Mt. Campbell
Merritt No. 1
Montague
Mc Gee
Nuss
Orosi School House
Peck
Reo
Rice Brubaker
Rosa
Sharp
Scoggins
Segrue
Sand ridge
Traver Town
Uphill
Van Noy
Wilson Hunter
Wilson School House
Windsor
Williams J. T.

3-Foot Width—

Carpenter Ditch
Hogan
Knestrie
Wahtoke

3½-Foot Width—

Bowhay Ditch

4-Foot Width—

Kennedy School House Ditch
Nichols-Cann
Smith A. N.
Stirewalt
Sontag - 2-2 foot gates

4½-Foot Width—

Cary-Hunter Ditch

6-Foot Width—

Caesar Ditch
Clark A. B.

16-Foot Width—

Monson ditch at head

Parshall Flumes

Buttonwillow No. 1	8 feet wide
Buttonwillow No. 2	8 feet wide
Button	4 feet wide
Clements	4 feet wide
Dinuba Town	4 feet wide
Monson No. 2	8 feet wide
Reedley Main	10 feet wide
Reedley Main No. 2	10 feet wide
Smith Mountain	4 feet wide
Traver Main	15 feet wide

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 rate of one lineal foot per second. An acre foot of water, the unit of quantity, may be defined as the amount of water required to cover an area of one acre, one foot deep. For convenience in computations, the following quantities are given:

One Second Foot of water flowing continuously for 12 hours is equivalent to pratically one acre foot.

One Second Foot of water flowing for one hour is equivalent to one acre inch, which is defined as the amount of water required to cover an area of one acre, one inch deep.

One Second Foot of water is equivalent to 7½ gallons per second, or to 450 gallons per minute.

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 overpour 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:

1st. From the level line established on the gate, measure vertically to the surface of the water below the gate.

2nd. From the same level line 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 from the first one, and the difference gives the head under which the water is flowing. To get the area of the opening, measure:

1st. The distance vertically from the saw scarf in the stem of the gate, to the top of the crossbar which is even with the saw mark when the gate is closed.

2nd. Measure the clear width of the gate between the cleats. Get both these measurements in inches and multiply them, and the result gives the number of square inches in the opening.

From Table I 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 from 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—WEIR MEASUREMENTS

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

The flow of water through an overpour 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:

1st. 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 water on the weir crest.

2nd. 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.

METHOD III—VELOCITY MEASUREMENT

Velocity may be measured with a current meter or 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:

1st. 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 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.

2nd. Measure the depth and width of 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 of 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 guesswork in 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 shown in Figure 1. In the slide stem have been drilled seven holes 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 of use of tables. With the slide stem set for a six-inch opening, a flow of two second feet is required.

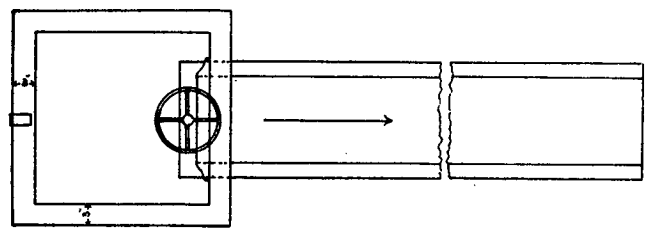
Answer: In Table III under the third column headed **six-inches** find **two second feet.** In the first column to the left, opposite two second feet find the required head which in this case is .7. Operate the turnout gate either up or down to obtain this head. Note: The head is obtained by means of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

TABLE I
Pressure Measurement
Discharge in cubic feet per second per square inch of opening.

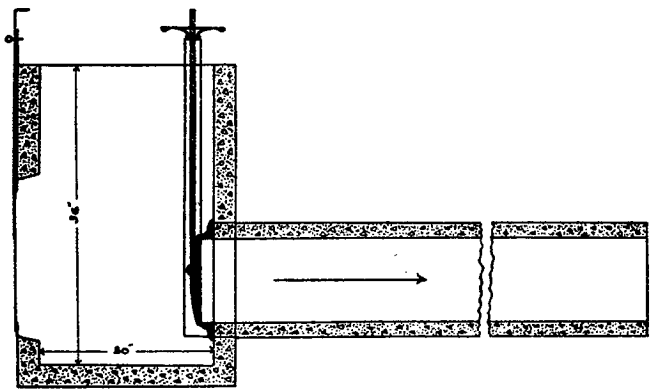
Head in Inches	Coefficient	Head in Inches	Coefficient	Head in Inches	Coefficient
1	.0106	14.5	.0404	28	.0562
1.5	.0130	15	.0412	28.5	.0568
2	.0150	15.5	.0418	29	.0572
2.5	.0168	16	.0425	29.5	.0578
3	.0184	16.5	.0432	30	.0582
3.5	.0199	17	.0439		
4	.0212	17.5	.0444		
4.5	.0225	18	.0451		
5	.0237	18.5	.0457		
5.5	.0249	19	.0464		
6	.0260	19.5	.0469		
6.5	.0272	20	.0476		
7	.0281	20.5	.0481		
7.5	.0292	21	.0487		
8	.0301	21.5	.0493		
8.5	.0310	22	.0498		
9	.0319	22.5	.0504		
9.5	.0327	23	.0510		
10	.0336	23.5	.0516		
10.5	.0345	24	.0521		
11	.0353	24.5	.0526		
11.5	.0361	25	.0531		
12	.0369	25.5	.0536		
12.5	.0376	26	.0542		
13	.0383	26.5	.0548		
13.5	.0391	27	.0553		
14	.0398	27.5	.0558		

TABLE II
Overpour Table
Discharges in cubic feet per second, per inch width of weir for each one-quarter inch depth.

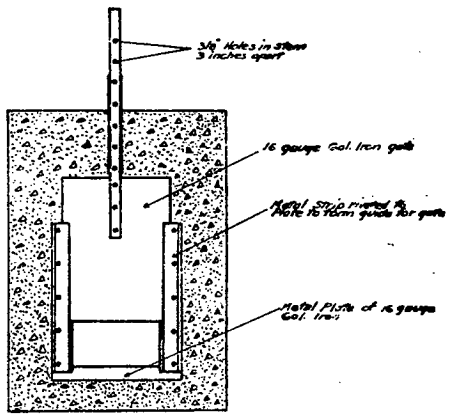
Depth of Overpour in Inches	0	One-Quarter	One-Half	Three-Quarters
0	.....	.0008	.0024	.0043
1	.0067	.0093	.0122	.0155
2	.0189	.0225	.0264	.0305
3	.0347	.0391	.0437	.0485
4	.0537	.0586	.0637	.0690
5	.0746	.0803	.0861	.0921
6	.0981	.1043	.1106	.1170
7	.1236	.1303	.1371	.1440
8	.1511	.1582	.1654	.1728
9	.1803	.1878	.1955	.2032
10	.2111	.2190	.2271	.2353
11	.2436	.2519	.2603	.2688
12	.2775	.2862	.2950	.3039
13	.3129	.3219	.3311	.3404
14	.3497	.3592	.3687	.3782
15	.3878	.3975	.4074	.4173
16	.4273	.4373	.4474	.4576
17	.4679	.4782	.4887	.4992
18	.5098	.5205	.5312	.5420
19	.5528	.5638	.5748	.5859
20	.5971	.6083	.6196	.6309
21	.6424	.6539	.6655	.6772
22	.6889	.7007	.7125	.7244
23	.7363	.7484	.7605	.7727
24	.7849	.7973	.8098	.8224



PLAN



SECTION THRU CENTER LINE



PRECAST HEAD AND DETAIL OF VARIABLE ORIFACE

FIGURE 1

TABLE III

DISCHARGE IN CUBIC FEET PER SECOND

FOR RECTANGULAR SUBMERGED ORIFICE 1 FOOT IN WIDTH

Head in Feet	Gate Opening in Inches											
	3"	6"	9"	1'0"	1'3"	1'6"	2'	2'6"	3'	3'6"	4'	4'6"
	SECOND FEET											
.02	.17	.34	.52	.69	.86	1.03	1.38	1.57	2.05	2.41	2.76	3.10
.04	.22	.49	.73	.98	1.22	1.47	1.95	2.48	2.94	3.42	3.92	4.40
.06	.30	.60	.89	1.20	1.49	1.79	2.38	3.00	3.58	4.17	4.78	5.36
.08	.34	.69	1.03	1.38	1.73	2.07	2.76	3.50	4.14	4.82	5.52	6.20
.10	.39	.77	1.16	1.55	1.94	2.32	3.09	3.86	4.65	5.41	6.20	6.95
.15	.47	.94	1.43	1.89	2.36	2.83	3.77	4.72	5.67	6.60	7.57	8.50
.20	.54	1.08	1.63	2.18	2.73	3.27	4.36	5.45	6.56	7.63	8.75	9.82
.30	.67	1.33	2.00	2.67	3.34	4.01	5.34	6.67	8.03	9.35	10.73	12.05
.40	.77	1.54	2.31	3.09	3.86	4.64	6.17	7.71	9.27	10.80	12.39	13.90
.50	.86	1.72	2.58	3.46	4.33	5.18	6.90	8.64	10.39	12.08	13.84	15.54
.60	.94	1.88	2.82	3.78	4.73	5.66	7.55	9.44	11.36	13.35	15.12	17.00
.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
.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
.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
1.0	1.22	2.44	3.66	4.90	6.12	7.34	9.78	12.23	14.70	17.10	19.60	22.00
1.1	1.28	2.56	3.84	5.14	6.44	7.70	10.28	12.85	15.45	17.98	20.60	23.10
1.2	1.33	2.66	3.99	5.34	6.67	8.00	10.66	13.35	16.00	18.62	21.35	24.00
1.3	1.39	2.78	4.17	5.59	6.98	8.37	11.15	13.96	16.75	19.50	22.30	25.05
1.4	1.44	2.88	4.32	5.78	7.22	8.65	11.54	14.45	17.33	20.18	23.10	25.95
1.5	1.49	2.98	4.46	5.98	7.47	8.95	11.93	14.93	17.92	20.85	23.90	26.80
1.6	1.54	3.07	4.61	6.17	7.70	9.25	12.32	15.41	18.50	21.52	24.84	27.70
1.7	1.59	3.17	4.76	6.37	7.96	9.54	12.71	15.90	19.10	22.20	25.42	28.60
1.8	1.63	3.27	4.90	6.57	8.20	9.84	13.10	16.38	19.70	22.90	26.22	29.47
1.9	1.68	3.37	5.05	6.77	8.45	10.10	13.50	16.88	20.30	23.60	27.02	30.38
2.0	1.72	3.44	5.16	6.90	8.63	10.35	13.80	17.27	20.74	24.13	27.62	31.00
2.1	1.75	3.51	5.27	7.06	8.82	10.57	14.10	17.63	21.20	24.62	28.22	31.70
2.2	1.80	3.61	5.42	7.25	9.06	10.85	14.48	18.10	21.73	25.30	29.00	32.53
2.3	1.84	3.68	5.53	7.40	9.25	11.08	14.78	18.46	22.20	25.80	29.60	33.20
2.4	1.89	3.78	5.67	7.60	9.50	11.37	15.16	18.98	22.80	26.50	30.39	34.10
2.5	1.93	3.86	5.77	7.74	9.67	11.60	15.45	19.30	23.22	27.00	31.00	34.80
2.6	1.96	3.93	5.90	7.89	9.85	11.82	15.75	19.70	23.66	27.50	31.56	35.40
2.7	2.00	4.00	6.00	8.03	10.05	12.04	16.04	20.02	24.10	28.00	32.12	36.10
2.8	2.03	4.07	6.11	8.18	10.22	12.26	16.34	20.40	24.55	28.58	32.75	36.75
2.9	2.07	4.15	6.22	8.33	10.41	12.47	16.62	20.80	25.00	29.05	33.30	37.40
3.0	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 ORIFICES 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 ft.	6 ft.	8 ft.	10 ft.	15 ft.		Upper Head	4 ft.	6 ft.	8 ft.	10 ft.	15 ft.
.20	1.3						2.35	61.6	93.8	126.3	159.1	227.0
.25	1.8	2.6					2.40	63.7	97.0	130.7	164.6	236.0
.30	2.4	3.5	4.6				2.45	65.8	100.2	135.1	170.2	242.0
.35	3.1	4.5	5.9				2.50	67.9	103.5	139.5	175.8	250.0
.40	3.8	5.6	7.3	9.1			2.55	70.1	106.8	143.9	181.6	258.0
.45	4.5	6.7	8.9	11.0			2.60	72.3	110.2	148.4	187.4	267.0
.50	5.4	7.9	10.5	13.0	19.0		2.65	74.5	113.7	153.0	193.2	275.0
.55	6.2	9.2	12.2	15.2	22.0		2.70	76.7	117.0	157.7	199.1	283.0
.60	7.1	10.6	14.1	17.5	25.0		2.75	78.8	120.5	162.4	205.1	292.0
.65	8.1	12.1	16.0	19.9	29.0		2.80	81.2	124.0	167.2	211.2	300.0
.70	9.1	13.6	18.0	22.5	33.0		2.85	83.5	127.6	172.0	217.3	309.0
.75	10.2	15.2	20.1	25.1	36.0		2.90	85.8	131.1	176.9	223.9	317.0
.80	11.3	16.8	22.4	27.9	40.0		2.95	88.2	134.8	181.8	229.8	326.0
.85	12.4	18.5	24.6	30.8	45.0		3.00	90.6	138.4	186.8	236.1	335.0
.90	13.6	20.3	27.0	33.7	49.0		3.05	93.0	142.1	191.8	242.4	344.0
.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	61.1	88.0		3.45					419.0
1.35	25.7	38.7	51.8	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	132.7	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 VI
DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE
2 FEET IN WIDTH

HEAD IN FEET	NET GATE OPENING IN FEET AND INCHES							
	3"	6"	9"	1.0'	1' 3"	1' 6"	1' 9"	2.0'
.02	.3	.7	1.0	1.4	1.8	2.1	2.5	2.8
.04	.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
.06	.6	1.2	1.8	2.4	3.0	3.6	4.3	4.9
.08	.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6
.10	.8	1.6	2.4	3.1	3.9	4.7	5.5	6.3
.12	.8	1.7	2.6	3.4	4.3	5.2	6.0	6.9
.14	.9	1.9	2.8	3.7	4.6	5.6	6.5	7.4
.16	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
.18	1.0	2.1	3.2	4.2	5.3	6.3	7.4	8.4
.20	1.1	2.2	3.3	4.4	5.5	6.7	7.8	8.9
.22	1.1	2.3	3.5	4.7	5.8	7.0	8.2	9.3
.24	1.2	2.4	3.7	4.9	6.1	7.3	8.5	9.7
.26	1.2	2.5	3.8	5.1	6.3	7.6	8.9	10.1
.28	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5
.30	1.3	2.7	4.1	5.4	6.8	8.1	9.5	10.9
.32	1.4	2.8	4.2	5.6	7.0	8.4	9.9	11.3
.34	1.4	2.9	4.3	5.8	7.2	8.7	10.1	11.6
.36	1.4	3.0	4.5	6.0	7.5	8.9	10.4	11.9
.38	1.5	3.1	4.6	6.1	7.7	9.2	10.7	12.3
.40	1.5	3.1	4.7	6.3	7.9	9.4	11.0	12.6
.45	1.6	3.3	5.0	6.6	8.3	10.0	11.7	13.3
.50	1.7	3.5	5.3	7.0	8.8	10.5	12.3	14.1
.55	1.8	3.7	5.5	7.4	9.2	11.1	12.9	14.8
.60	1.9	3.9	5.8	7.7	9.6	11.6	13.5	15.5
.65	1.9	4.0	6.0	8.0	10.0	12.0	14.0	16.0
.70	2.0	4.2	6.2	8.3	10.4	12.5	14.6	16.7
.75	2.1	4.3	6.5	8.6	10.8	12.9	15.1	17.3
.80	2.2	4.5	6.7	8.9	11.1	13.4	15.6	17.8
.85	2.2	4.6	6.9	9.2	11.5	13.8	16.1	18.4
.90	2.3	4.7	7.1	9.5	11.8	14.2	16.6	18.9
.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 VII
DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE
3 FEET IN WIDTH

HEAD IN FEET	NET GATE OPENING 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
.02	.4	.8	1.3	1.7	2.1	2.5	3.0	3.4	3.8	4.2	5.3	6.4
.04	.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	7.4	8.9
.06	.7	1.4	2.2	2.9	3.6	4.4	5.1	5.8	6.6	7.3	9.1	10.9
.08	.8	1.7	2.5	3.4	4.2	5.1	5.9	6.8	7.6	8.4	10.6	12.7
.10	.9	1.9	2.8	3.8	4.7	5.6	6.6	7.5	8.5	9.4	11.8	14.1
.12	1.0	2.0	3.1	4.1	5.2	6.2	7.2	8.3	9.3	10.3	12.9	15.5
.14	1.1	2.2	3.4	4.5	5.6	6.7	7.8	8.9	10.0	11.2	13.9	16.7
.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
.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
.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
.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
.24	1.4	2.9	4.4	5.9	7.3	8.8	10.2	11.7	13.2	14.6	18.3	21.9
.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
.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
.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
.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
.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
.36	1.8	3.6	5.4	7.2	8.9	10.7	12.5	14.3	16.1	17.9	22.4	26.8
.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
.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
.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
.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
.55	2.2	4.4	6.7	8.9	11.1	13.3	15.5	17.7	19.9	22.1	27.7	33.2
.60	2.3	4.6	7.0	9.3	11.5	13.8	16.1	18.5	20.8	23.1	28.8	34.7
.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
.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
.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
.80	2.6	5.3	8.0	10.7	13.4	16.0	18.7	21.4	24.1	26.7	33.4	40.1
.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
.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
.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	25.1	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	28.8	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 VIII
DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE
3.5 FEET IN WIDTH

BOWHAY

HEAD IN FEET	NET GATE OPENING IN FEET AND TENTHS OF FEET									
	.2	.4	.6	.8	1.0	1.5	2.0	2.5	3.0	3.5
	SECOND FEET									
.02	.5	1.0	1.5	2.0	2.5	3.7	4.9	6.1	7.4	8.6
.04	.7	1.4	2.1	2.8	3.5	5.2	7.0	8.7	10.4	12.2
.06	.8	1.7	2.5	3.4	4.2	6.4	8.5	10.6	12.7	14.9
.08	1.0	2.0	2.9	3.9	4.9	7.4	9.8	12.2	14.7	17.2
.10	1.1	2.2	3.3	4.4	5.5	8.3	11.0	13.7	16.5	19.3
.12	1.2	2.4	3.6	4.8	6.0	9.0	12.0	15.1	18.1	21.1
.14	1.3	2.6	3.9	5.2	6.5	9.7	13.0	16.2	19.5	22.8
.16	1.4	2.8	4.2	5.6	7.0	10.4	13.9	17.4	20.9	24.4
.18	1.5	2.9	4.4	5.9	7.4	11.1	14.7	18.5	22.1	25.8
.20	1.6	3.1	4.7	6.2	7.8	11.7	15.6	19.5	23.4	27.2
.22	1.6	3.3	4.9	6.5	8.2	12.2	16.3	20.4	24.4	28.5
.24	1.7	3.4	5.1	6.8	8.5	12.8	17.1	21.4	25.6	29.8
.26	1.8	3.6	5.3	7.1	8.9	13.3	17.8	22.2	26.6	31.1
.28	1.8	3.7	5.5	7.3	9.2	13.8	18.4	23.0	27.6	32.2
.30	1.9	3.8	5.7	7.6	9.5	14.2	19.0	23.8	28.5	33.2
.32	2.0	3.9	5.9	7.8	9.8	14.7	19.7	24.6	29.5	34.4
.34	2.0	4.1	6.1	8.1	10.1	15.2	20.3	25.4	30.4	35.5
.36	2.1	4.2	6.3	8.4	10.5	15.7	20.9	26.2	31.4	36.6
.38	2.1	4.3	6.4	8.6	10.7	16.1	21.4	26.8	32.2	37.5
.40	2.2	4.4	6.6	8.8	11.0	16.5	22.0	27.5	33.0	38.4
.45	2.3	4.7	7.0	9.3	11.7	17.5	23.3	29.2	35.0	40.8
.50	2.5	4.9	7.4	9.9	12.3	18.4	24.6	30.7	36.8	43.0
.55	2.6	5.2	7.7	10.3	12.9	19.3	25.8	32.2	38.6	45.1
.60	2.7	5.3	8.1	10.7	13.5	20.2	26.9	33.6	40.4	47.1
.65	2.8	5.6	8.4	11.2	14.0	21.0	28.0	35.0	42.1	49.0
.70	2.9	5.8	8.7	11.6	14.6	21.8	29.1	36.4	43.7	50.9
.75	3.0	6.0	9.0	12.0	15.1	22.6	30.1	37.6	45.2	52.7
.80	3.1	6.2	9.3	12.4	15.5	23.3	31.1	38.8	46.6	54.4
.85	3.2	6.4	9.6	12.8	16.1	24.1	32.1	40.0	48.1	56.1
.90	3.3	6.6	9.9	13.2	16.5	24.8	33.0	41.2	49.5	58.0

TABLE IX
DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE
4 FEET IN WIDTH

HEAD IN FEET	NET GATE OPENING IN FEET AND TENTHS OF FEET										
	.2	.4	.6	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0
	SECOND FEET										
.02	.55	1.15	1.70	2.25	2.85	4.20	5.60	7.00	8.40	9.80	11.30
.04	.80	1.60	2.40	3.20	4.00	5.95	8.00	9.95	11.90	13.95	15.90
.06	.95	1.95	2.90	3.90	4.80	7.30	9.70	12.15	14.55	17.00	19.50
.08	1.15	2.25	3.35	4.45	5.60	8.45	11.20	14.00	16.80	19.60	22.50
.10	1.25	2.50	3.75	5.05	6.30	9.45	12.60	15.70	18.85	22.05	25.10
.12	1.35	2.75	4.10	5.50	6.85	10.30	13.75	17.25	20.65	24.10	27.50
.14	1.50	2.95	4.45	5.95	7.45	11.10	14.85	18.55	22.30	26.00	29.70
.16	1.60	3.20	4.80	6.40	8.00	11.90	15.90	19.80	23.85	27.85	31.80
.18	1.70	3.35	5.05	6.75	8.45	12.65	16.80	21.10	25.25	29.50	33.70
.20	1.80	3.55	5.35	7.10	8.90	13.35	17.80	22.30	26.70	31.10	35.50
.22	1.85	3.75	5.60	7.45	9.35	13.95	18.65	23.30	27.90	32.55	37.30
.24	1.95	3.90	5.85	7.75	9.75	14.60	19.55	24.40	29.25	34.10	38.90
.26	2.05	4.10	6.05	8.10	10.15	15.20	20.30	25.40	30.40	35.55	40.50
.28	2.10	4.25	6.30	8.40	10.50	15.75	21.05	26.30	31.50	37.05	42.00
.30	2.15	4.35	6.50	8.70	10.85	16.25	21.75	27.20	32.60	38.00	43.50
.32	2.25	4.45	6.75	8.95	11.25	16.85	22.55	28.10	33.70	39.35	45.00
.34	2.30	4.65	6.95	9.25	11.55	17.35	23.20	29.00	34.75	40.55	46.40
.36	2.40	4.80	7.15	9.55	11.95	17.90	23.90	29.90	35.85	41.80	47.80
.38	2.50	4.90	7.30	9.80	12.25	18.35	24.50	30.60	36.75	42.95	49.00
.40	2.55	5.00	7.50	10.05	12.70	18.85	25.15	31.40	37.70	43.90	50.40
.45	2.65	5.35	8.00	10.65	13.35	19.95	26.65	33.35	40.00	46.65	53.30
.50	2.85	5.60	8.40	11.25	14.05	21.00	28.10	35.35	42.10	49.15	56.20
.55	2.95	5.90	8.75	11.80	14.75	22.05	29.50	36.85	44.15	51.55	59.00
.60	3.10	6.10	9.25	11.90	15.45	23.10	30.80	38.45	46.15	53.85	61.60
.65	3.20	6.40	9.60	12.80	16.00	24.00	32.00	40.00	48.05	56.00	64.10
.70	3.30	6.65	9.95	13.30	16.65	24.90	33.25	41.55	49.85	58.15	66.60
.75	3.45	6.85	10.30	13.75	17.25	25.80	34.45	43.00	51.60	60.20	68.90
.80	3.55	7.10	10.65	14.20	17.75	26.65	35.55	44.40	53.30	62.15	71.20
.85	3.65	7.30	11.00	14.65	18.35	27.55	36.70	45.80	54.95	64.15	73.30
.90	3.75	7.55	11.30	15.10	18.85	28.35	37.75	47.15	56.60	66.20	75.50
.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 X

DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE 4.5 FEET IN WIDTH

CAREY-HUNTER

Head in Feet	NET GATE OPENING 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
	SECOND FEET											
.02	.6	1.3	1.9	2.5	3.2	4.7	6.3	7.9	9.5	11.0	12.6	14.4
.04	.9	1.8	2.7	3.6	4.5	6.7	9.0	11.2	13.4	15.7	17.9	20.4
.06	1.1	2.2	3.3	4.4	5.4	8.2	10.9	13.7	16.4	19.1	21.8	24.8
.08	1.3	2.5	3.8	5.0	6.3	9.5	12.6	15.8	18.9	22.0	25.2	28.7
.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
.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
.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
.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
.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
.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
.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
.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
.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
.28	2.4	4.8	7.1	9.5	11.8	17.7	23.7	29.6	35.4	41.9	47.2	53.8
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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 XI

DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE

6 FEET IN WIDTH

HEAD IN FEET	NET GATE OPENING 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														
.02	.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
.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
.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
.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
.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
.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
.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
.16	2.4	4.8	7.2	9.6	11.9	17.9	24.1	29.8	35.9	42.1	47.8	53.9	59.7	65.8	71.6
.18	2.5	5.1	7.6	10.1	12.6	19.0	25.5	31.6	38.1	44.5	50.7	57.1	63.2	69.7	75.8
.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
.22	2.8	5.6	8.4	11.2	14.0	21.0	28.2	35.0	42.1	49.2	56.0	63.2	69.9	77.1	83.8
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.50	4.2	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
.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
.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
.65	4.8	9.6	14.4	19.3	24.0	36.0	48.4	60.1	72.4	84.6	96.3	108.5	120.2	132.4	144.1
.70	5.0	10.0	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
.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
.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
.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
.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
.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	19.2	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 XII

DISCHARGE IN SECOND FEET FOR ADJUSTABLE RECTANGULAR SUBMERGED ORIFICE

MONSON

16 FEET IN WIDTH

HEAD IN FEET	NET GATE OPENING 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
	SECOND FEET													
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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
.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

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1999 Report

Artificial Groundwater Recharge

in the

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1.0 Introduction

1.1 Objective

In the past, the great water projects of the State and Federal Governments were considered to be a panacea, and it appeared that the water needs of this area would be met well into the next century by supplementing the area's own water supplies with surface water imported form northern California. The reality is that although those projects did indeed fulfill a great need, their expansion is virtually halted for now, and in today's climate of economic, environmental, and political concerns, there is no guarantee that they will move ahead anytime soon.

Consequently, because the supply of surface water is finite and the demand for water is increasing, the deficit is being met by extracting more and more water from the groundwater supply by pumping. Because this source is also finite, many areas are suffering an overdraft of the groundwater supply as a result of this pumping. The overdraft, with its attendant increased depth to the water table, makes it necessary to deepen existing wells and to construct new wells, both of which are expensive in capital outlay and increased energy costs.

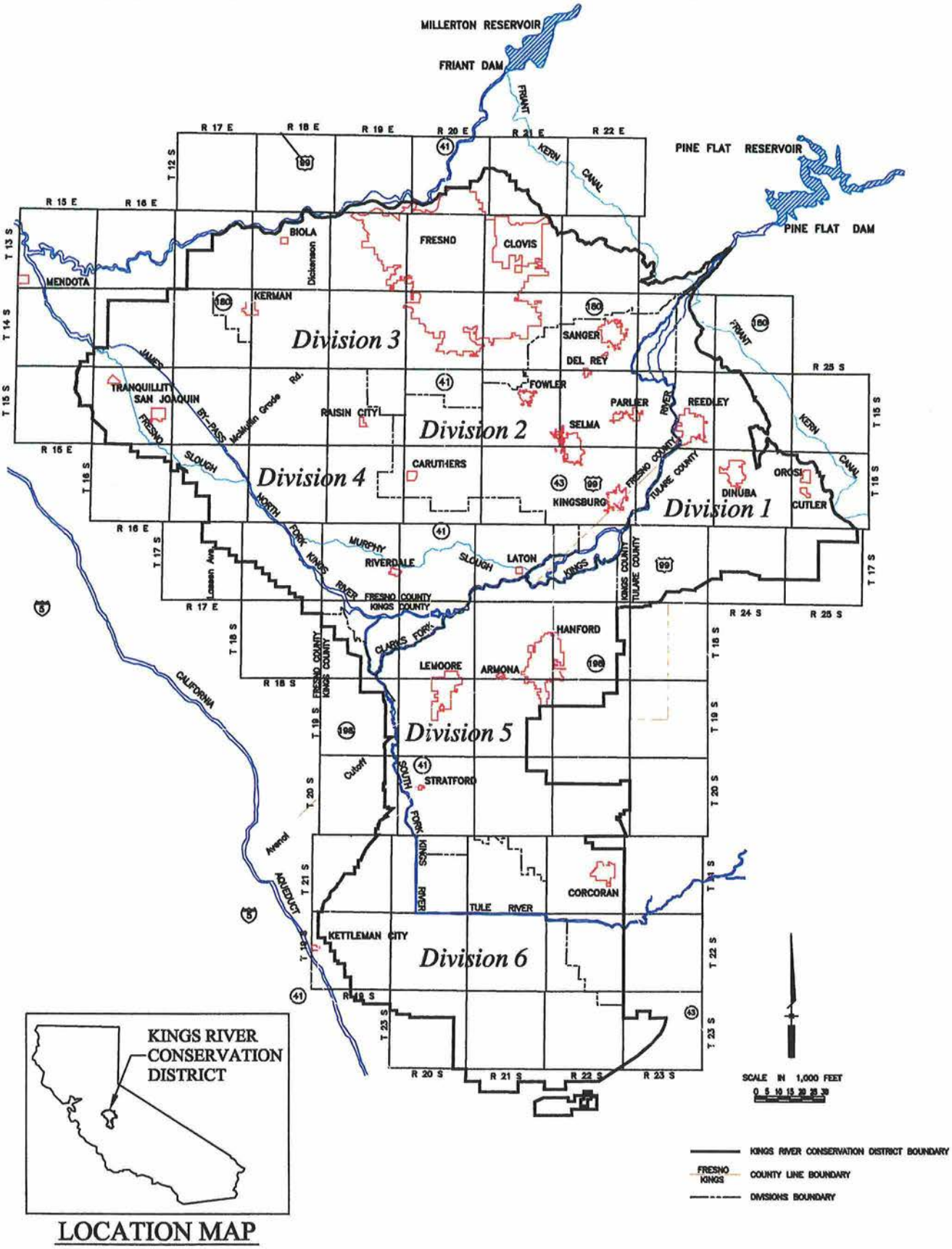
Many of the water management agencies within the Kings River service area are taking deliberate action to alleviate the problems caused by groundwater overdraft. Among the limited courses of action which they may take is one which was first conducted in California before the turn of the century, namely artificial groundwater recharge. In December 1989, in order to promote the development of additional groundwater recharge, the Kings River Conservation District Board of Directors adopted a policy providing for joint development of groundwater recharge facilities in cooperation with other agricultural water agencies within the Kings River Conservation District. The Kings River Conservation District offers technical and financial assistance in evaluating and developing recharge sites. In its policy statement, the term "groundwater recharge facilities" or "recharge site" includes facilities for the regulation of each agency's water delivery system either independent of or in conjunction with a groundwater recharge facility.

This report has been prepared by the staff of the Kings River Conservation District for the purpose of describing the programs being conducted by various public entities within and adjacent to the boundaries of the Kings River service area in regard to artificial groundwater recharge.

1.2 Geographical Area Included In Report

This report includes the entire Kings River service area, encompassing approximately 1.1 million acres of land in the central San Joaquin Valley of the State of California. The service area receives its surface water supply primarily from the Kings River. The service area lies partly in three counties – Fresno, Kings and Tulare. The entire service area lies within the boundaries of the Kings River Conservation District (KRCD).

At the time of its formation, KRCD's boundaries coincided with those of the service area. Then, in 1989, KRCD annexed approximately 140,000 acres of land which has no permanent surface water supply. This area suffers from a groundwater overdraft due to pumping. The purpose of the annexation was to allow KRCD to address the overdraft. This brought the total area of KRCD to approximately 1.24 million acres. The map on **Figure 1** shows the boundaries of the KRCD, including the six divisions into which KRCD is divided (Division 4 includes the annexation area).



KINGS RIVER CONSERVATION DISTRICT
BOUNDARY AND DIVISIONS

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 1

1.3 Formation of the Kings River Conservation District

The Kings River Conservation District is a political subdivision of the state created by the California Legislature in 1951 by passage of the "Kings River Conservation District Act". The principal reason for the formation was the need for one public agency to act on behalf of the entire Kings River service area.

There were three reasons why establishment of the Kings River Conservation District was so critically important:

1. An overall public district was needed to safeguard local water rights for the entire service area.
2. An overall public district was needed to negotiate and contract with the United States for the use of storage space in Pine Flat Reservoir for irrigation purposes.
3. An overall public district was needed with the ability to plan, finance, construct and operate hydroelectric power plants on the Kings River.

1.4 Participating Agencies

The following agencies within the Kings River service area are conducting, planning, or cooperating in artificial groundwater recharge programs and have participated in the preparation of this report by providing information on their respective programs:

Alta Irrigation District
City of Clovis
City of Fresno
Consolidated Irrigation District
Fresno Irrigation District
Fresno Metropolitan Flood Control District
Kings County Water District
Lakeside Irrigation Water District
Riverdale Irrigation District

These participating agencies represent a land area within the KRCD boundaries of 619,000 acres, or 50 percent of the total land area of the KRCD. In addition, Kaweah Delta Water Conservation District's active recharge program has also been included in this report due to the fact that a portion of its area overlaps a portion of the eastern area of KRCD.

1.5 Glossary

The following definitions are provided in order to acquaint the readers of this report with the various terms and phrases used in connection with groundwater management and studies:

Acre-Foot. The amount of water required to cover one acre of land to a depth of one foot.

Applied water requirements. The amount of water that must be developed or delivered to the place of use. This includes the water transpired by vegetation, evaporated from the ground surface, applied to leach salts from the root zone, and deeply percolated, and any surface runoff as tailwater or return flow.

Aquifer. A geologic formation that stores, transmits and yields significant amounts of water.

Artificial recharge. The intentional percolation of water through stream channels, canals, basins, wells, and fields for the purpose of replenishing the groundwater supply.

Basin. A naturally or artificially created space or structure on or beneath the surface capable of storing water.

Class A pan. An open container of water built to rigid specifications and used to accurately measure the rate of evaporation of water to the air.

Cone of depression. The inverted conical pattern created in an aquifer when an operating well dewaters the aquifer around it.

Conjunctive use. A term used to describe operation of a groundwater basin in coordination with a surface water

reservoir system. The purpose is to artificially recharge the basin during years of above-average precipitation so that water can be withdrawn during years of below-average precipitation when surface supplies are below normal.

Consumptive use. The amount of available water transpired by the crop and evaporated from foliage and adjacent soil.

Drought. A long period of abnormally low rainfall.

Entitlement water. Federal Central Valley Project water or State Water Project water that is made available for delivery to contractors in annual amounts designated in water delivery contracts. Contractors pay for this water whether or not they use it.

Evapotranspiration. The total water loss from the soil, including loss by direct evaporation and by transpiration from the surface of plants.

Groundwater. Water found beneath the surface of the earth occupying voids in the rock and soil strata.

Groundwater management. A program purposely devised for the utilization of the groundwater resources to achieve desired physical or economic objectives.

Imported water. Surface water brought in from another hydrologic basin.

Incidental recharge. Artificial recharge that occurs as a by-product of irrigation applications, infiltration from sewage effluent spreading grounds and septic tank leach fields, seepage from man-made reservoirs, canals drainage ditches and ponds, or deep-well injection of waste water.

Intentional recharge. Artificial recharge due to the introduction of uncontaminated water into naturally occurring groundwater through planned systems such as spreading grounds, infiltration ponds, and recharge wells with the express intent of supplementing the volume and /or improving the quality of the groundwater.

Natural recharge. Recharge of the groundwater reservoir by deep percolation of precipitation, seepage from streams and lakes, and subsurface flow between hydraulically connected aquifers.

Overdraft. The temporary condition of a groundwater basin where the amount of water withdrawn by pumping exceeds the amount of water replenishing the basin over a period of time.

Percolation. The flow of water through the soil along the line of least resistance and under the force of gravity to the water table.

Permeability. The capability of soil or other geological formations to transmit water.

Recharge. The downward flow of water to the water table through the soil overlying an aquifer. Recharge occurs both naturally and artificially.

Subsidence. The general lowering in elevation of an area of land surface, due to any of several process. In the San Joaquin Valley, the principal cause is the compression of soil layers due to declining groundwater levels.

Subsurface inflow. Groundwater flowing into an underground basin.

Subsurface movement. Water movement underneath the earth's surface.

Subsurface outflow. Groundwater flowing out of an underground basin.

Surface supply. Water in reservoirs, lakes, rivers, streams or other channels which has not been extracted from the groundwater table.

Surplus water. The amount of State or Federal project water available in a given year in excess of contractual requirements. The amount varies from year to year, but in general, more water is available in wet years and less is available in dry years.

Urban. All populated areas, incorporated and rural, comprising residential, commercial and industrial uses.

Water table. The upper surface where groundwater is encountered in a well or in an unconfined aquifer.

Water year. A one year cycle, commonly beginning October 1st and ending September 31st.

1.6 Acknowledgments

The staff of the Kings River Conservation District gratefully acknowledges the cooperation of the following individuals and the members of their staffs who took time to furnish the information necessary for preparation of this report:

Mr. Chris Kapheim, Manager,
Alta Irrigation District

Mr. Cecil Leonardo, Director, Public Utilities,
City of Clovis

Mr. Martin McIntyre, Water Systems Manager,
Water Division, City of Fresno

Mr. Eugene J. Branch, Manager,
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Mr. Robert B. Mount, Manager,
Fresno Irrigation District

Mr. Doug Harrison, Manager,
Fresno Metropolitan Flood Control District

Mr. Bruce George, Manager,
Kaweah Delta Water Conservation District

Mr. Don Mills, Manager,
Kings County Water District

Mr. Ken Cartwright, Manager,
Lakeside Irrigation Water District

Mr. Frank Thomas, Manager,
Riverdale Irrigation District

Mr. Douglas Woodman, Watermaster,
Kings River Water Association

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2.0 The Kings River Service Area

2.1 Land Use

According to land use surveys conducted by the California Department of Water Resources in 1991, 1992 and 1994, the land within the Kings River service area is being utilized as follows:

Land Use	Acres
Irrigated crops	987,050
Fallow and idle (irrigable)	89,971
Non-irrigated crops and fallow	6
Farmsteads, feedlots, dairies	18,983
Native vegetation	91,775
Municipal and industrial	125,950
Parks, cemeteries, golf courses	5,950
Total Acres	1,319,685

These statistics indicate that approximately 10.0 percent (131,900 acres) of the Kings River service area is being used for urban purposes. The major population centers are the cities of Fresno, Clovis, Kerman, Sanger, Reedley, Dinuba, Orosi, Cutler, Fowler, Selma, Kingsburg, Hanford, Lemoore, Armona and Corcoran.

Approximately 6.9 percent (91,775 acres) is undeveloped. A portion of this land may be used as non-irrigated pasture.

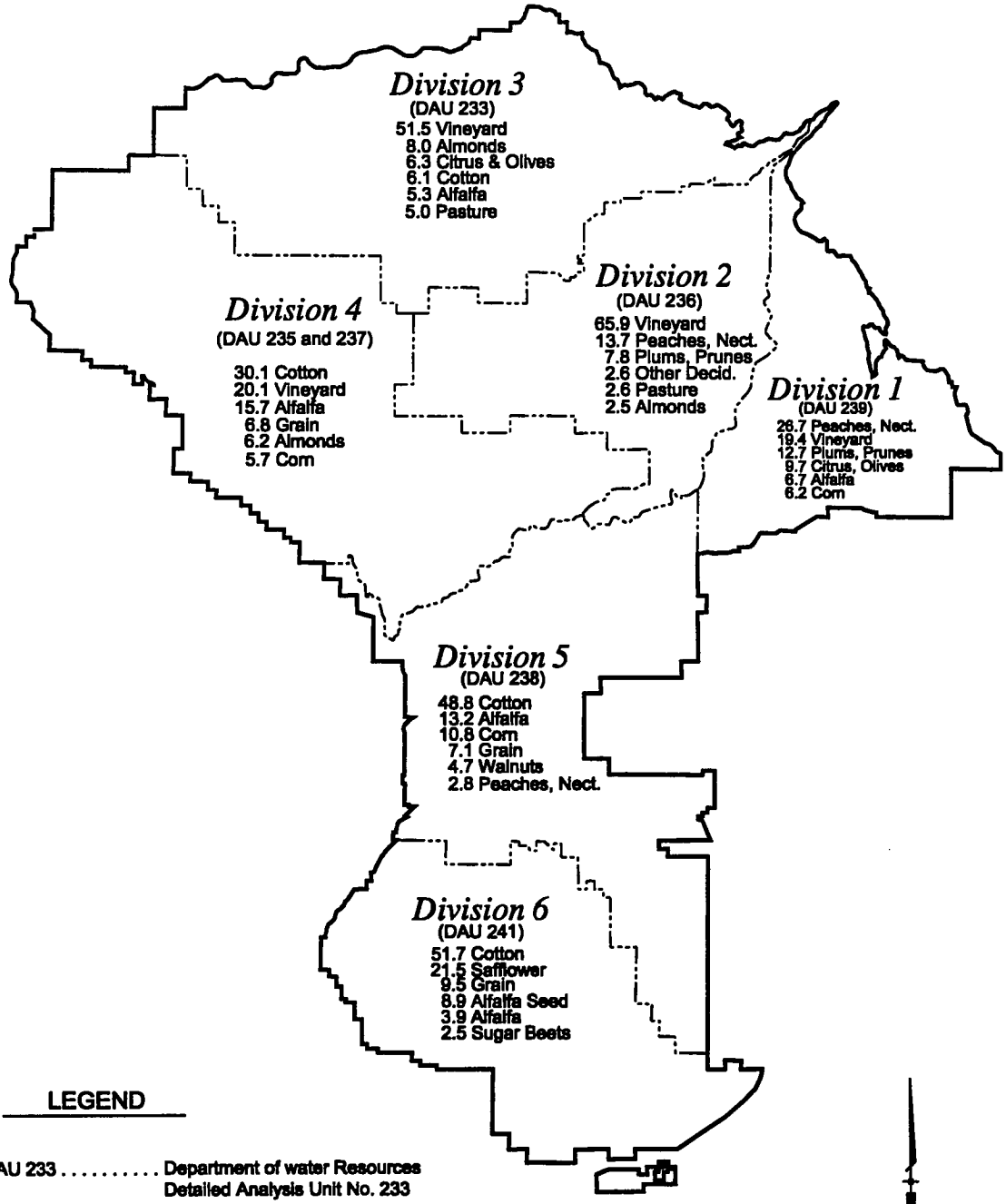
The remaining land (83.1 percent or 1,096,010 acres) is devoted to agriculture, including irrigated and non-irrigated crop production, fallow but irrigable land, farmsteads, feedlots and dairies.

Because of the generally moderate climate and excellent soil conditions which exist throughout most of the Kings River service area, agricultural development is extensive and varied with about thirty types of crops being produced making this one of the top agricultural production areas in the nation. Due to the relatively large size of the Kings River service area, the conditions which affect crop development and production, such as climate, soil type, and availability of water, vary significantly enough to affect the locations of the various types of crops. **Figure 2** shows the percentages of the major crops within each of the six divisions of KRCD. **Table 1** gives a detailed breakdown of all the crops grown within each division according to the latest land use survey conducted by the Department of Water Resources. The values in the table are rounded to the nearest 100 acres and include 2,378 acres of double cropping, resulting in a total area greater than that given for irrigated crops in the preceding table.

A review of the data in Table 1 reveals that in the northern end of the Kings River service area (Divisions 1, 2 and 3 of the Kings River Conservation District), vineyards constitute almost half of the crops, followed by deciduous fruit and nut trees at about 27.7 percent, and field crops at about 8.8 percent of the total crop acreage. The bulk of the remaining crops are alfalfa, pasture, citrus and olives.

To the west, in Division 4, field crops constitute 46.1 percent of the total, with cotton as the predominant field crop at 30.1 percent. Vineyards, which were predominant in Divisions 1, 2 and 3 comprise only 20.1 percent of the crop acreage in Division 4. Alfalfa and alfalfa seed comprise the majority of the remaining acreage while deciduous fruit and nut trees, pasture, and truck crops make up the remainder.

In the southern half of KRCD (Divisions 5 and 6), field crops constitute 79.6 percent of the total crop acreage, with cotton again being predominant at about 50.6 percent. Safflower makes up about 13.7 percent, with the remaining 6.7 percent devoted to pasture, alfalfa, alfalfa seed, tomatoes, and vineyards. Deciduous fruit and nut trees are found only in Division 5.



LEGEND

DAU 233 ..... Department of water Resources
Detailed Analysis Unit No. 233

51.5 Vineyard ..... Percentage of Cropping Area
Devoted to a Particular Crop
Based on Department of Water
Resources Land Use Surveys
Conducted in 1991, 1992 and 1994.

SCALE IN 1,000 FEET
0 5 10 15 20 25 30

KINGS RIVER CONSERVATION DISTRICT BOUNDARY

DIVISIONS BOUNDARY

KINGS RIVER CONSERVATION DISTRICT
CROPPING PATTERNS

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 2

Table 1

KINGS RIVER SERVICE AREA CROPPING PATTERNS
(acres)

KRCD DIVISION	1	2	3	4	5	6
Detailed Analysis Unit	239	236	233	235+237	238	241
CROP						
Field Crops						
Grain	4,819	796	2,509	18,526	8,652	18,097
Rice	0	0	0	0	0	0
Cotton	6,086	917	9,168	81,926	59,038	98,595
Safflower	0	0	0	3,468	1,593	41,051
Sugar Beets	27	0	0	2,905	934	4,805
Corn	6,711	512	3,166	15,531	13,040	1,047
Grain Sorgham	0	0	0	0	0	0
Dry Beans	0	206	257	663	0	0
Milo	0	0	0	0	0	0
All Other Field Crops	166	62	40	2,459	948	59
Truck Crops						
Melons	8	194	202	1,085	151	0
Tomatoes	0	2	0	3,838	3,174	1,157
Onions and Garlic	0	94	75	1,916	0	0
Cauliflower	573	0	0	0	0	0
Lettuce	0	10	263	154	0	0
All Other Truck Crops	958	1,023	6,235	878	599	1,024
Alfalfa	7,259	1,727	8,034	42,816	15,948	7,526
Alfalfa Seed	0	0	0	8,895	0	16,957
Pasture	3,336	3,759	7,552	2,546	2,620	421
Deciduous Fruit and Nuts						
Peaches/Nectarines	28,866	19,805	4,632	6,101	3,449	0
Plums/Prunes	13,742	11,259	3,812	3,743	1,678	0
Figs	0	0	3,311	0	0	0
Almonds	1,205	3,643	11,948	16,927	589	0
Walnuts	184	361	0	568	5,724	0
Pistachios	91	0	0	13	97	0
All Other Deciduous	2,793	3,828	2,117	4,396	565	0
Citrus and Olives	10,466	1,122	9,521	97	245	0
All Other Subtropical	204	0	0	0	0	0
Vineyard	21,037	95,387	77,321	54,774	2,019	0
Sub-Total	108,531	144,707	150,163	274,225	121,063	190,739
Double Crop	259	0	50	1,828	78	163
Total	108,272	144,707	150,113	272,397	120,985	190,576
Irrigated Fallow and Idle	4,946	6,422	12,006	16,975	15,825	33,797
Non-irrigated Grain and Fallow	0	0	0	6	0	0
Farmsteads, Feedlots and Dairies	2,637	2,413	3,852	4,760	4,733	588
Parks, Cemeteries and Golf Courses	845	674	1,852	2,579	0	0
Urban	8,645	13,092	83,048	6,426	11,293	3,446
Native Vegetation	8,330	7,480	12,463	16,770	16,287	30,445
TOTAL	133,675	174,788	263,334	319,913	169,123	258,852

2.2 Water Use

Water is presently used within the Kings River service area to satisfy the needs of both urban and agricultural users, with agriculture using an estimated 95 percent of the total. The total amount of water usage normally exceeds local surface supplies, which results in recurring patterns of overdrafting of available groundwater reserves and importation of new water to supplement the local surface water supplies.

An estimate of the total requirement for all agricultural users within the Kings River service area was made for the years 1991, 1992 and 1994 by the California Department of Water Resources. This estimate, based on the Department's land use survey and a theoretical water requirement for each crop variety, indicates a total applied water requirement of 3,027,600 acre-feet and total evapotranspiration of 1,888,000 acre-feet. This water would have come from all sources, including surface water from local rivers and streams, imported water, precipitation, and groundwater.

The participating agencies that are listed in Chapter 1 have reported estimated surface water deliveries for the water year 1997-98 based upon their records, and the estimated groundwater extractions. These quantities are included in **Table 2**.

Table 2

WATER USE BY PARTICIPATING AGENCIES WITHIN THE KINGS RIVER SERVICE AREA FOR WATER YEAR 1997-98

Agency	Estimated Annual Surface Water Deliveries (Acre-Feet)	Estimated Annual Groundwater Extractions (Acre-Feet)
Alta Irrigation District	170,515	230,000
City of Clovis	6,000	17,710
City of Fresno	16,063	148,669
Consolidated Irrigation District	293,000	300,000
Fresno Irrigation District	423,800	165,000
Fresno Metropolitan Flood Control District	40,180	0
Kaweah Delta Water Conservation District	277,000	713,000
Kings County Water District	150,000	282,500
Lakeside Irrigation Water District	40,000	40,000
Riverdale Irrigation District	29,000	22,000
Totals	1,445,558	1,918,879
Percent of Total	43	57

2.3 Climate and Hydrology

The Kings River service area is characterized by hot, dry summers with high temperatures reaching 115 degrees Fahrenheit, and moderate winters with temperatures dipping to 17 degrees Fahrenheit. In the mountain watershed at elevation 6,700 feet, the summer high temperature can reach 94 degrees Fahrenheit and the winter low can dip to minus 18 degrees Fahrenheit.

Precipitation averages approximately 11 inches annually (based on National Weather Service 50-year average for Fresno); however, in the Sierra Nevada watershed, the annual precipitation may be as high as 60 inches. About 90 percent of the runoff-producing precipitation occurs during the months of November through April.

Precipitation usually occurs as rain at elevations below 4,000 feet and as snow at higher elevations. The snowpack that accumulates during the winter and early spring normally begins melting in April, and by the end of July, 95 percent of the average annual runoff has occurred.

Total annual evaporation from Class A pans ranges from about 100 inches on the valley floor to about 60 or 70 inches at 2,500 feet. About two-thirds of the annual evaporation occurs during the months of June through October. Monthly evaporation losses during the winter is generally less than 2 inches, but in a typical summer month, losses may reach as high as 18 inches. The higher humidity associated with large irrigated areas may result in somewhat lower rates of evaporation in such areas. Evaporation from lakes is about 75 percent of that from Class A pans.

2.4 Available Water Supplies

The water resources available for use in the Kings River service area consist of runoff in major and minor local streams from the mountains and foothills to the east, imported water diverted from the Sacramento-San Joaquin Delta to the north, direct precipitation and groundwater.

The primary source of surface water for the Kings River service area is the Kings River, which supplies an average of 1.7 million acre-feet annually, or about 79 percent of the total supply entering the service area. The Kaweah and Tule Rivers contribute about 34,000 acre-feet annually, and minor streams contribute about 10,000 acre-feet annually. The importation of Federal Central Valley Project water, which originates in the San Joaquin River and enters the service area through the Friant-Kern Canal, contributes about 175,000 acre-feet annually.

The Kings River drains an area of 1,694 square miles above the community of Piedra, which has an approximate elevation of 500 feet and is near the juncture where the river exits the foothills of the Sierra Nevada and enters the San Joaquin Valley. The watershed is extremely steep and rough with some of the highest elevations in the 48 contiguous states. About 71 percent of the drainage area is above 5,000 feet. Runoff from rainfall occurs very rapidly, as 22 percent of the watershed is at an elevation of 10,000 feet or more and consists of surfaces of granite made bare by glacial action. Runoff is characteristic of a snow melt watershed, that is, while most of the precipitation in the drainage area in the form of snow occurs during the months of December to April, a large portion of the runoff from the melting snow occurs after April, continuing into July and even to August in some years.

After reaching the valley floor, the Kings River main channel rides the ridge of its large alluvial fan, moving southwesterly to a point about 6 miles north of the town of Lemoore. At this point, the Kings River divides, with one branch going straight south into Tulare Lake, and the other branch heading northwest until it intercepts the San Joaquin River near the town of Mendota.

The Kings River is controlled by Pine Flat Dam, located approximately 26 miles east of Fresno. Pine Flat Dam was constructed by the Corps of Engineers in 1954, primarily as a flood control project. The Kings River is also controlled by two other dams upstream of Pine Flat Dam which were constructed by Pacific Gas and Electric Company for power generation purposes.

The Kaweah River drains an area of 561 square miles of the Sierra Nevada. The headwaters are at elevations of up to 12,600 feet, with 61 percent of the drainage area lying at elevations over 5,000 feet. Runoff is characteristic of a snowmelt stream. Below the foothills, the river divides into several distributaries which cross the alluvial fan in a westerly and southwesterly direction and terminate in Tulare Lake. The Kaweah River is controlled by Terminous Dam, located approximately 17

miles northeast of the City of Visalia in Tulare County. The dam was completed by the Corps of Engineers in 1962 primarily for flood control and secondarily for irrigation control. The average annual runoff of the river is about 404,000 acre-feet, 15,000 acre-feet of which enters the Kings River service area.

The Tule River has a water shed of 390 square miles, with headwaters rising to an elevation of about 9,500 feet. About 34 percent of the drainage area is above 5,000 feet. The river has an alluvial fan similar to those of the Kings and Kaweah Rivers, with distributaries crossing it in a westerly direction and terminating in Tulare Lake. The river is controlled by Success Dam, located about 5 miles east of the city of Porterville. The dam was completed by the Corps of Engineers in 1961 primarily for flood control and secondarily for irrigation control. The average annual runoff of the river is approximately 136,000 acre-feet, with about 19,000 acre-feet entering the service area.

There are minor east-side streams that drain the foothills between the major rivers. Some of these streams become tributaries of the major rivers under high flow conditions but generally disappear on the valley floor.

Average annual precipitation within the service area varies from about 5 inches near the southern end of the area to about 14 inches near the base of the Sierra Nevada foothills, with wide variation between wet and dry years. The precipitation contributes some to soil moisture for plant growth but contributes essentially nothing to groundwater.

The estimated groundwater storage capacity underlying the Kings River service area is 26,630,000 acre-feet in the uppermost 200 feet of sediments. Percolation from stream channels, reservoirs, recharge basins and applied irrigation water contribute to the groundwater supply.

2.5 Geology

The Kings River service area contains unconsolidated alluvial deposits underlain by thick sequences of sedimentary rocks of Jurassic to Recent age that rest on a basement floor of metamorphic and igneous rock. These basement rocks, which are exposed in the adjoining Sierra Nevada, are composed chiefly of Paleozoic and Mesozoic metasedimentary and metavolcanic rock, as well as Jurassic and Cretaceous age granites.

The topography of the Kings River watershed in the Sierra Nevada is rugged, with elevations ranging from 600 feet to 14,000 feet above sea level. At the higher elevations, particularly above 8,000 feet, glacial-derived features are slightly modified by recent stream erosion.

The watershed is within a complex geologic area containing metamorphosed sedimentary and volcanic rocks that have been folded, faulted and intruded by granitic rocks of three different ages. In addition, volcanism and, later glaciation have modified the topography to essentially the present-day landscape. Major geologic structures trend to the northwest. Bedding and foliation of the rock typically strike northerly and dip steeply west. Fractures and joints are prominent features. The degree of weathering is variable, depending on rock type and jointing, and is known to penetrate to considerable depth along fractures in phyllites and schists.

No major fault zones are known to exist within the watershed. The closest major faults are the Independence and Owens Valley faults east of the Sierra Nevada divide. An unnamed fault has been plotted for a relatively short distance on the Fresno Geologic quadrangle map. This fault trends northwest and parallels the base of the foothills near Piedra. The seismic history of the area indicated a general absence of both earthquake epicenters and large-intensity shocks due to tremors.

3.0 Groundwater Recharge Programs

This chapter provides brief background information for each of the participating agencies listed in Chapter 1. Pertinent information regarding the groundwater recharge program that each agency is planning, conducting or cooperating in is also included in this chapter.

3.1 Alta Irrigation District

Alta Irrigation District was formed by election on August 14, 1888 under the provisions of the Irrigation District (Wright) Act and is a successor to the pioneer '76 Land and Water Company formed on June 7, 1882. The District's purpose is to acquire existing canal and irrigation companies and to manage the canal systems on behalf of the community as a whole.

The District is located in the east central part of the service area as shown in **Figure 3**, and its boundary coincides, for the most part, with Division 1 of KRCD. The total area of the District is approximately 129,300 acres, consisting of about 33,000 acres in the southeast part of Fresno County, 3,700 acres in the northeast part of Kings County, and 92,600 acres in the northwest corner of Tulare County.

The District owns and operates several recharge basins which are used in their artificial groundwater recharge program. Descriptions of those recharge basins are as follows:

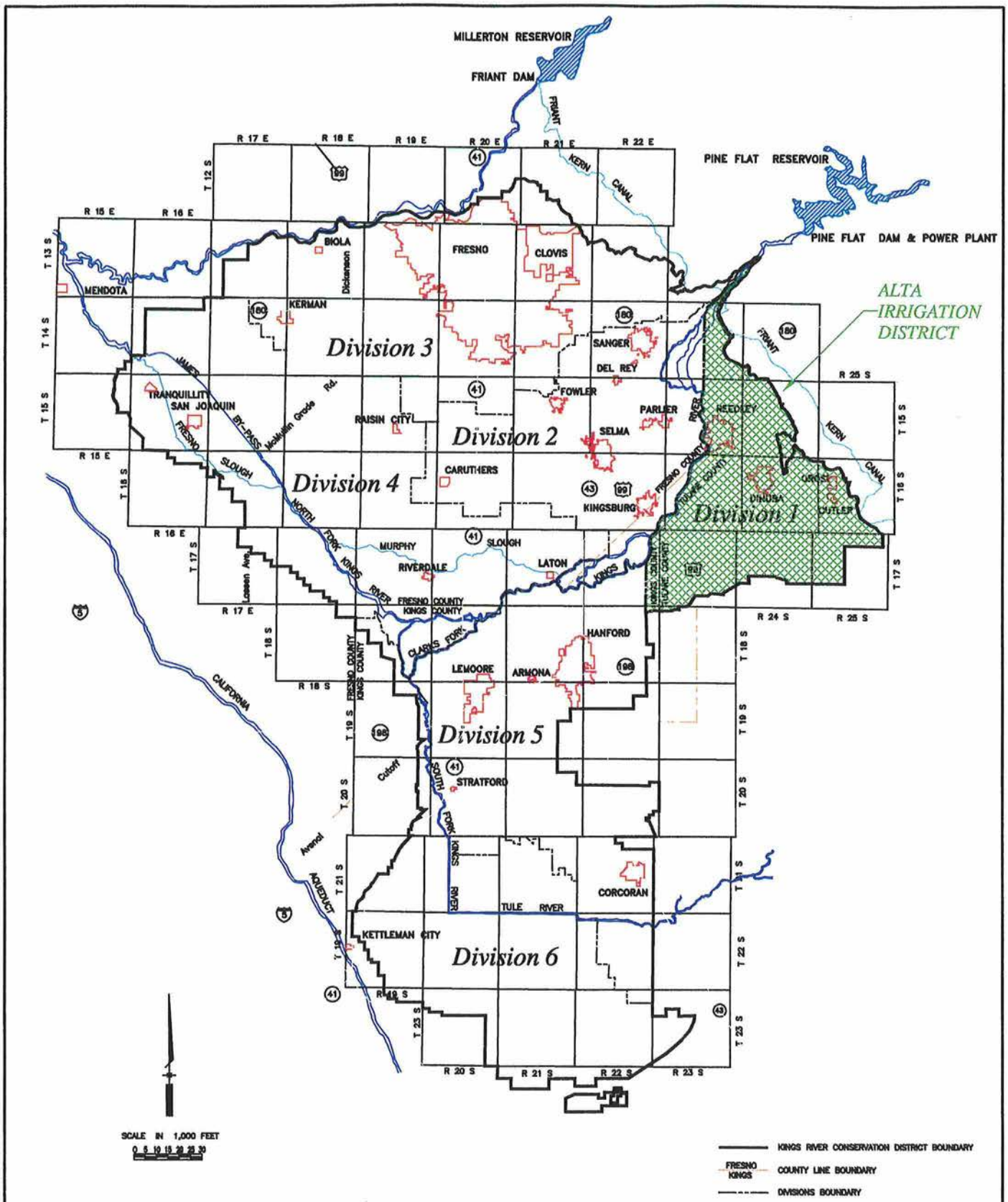
1. A five acre basin, known as Meek Ponding Basin, in the southwest quarter of Section 1, T16S, R23E. This basin was formerly a county-owned borrow pit, but since 1978 it has been used exclusively for recharge.

2. A sixty-three acre basin, known as London Ponding Basin, was formerly a county-owned borrow pit in the northeast quarter of Section 2, T17S, R23E. Since 1980, the basin has been used as a balancing reservoir, recently utilizing pumps, for the District's irrigation distribution system and as a recharge basin when water is available.

3. A fifteen acre basin, known as Boone Pond, in the northwest quarter of Section 36, T16S, R24E, is used exclusively as a recharge basin.

4. A five acre basin, known as Traver Pond (also known as Jost Ponding Basin), completed in February of 1989, is located in the northeast quarter of Section 13, T17S, R22E. This basin is used primarily to capture and percolate local area rainfall collected by the Traver Canal that would otherwise be dumped into the Kings River. Also, adjacent farmers may pump directly from the reservoir in lieu of pumping from the underground.

5. A forty-six acre basin, known as Button Ponding Basin, located in the southeast quarter of Section 1, T17S, R24E, which is used as an irrigation canal flow regulating basin. Recharge is incidental to it's primary operation.



ALTA IRRIGATION DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 3

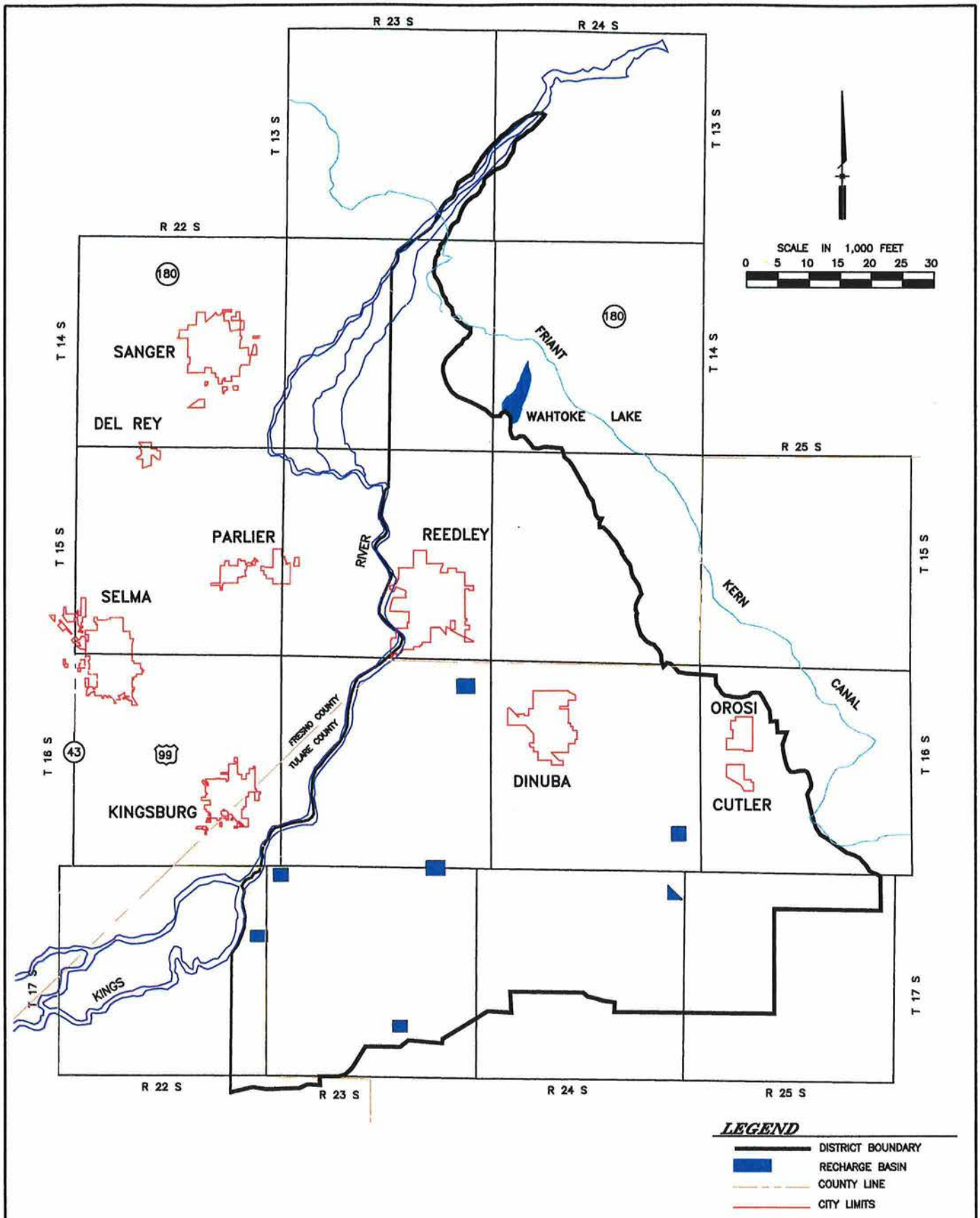
In addition to the recharge basins, the District also owns approximately 80 percent of Wahtoke Lake, A twenty-acre reservoir located outside the District but abutting its boundary at the junction of Wahtoke Creek and the Alta Canal in the eastern half of Section 30, T14S, R24E. Since 1900, this lake has been used as a combination balancing reservoir and recharge basin.

The District also operates two leased recharge sites as follows:

1. A fifteen acre basin, known as Bowen Ponding Basin, in the southeast quarter of Section 27, T17S, R23E. Since 1973, this basin has been used exclusively as a recharge basin.
2. A five acre basin, known as Harder Pond, near the center of Section 6, T17S, R23E. Since 1983, this basin has been used as a combination balancing reservoir and recharge basin.

Sources of water for the District's recharge program are flood releases in the Kings River, floods in the local area, and operational spills. **Figure 4** shows the location of the recharge reservoirs.

Additionally, it is estimated that approximately 45,600 acre-feet of incidental recharge occurs annually along the District's 360 miles of unlined irrigation delivery channels.



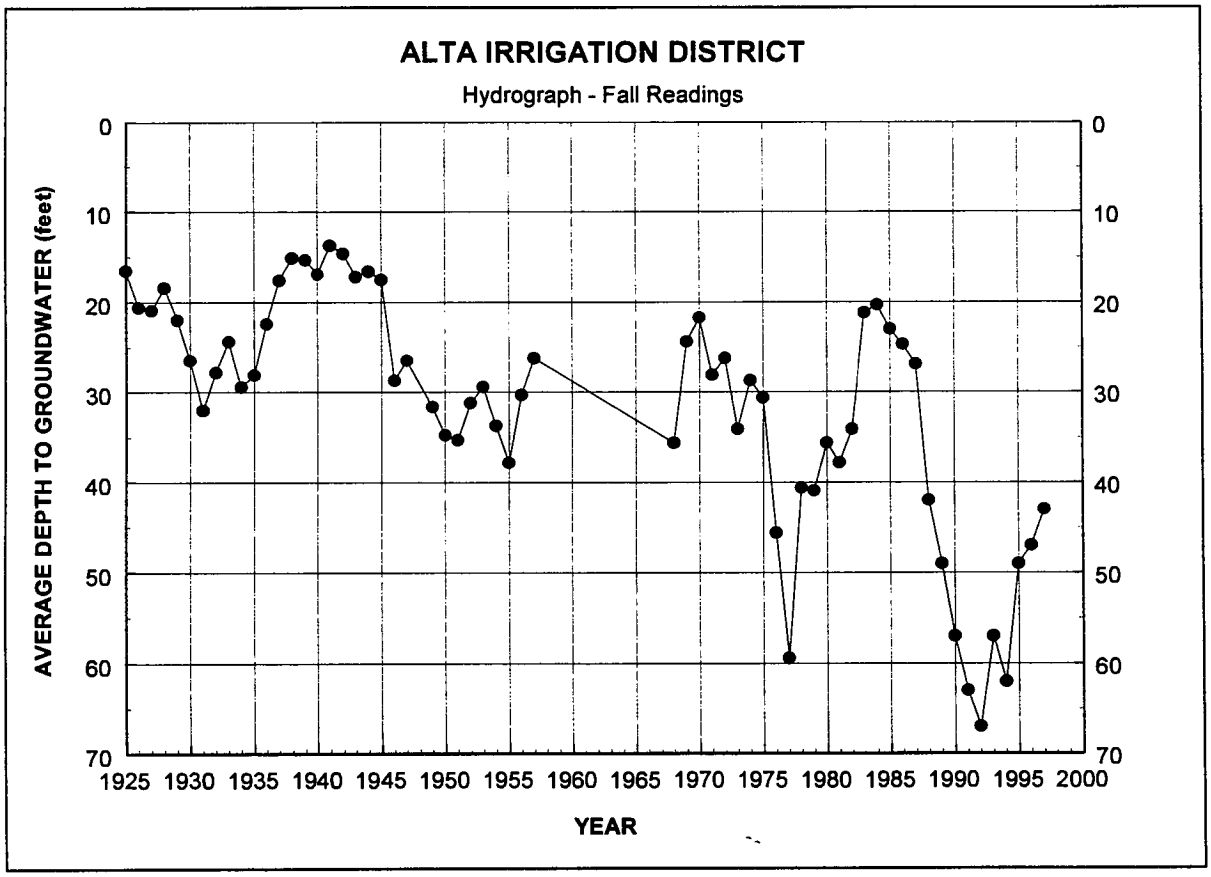
ALTA IRRIGATION DISTRICT
LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 4

There is no monitoring of the amount of water delivered to each of the existing recharge basins. However, the District has monitored the groundwater level since 1921 by the annual measurement of the depth to groundwater in irrigation wells. The average annual depth to groundwater is shown on the hydrograph in **Figure 5**. At the present time, 130 wells are included in the program. Ideally, the District tries to monitor one well per section of land. As of November, 1997, the average depth to groundwater in the District was 43 feet.

Figure 5

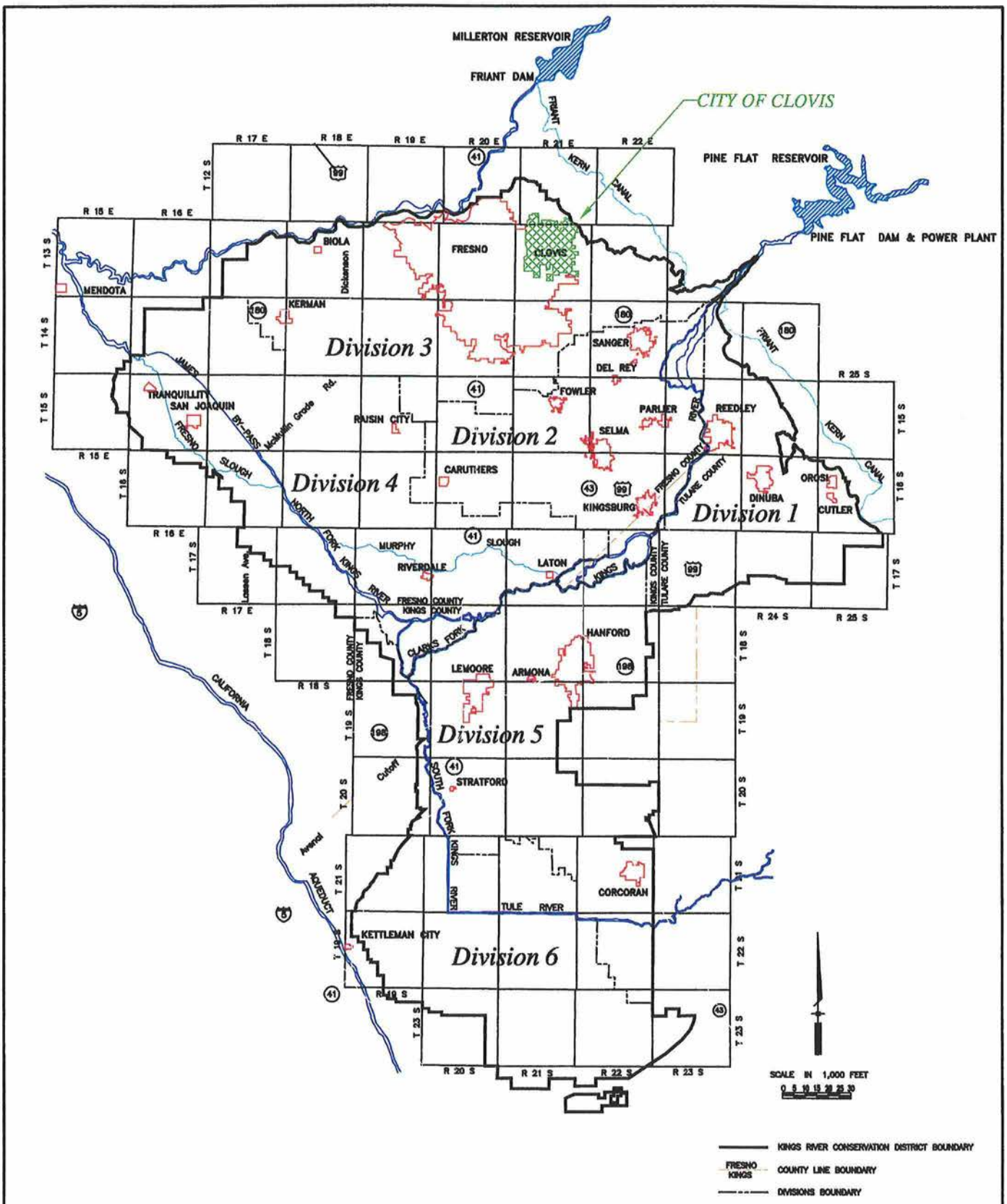


3.2 City of Clovis

The City of Clovis is located in Fresno County at the northern end of the service area as shown in **Figure 6**. Clovis is adjacent to and northeast of the City of Fresno, and is within the boundaries of the Fresno Irrigation District. Clovis was incorporated in 1912 and presently includes an area of 15.95 square miles with a population of nearly 68,000. Clovis also serves the Tarpey Village area which is 1.06 square miles with a population of 4,035.

All of the water used by the City for municipal and industrial purposes is pumped from City-owned wells. The City presently owns 35 wells, thirty-one of which are now in service. Two new wells are proposed for the near future. The average amount pumped annually is about 18,000 acre-feet, which compares favorably with the amount pumped in 1997 as shown in the following table:

Month	Pumpage (acre-feet)
January	693
February	684
March	1,224
April	1,644
May	2,161
June	2,317
July	2,483
August	2,341
September	2,010
October	1,474
November	1,003
December	694
Total	**18,728**



CITY OF CLOVIS
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 6

The depth to groundwater is read semi-annually in most of the City wells. Records of water table levels indicate an overdraft of the groundwater supply with a net drop in the water table of over 80 feet in the last 47 years. A summary of the city's records of average depth to the water table is provided in the hydrograph in **Figure 7**.

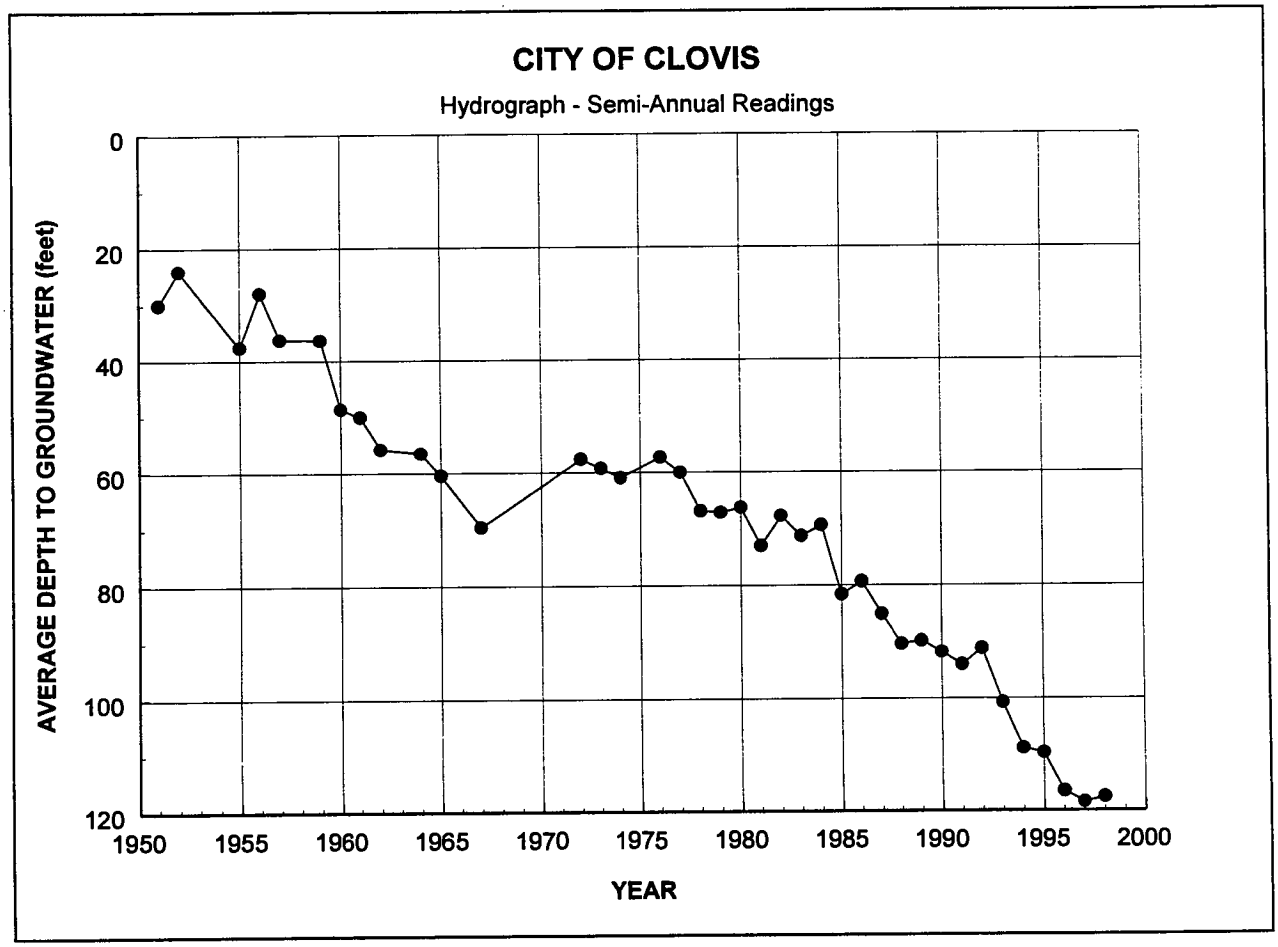


Figure 7

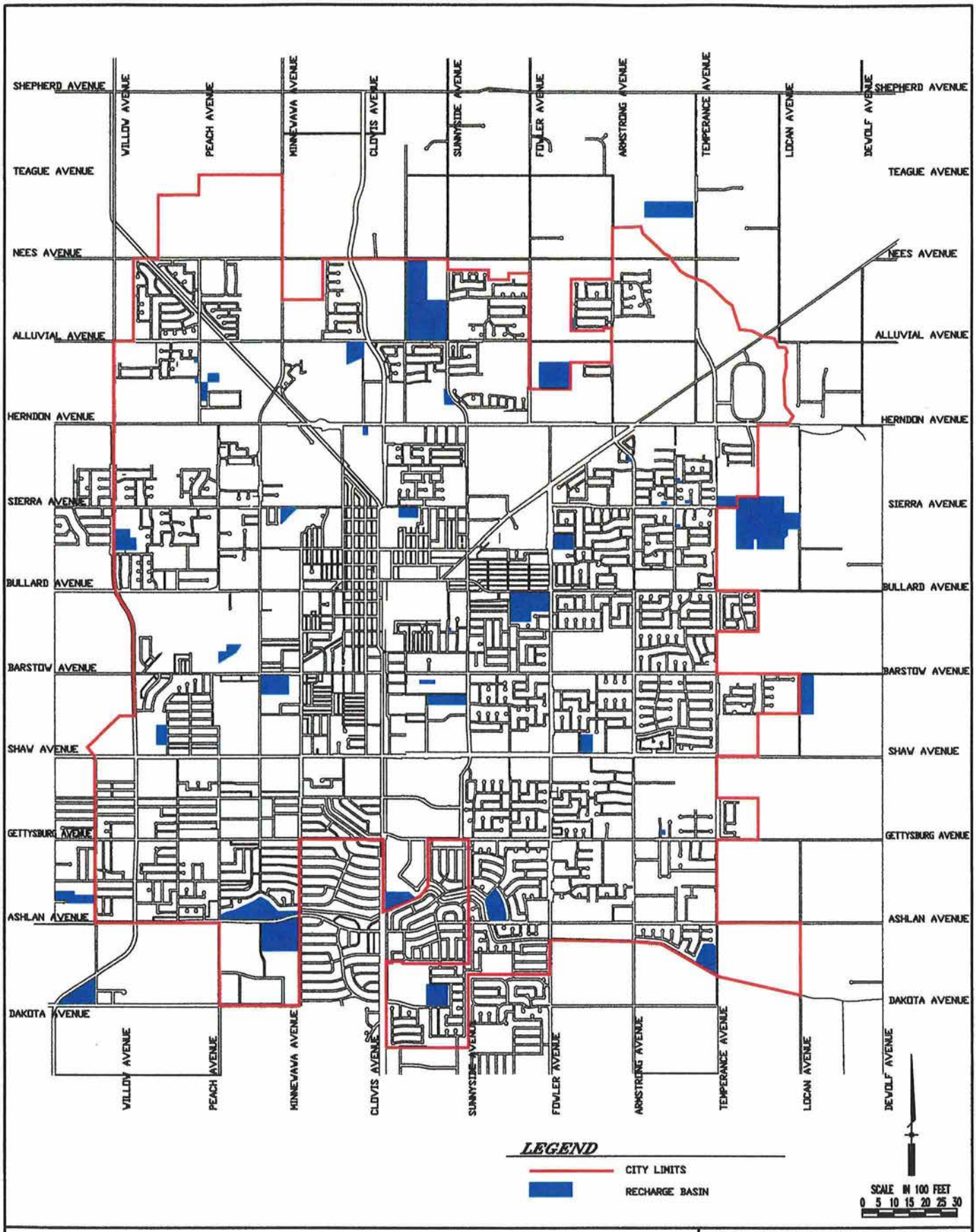
Clovis recognized the problem of overdraft and in 1974, put into service the first dedicated artificial groundwater recharge basin. Today, the city owns and operates two such basins, for a total area of 63.5 acres, as follows:

Location	Size (acres)
Ashlan Ave./Minnewawa	16.5
N. Marion/Alluvial Ave.	47.0

The Marion/Alluvial Avenue facility is planned for expansion to the west and will eventually cover 86.0 acres. Twelve storm water basins throughout Clovis are utilized during the summer months for recharge activities in addition to the two dedicated facilities. Clovis also utilizes a 2.5 mile reach of the Dry Creek channel that meanders through the City for recharge. All of these facilities are shown on **Figure 8**.

Water for the City's recharge program comes from storage in Pine Flat Reservoir and is delivered by Fresno Irrigation District through its canal system normally during the months of March to October, depending upon availability. An average of 6,000 acre-feet is delivered annually, and since 1974 a total of 145,140 acre-feet has been artificially recharged to the groundwater. Clovis has spent $5.6 million over the past five years in capital costs for recharge property acquisition, design and construction. The City currently spends approximately $200,000 annually for the recharge water. In five years, Clovis plans to have an additional dedicated recharge facility in the northeast part of the city.

Beyond the concern for the quality of the groundwater in its immediate area, Clovis is concerned about the larger picture and has joined with the City of Fresno, Fresno County, Fresno Irrigation District, and Fresno Metropolitan Flood Control District in a master agreement for management of water quality and quantity for the Fresno-Clovis urban area and northeast Fresno County. In addition, Clovis is a participant in a Water Quality Management Planning Program under Section 205(j) of the Federal Clean Water Act. Major objectives under the program are: continued monitoring of groundwater elevations, groundwater quality, and completion of a groundwater model being developed in conjunction with the U.S. Geological Survey.



CITY OF CLOVIS

LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 8

3.3 City of Fresno

Incorporated in 1885, the City of Fresno is located at the north end of the Kings River service area, as shown in **Figure 9**, and is the largest city in the service area. Presently, the City has a land area of almost 110 square miles and serves water to a population of approximately 500,000. The City lies at the geographical center of the Fresno Irrigation District (FID). With the cooperation of the FID and the Fresno Metropolitan Flood Control District (FMFCD), the City maintains the largest artificial recharge program in the area.

All of the water used by the City is currently pumped from City-owned wells, of which there are 261 dispersed throughout the City. Approximately 148,000 acre-feet of water was pumped from these wells in 1997, and it is anticipated that 159,000 acre-feet will be pumped in 1998. It is estimated that another 25,000 acre-feet is extracted by other users in the Fresno Metropolitan Area (FMA).

The City began a program of artificial groundwater recharge in 1971 with the development of "Leaky Acres". The facility includes approximately 200 acres of spreading basins northwest of the intersection of North Chestnut and East Dakota Avenues. Water for recharge is delivered to the basins by FID from the City's Central Valley Project (CVP) supply via the Gould Canal during the irrigation season. In 1997, there were 12,448 acre-feet of water delivered to Leaky Acres. The peak year was 1991 when 23,629 acre-feet of water was delivered. The average annual delivery over the past 19 years is 16,000 acre-feet. The City's Water Division expends approximately $2,400,000 in annual O&M in its artificial recharge program.

In addition to Leaky Acres, a joint effort by the City, FID and the FMFCD recharges additional water at flood control basins under a cooperative agreement entered into in 1980 (see Section 3.6 of this report). Locations of the flood control basins available for use in the recharge program are shown on **Figure 10**.

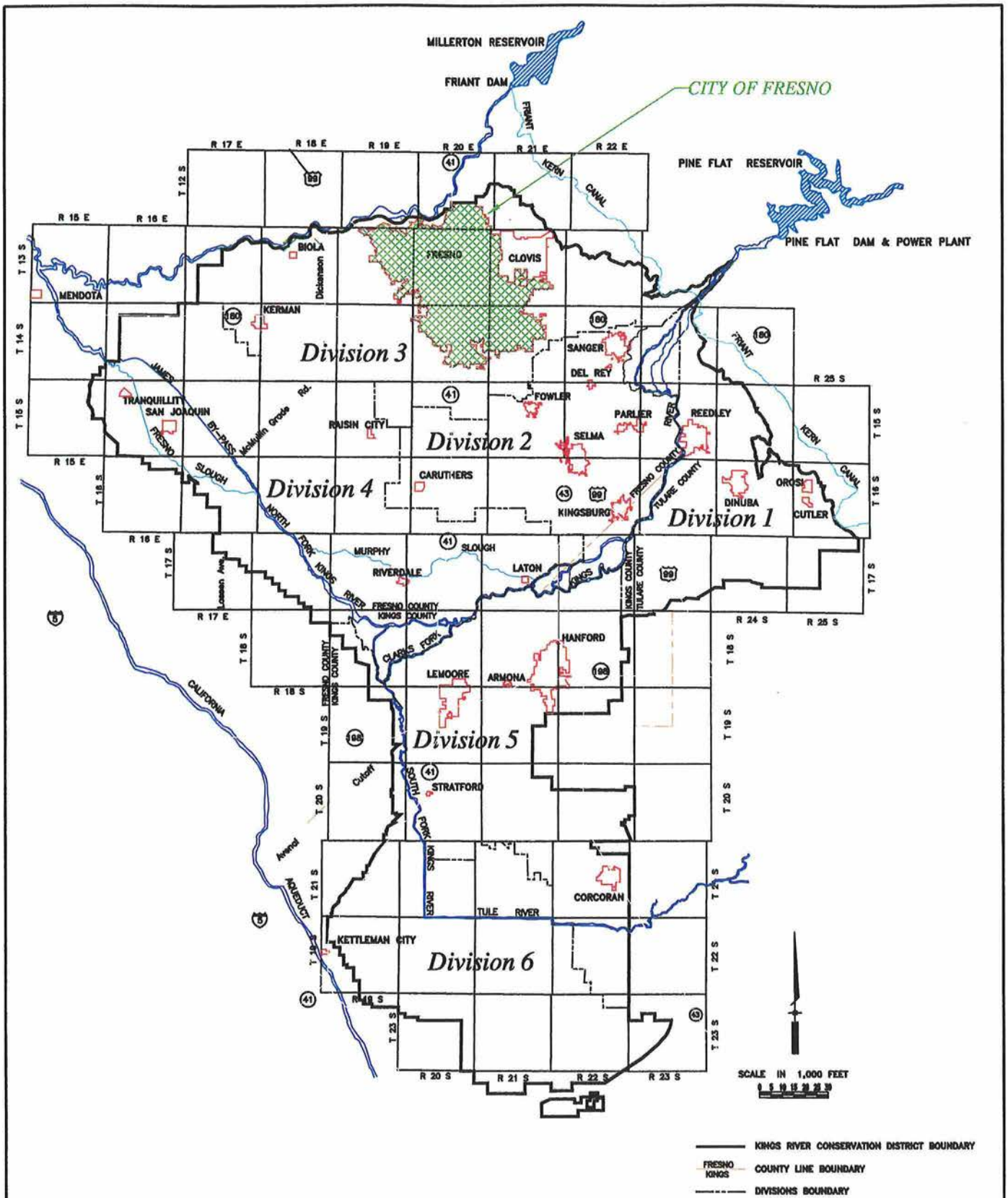
The quantity of water used in the artificial groundwater recharge program is monitored. Daily staff gauge readings in the ponds at Leaky Acres are used to monitor basin water levels. Upstream and downstream weir readings are taken daily to measure the inflow to the facility. Percolation rates of the ponds are measured periodically to determine appropriate maintenance schedules.

The effectiveness of the artificial groundwater recharge program is monitored through measurement of the groundwater level taken in the City wells. The average annual depth to groundwater since the year 1931 is plotted on the hydrograph in **Figure 11**. The water table has been declining since 1944, with a steady decline of 2.51 feet per year between 1944 and 1968. From 1968 to 1996, the decline has slowed to about one foot per year, representing a current annual overdraft in the urban area of 10,000 - 15,000 acre feet.

Two developments have had a negative impact on recharge capacity. As the FMA has urbanized, canals have been lined and others piped, decreasing in-channel recharge. Pressure for additional neighborhood recreational areas has also resulted in an increasing number of FMFCD basins being converted to parks uses. Nevertheless, available acreage for groundwater recharge has been steadily expanding. Available water and/or basin capacity governs the amount of recharge achieved annually. Ironically, a "wet" year often prohibits average recharge deliveries by minimizing the time the basins can be used for FID deliveries.

In the past five years the City has expended over $5,000,000 in capital facility expansion to increase recharge capacity. Projects included improving conveyance systems, connecting additional FMFCD basins, placement of check structures in certain FID canals to promote in-channel infiltration and installing flow and totalizer meters at connected basins. Two joint FID/City dedicated recharge basins were also initiated which will add another 60 acres of basins area. These facility enhancements will increase the FMA recharge capacity to over 65,000 acre-feet annually.

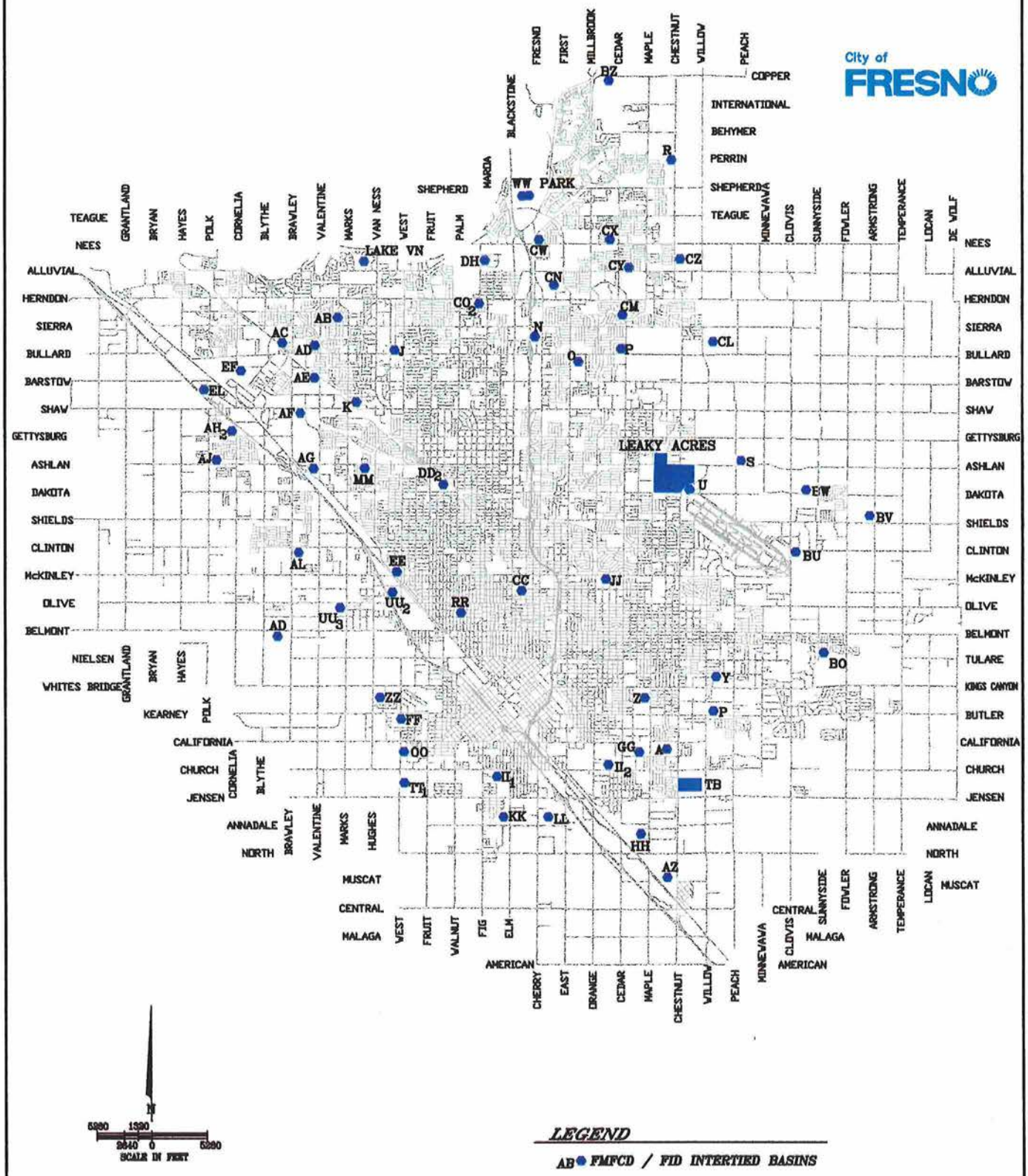
It is anticipated that these new facilities, along with the City's surface water treatment facility (scheduled for completion in 2001) will balance the FMA water budget for the first time in over 50 years. FMFCD, FID and the cities of Fresno and Clovis attended the first of several workshops planned for 1999 which will focus on operational enhancements to increase effective recharge. Often overlooked, but extremely important in basin groundwater management is the approximately 60,000 acre-feet recharged each year at the City's wastewater treatment facility where 1,700 acres of recharge ponds are maintained.



CITY OF FRESNO
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 9



CITY OF FRESNO
LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 10

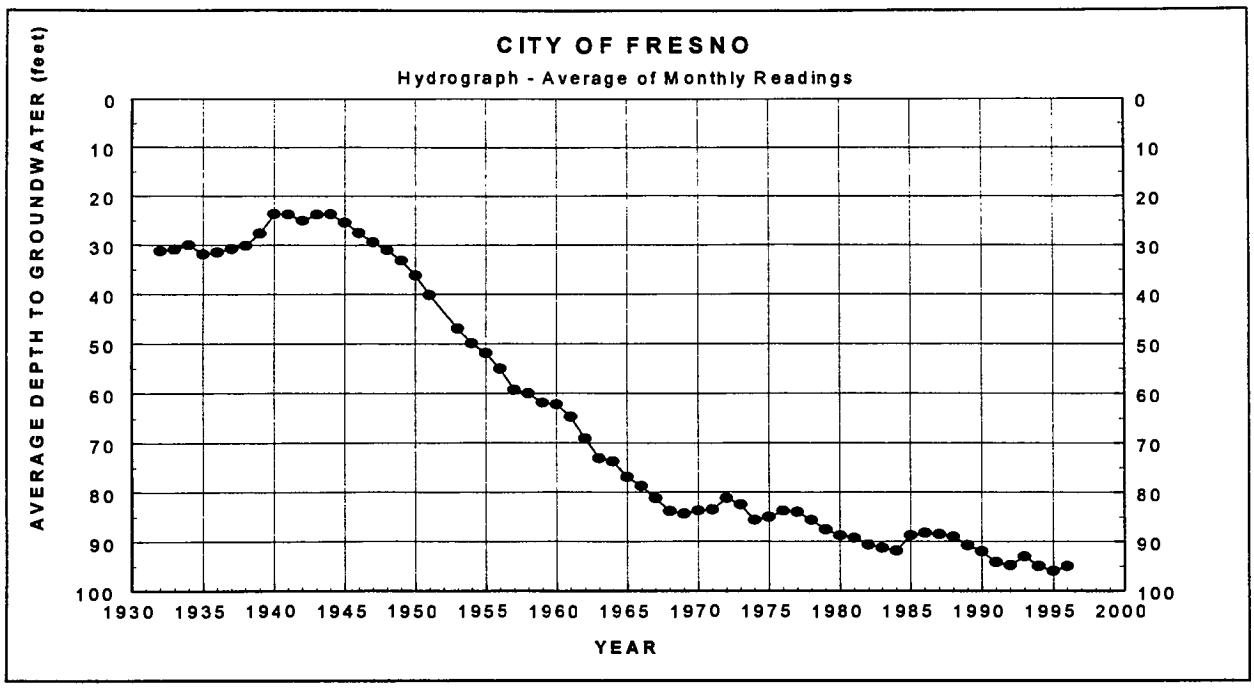


Figure 11

The most direct way to alleviate the groundwater overdraft is to simply pump less water. Substituting surface water for groundwater is one method of accomplishing this. The design phase for the construction of Fresno's first Surface Water Treatment Project is under way, and as already discussed is scheduled for completion in 2001. When completed and brought into operation, the facility will treat water from the Kings and San Joaquin Rivers to drinking water quality standards which will help ensure a reliable water supply for Fresno customers, while simultaneously removing some of the burden on the groundwater supply.

The CVP contract is due for renewal at the year 2007. The City has a Class 2 water entitlement for 85,000 acre-feet. Given the precarious nature of the rights holders of CVP water, the City continues to diligently pursue additional recharge and investigate alternative water supply sources.

Maintenance of the flood control ponds is done by the FMFCD. Maintenance of Leaky Acres, consisting of spraying weeds and ripping and discing the sides and bottoms annually is done by the City.

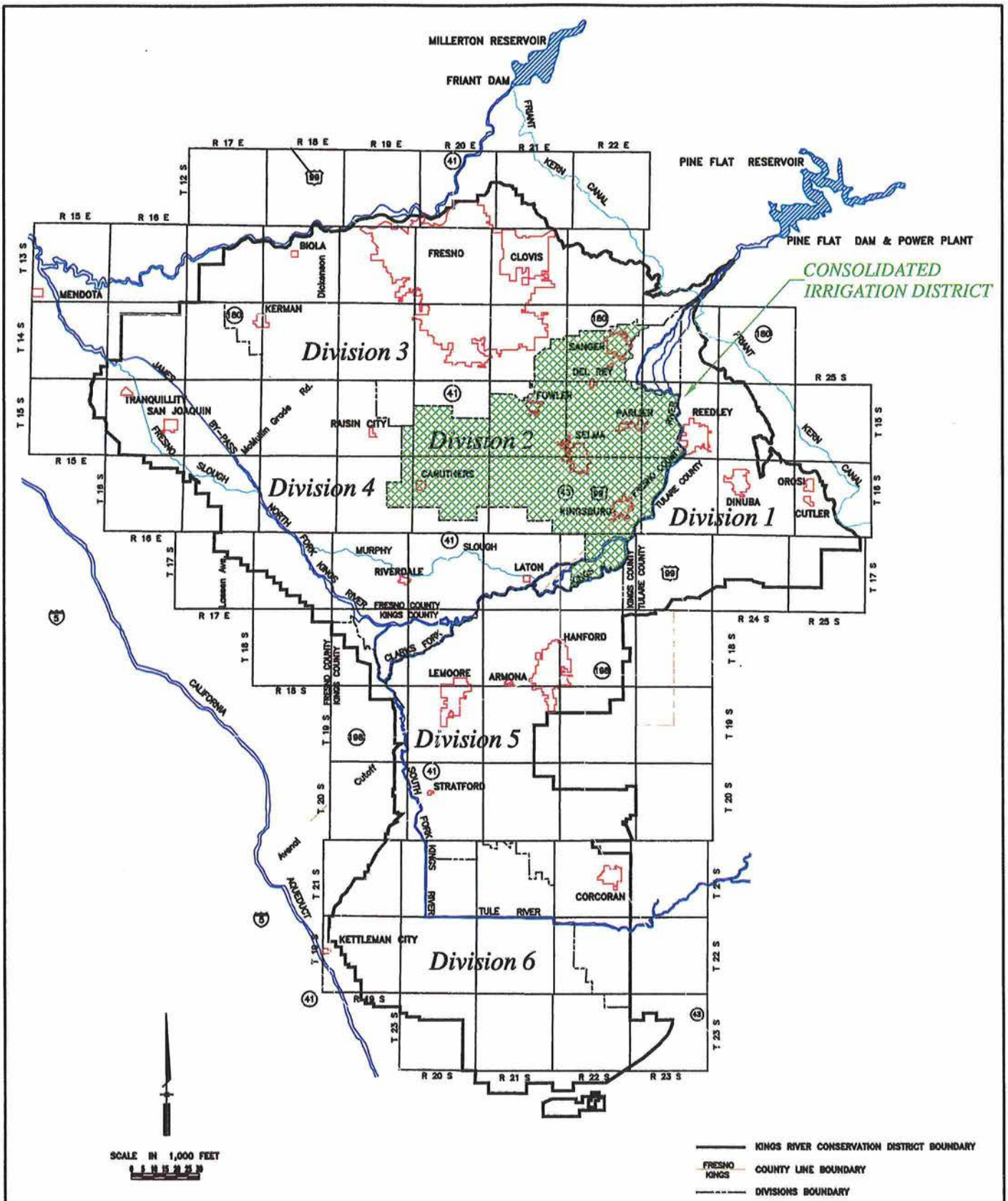
3.4 Consolidated Irrigation District

Consolidated Irrigation District ("CID") was formed in 1921 for the purpose of securing and distributing a supply of surface water for irrigation to an area of approximately 145,000 acres. The CID is located in the northern third of the service area, as shown on **Figure 12**, and lies almost entirely in southern Fresno County. A small portion, approximately 4,000 acres, lies in the northwest corner of Tulare County, and approximately 6,300 acres lies in the northeast corner of Kings County. The cities of Fowler, Selma, Kingsburg, Sanger, and Parlier are included in the District. The CID's boundaries primarily coincide with those of Division 2 of the KRCD.

The CID's goal is to effectively use all of the surface water made available to it. Its principal supply of surface water is from the Kings River by diversion of water at the Fresno Weir (located approximately nine miles downstream from Pine Flat Dam) into the Consolidated Canal, and subsequently into a network of canals totaling approximately 500 miles in length.

Virtually all the land within the CID is productive farmland, 60 percent of which receives surface water for irrigation. Irrigation is the primary use of the water received from the Kings River. The remaining 40 percent of farmland depends upon water pumped from the groundwater supply. Each farm that receives surface water is also capable of drawing from privately owned wells when surface water is unavailable. Water for municipal and industrial uses comes totally from wells. There are approximately 4,500 wells within the CID which extract an average of 300,000 acre-feet of water annually from the groundwater supply.

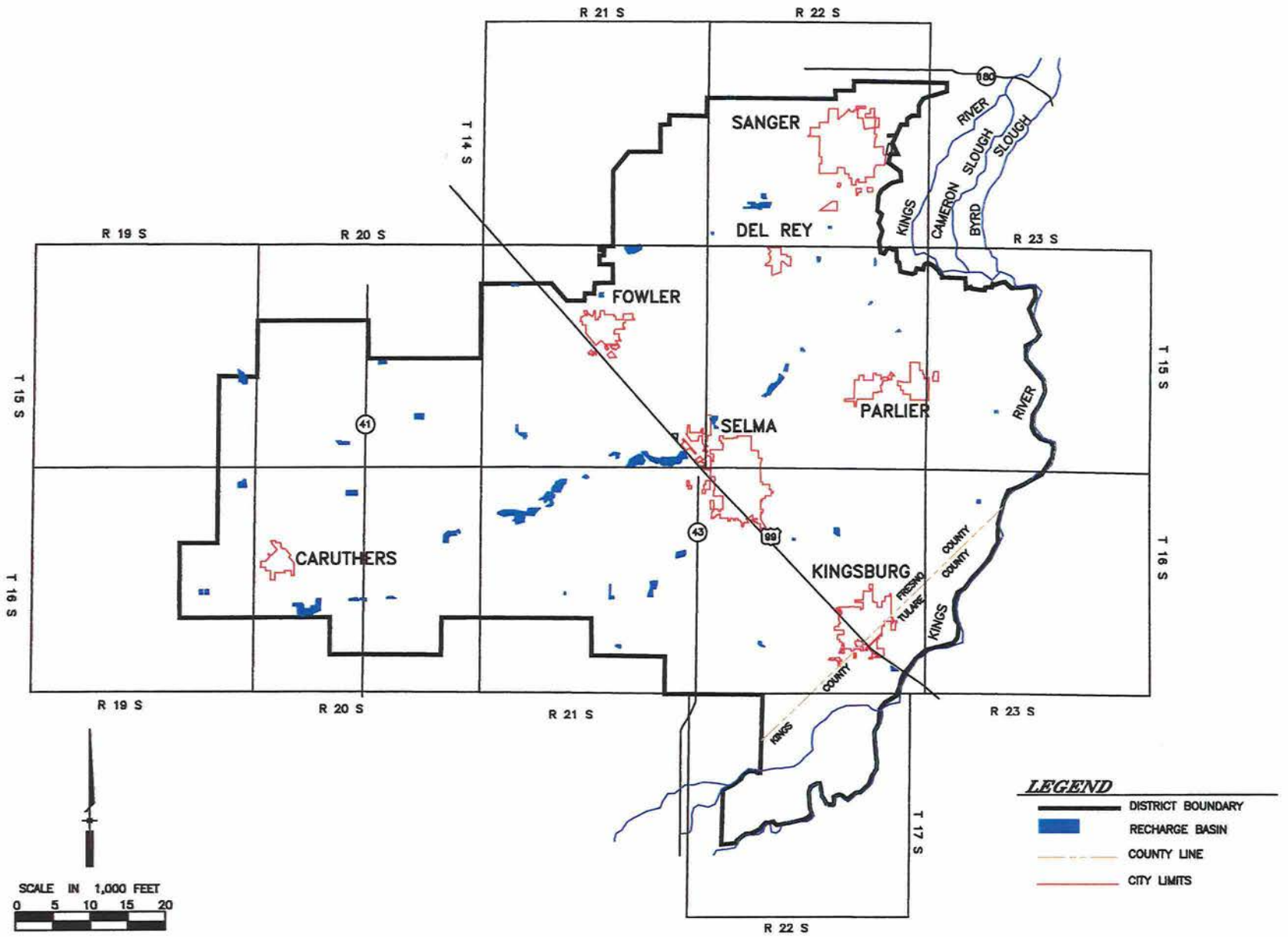
The secondary use of surface water in the CID is for groundwater recharge. Because of its permeable soils, with direct hydraulic continuity between the surface and groundwater, the CID has the capability of recharging large amounts of water. In the early 1930's, the CID recognized the need to artificially recharge its groundwater supply and thus began a program of purchasing sites for recharge basins which continues today. The CID currently manages a large conjunctive use program which continues to expand and owns 44 basins distributed throughout the CID, as listed on **Table 3** and shown in **Figure 13**, having a total area of approximately 1,250 acres. These basins are also used for regulation of flows in the canals. In addition to its own basins, the CID uses numerous small privately-owned basins for recharge when water is available, and approximately 370 miles of unlined canals provide incidental recharge of the groundwater.



CONSOLIDATED IRRIGATION DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 12



CONSOLIDATED IRRIGATION DISTRICT
LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 13

Table 3

Consolidated Irrigation District
Groundwater Recharge Basins

Name of Basin	Location (Section/Township-Range)	Size (acres)
Reitz	29/14-22	59.90
Sheppard	29/14-22	11.56
Malaga Head	31/14-22	4.85
Kimball	34/14-22	4.20
Goldie	24/15-19	26.00
Cherry Avenue	22/15-20	6.73
Orange Avenue	26/15-20	20.00
Saterburg	33/15-20	16.25
Malaga	2&3/15-21	45.51
Mullen	30/15-21	9.43
Iowa	32/15-21	17.80
McCoy	34/15-21	37.69
Shaughniss	35/15-21	83.66
Rockwell	35&36/15-21	98.56
Tarn	2/15-22	17.61
Hoffer	3/15-22	9.61
Miley	11/15-22	9.33
Santa Fe	13/15-22	6.47
Stroud	20&21/15-22	77.41
Mahan	21/15-22	11.92
L. W. Martin	30/15-22	17.19
Young	30/15-22	29.93
Lac Jac	29/15-23	7.80
Marks Avenue	1/16-19	33.37
Blythe Avenue	23/16-19	20.00
Hansen	4/16-20	9.92
Davis	12/16-20	80.00
Elkhorn	20/16-20	85.27
Gunland	21/16-20	10.29
Reddell	21/16-20	6.92
Cattuzzo	22/16-20	10.61
Cruff	4/16-21	32.54
Singh	4/16-21	47.96
Martin	5/16-21	73.11
Willow Lake	7&8/16-21	111.38
Weber	21/16-21	2.00
Swift	22/16-21	3.21
Wildflower	22/16-21	3.90
Benight	23/16-21	40.64
Crosno	27/16-21	7.72
Gillespie	9/16-22	4.18
Thiesen	10/16-22	19.82
Cole Slough	36/16-22	11.30
Smith Ferry	5/16-23	7.50
	Total	1251.05

The CID monitors and evaluates its recharge program by recording the amounts of water diverted through the various diversion structures throughout the CID, including what is stored in the ponding basins. Monthly readings are also taken and recorded of the depth to water in each of 82 wells distributed throughout the CID. The hydrograph on **Figure 14** shows the District-wide average of the well readings for the years 1923 through 1996. The graph indicates an overall decline in the water table of about 0.8 feet per year from 1923 to 1966, but since that time although there have been fluctuations, the water table has remained level. This fact can be attributed largely to the CID's successful management of its artificial groundwater recharge program.

CID management aggressively pursues the recharge program by ensuring that any surplus surface water which exceeds the needs of CID users, such as flood releases and precipitation runoff not storable in Pine Flat Reservoir or other upstream reservoirs, is directed to the basins for percolation to the groundwater. The philosophy of the CID is that any and all efforts should be taken to stabilize or raise the water table if it results in the reduction of the lift and energy required to pump from the groundwater supply. In addition, in years when the surface water supply is plentiful, the distribution of the water for irrigation is less restricted than in years of tighter supplies. CID management feels that it is better to conserve the water by using the farmland to percolate it to the groundwater than to let it escape from the CID boundaries. During a normal irrigation season, regulation of flows in the canals may result in approximately 20 percent of the water going into ponding basins. During the non-irrigation season, 100 percent of any water available will be directed to the ponding basins for intentional recharge.

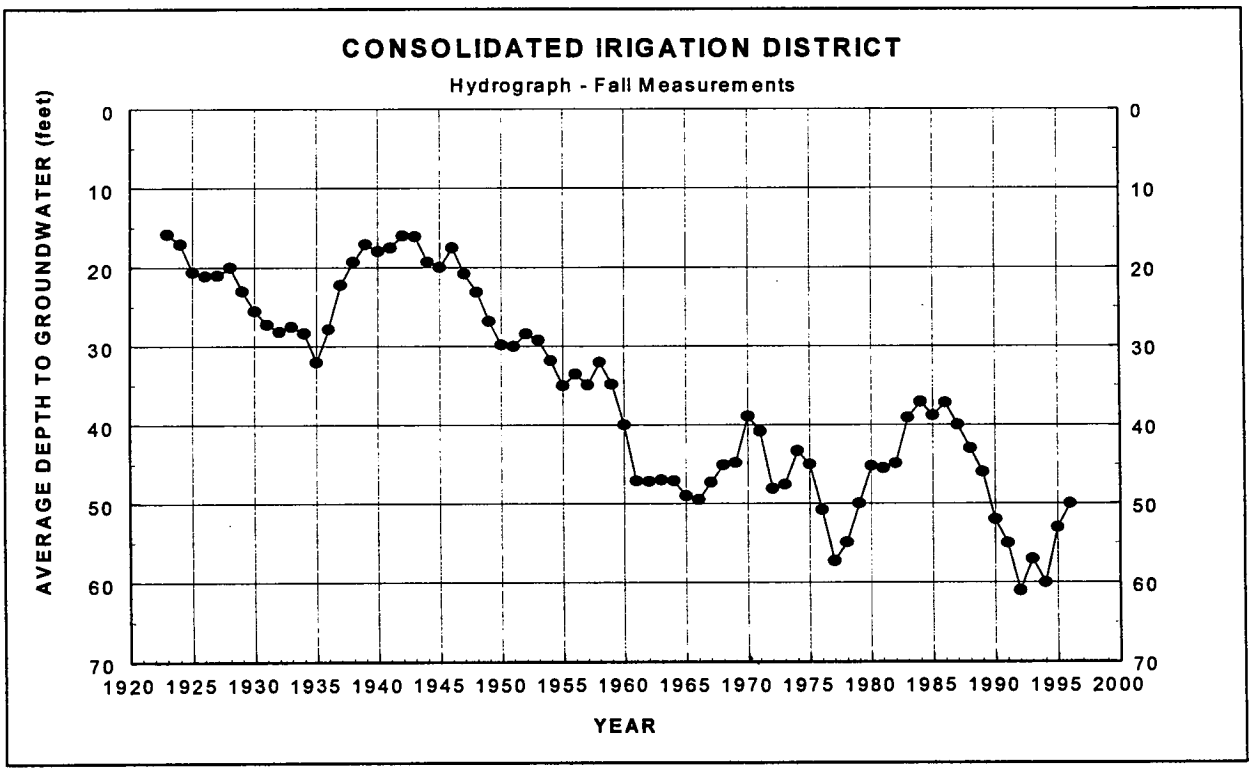


Figure 14

3.5 Fresno Irrigation District

The Fresno Irrigation District ("FID") was formed in 1921 as the successor to the Fresno Canal and Land Corporation, which was successor to the Fresno Canal and Irrigation Company, which had been diverting water from the Kings River since 1871. The FID is comprised of approximately 250,000 acres of land, and is the northernmost and largest of the 28 entities within the Kings River service area. As shown on **Figure 15**, FID is located entirely within Fresno County, with the Fresno/Clovis metropolitan area at its geographic center. The boundaries of FID coincide with those of Division 3 of KRCD for the most part.

Of FID's total acreage, approximately 150,000 acres are receiving surface water for irrigation, approximately 65,000 acres are urbanized, and the remaining 35,000 acres are suburban.

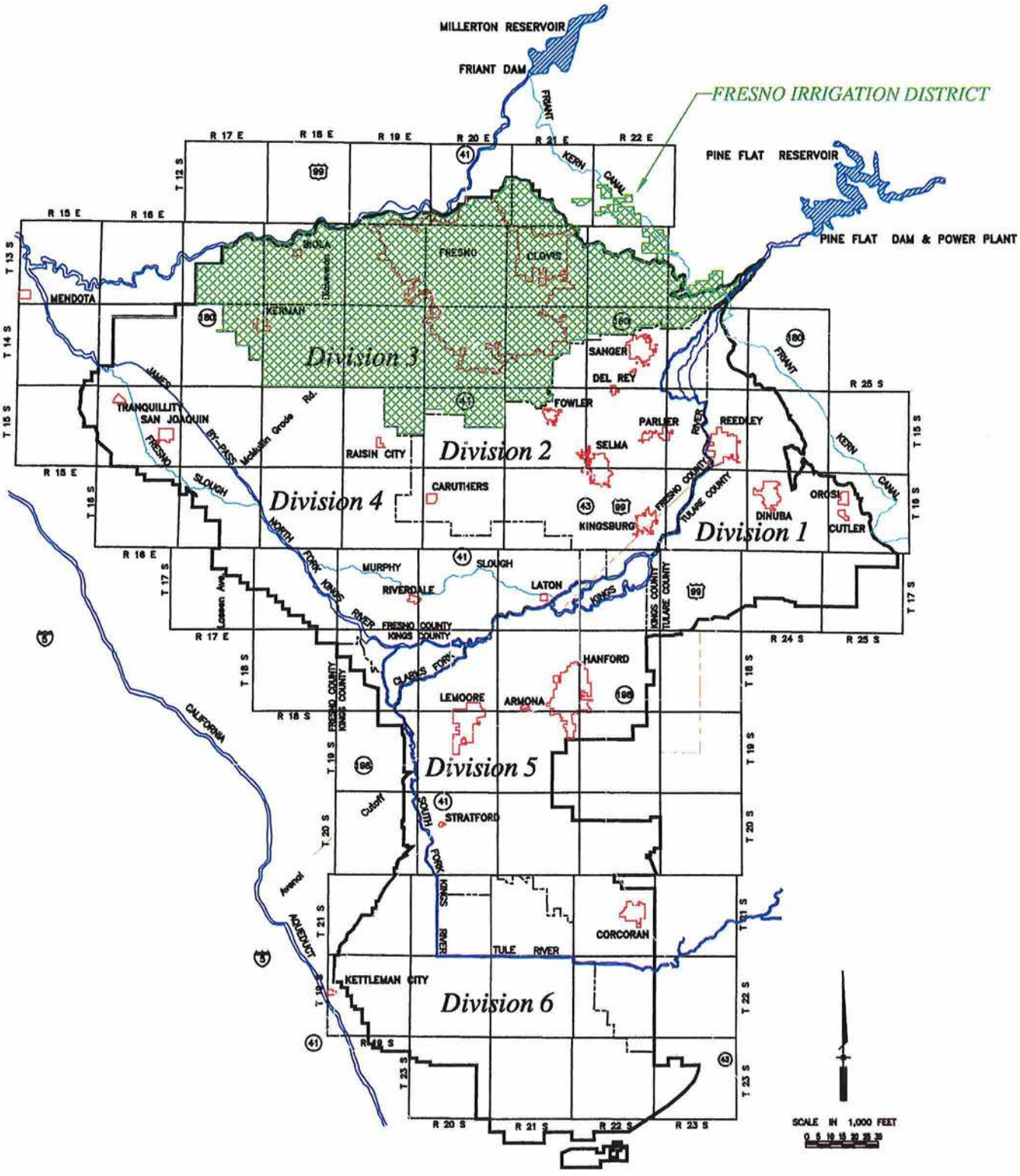
FID delivers an average of 516,000 acre-feet (40 year average) of surface water annually, most of which goes to agricultural users, but with an ever-increasing amount going to the cities of Fresno and Clovis for their artificial groundwater recharge programs. The primary source of water is the Kings River, from their entitlement of 26% of the total runoff, this is an average of 424,000 acre-feet coming from two diversion points. The first diversion point is the Gould Weir, located approximately 7.5 miles downstream from Pine Flat Dam, which diverts water into the Gould Canal. The second diversion point is at the Fresno Weir, located approximately 9 miles downstream from the dam, where water is diverted into the Fresno Canal. The remaining 92,000 acre-feet comes from entitlements to Central Valley Project water. This water is diverted from the Friant-Kern Canal near its crossing of Trimmer Springs Road into the Gould Canal.

In addition to surface water, agricultural users pump from the groundwater supply through their own wells. The pumping is not monitored, but an estimated 165,000 acre-feet is extracted annually. All water used for municipal and industrial purposes is also pumped from the groundwater supply. Because of the substantial urbanization of FID, particularly in the Fresno/Clovis metropolitan area which has an estimated population of at least 500,000, pumping for municipal and industrial uses has created an overdraft of the groundwater and the development of a substantial cone of depression beneath the City of Fresno. This has led to the cooperative development and implementation of a comprehensive surface and groundwater management program involving the FID, the Fresno Metropolitan Flood Control District (FMFCD), the City of Fresno, the City of Clovis, and Fresno County.

The surface water management portion of the program involves expansion of the surface distribution system to deliver water to agricultural lands that have not received surface water in the past, but instead have obtained all of their irrigation requirements by pumping groundwater. This expansion is aimed at reducing the drain on the groundwater supply. The program also includes acquiring land for purposes of constructing new recharge facilities to capture available surface water for percolation to groundwater. Existing facilities are shown on **Figure 16**. Also shown on the drawing are lands where FID has acquired flooding rights during periods of high snowmelt or when necessary as a result of operational spills. Additional recharge occurs but since the frequency is irregular, the recharge benefits are not a part of the surface and groundwater management program. A listing of the existing recharge basins is presented in **Table 4**.

The groundwater management portion of the program involves the delivery of approximately 16,000 acre-feet annually of the City of Fresno's contractual supply of Central Valley Project water to an artificial groundwater recharge basin within the City Limits. The 117 acre basin, known as "Leaky Acres", overlies the cone of depression in the water table created by Fresno City's pumping. A similar arrangement with the City of Clovis delivers water to a 70-acre recharge basin owned by the City.

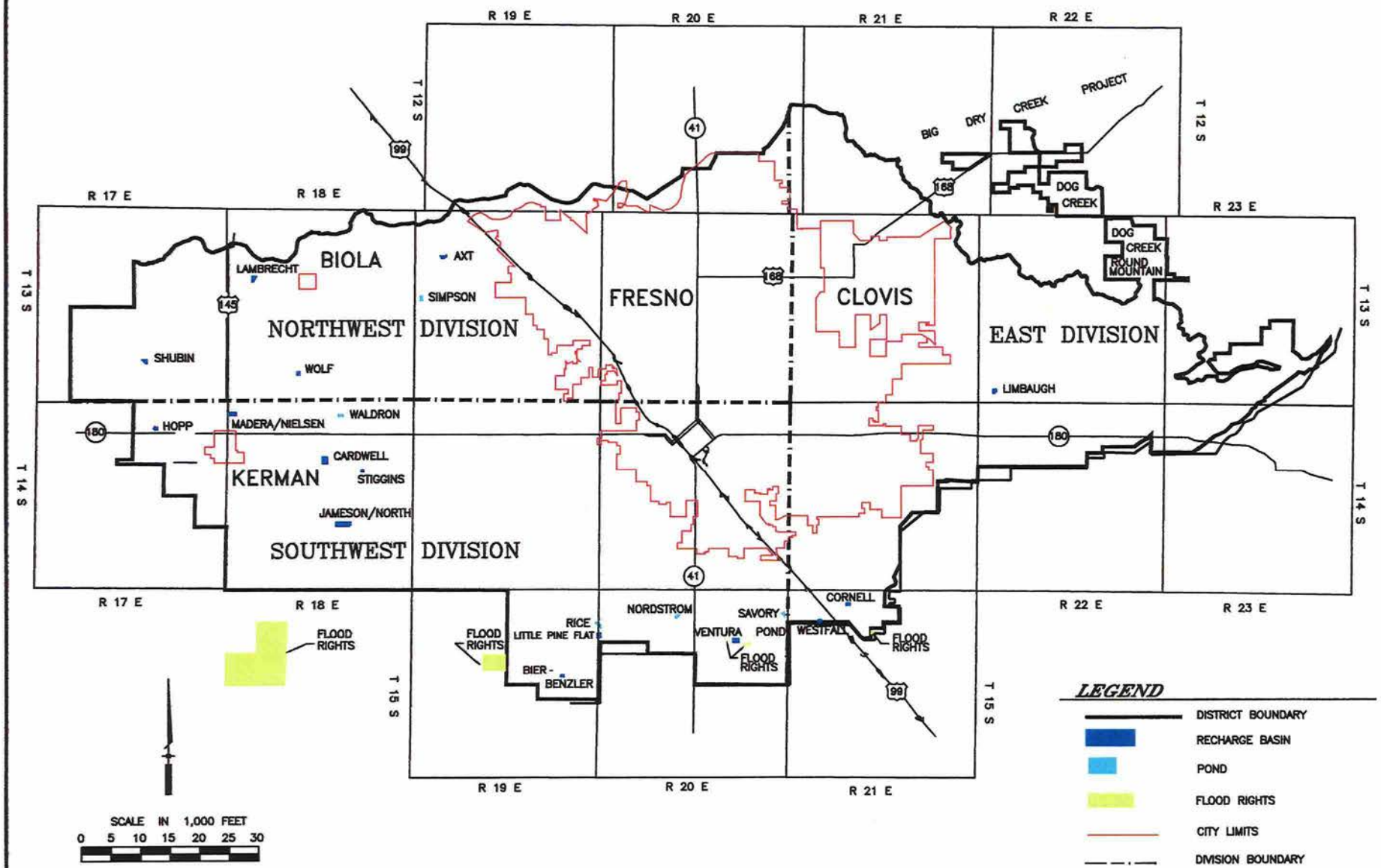
In cooperation with the City of Fresno and the FMFCD, FID is also utilizing flood control basins for groundwater recharge during the summer months. The basins are owned by the FMFCD and were constructed primarily to collect storm runoff and dispose of the water by percolation. Since these basins are empty most of the summer, are fenced for security, and are located throughout the City, it was agreed by all concerned that the basins could be used for recharge. Interties have been constructed between selected basins and the FID's canals, and during the summer months since 1988, an average of 52,450 acre-feet per year has been placed in the basins to percolate to groundwater.



FRESNO IRRIGATION DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 15



FRESNO IRRIGATION DISTRICT

LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT

4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 16

Table 4

Fresno Irrigation District
Groundwater Recharge Basins

Name of Basin	Location (Section/Township-Range)	Size (acres)
Axt Pond	7/13-19	13.5
Benzler and Clay Ponds	14/15-19	3.0
Bier Pond	14/15-19	4.7
Blasingame Pond	31/13-22	40.0
Cardwell Pond	10/14-18	10.0
Cornell Pond	5/15-21	5.0
Hopp Pond	3/14-17	5.0
Jameson Pond	22/14-18	40.0
Jefferson Avenue Pond	5/15-21	8.0
Lambrecht Ponds (Goldenrod)	18/13-17	30.0
Limbaugh Pond	31/13-22	7.0
Little Pine Flat Pond	12/15-19	9.5
Madera Pond	6/14-18	10.0
Rolinda High Pond	14/14-18	3.1
Shubin Pond	27/13-17	7.4
Ventura Pond	11/15-20	15.0
Waldron Pond	3/14-18	22.0
Westfall Pond	6/15-21	5.0
Wolf Pond	33/13-18	9.5
Nordstrom Pond	4/15-20	5.0
Rice Pond	12/15-19	8.0
Savory Pond	1/15-20	14.5
	Total	275.2

In another cooperative agreement with the City of Fresno, waste water which has been subjected to secondary treatment at the City's waste water treatment plant is discharged to a 1,500-acre infiltration bed to percolate to groundwater, thereby effecting "activated secondary" treatment. On request by the FID, the City extracts groundwater from beneath the infiltration bed through 21 wells which discharge into the FID's canal system. The groundwater is extracted from a depth of about 200 feet, well below the water table so that the additional percolation provides for greater filtration. This treated water is then delivered to agricultural users. In return, for each two acre-feet of treated water pumped into the FID's canal system by the City, the FID delivers one acre-foot of fresh water to the City's "Leaky Acres" recharge basin. This arrangement is in effect during the irrigation season each year (May through August), and is activated only when the FID's surface water supplies are inadequate to meet demands. When it is activated, it benefits both parties in that the FID can better serve its customers with surface water, and the City can improve its groundwater reservoir through recharge and at the same time reduce the mound of water beneath its infiltration bed that would interfere with the percolation of the waste water.

The FID monitors the groundwater by quarterly well measurements of the depth to groundwater. A weighted average of the readings taken in wells throughout the FID is shown by the hydrograph on **Figure 17**. The hydrograph indicates an overall increase in the depth to groundwater from 1922 to 1977. From 1977 to the present, the depth has fluctuated, but the net change has been a slight decrease in the depth to groundwater. However, the hydrograph does show that the water table has been declining since 1987 as a result of a six-year drought and the increased water demand by a growing population. It is clear that the FID is not going to be able to relax in its efforts to maintain an economical groundwater supply that is sufficient to meet the needs of those within the FID.

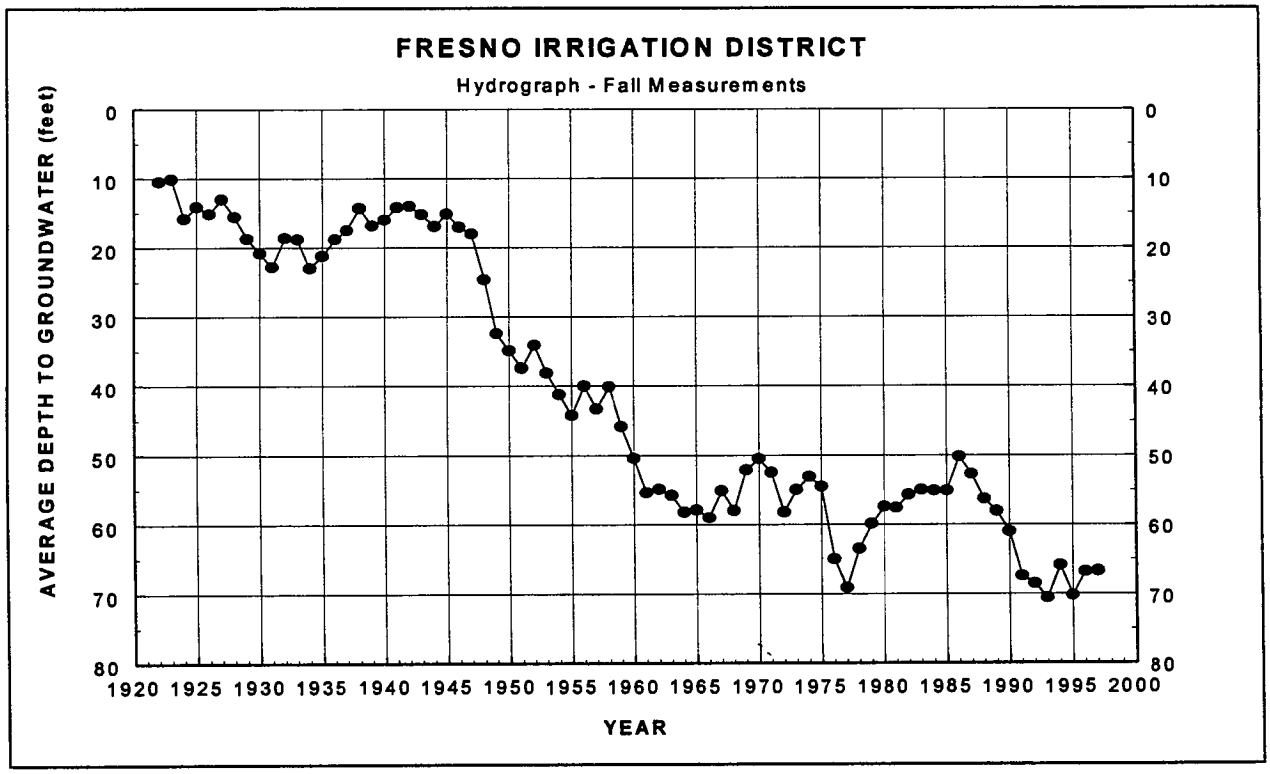


Figure 17

3.6 Fresno Metropolitan Flood Control District

The Fresno Metropolitan Flood Control District ("FMFCD") was formed by a special act of the California Legislature in 1956 with passage of the "Fresno Metropolitan Flood Control District Act." FMFCD was designed to provide fully coordinated flood control and drainage services on a regional basis. FMFCD encompasses an area of 257,600 acres, including the Fresno/Clovis metropolitan area, as shown on **Figure 18**, and is located entirely within Fresno County.

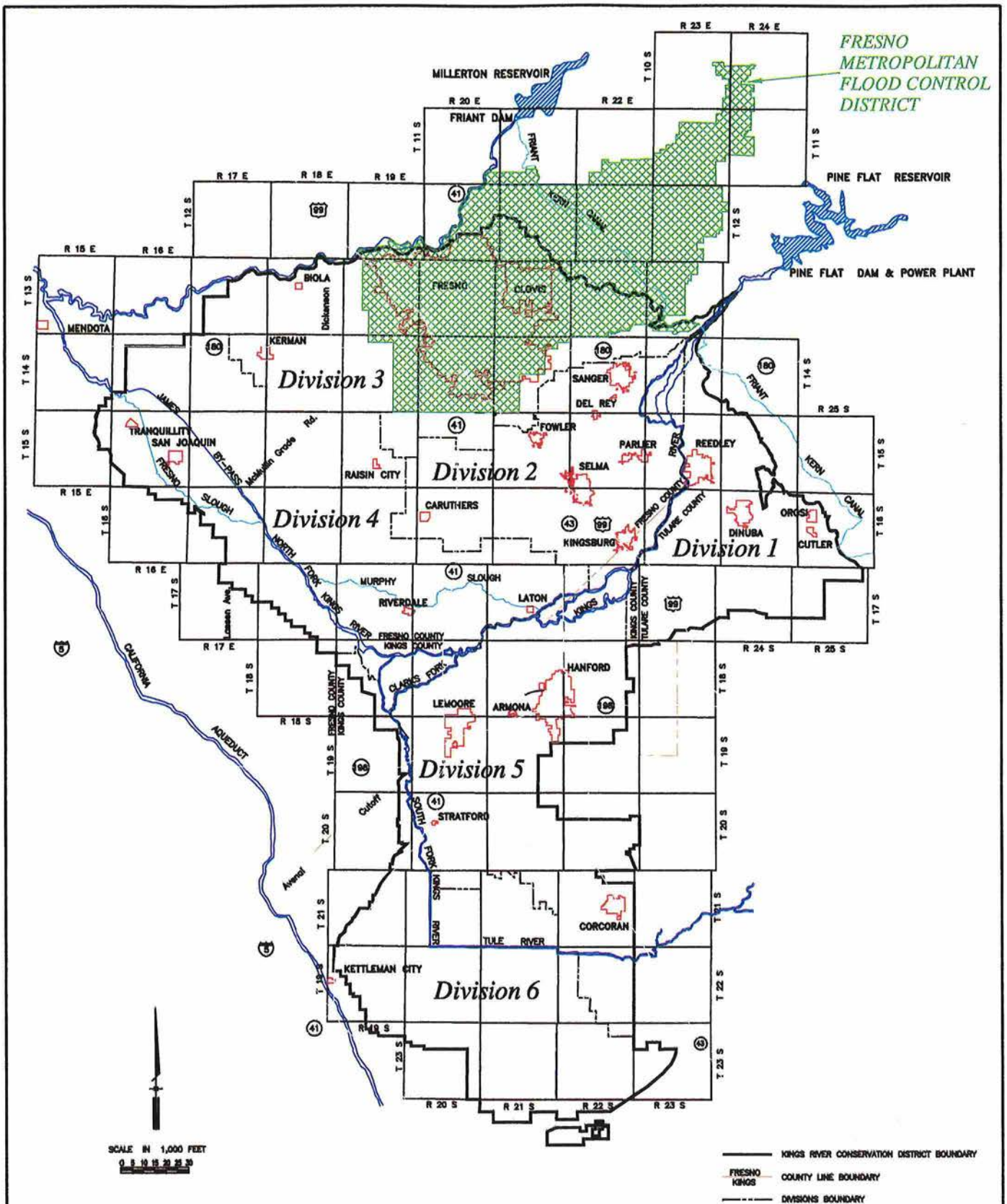
FMFCD is responsible for providing to the citizens and property within its boundaries: (1) protection from storm runoff from the Sierra Nevada foothills and from severe localized flooding by the use of dams, reservoirs, channels and streams; (2) protection from local storm damage by the use of underground pipelines, ponding basins and pumping plants; (3) water conservation through the use of FMFCD reservoirs and basins in conjunction with other water resource management programs to replenish the underground water supply; and (4) recreation by allowing the use of selected landscaped ponding basins to provide open space and outdoor recreational activities when not in use for flood control, drainage or water conservation.

In accordance with its responsibility for water conservation, FMFCD entered into a cooperative agreement in 1980 with the City of Fresno, the City of Clovis, fifteen Fresno County Water Works Districts, and the FID under which certain of FMFCD's flood control basins were to be used for artificial groundwater recharge during the summer months when they were not needed for storm runoff. Following consolidation of the Fresno County Water Works Districts into the City of Fresno Water Department in 1991, a new recharge agreement was executed which provided for the continuation of the program. Under the recharge agreement, FID delivers its own water from the Kings River to the ponding basins, and also delivers the City of Fresno's entitlement of Central Valley Project water from the Friant-Kern Canal to the ponding basins. The water is delivered via the FID's canals and pipeline interties to the basins.

FMFCD monitors the recharge program and makes semi-monthly reports to the City of Fresno, the City of Clovis and the FID. The reports indicate the volume of water in each basin and recommends any adjustments in the delivery rates that may be necessary, to meet authorized basin recharge levels.

FMFCD does not make measurements of depth to groundwater. Currently, 63 basins are being used in the program ranging in size from 3 acres to 45 acres, for a combined total area of 827 acres. The average annual recharge in individual basins during the period from 1980 to 1997 ranged from 60 acre-feet to 4,800 acre-feet. While not all of the 63 basins are used each year, their theoretical combined recharge potential is over 65,000 acre-feet per year. There are also seven basins that have the potential of being added to this program. Such additional basins would add 96 acres of basin area with an estimated annual recharge capacity of 4,200 acre-feet. To date, approximately 328,000 acre-feet have been recharged. The locations of the basins are shown on **Figure 19** and **Tables 5 and 6** list specifics about each basin. The future basin network within the FMFCD system encompasses nearly 60 additional basins which, if added to the groundwater recharge program, would increase the potential for recharging to more than 100,000 acre-feet per year.

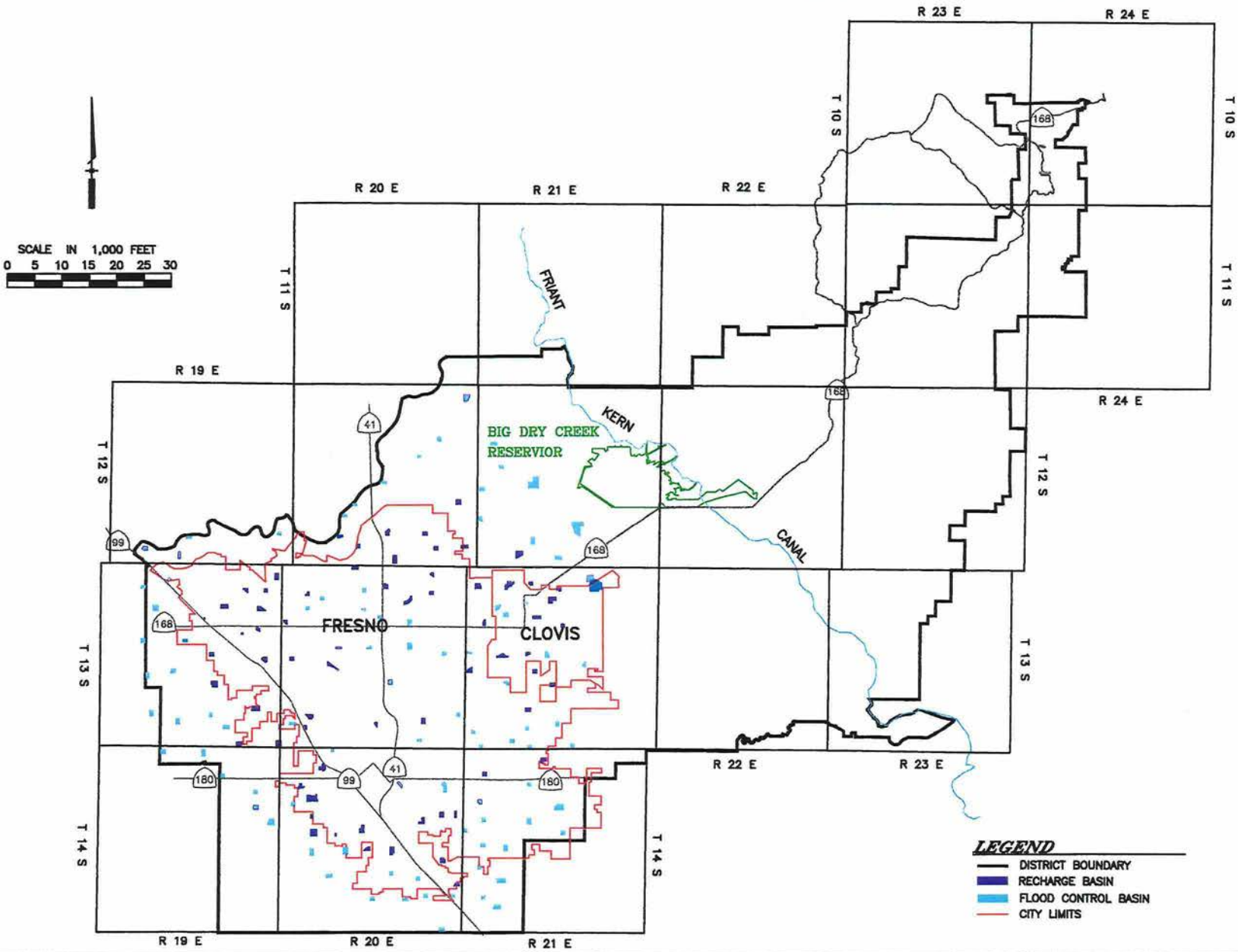
Maintenance of the basins is performed as needed by FMFCD. Accumulated silt that would tend to seal the basins and reduce percolation is removed on a three year cleaning cycle. Basins with highly permeable soils are cleaned on a one or two year cycle depending on soil composition. Better soils are cleaned more frequently to enhance recharge performance. The cost of maintenance performed by FMFCD is partially reimbursed by the cities of Fresno and Clovis. The Cities portion presently amounts to approximately $1.25 per acre-foot of water recharged. The cost of constructing new basin-interties is paid by either the City of Fresno or the City of Clovis, depending on whose program the basin is included.



FRESNO METROPOLITAN FLOOD CONTROL DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 18



FRESNO METROPOLITAN FLOOD CONTROL DISTRICT

LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT

4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 19

Table 5

Fresno Metropolitan Flood Control District
Existing Recharge Basins

Basin	Location	Size (acres)	Average Annual Recharge for 1980-1997 (acre-feet)	Estimated Annual Recharge Potential (acre-feet)
A	Maple/Florence	10.00	296.0	500.0
J	Bullard/Forkner	6.80	420.0	1,000.0
K	Shaw/Santa Fe	8.40	298.0	500.0
N	Fresno/Escalon	12.50	951.0	1,600.0
O	First/Bullard	12.50	61.0	100.0
P	Cedar/Bullard	8.90	71.0	200.0
R	Chestnut/Shepherd	16.00	888.0	1,500.0
S	Ashlan/Minnewawa	20.00	684.0	1,600.0
U	Chestnut/Dakota	12.00	479.0	700.0
Y	Adler/Kings Canyon	9.80	148.0	100.0
AB	Palo Alto/Marks	14.00	468.0	1,500.0
AC	Santa Fe/Bullard	10.40	4,801.0	700.0
AD	Escalon/Valentine	9.10	221.0	500.0
AE	Barstow/Brawley	19.00	546.0	1,600.0
AF	Shaw/Brawley	10.00	601.0	1,300.0
AG	Ashlan/Valentine	11.30	357.0	700.0
AH	Cornelia/Dakota	18.50	646.0	1,500.0
AJ	Gettysburg/Polk	10.20	568.0	1,000.0
AL	Clinton/Brawley	17.10	902.0	1,500.0
AO1	Belmont/Blythe	17.00	403.0	1,000.0
AZ	Chestnut/Malaga	14.50	349.0	1,000.0
BO	Sunnyside/Belmont	15.00	343.0	700.0
BU	Clovis/McKinley	19.00	255.0	500.0
BV	Fowler/Shields	12.00	281.0	500.0
BW	Clovis/Dakota	10.00	222.0	500.0
CC	Clark/Floradora	4.20	172.0	300.0
CL	Willow/Sierra	14.50	334.0	600.0
CM	Cedar/Palo Alto	10.10	389.0	1,000.0
CN	Fresno/Herndon	21.00	1,921.0	1,500.0
CO2	Herndon/Maroa	12.30	2,713.0	4,000.0
CW	Fresno/Nees	15.30	1,427.0	2,000.0
CX	Nees/Ninth	12.00	525.0	700.0
CY	Alluvial/Cedar	10.00	196.0	500.0
CZ	Chestnut/Alluvial	18.00	484.0	1,000.0
DD2	Palm/Dakota	16.80	1,439.0	2,500.0

Table 5 (cont'd)

Basin	Location	Size (acres)	Average Annual Recharge for 1980-1997 (acre-feet)	Estimated Annual Recharge Potential (acre-feet)
DH	Ingram/Bedford	9.00	148.0	800.0
EE	McKinley/West	11.10	267.0	500.0
EF	Cornelia/Bullard	17.36	380.0	2,000.0
EL	Highway 99/Barstow	2.60	253.0	500.0
FF	Kearney/West	44.80	603.0	1,000.0
GG	Florence/Maple	12.00	212.0	500.0
HH	North/Maple	13.50	462.0	1,000.0
II1	Church/Elm	11.30	237.0	500.0
II2	Church/Cedar	11.20	137.0	500.0
JJ	Floradora/Ninth	11.40	426.0	750.0
KK	Elm/Annadale	14.00	364.0	1,750.0
LL	Anadale/Cherry	18.70	429.0	800.0
MM	Ashlan/Hughes	8.50	1,416.0	2,400.0
OO	West/California	9.30	536.0	1,000.0
RR1	Thorn/Nielson	16.80	2,107.0	2,500.0
TT1	West/Jensen	19.00	608.0	1,000.0
UU2	Highway 99/Olive	6.11	204.0	500.0
UU3	Belmont/Marks	20.90	4,059.0	4,500.0
ZZ	Crystal/Whitesbridge	14.40	744.0	1,500.0
5B5C	Sierra/Villa	14.56	85.0	500.0
2D	Ashlan/Clovis	6.62	314.0	500.0
3A	Shaw/Helm	6.10	276.0	500.0
3D	Hoblett/Sunnyside	8.83	105.0	500.0
3F	Shaw/Laverne	6.86	158.0	500.0
5F	Fowler/Vartikian	7.60	65.0	500.0
6D	Clovis/Sierra	6.18	143.0	400.0
4E	Fowler/Bullard	16.35	91.0	800.0
7C	Alluvial/Minnewawa	23.50	492.0	1,200.0
Totals	**63 Basins**	**826.77**	**40,180.0**	**65,800.0**

Table 6

Fresno Metropolitan Flood Control District
Proposed Recharge Basins

Basin	Location (nearest cross streets)	Size	Estimated Recharge Potential (acre-feet)
T	Shields/Clovis	9.10	400
W	Minnewawa/Olive	10.02	500
1G	Temperance/Ashlan	9.50	500
4B	Villa/Barstow	9.97	300
BJ	Central/Chestnut	8.10	500
BT	Nees/Marion	18.51	1,000
DO	Locan/Dakota	30.50	1,000
	Total	**95.70**	**4,200**

3.7 Kaweah Delta Water Conservation District

The Kaweah Delta Water Conservation District (KDWCD) was formed in 1927 under provisions of the Water Conservation Act of 1927 for the purpose of conserving and storing waters of the Kaweah River and of conserving and protecting the underground waters of the Kaweah Delta.

The KDWCD is located in the south-central portion of the San Joaquin Valley. The total area of the KDWCD is about 337,000 acres, with approximately 255,000 acres located in the westerly portion of Tulare County and the balance of about 82,000 acres in the northeasterly corner of Kings County. The westerly boundary crosses the easterly boundary of KRCD at several locations, creating an overlap of the two districts as shown on **Figure 20**. This overlap amounts to approximately 34,500 acres, hence the inclusion of the KDWCD's groundwater recharge program in this report.

The major city in the KDWCD is Visalia with a January 1, 1997 census population of 92,473. Smaller urbanized areas are the towns of Farmersville (population 6,200) and the unincorporated communities of Goshen, Ivanhoe, Waukena and Guernsey.

Approximately 300,000 acres of the KDWCD's land are devoted to irrigated agriculture and about 22,500 acres are devoted to urban and industrial activities. The remaining 14,500 acres of land are undeveloped and are considered largely unsuitable for agriculture.

Water used in the KDWCD is obtained by diverting the stream flow of the Kaweah River, by importation from the Kings River to the north of the District, by deliveries from the Central Valley Project (CVP) Friant-Kern Canal which passes through the District, by pumping from groundwater, and from direct precipitation. Each of these sources is used to satisfy the irrigation requirements of the KDWCD, while pumping from the groundwater alone satisfies the needs of the municipal, industrial, and domestic users.

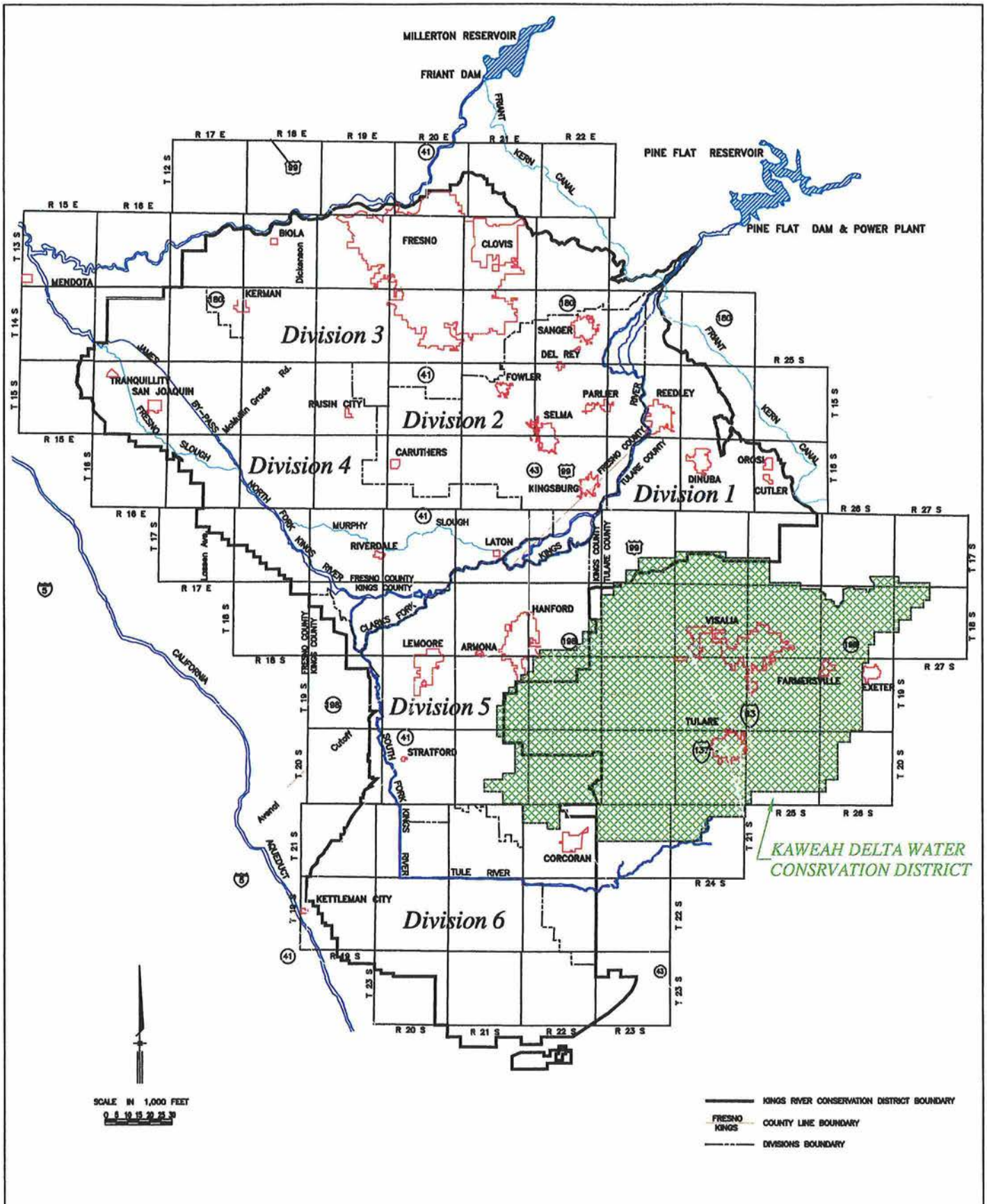
Tulare Irrigation District is the only entity within the KDWCD with a long-term contract with the U.S. Bureau of Reclamation for CVP water. This contract provides for an average annual delivery of about 100,000 acre-feet. In addition, the KDWCD and constituents have purchased, when available, water surplus to the needs of the long-term CVP contractors in amounts which average 55,000 acre-feet per year.

At the present time, about 1,044,000 acre-feet of water per year is delivered for agricultural irrigation, municipal, industrial, and domestic uses. Water is used primarily to satisfy the demands of irrigated agriculture which constitutes about 95 percent of the total deliveries, or 990,000 acre-feet per year. On average, about 277,000 acre-feet is obtained from surface supplies, with the balance of 713,000 acre-feet being pumped from the groundwater.

The KDWCD completed an in-depth study in 1972 of its water supply and demands. They used a 22-year base period (1958/59 through 1979/80), and assumed that CVP water will no longer be available to the District. Results of the study indicate that demand for water at that time exceeded supply by 133,000 acre-feet per year. This deficiency was expected to remain constant into the future. Unless additional surface water supplies are acquired, this deficiency will have to be made up by pumping from the groundwater, which will result in an overdraft that will be reflected by gradual lowering of the water table in portions of the KDWCD.

Since 1930, the KDWCD has conducted a program of artificial recharge of groundwater, both in the natural channels of the Kaweah River distributaries and in off-stream basins. In addition to the planned recharge program, recharge naturally occurs from the daily operations within the KDWCD through percolation in the Kaweah River system, percolation in canals and channels carrying Kaweah River, Kings River, and CVP water, deep penetration of the unconsumed portion of applied irrigation water, deep penetration of unconsumed direct precipitation, and by percolation of sewage effluent.

For the most part, groundwater recharge is obtained from percolation losses occurring in connection with the deliveries or surface water for irrigation. Canals and natural channels used for the conveyance of water are unlined, passing through highly pervious materials wherein substantial losses are experienced. It is estimated that of the 500,000 acre-feet of Kaweah River and CVP water delivered to the KDWCD, about 40 percent percolates from the conveyance system to groundwater storage.



KAWEAH DELTA WATER CONSERVATION DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

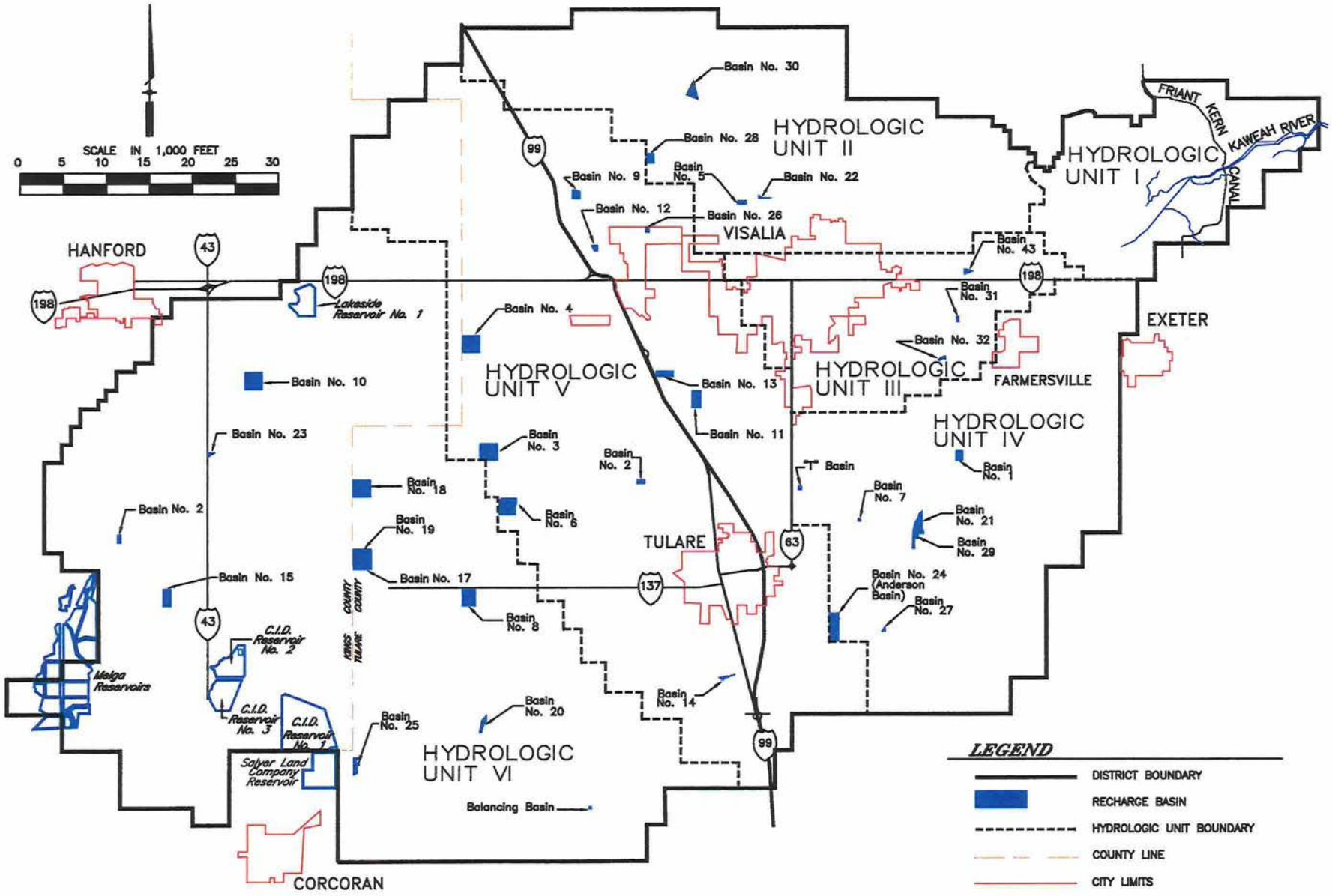
FIGURE 20

It is assumed that deep percolation of precipitation occurs only in years of abnormally high precipitation, thus the contribution to groundwater by this source may be no more that a few thousand acre-feet per year on average. Deep percolation of sewage effluent does not constitute true groundwater recharge since the water recharged was originally pumped from groundwater by the municipal, industrial and domestic users that produce the effluent.

From time to time, the KDWCD has purchased surplus CVP water and released it into the natural channels of the Kaweah River system for percolation to groundwater. Additionally, the KDWCD has percolated its Kaweah River entitlements in these channels. Since the KDWCD's entitlement is of relatively low priority, yielding water only during periods of high river flows, such practice has been infrequent. The KDWCD, in cooperation with Tulare Irrigation District, Lakeside Irrigation Water District, and Corcoran Irrigation District, has participated financially in the acquisition of surplus CVP water which, in part, was percolated to the underground in its conveyance to the three districts.

Over the years, the KDWCD has constructed 39 off-stream basins for groundwater recharge. The total area of these basins is approximately 4,800 acres with an estimated total infiltration capacity of about 1,100 acre-feet per day. These basins vary in their ability to percolate water, with those in the easterly part of the KDWCD having greater percolation rates than those in the west because of the presence of more permeable surface soils. The locations of the basins are shown on **Figure 21**. The tabulation below presents specific information on the recharge basins within each of six hydrologic units. The hydrologic units are divisions of the KDWCD used for purposes of quantitative analysis. The boundaries of the units were established primarily on the basis of the subsurface geologic features which affect the occurrence and movement of groundwater and, to a lesser degree, upon the pattern of surface water conveyance and distribution within the KDWCD.

Hydrologic Unit	Number of Recharge Basins	Total Area of Basins (acres)	Estimated Total Percolation Capacity (AF/day)
I	0	0	0
II	4	170	80
III	4	33	29
IV	6	271	100
V	11	713	377
VI	14	3,580	556
Totals	**39**	**4,767**	**1,142**



KAWEAH DELTA WATER CONSERVATION DISTRICT
LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 21

Although quantitative determinations of annual amounts of groundwater recharge from the basins are not available, it is recognized that such recharge is greatly exceeded by that of channel percolation, which is estimated to average 200,000 acre-feet per year.

The quantity of water delivered to the recharge basins is not measured and there is no practical way to measure the amount of water percolating to groundwater. The KDWCD does, however, measure semiannually the depth to groundwater in approximately 230 irrigation wells. In addition, approximately 120 wells within the KDWCD are measured semiannually by Tulare Irrigation District and Kings County Water District. These measurements are plotted in the hydrograph shown on **Figure 22**. The hydrograph indicates a fluctuating water table, with an increase in the depth to groundwater in drought years and a decrease in the depth in wet years. This indicates that the KDWCD's artificial groundwater recharge program is effective when water is available.

As the demand for water increases, as it surely will, the deficit in the groundwater supply will continue, disrupting the relatively stable groundwater levels. To offset the deficit, the KDWCD anticipates utilizing the following two approaches: (1) increase activity in the artificial recharge basins in the area west of U.S. Highway 99, where studies indicate the largest groundwater deficit occurs; and (2) acquire additional supplies of imported surface water.

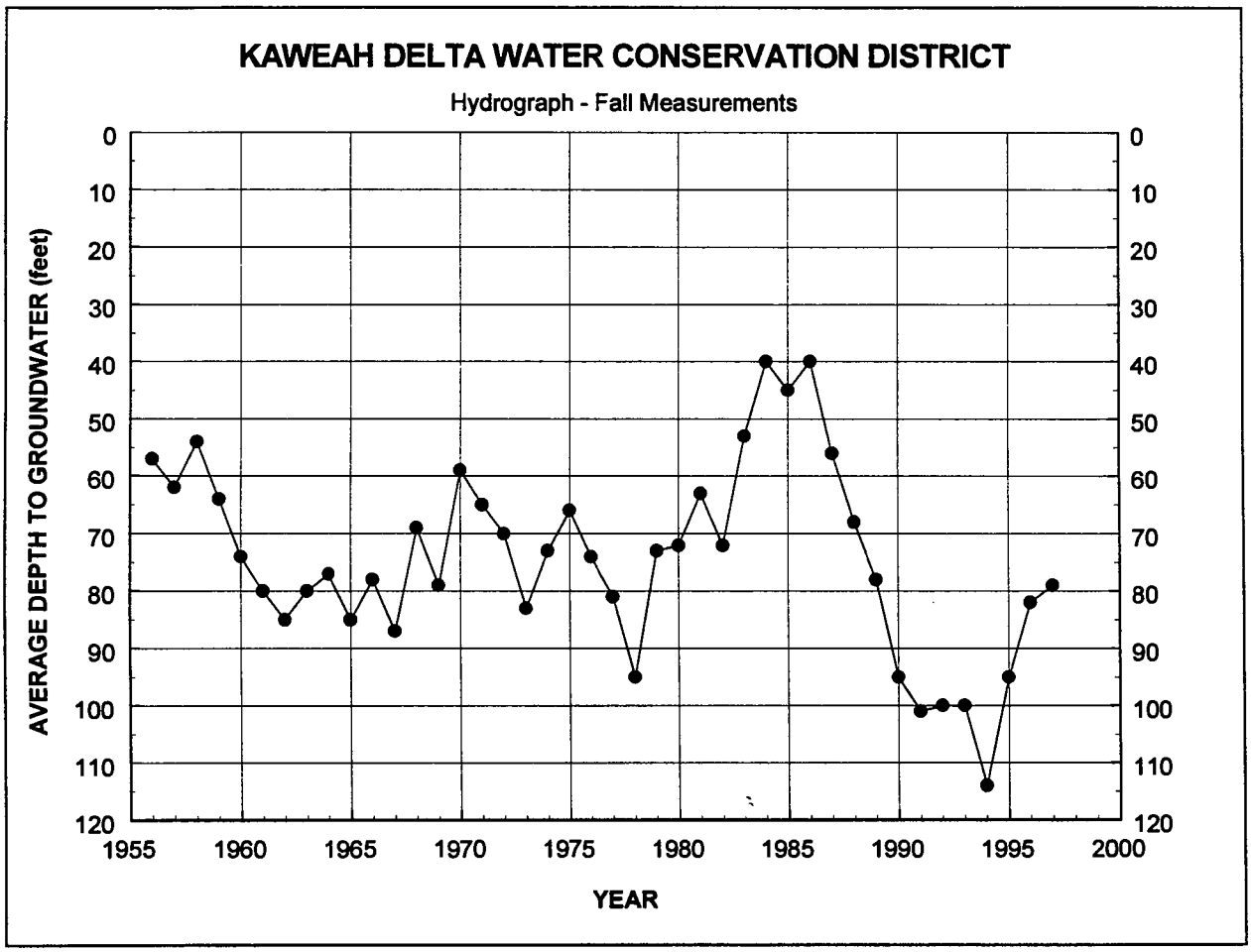


Figure 22

3.8 Kings County Water District

The Kings County Water District (KCWD) was formed in 1954 under the County Water District Act to provide a legal entity for water management in the northeast portion of Kings County. The basic programs of the KCWD are: (1) protection, conservation, and stabilization of groundwater; (2) negotiating and contracting for supplemental water; (3) maintaining facilities for distribution of surface water for irrigation and groundwater recharge; and (4) preserving the existing surface water rights held by mutual water companies through a program of water stock acquisition and retention.

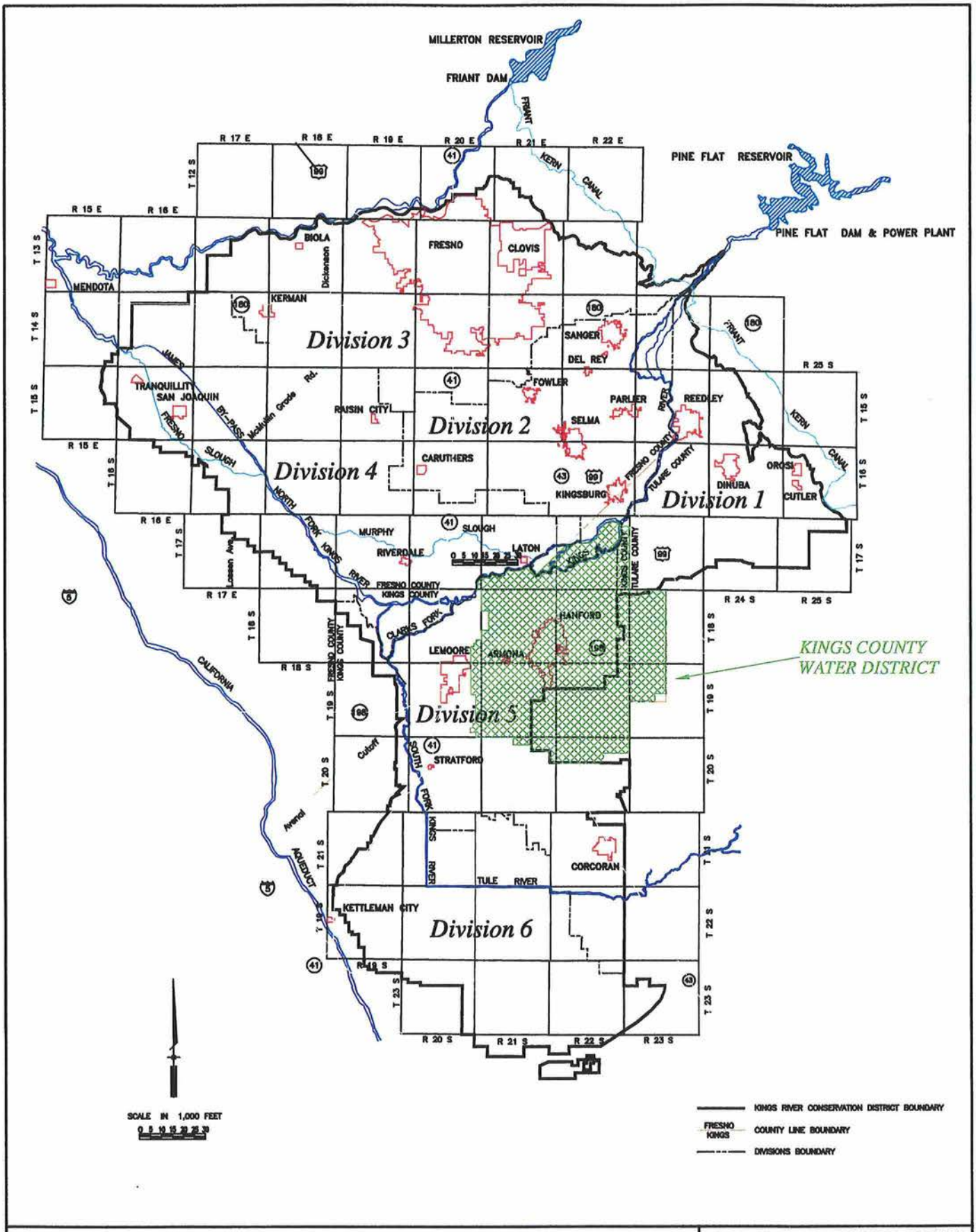
The KCWD is located in the east-central part of the Kings River service area and is entirely within Kings County as shown in **Figure 23**. The City of Hanford, with a population of 38,000, lies near the center of the KCWD. The total area of the KCWD is 143,000 acres, of which 51,150 acres are solely within KRCD, 82,610 acres are solely within the boundaries of Kaweah Delta Water Conservation District, and 9,240 acres are within the area where the two districts overlap.

The KCWD includes portions of the service areas of three major mutual ditch companies; Peoples Ditch Company and Last Chance Water Ditch Company, both of which possess water rights on the Kings River, and Lakeside Ditch Company, which holds water rights on the Kaweah River. The KCWD boundary completely encompasses the Lakeside Irrigation Water District, a California Water District formed to administer the water rights and distribution system of the Lakeside Ditch Company stockholders, and to acquire additional surface water supplies. The KCWD also operates and maintains the Riverside Ditch, a conveyance system used to distribute the KCWD and Peoples Ditch Company's water.

Currently, the KCWD has over 1,100 acres of artificial groundwater recharge basin area, and also uses some 230 miles of unlined canals owned by the ditch companies which contributes to incidental recharge. The basins are located near the conveyance systems of the Peoples, Settlers, Last Chance, Lakeside and Riverside Ditch Companies. The KCWD also uses old slough and river channels and has a continuing program of purchasing and leasing property for groundwater recharge, also, there are water companies within KCWD boundaries that contribute to incidental recharge. Maintenance consisting of weed control and efforts to maintain permeability of the recharge basins is performed by the KCWD. A map of the KCWD boundary with the basin locations is shown on **Figure 24**.

The quantity of water used in the recharge program has only recently been measured. Critically dry years such as 1976-77 resulted in zero recharge while wet years such as 1982-83 yielded 125,000 acre-feet of recharge. The results of the program are monitored by semiannual measurements of the groundwater level in 230 wells. The average of the measurements taken in these wells each fall is plotted on the hydrograph in **Figure 25**, which shows an erratic decline in groundwater levels.

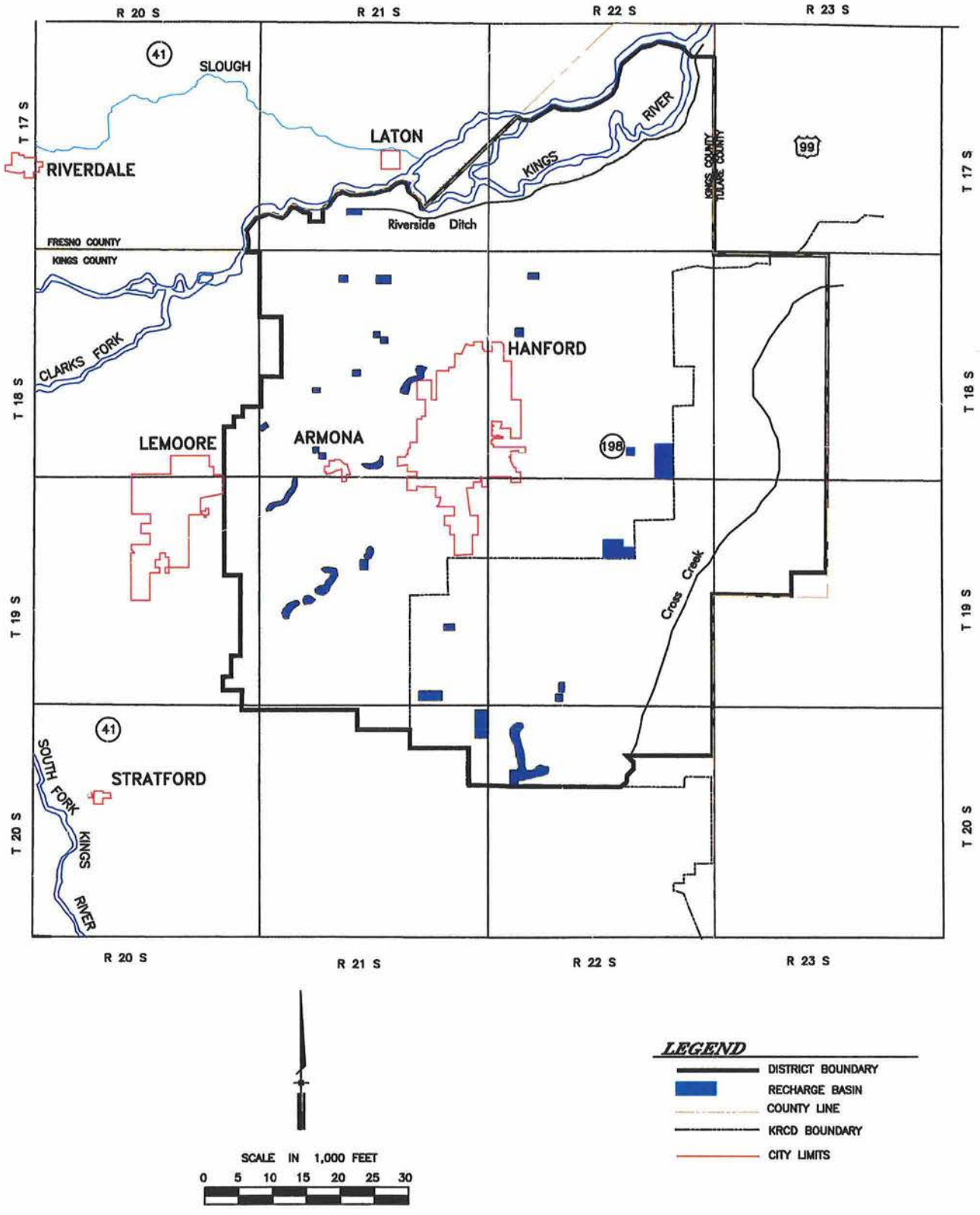
Since the KCWD's formation in 1954, the average depth to groundwater has gone from 37 feet to 74 feet, measured in the fall of 1997. The average yearly decline in groundwater levels is 0.86 feet per year since 1954. This equates to an annual average overdraft of 12,300 acre-feet. To counteract this overdraft, the KCWD has practiced conjunctive use of surface water and groundwater, plus the planned artificial recharge of the groundwater by importing available surplus water and flood release water from reservoirs on the San Joaquin, Kings, and Kaweah rivers and placing it in recharge basins. The KCWD's practices appear to be producing positive results because the rate of decline in groundwater levels is less after 1954 than in years preceding it's formation. The KCWD's efforts are enhanced by the cooperation of Last Chance, Peoples, Settlers, and Lakeside Ditch Companies which provide the conveyance system to these basins and help regulate the rate of recharge. They also help distribute surface water purchased by the KCWD to local farmers who would otherwise pump groundwater.



KINGS COUNTY WATER DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 23

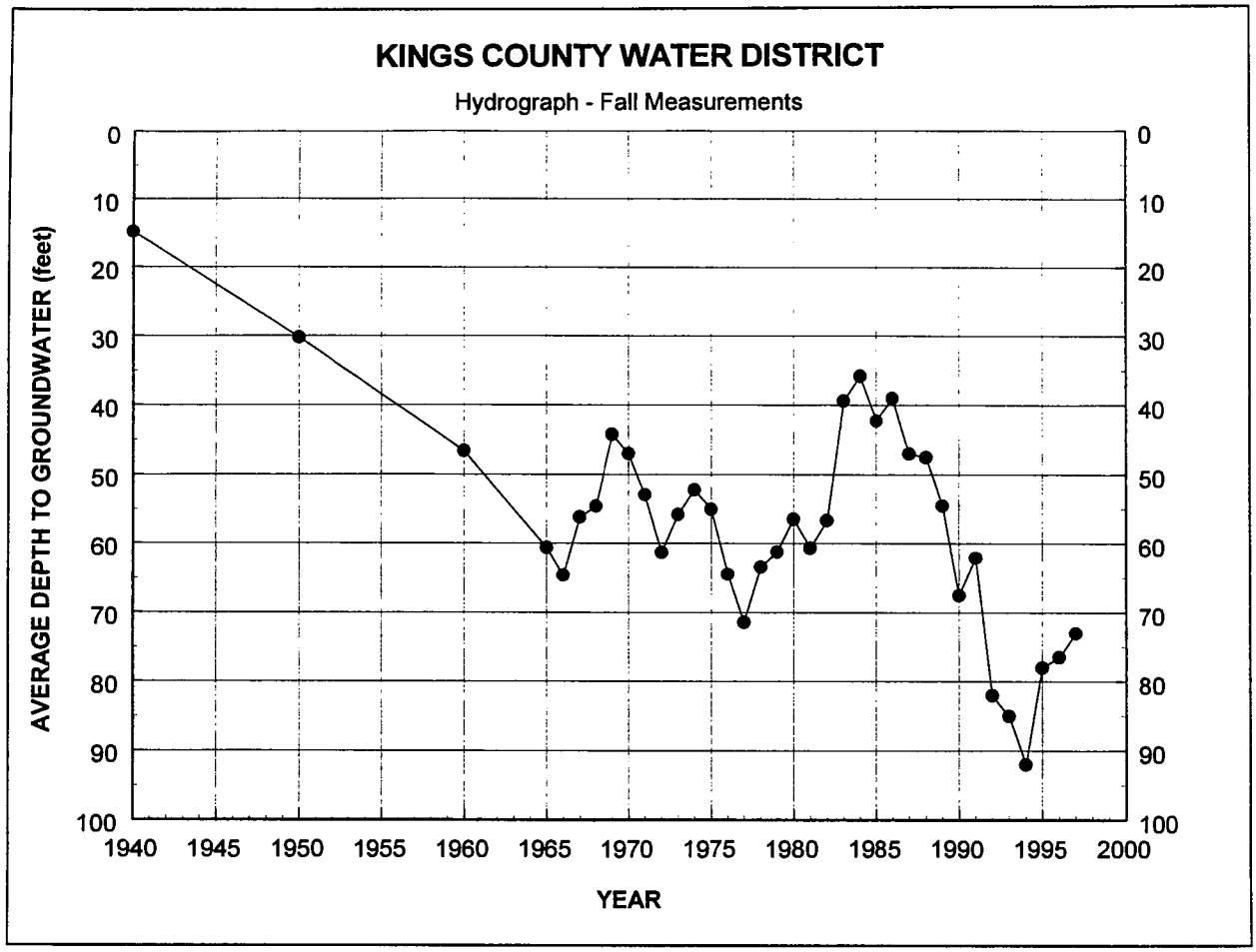


KINGS COUNTY WATER DISTRICT
LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 24

Figure 25



An estimated 135,000 acres (almost 95 percent of the KCWD) is devoted to irrigated agriculture. Surface water supplies for irrigation come from diversions from the Kings and Kaweah Rivers, and from exchanges and purchases of surplus CVP and State Water Project water. The supply of surface water is inconsistent, and ranges from a low of 30,000 acre-feet in 1977 to a high of 327,000 acre-feet in 1983. The estimated average annual surface supply is 150,000 acre-feet.

Because the surface supplies, even in the best years, are inadequate to meet the total demands for water within the KCWD, groundwater is pumped through private wells by landowners to meet their individual needs. In addition, all the water requirements for municipal and industrial users are pumped from groundwater. Approximately 282,500 acre-feet of groundwater is pumped annually, which has created an overdraft. Which is expected to worsen as the urban population grows.

3.9 Lakeside Irrigation Water District

Lakeside Irrigation Water District (LIWD) was formed in 1962 to purchase and import supplemental water and to administer the water rights from stock owned in the Lakeside Ditch Company. As shown in **Figure 26**, LIWD comprises 31,900 acres of land located in the east-central part of the Kings River service area, immediately southeast of the city of Hanford in Kings County. It is located entirely within the boundaries of the Kings County Water District, and largely within the boundaries of the Kaweah Delta Water Conservation District. Of the 31,900 acres in the LIWD, approximately 28,000 acres are used for agricultural purposes.

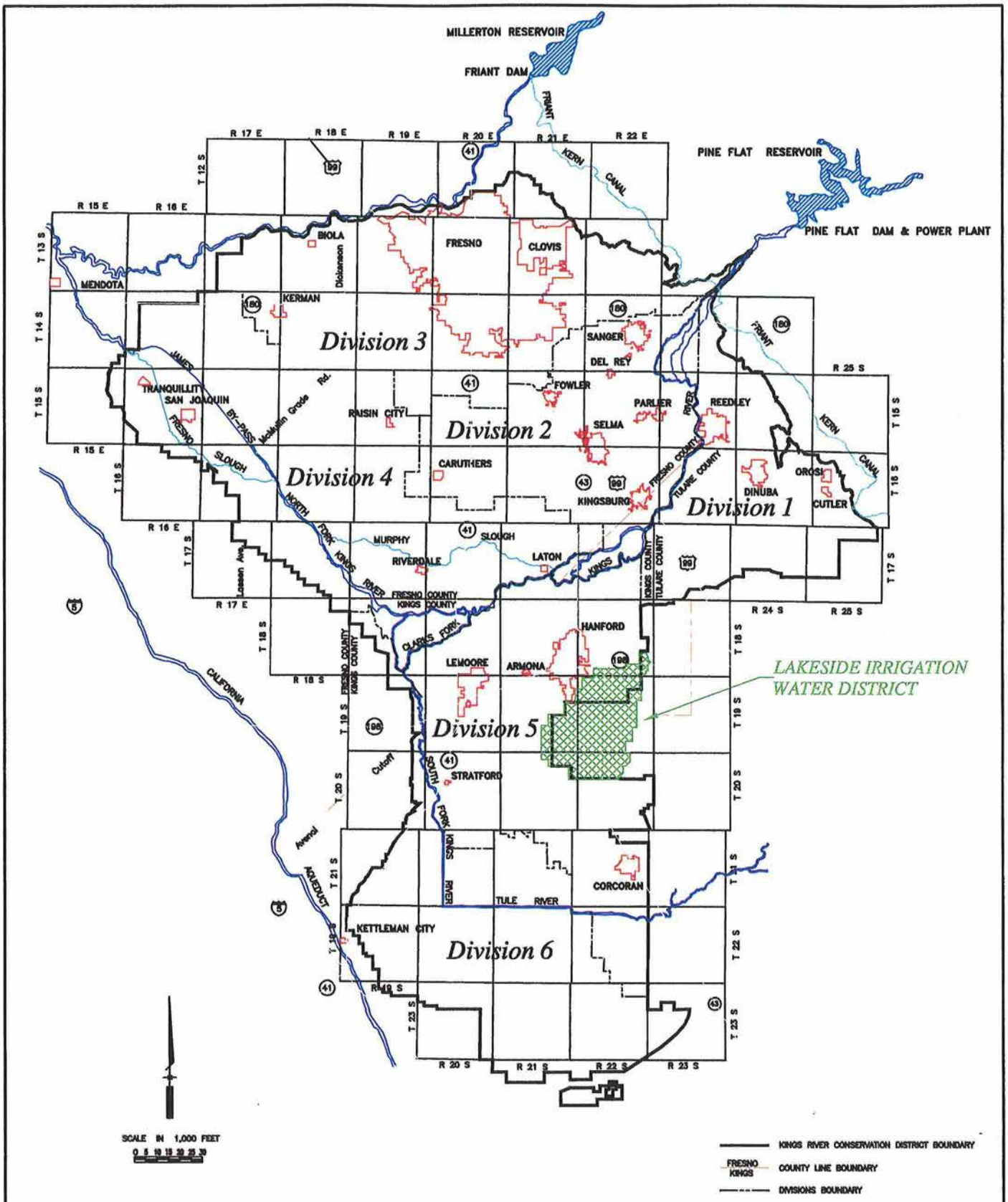
LIWD receives from the Lakeside Ditch Company stock ownership a long-term average annual entitlement of 36,000 acre-feet from the Kaweah River and an annual average of 18,000 acre-feet of supplemental water from the Kings River and the CVP. In addition to the above annual surface water supply, individual farmers also pump approximately 42,000 acre-feet of groundwater to satisfy crop water demands.

Since its formation in 1962, the LIWD has continuously conducted conjunctive use of surface and groundwater and has developed an artificial groundwater recharge program. The eleven basins situated throughout the District used for groundwater recharge are shown in **Table 7** below and in **Figure 27**.

Table 7

Lakeside Irrigation Water District
Existing Recharge Basins

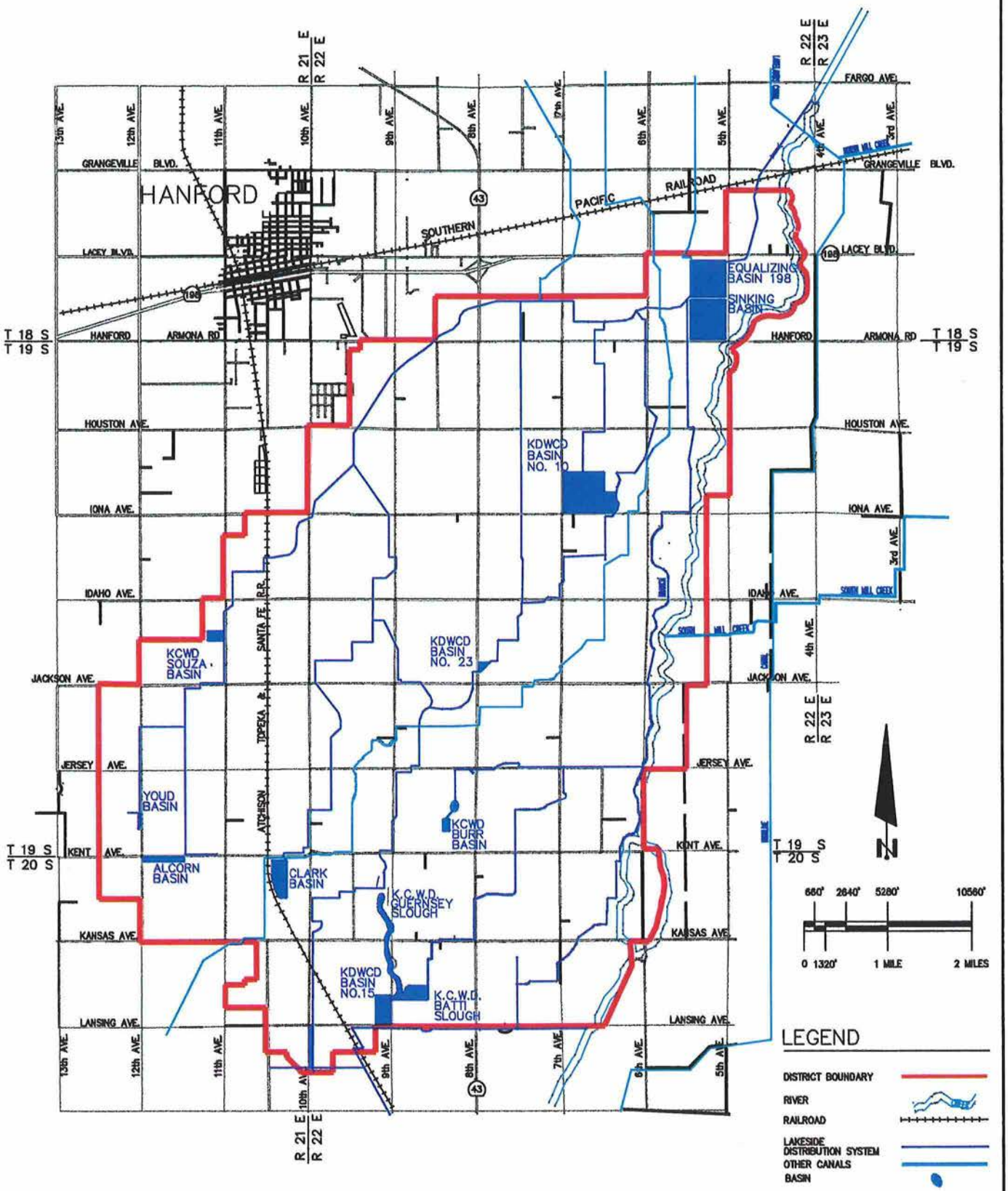
Location	Size (acres)	Percolation Rate (acre-feet/day)
E ½, Section 35, T18S, R22E (Equalizing Basin)	160	30
NW ¼, Section 5, T19S, R22E (Golf Course)	10	6
S ½, Section 10, T19S, R22E	185	40
NE ¼, Section 23, T19S, R21E	7	6
NW ¼, Section 2, T20S, R21E (Tailwater Management Basin)	12	2
NE ¼, Section 1, T20S, R21E (Tailwater Management Basin)	66	6
E ½, Section 32, T19S, R22E (Tailwater Management Basin)	10	8
Sections 6, 7, & 8, T20S, R22E (Tailwater Management Basins)	100	10
SE ¼, Section 34, T19S, R21E (Tailwater Management Basin)	5	2
SW ¼, Section 21, T19S, R22E	3	2



LAKESIDE IRRIGATION WATER DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 26



LAKESIDE IRRIGATION WATER DISTRICT
LOCATION OF RECHARGE FACILITIES

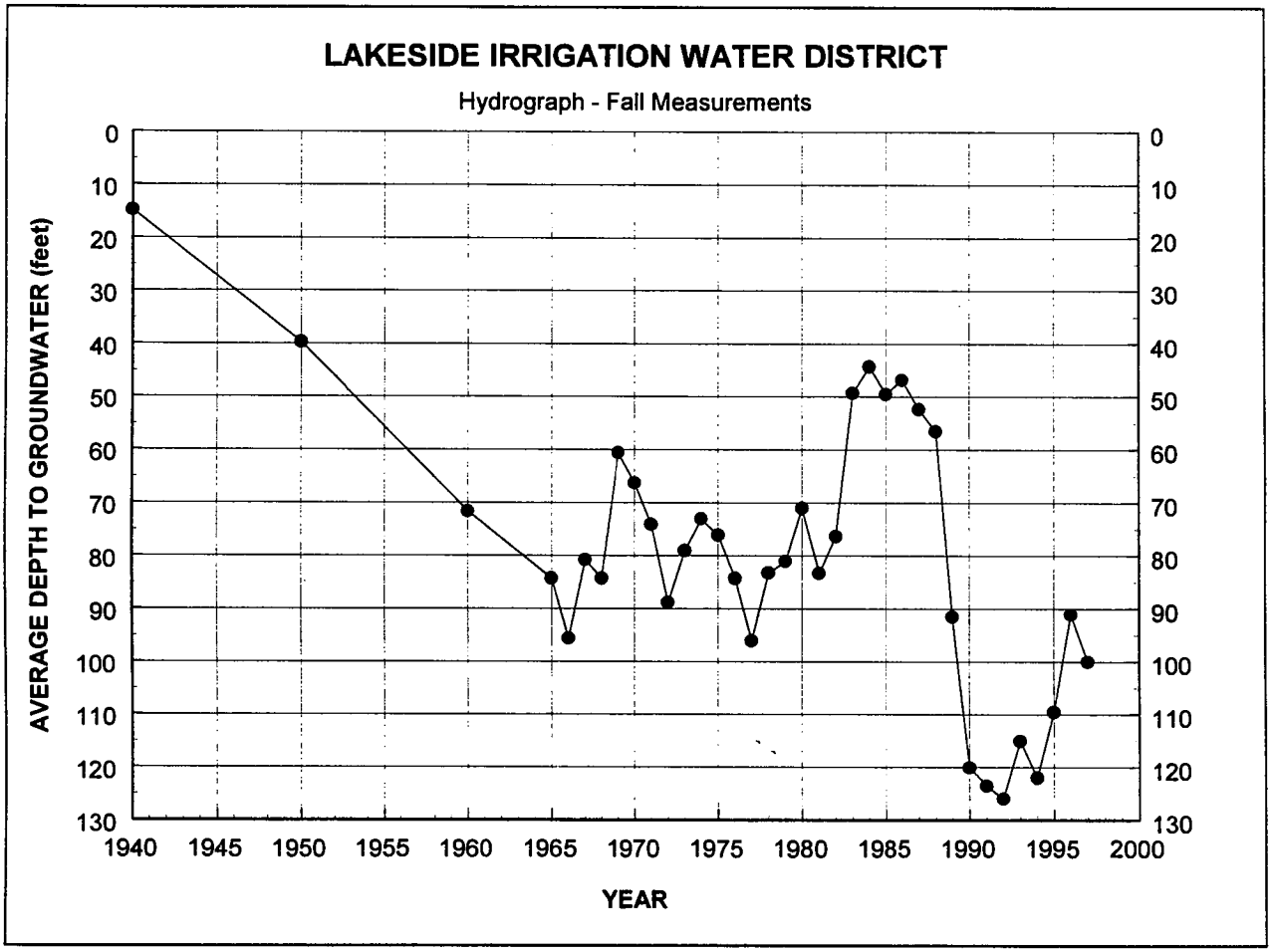
KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 27

The LIWD is experiencing a long-term average annual overdraft of the groundwater supply estimated to be approximately 30,000 acre-feet. This overdraft has produced subsidence of the surface and increased the depth to groundwater by more than 85 feet since 1940, as can be seen in the hydrograph in **Figure 28**. Between 1940 and 1966, the water table declined at a steady rate of 3.1 feet per year for a total of 80.8 feet. Then, from 1966 to 1997, the water table dropped by only 4.5 feet, for a total of 85.3 feet. LIWD management predicts that the overdraft will continue and increase unless an additional 30,000 acre-feet of supplemental water is imported annually to offset it.

The artificial groundwater recharge program is restricted to those periods of time that surplus or flood waters are available from the Kings or Kaweah Rivers. During a normal year or during periods of drought, all water available is delivered directly for irrigation and none is diverted to the recharge basins except as a result of regulation. When surplus and flood waters are available for intentional recharge, it is delivered to the basins through LIWD's canals. Monitoring the effects of the recharge program is included in the normal monitoring of the depth to groundwater with measurements made semiannually in 33 private wells located throughout the LIWD.

Figure 28



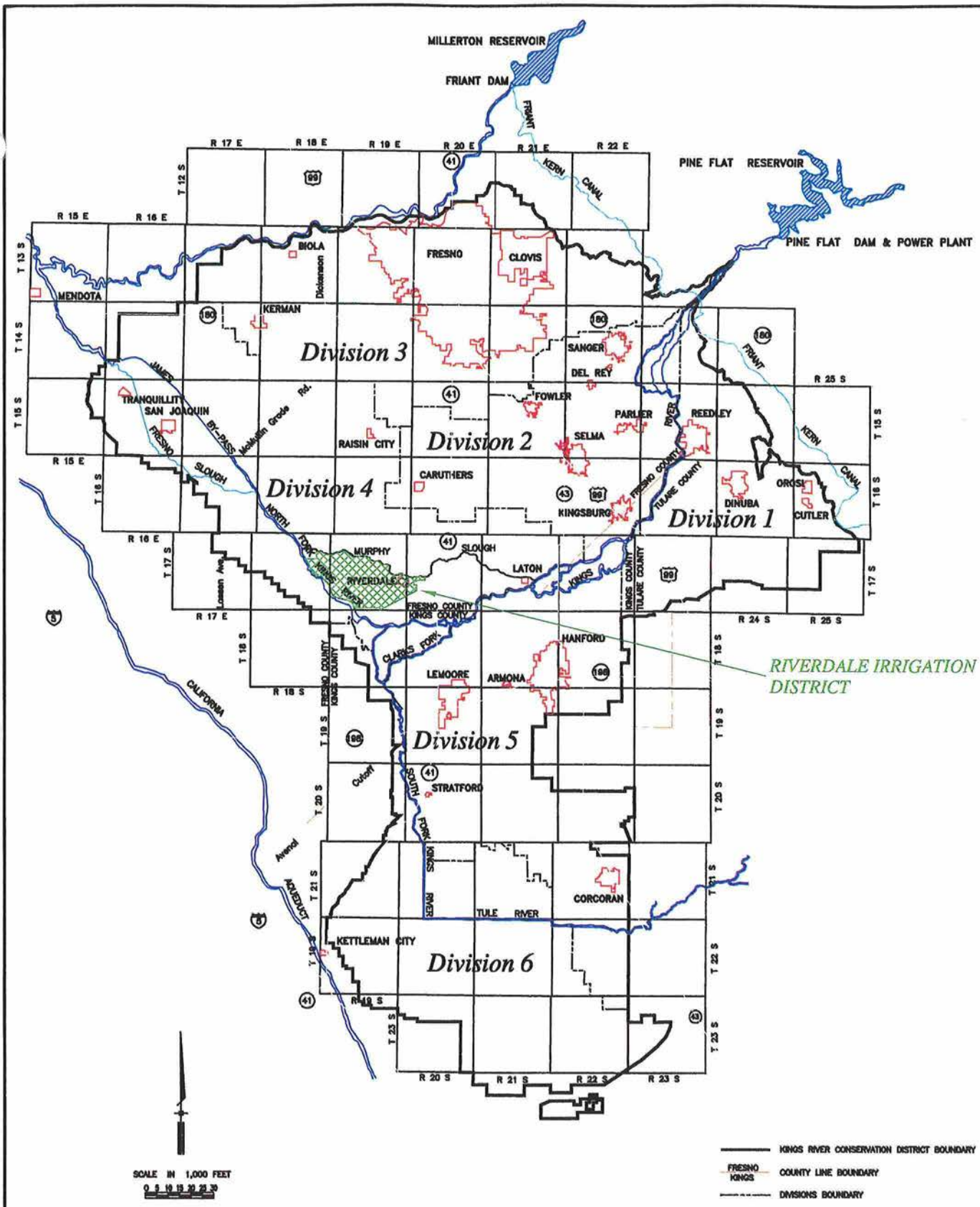
3.10 Riverdale Irrigation District

Riverdale Irrigation District (RID), formed in 1923, is located in the west-central part of the Kings River service area, as shown on **Figure 29**. The RID lies completely in Fresno County and is comprised of approximately 15,000 acres of land, 14,000 acres of which is irrigated crop land, 700 acres is taken by the town of Riverdale, and 300 acres are devoted to suburban uses other than agriculture.

The RID receives an average of 29,000 acre-feet of surface water annually from the Kings River, which is distributed throughout the RID by approximately 27 miles of unlined canals. In addition, individual farmers pump an estimated 22,000 acre-feet of water annually from the groundwater supply.

On December 5, 1995, the RID adopted a Groundwater Management Plan and now measures thirteen wells in the RID in the spring and fall of every year. The average depth to groundwater from the fall 1997 measurements was 120 feet.

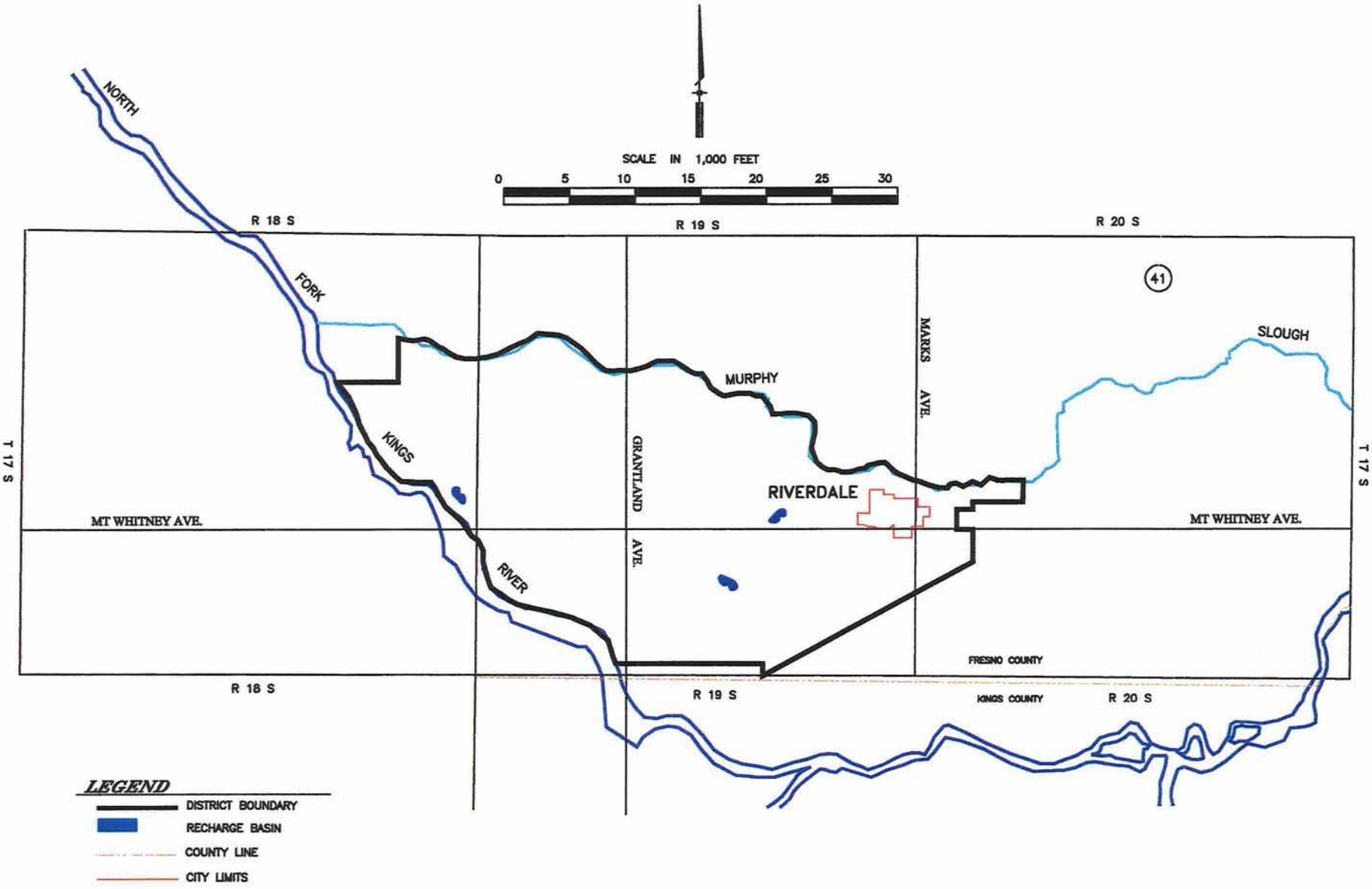
The RID has conducted a limited artificial groundwater recharge program since its formation by delivering Kings River flood flows, or surplus CVP water when available, to one or all of three ponding basins located as shown on **Figure 30**. Two of the basins formed naturally and are used for the control of flood flows as well as for recharge. One basin has no means of removing water. A pump was installed in 1997 in the second basin so water could be removed. These two basins have been in use since the RID formation in 1923. The third basin was constructed in 1985 to serve as a storage and regulation reservoir and to also be used for recharge. It has a pump by which water may be removed. The three basins cover a combined area of approximately 40 acres. Use of the basins for recharge is sporadic because the supply of water available for recharge is unpredictable.



RIVERDALE IRRIGATION DISTRICT
LOCATION MAP

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 29



RIVERDALE IRRIGATION DISTRICT

LOCATION OF RECHARGE FACILITIES

KINGS RIVER CONSERVATION DISTRICT

4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 30

4.0 Summary, Conclusions and Recommendations

4.1 Summary

(1) The first artificial groundwater recharge program was started in the Kings River service area in 1923. Today, there are eleven entities within the service area engaged in artificial groundwater recharge programs including city and county agencies and public water and irrigation districts.

(2) These entities, excluding the Kings River Conservation District, represent approximately 619,000 acres of land, or 56 percent of the total land in the Kings River service area.

(3) Groundwater extractions make up approximately 43 percent of the total water used by these entities.

(4) Groundwater levels within the service area are being lowered at rates as low as 1.9 feet per year in the north to as high as 12.0 feet per year in the south.

(5) The conjunctive use programs of imported surface water with groundwater currently utilized throughout the service area have been successfully implemented on a voluntary basis.

(6) Groundwater management programs within the service area are complex, requiring numerous and differing recharge techniques, water exchanges between entities, and other cooperative measures.

4.2 Conclusions

(1) Continued growth, particularly urban growth, urban growth, is inevitable. This growth will result in presently irrigated land and presently undeveloped land becoming urbanized, with attendant changes in water requirements.

(2) Unmitigated overdraft of the groundwater will result in a continued lowering of groundwater levels. While there is no immediate danger of running out of groundwater, the lower water table will result in the need to extend existing wells or install new ones, to pump from greater depths, and to install higher horsepower pumps, all of which will result in increased energy consumption and increased cost to those doing the pumping.

(3) Continued overdraft will result in additional subsidence in portions of the service area.

(4) Continued overdraft will contribute to localized problems with groundwater quality, such as is being experienced in the Fresno-Clovis metropolitan area with water contaminated by agricultural and industrial chemicals being drawn into the zone of influence of the city pumps.

(5) There is a need for more surface and subsurface storage to meet the growing demands. However, because of the unlikelihood of increased surface storage (new reservoirs on the river systems), there must be more reliance on subsurface storage. At this time, without consistent abnormally high runoff, the existing facilities would be inadequate.

(6) The problem of overdraft affects the Kings River service area as a whole.

4.3 Recommendations

(1) All entities within the Kings River service area should become involved in groundwater management and participate in programs of artificial groundwater recharge.

(2) There needs to be a sharing of information and ideas on groundwater management.

(3) There needs to be improved monitoring of the amounts of water being utilized in artificial groundwater recharge programs

(4) Conservation measures need to be instituted by the districts and the individual water users, such as lining ditches and installing pipelines where appropriate, installing drip systems, using soil moisture monitors, etc.

(5) Treatment of surface water supplies by municipal and industrial users should be considered.

(6) All agencies within the service area should support the importation of more surface water and construction of new or enlargement of existing water storage facilities on the rivers and streams supplying the service area.

6

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Kings River Service Area

Annual Groundwater Report 1997

Kings River Conservation District
Fresno, California

KINGS RIVER CONSERVATION DISTRICT

1997 Annual Groundwater Report

for

Kings River Service Area

December 1998

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INTRODUCTION

The Kings River Conservation District (District) is a political subdivision of the State of California and was formed by the California Legislature with the passage of the "Kings River Conservation Act" in 1951. The District covers an area of approximately 1,240,000 acres in the central San Joaquin Valley which includes portions of Fresno, Kings and Tulare Counties. The District's boundaries encompass the entire service area of the Kings River, which is the primary source of surface water for the area. The District's boundaries and its six divisions are shown on Figure 1.

The flow of water in the Kings River is variable from year to year. During "normal" and "dry" (when runoff is less than normal) years, the available surface water supply does not meet the total water demand of the area. When such a shortage of water exists, the deficiency is remedied by the pumping of groundwater which may result in a drop in the water table. During the years when runoff exceeds normal, commonly referred to as "wet" years, the water table may rise due to a decrease in pumping and an increase in natural recharge. Since, on the average, "wet" years occur only four out of ten years, the long-term trend is a decline in the water table.

The District initiated a groundwater study in 1987 to monitor the trends within the service area. This report is the eighth in a series of groundwater reports which presents groundwater data and analysis pertinent to the District on an annual basis. Previous reports were produced semiannually, one for each spring and fall measurement period.

OBJECTIVE

The objective of this report is to present groundwater conditions within the District as they existed during the spring and fall of 1997, and to compare those conditions with previous years. This report includes tables showing the depths to groundwater, changes in depth to groundwater, and net changes in water storage. It also includes maps showing contours of groundwater surface elevations, depth to groundwater, and changes in the depth to groundwater. This report will also identify specific areas within the District that are experiencing severe overdraft.

GROUNDWATER STUDY

The basis for the groundwater study is data derived from measurements of the depths to groundwater in wells throughout the San Joaquin Valley. The well measurements are taken by a variety of local, city, state and federal agencies, and the data is compiled by the U.S. Bureau of Reclamation (Bureau). In regard to this report, the District's database utilized data that was collected by eighteen various agencies (see Appendix page 2).

During each measurement period, certain wells may not be measured for a variety of reasons and are omitted from the database. The specific spring and fall well measurement data are presented on pages A-1 through A-18 and B-1 through B-18, respectively.

In order to perform a groundwater study that is focused solely on the District, only those wells in the Bureau's valley-wide database which have been measured, and are within or near the District boundaries are analyzed. In order to provide continuity across the District boundaries, wells that are adjacent to, but outside, the District boundaries are included. For well locations, please refer to Figure 1.

Unfortunately, the database used for this report does not completely cover the District. Divisions 1, 2, 3 and 4 are reasonably well covered, but a large portion of Division 5, and all of Division 6, have few if any well readings. As a result, an analysis of the groundwater conditions for a portion of Division 5 and all of Division 6 cannot be performed. For the area of the District where there is sufficient data to draw reasonable conclusions, the term "Study Area" has been assigned.

The District's Board of Directors adopted Resolution No. 90-1 on September 12, 1989, which provided for the annexation of nearly 140,000 acres to Division 4 of the District. The area annexed was previously situated between Divisions 2, 3 and 4. As a result of this annexation, the calculated average depths to groundwater, average changes in depths to groundwater, and net change in storage for Division 4 and for the District totals will not be entirely comparable to similar type data included in reports prior to the fall 1989 report.

When analyzing the groundwater data that is compiled by the Bureau, it is important to realize that there are several factors which can lead to the lack of quality control of the data that has been collected. First, the complexity and size of the data collection program can lead to less than perfect results. Second, variations in measurement technology, expertise of personnel and date of measurements among the agencies, can contribute to the lack of quality control in data collection. A final factor that contributes to inaccurate data is the lack of information regarding well construction. Many wells are driven through several water bearing formations and are screened for long distances. Therefore, some data may represent a composite of depths to water for confined and unconfined aquifers and not the depth to water in a specific aquifer.

Average depth to groundwater, change in depth to groundwater and net change in storage have been calculated for each Division of the District and are presented in Table 1 for spring readings and in Table 2 for fall readings. The spring measurements were taken during

the months of January, February, and March of 1997 and the fall measurements were taken during the months of October and November of 1997. Additionally, average depth to groundwater, change in depth to groundwater and net change in storage have been calculated for groundwater management areas "A" and "B" and have been tabulated for spring and fall in Table 3 and Table 4, respectively. The net change in storage values presented in the tables reflect values calculated to the nearest 100 acre-feet. Values stated in the text of this report may not duplicate those in the tables due to the rounding effects of significant digits. Divisions with incomplete coverage have depth to groundwater calculations and change in storage estimates for the Study Area only. The computer program Quicksurf (Schreiber Instruments, Inc.) is utilized for the depth to groundwater, and change in storage calculations, and to create the groundwater contour maps. Quicksurf maps points and corresponding depths and changes in depth to create a contour surface for groundwater surface elevation, depth to groundwater, and change in depth to groundwater. These maps were created for changes in depth from 1986 to 1997 and from 1996 to 1997 for spring and fall. In determining the net change in storage for each subdivision, the specific yield of the aquifer is used. Specific yield is defined as the ratio of the volume of water drained from a saturated soil (aquifer) under the force of gravity to the volume of soil. Values representing the specific yield for every quarter township were input into Quicksurf and a contour map similar to those created for depth to and change in depth was created, with specific yield representing what is normally the "Z" coordinate. The surfaces created for change in depth were then multiplied by this "specific yield surface", and Quicksurf calculated a volume representative of the change in groundwater storage.

The raw data acquired from the Bureau represents elevation above mean sea level for a composite water table. This data is used to calculate depths to groundwater and changes in depths to groundwater from previous periods. Groundwater contour maps show lines of equal groundwater elevation, depth to groundwater and change in depth to groundwater over a period of time. Due in part to the composite nature of the groundwater data, reported values for change in depth to groundwater and storage are approximations only.

For the most part, meaningful interpretation of the results of this report can best be made by comparing data from similar periods, such as from the spring (or fall) of one year to the spring (or fall) of another year. This report will follow that criteria. No comparisons are made between spring and fall data.

RESULTS

The six divisions that comprise the District have been divided into smaller areas, or subdivisions (see Figure 2), for purposes of reporting depths and changes in depth to groundwater and storage changes in Tables 1 and 2. Groundwater Management Areas "A" and "B" (see Figure 3) were also studied individually, and the results are summarized in Tables 3 and 4. Groundwater elevation, depth to groundwater, and change in depth to groundwater contour maps (see Figure 4 thru 15) have been created to help identify trends across the service area and areas of significant change.

Spring 1996 to Spring 1997

An examination of the data for the change in depth to groundwater for the period from spring 1996 to spring 1997 shows an overall decrease in the depth to groundwater of 3 feet (Table 1). The portion of Division 5 South within the Study Area showed the greatest decrease in depth to groundwater at 13 feet. Only Fresno/Clovis Metropolitan and Western Fresno Irrigation District showed increases in the depth to groundwater of 6 and 3 feet, respectively. The remaining subdivisions all experienced decreases in depth to groundwater, the minimum recharge being 1 foot in Eastern Fresno Irrigation District.

During the period, the calculated net change in groundwater storage was an increase of 335,800 acre-feet. Division 5 South showed the greatest increase in storage at 105,000 acre-feet. All remaining subdivisions recorded noticeable increases with the exception of Fresno/Clovis Metropolitan and Western Fresno Irrigation District which showed minimal decreases in storage of 54,000 and 44,500 acre-feet respectively.

The depths to groundwater in both Management Areas "A" and "B" had significant changes for 1997. Management Area "A" had a decrease in average depth to groundwater of 1 foot with a corresponding increase in storage of 18,500 acre-feet (Table 3). Management Area "B" had a decrease in average depth to groundwater of 10 feet with a corresponding increase in storage of 77,600 acre-feet. The groundwater Management Areas combined had a net decrease in depth to groundwater of 4 feet and a corresponding increase in storage of 96,100 acre-feet.

Fall 1996 to Fall 1997

For the period of fall 1996 to fall 1997, the only increase in the depth to groundwater was within the Fresno/Clovis Metropolitan subdivision, which experienced an increase in depth of 4 feet (Table 2). The entire District Study Area had a calculated average decrease in the depth to groundwater of 2 feet. The subdivision with the largest decrease in depth to groundwater is Division 4 South with a calculated decrease of 6 feet (see Figure 2 for location). Based on individual Divisions, the total calculated average change in the depth to groundwater varied from an increase of 1 foot in Division 3 to the largest decrease of 4 feet in Division 1.

During the period, the calculated net change in groundwater storage for each Division ranged from a decrease of 48,200 acre-feet in Division 3 to an increase of 155,900 acre-feet in Division 4. The total calculated net change in groundwater storage for the entire Study Area was an increase of 268,700 acre-feet (Table 2).

Management Areas "A" and "B" both benefitted from a decrease in average depth to groundwater, displaying a net change of 4 and 5 feet respectively (Table 4). Corresponding changes in storage exhibited for these areas were an increase of 78,600 acre-feet for Area "A" and an increase of 68,100 acre-feet for Area "B." The Management Areas combined had an average decrease in depth to groundwater of 4 feet and a net increase in storage of 146,700 acre-feet.

CONCLUSIONS

Based on the graph "Average Depth to Groundwater" (See Figure 16), 1987 was the beginning of a period when the depth to groundwater increased each year, resulting in a decline in water storage. This trend continued until the spring of 1991 when the decline leveled off. As the graph also indicates, a reversal of the decline in water storage began in the fall of 1995.

Runoff for the Kings River was 180.3 percent of average for the 1997-1998 water year. This above-average surface water supply combined with a large carry-over of storage in Pine Flat Reservoir from the 1996-1997 water year should allow for less-than-normal pumping of groundwater storage for 1997. However, although the drought may be considered over, it is likely that overdraft conditions will remain as industry, agriculture and population continue to expand within the Kings River service area.

Due to the limited natural supply of water available to the service area, it is important that certain steps are taken to offset the anticipated increase in water usage. Enhancing the management of existing surface and groundwater supplies as well as increasing the amount of water available by constructing new or expanding existing above-ground reservoirs and groundwater recharge facilities to store additional water are two possibilities which could increase the amount of water available to the service area. Additional supplies of water could also be imported to the service area from areas with excess water or simply from the excess (flood) flows within the service area.

TABLES

TABLE 1

KRCD DIVISION SUMMARY
SPRING 1997

KRCD DIVISION	SUBDIVISION	Percent of Division within Study Area	SPRING 97 Depth to Groundwater (feet)	AVERAGE CHANGE IN DEPTH TO GROUNDWATER Spring 96 to Spring 97 (feet)	Spring 86 to Spring 97 (feet)	NET CHANGE IN STORAGE Spring 96 to Spring 97 (acre-feet)	Spring 86 to Spring 97 (acre-feet)
DIVISION 1							
	ALTA - FRESNO CO.		44	-5	13	17,700	(32,400)
	ALTA - TULARE/KINGS CO.		40	-5	14	53,200	(141,200)
	TOTAL / AVERAGE DIVISION 1	99%	41	-5	13	70,900	(173,600)
DIVISION 2							
	CONSOLIDATED NORTHEAST OF HWY 99		37	-2	5	32,100	(38,000)
	CONSOLIDATED SOUTHWEST OF HWY 99		63	-2	18	22,800	(252,200)
	TOTAL / AVERAGE DIVISION 2	100%	49	-2	11	54,900	(290,200)
DIVISION 3							
	WESTERN FRESNO IRRIGATION DISTRICT		68	3	12	(44,500)	(194,300)
	FRESNO/CLOVIS METROPOLITAN		99	6	22	(54,000)	(176,800)
	EASTERN FRESNO IRRIGATION DISTRICT		41	-1	9	400	(67,700)
	TOTAL / AVERAGE DIVISION 3	99%	69	3	14	(98,100)	(438,800)
DIVISION 4							
	DIVISION 4 NORTH		126	-3	23	50,000	(577,400)
	DIVISION 4 SOUTH		86	-7	15	96,400	(117,100)
	TOTAL / AVERAGE DIVISION 4	95%	112	-4	20	146,400	(840,900)
DIVISION 5							
	DIVISION 5 NORTH		73	-6	17	56,700	(188,600)
	DIVISION 5 SOUTH		61	-13	26	105,000	(160,300)
	TOTAL / AVERAGE DIVISION 5	64%	68	-9	21	161,700	(348,900)
DIVISION 6							
	NO DATA		—	—	—	—	—
	TOTAL / AVERAGE DIVISION 6	0%					
DISTRICT TOTALS		76%	73	-3	16	335,800	(2,092,400)

* FOR BOUNDARIES USED FOR SUBDIVISIONS SEE FIGURE 2

NOTE: POSITIVE VALUES FOR CHANGE IN DEPTH TO GROUNDWATER REFLECT AN INCREASE IN THE DEPTH TO GROUNDWATER AND A CORRESPONDING DECREASE IN STORAGE.
NEGATIVE VALUES REFLECT A DECREASE IN THE DEPTH TO GROUNDWATER AND A CORRESPONDING INCREASE IN STORAGE.

TABLE 2

KRCD DIVISION SUMMARY
FALL 1997

KRCD DIVISION	SUBDIVISION	Percent of Division within Study Area	FALL 97 Depth to Groundwater (feet)	AVERAGE CHANGE IN DEPTH TO GROUNDWATER Fall 96 to Fall 97 (feet)	AVERAGE CHANGE IN DEPTH TO GROUNDWATER Fall 86 to Fall 97 (feet)	NET CHANGE IN STORAGE Fall 96 to Fall 97 (acre-feet)	NET CHANGE IN STORAGE Fall 86 to Fall 97 (acre-feet)
DIVISION 1							
	ALTA - FRESNO CO.		48	-3	18	9,400	(65,500)
	ALTA - TULARE/KINGS CO.		42	-4	22	34,700	(272,200)
	TOTAL / AVERAGE DIVISION 1	99%	43	-4	21	44,100	(337,700)
DIVISION 2							
	CONSOLIDATED NORTHEAST OF HWY 99		33	-2	13	40,000	(126,500)
	CONSOLIDATED SOUTHWEST OF HWY 99		63	-3	23	39,600	(300,900)
	TOTAL / AVERAGE DIVISION 2	100%	48	-2	19	79,600	(427,400)
DIVISION 3							
	WESTERN FRESNO IRRIGATION DISTRICT		65	0	11	(7,500)	(187,200)
	FRESNO/CLOVIS METROPOLITAN		101	4	19	(31,200)	(144,500)
	EASTERN FRESNO IRRIGATION DISTRICT		42	0	10	(9,500)	(93,100)
	TOTAL / AVERAGE DIVISION 3	99%	69	1	14	(48,200)	(424,800)
DIVISION 4							
	DIVISION 4 NORTH		105	-1	31	54,100	(628,700)
	DIVISION 4 SOUTH		117	-6	23	101,800	(335,100)
	TOTAL / AVERAGE DIVISION 4	95%	117	-3	28	155,900	(963,800)
DIVISION 5							
	DIVISION 5 NORTH		46	-3	25	40,100	(242,400)
	DIVISION 5 SOUTH		29	0	44	(2,800)	(318,900)
	TOTAL / AVERAGE DIVISION 5	64%	32	-2	24	37,300	(561,300)
DIVISION 6							
	NO DATA		—	—	—	—	—
	TOTAL / AVERAGE DIVISION 6	0%					
DISTRICT TOTALS		76%	70	-2	20	268,700	(2,715,000)

* FOR BOUNDARIES USED FOR SUBDIVISIONS SEE FIGURE 2

NOTE: POSITIVE VALUES FOR CHANGE IN DEPTH TO GROUNDWATER REFLECT AN INCREASE IN THE DEPTH TO GROUNDWATER AND A CORRESPONDING DECREASE IN STORAGE.
NEGATIVE VALUES REFLECT A DECREASE IN THE DEPTH TO GROUNDWATER AND A CORRESPONDING INCREASE IN STORAGE.

TABLE 3

KRCD GROUNDWATER MANAGEMENT AREA SUMMARY
SPRING 1997

GROUNDWATER MANAGEMENT AREA*	Percent of Area within Study Area	SPRING 97 Depth to Groundwater (feet)	AVERAGE CHANGE IN DEPTH TO GROUNDWATER Spring 96 to Spring 97 (feet)	Spring 86 to Spring 97 (feet)	NET CHANGE IN STORAGE Spring 96 to Spring 97 (acre-feet)	Spring 86 to Spring 97 (acre-feet)
AREA A						
NORTHWESTERN PORTION OF AREA A		139	-2	23	27,500	(347,100)
SOUTHEASTERN PORTION OF AREA A		63	4	30	(9,000)	(62,900)
TOTAL / AVERAGE AREA A	100%	132	-1	25	18,500	(410,000)
AREA B						
TOTAL / AVERAGE AREA B	100%	144	-10	31	77,600	(160,900)
MANAGEMENT AREA TOTALS	100%	136	-4	24	96,100	(570,900)

TABLE 4

KRCD GROUNDWATER MANAGEMENT AREA SUMMARY
FALL 1997

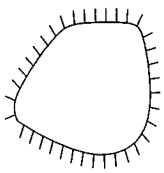
GROUNDWATER MANAGEMENT AREA*	Percent of Area within Study Area	Fall 97 Depth to Groundwater (feet)	AVERAGE CHANGE IN DEPTH TO GROUNDWATER Fall 96 to Fall 97 (feet)	Fall 86 to Fall 97 (feet)	NET CHANGE IN STORAGE Fall 96 to Fall 97 (acre-feet)	Fall 86 to Fall 97 (acre-feet)
AREA A						
NORTHWESTERN PORTION OF AREA A		147	-4	25	70,300	(362,900)
SOUTHEASTERN PORTION OF AREA A		57	-3	25	8,300	(52,500)
TOTAL / AVERAGE AREA A	100%	138	-4	40	78,600	(415,400)
AREA B						
TOTAL / AVERAGE AREA B	100%	154	-5	39	68,100	(199,100)
MANAGEMENT AREA TOTALS	100%	141	-4	28	146,700	(614,500)

* FOR BOUNDARIES USED FOR GROUNDWATER MANAGEMENT AREAS SEE FIGURE 3

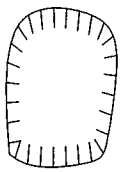
NOTE: POSITIVE VALUES FOR CHANGE IN DEPTH TO GROUNDWATER REFLECT AN INCREASE IN DEPTH TO GROUNDWATER AND A CORRESPONDING DECREASE IN STORAGE. NEGATIVE VALUES REFLECT A DECREAE IN DEPTH TO GROUNDWATER AND A CORRESPONDING INCREASE IN STORAGE.

FIGURES

Map Legend



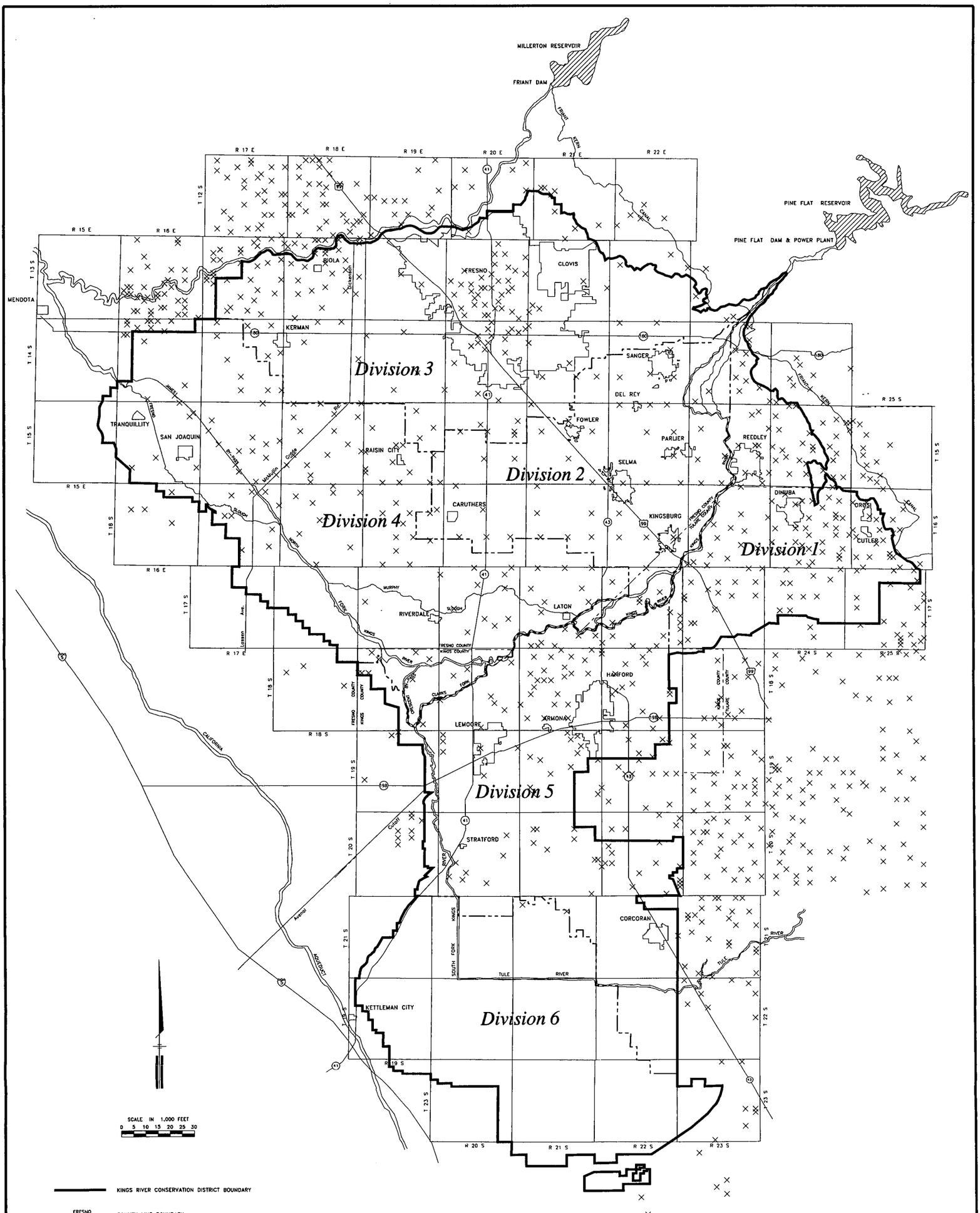
Tick marks on the outside of a closed contour indicate that groundwater is "mounded" at this location similar to a mountain shown on a topographical map.



Tick marks on the inside of a closed contour indicate that groundwater is "depressed" at this location, similar to a valley shown on a topographical map.

Standard line width used for most contours.

Thick line width used to emphasize every 50 foot change in elevation or depth. The 0, 50, and 100 foot elevations, for example, will use this thick line width.



MARK	DATE	REVISION	MARK	DATE	REVISION

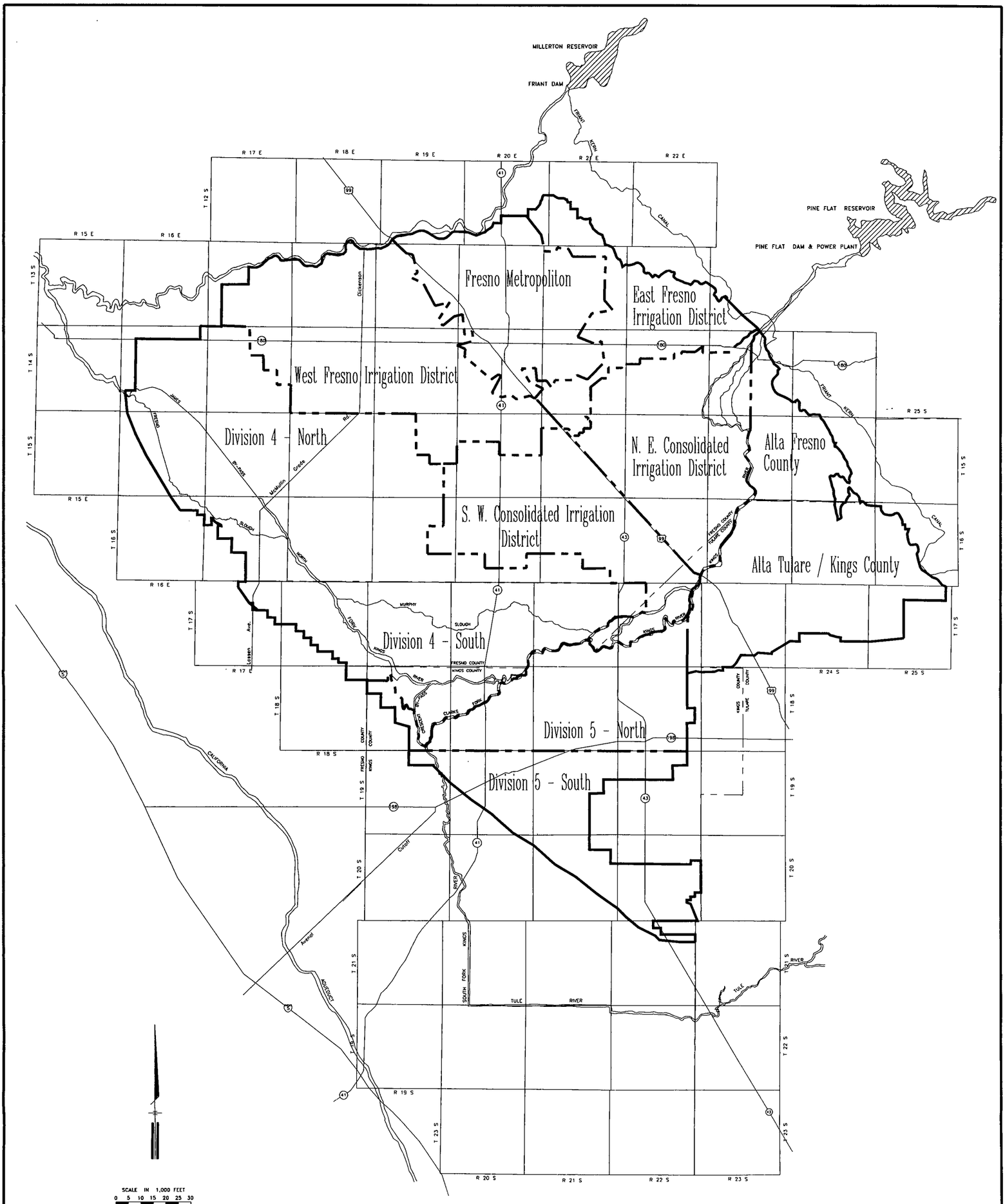
DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Monitored Wells

KRCD Groundwater Database

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 1



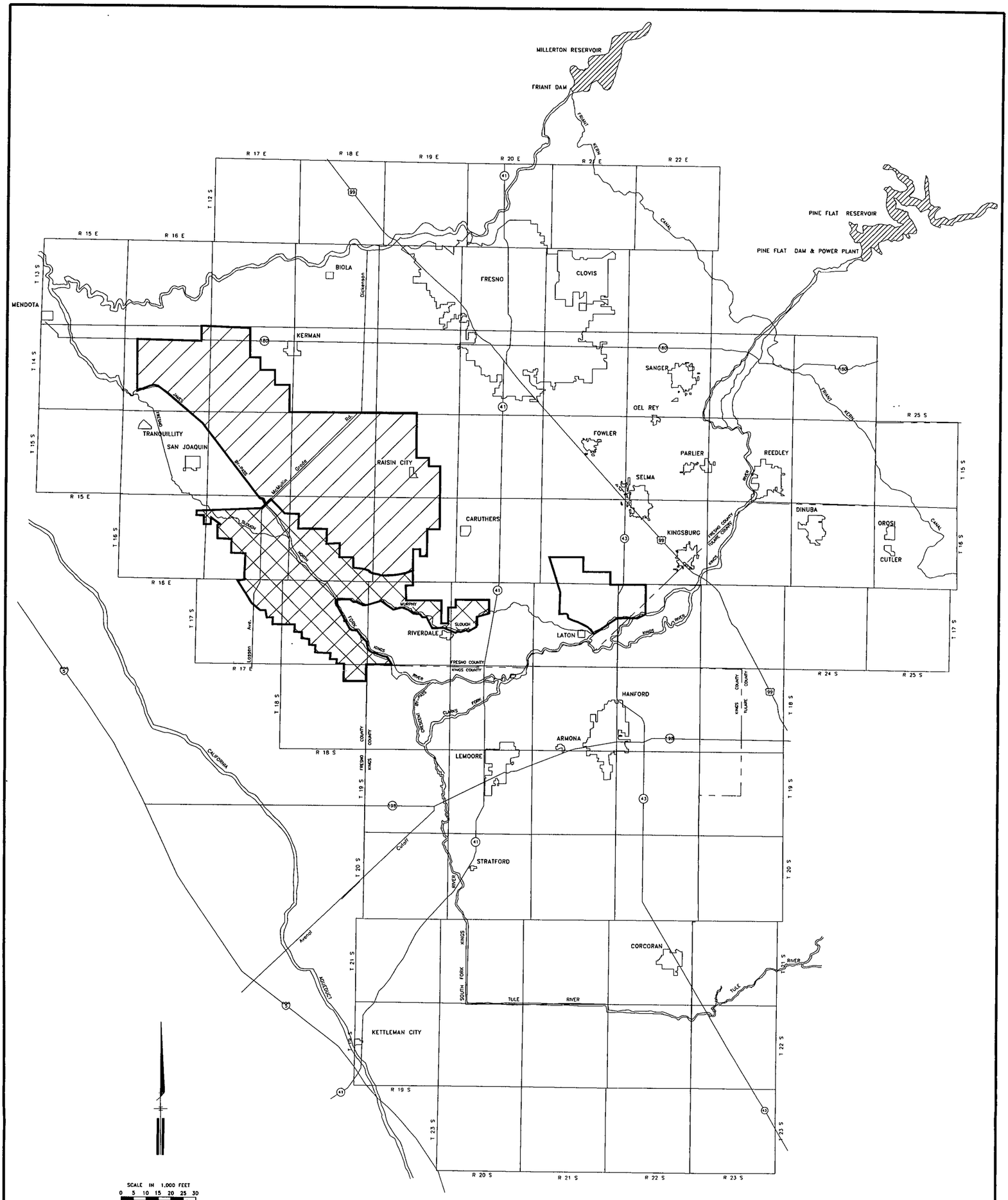
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R Segura
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

KRCD Subdivision Boundaries Used for Calculations

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 2



LEGEND

- Area "A" – North
- Area "A" – South
- Area "B"

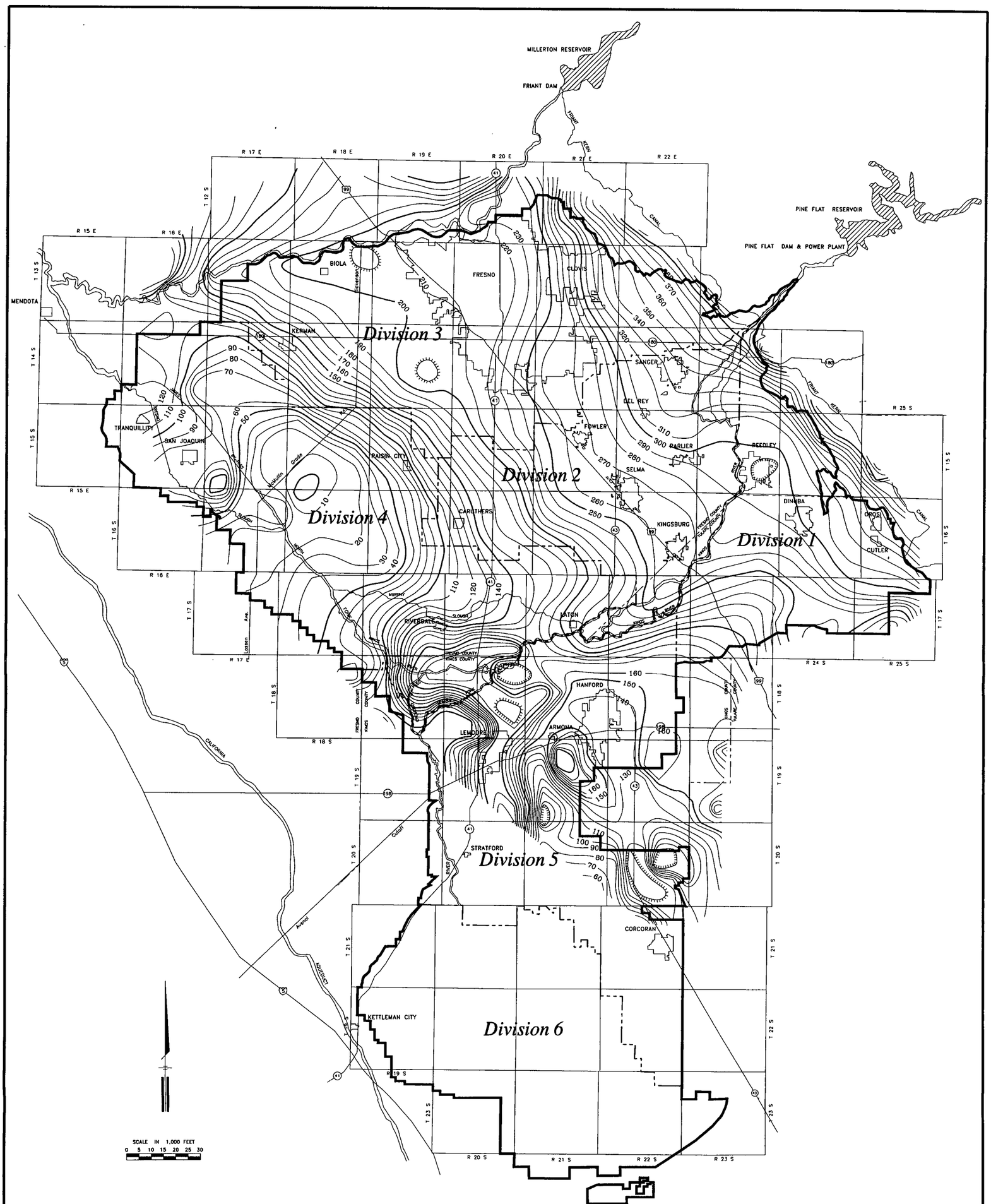
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R Segura
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Groundwater Management Area Boundaries Used for Calculations

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 3



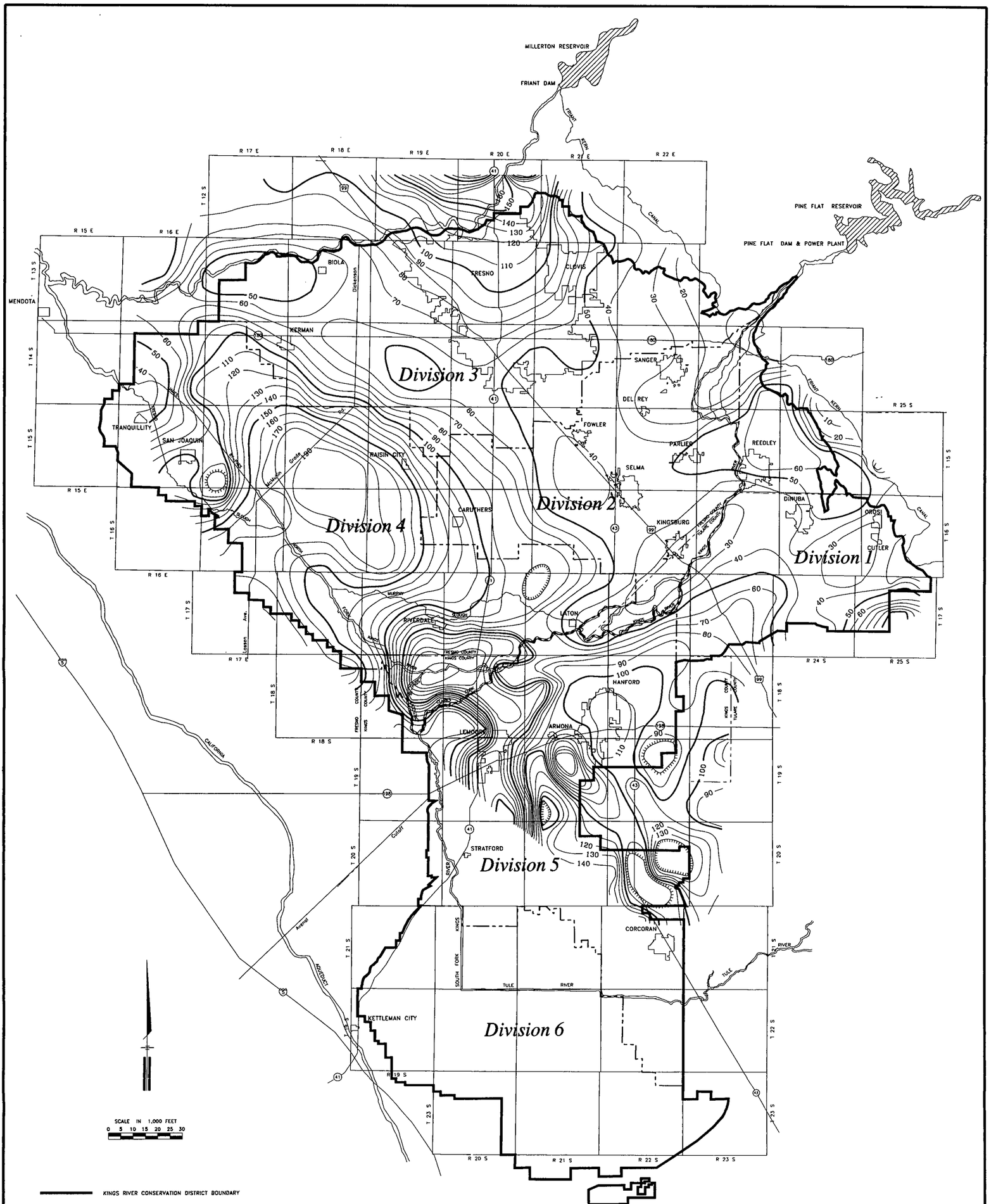
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R Segura
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Groundwater Surface Elevation
(feet above mean M.S.L.)
Spring 1996

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 4



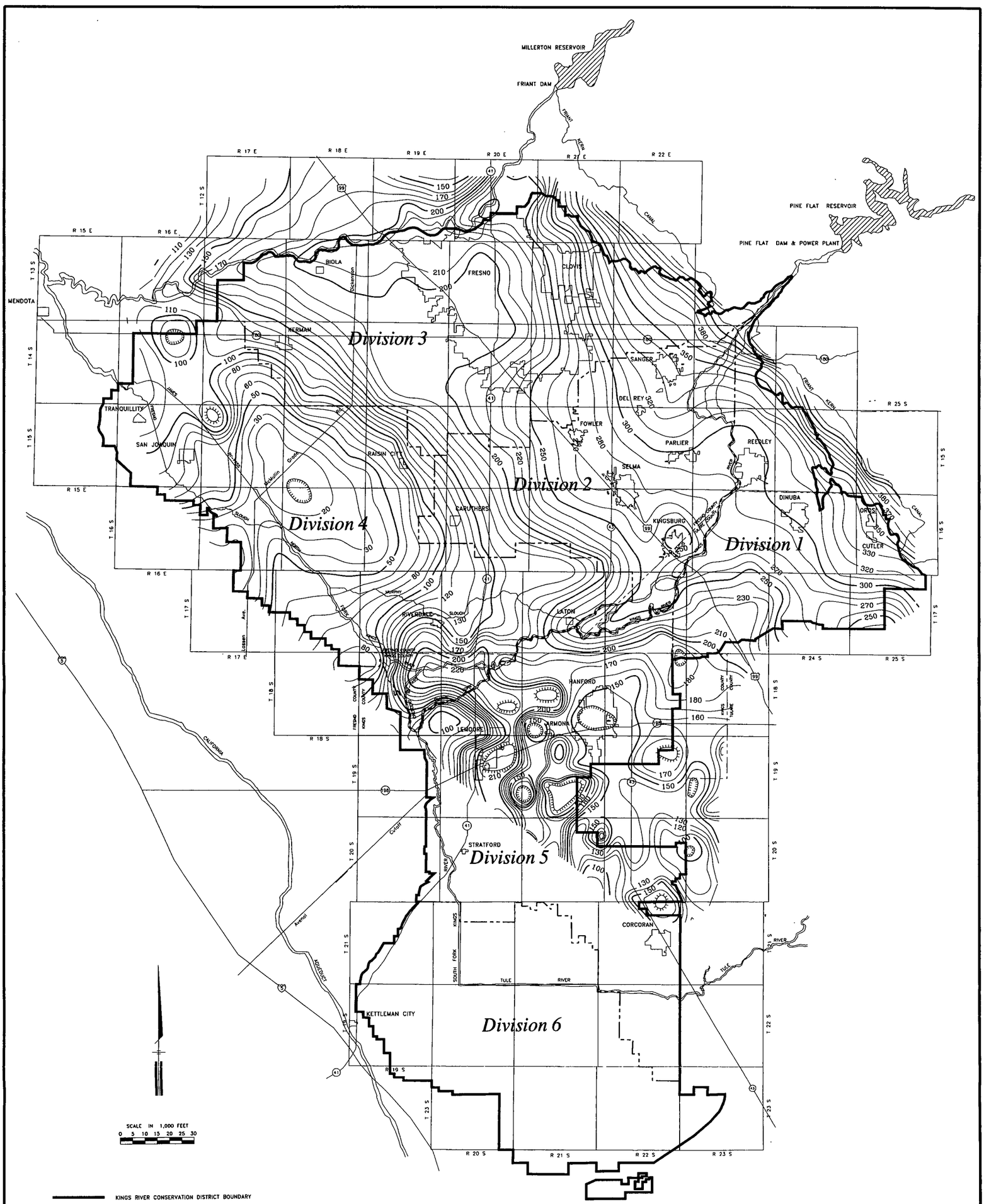
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R Segura
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Depth to Groundwater (feet)
Spring 1996

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 5



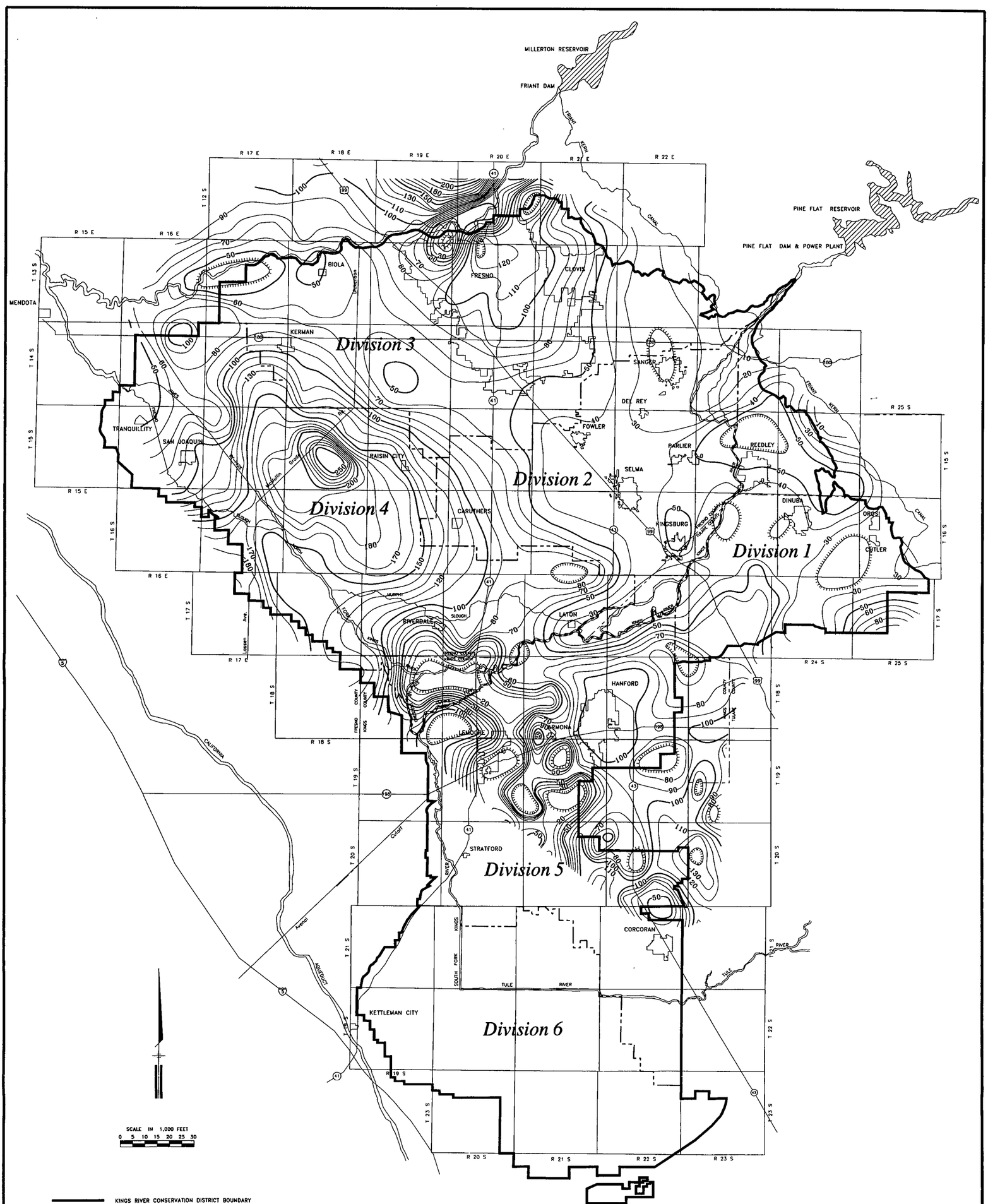
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Groundwater Surface Elevation
(feet above mean M.S.L.)
Spring 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 6



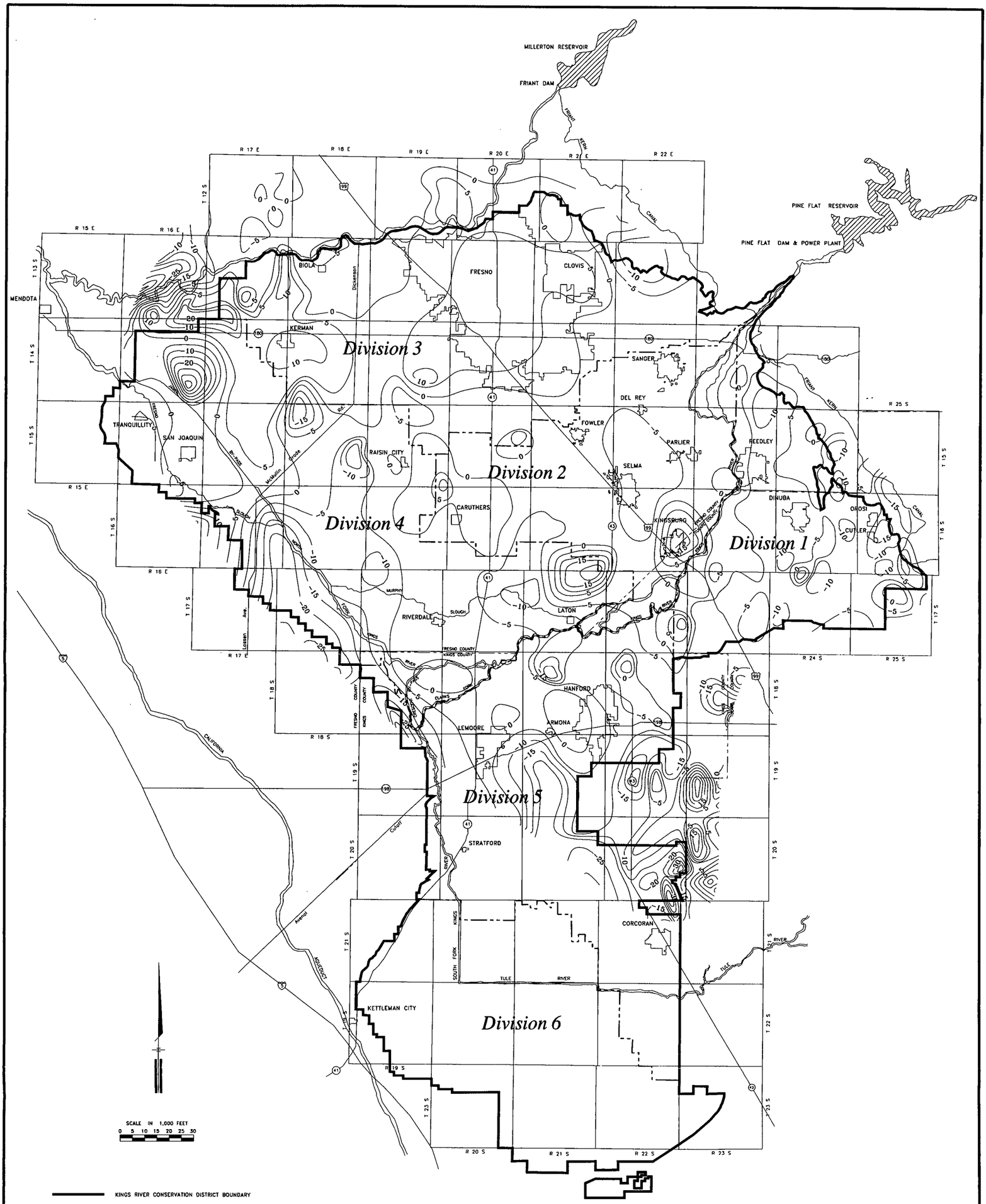
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 2/3/97
SCALE: AS SHOWN
CHECKED:

Depth to Groundwater (feet)
Spring 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 7



LEGEND

"10" INDICATES AN INCREASE IN DEPTH

"0" INDICATES NO CHANGE

"-5" INDICATES A DECREASE IN DEPTH

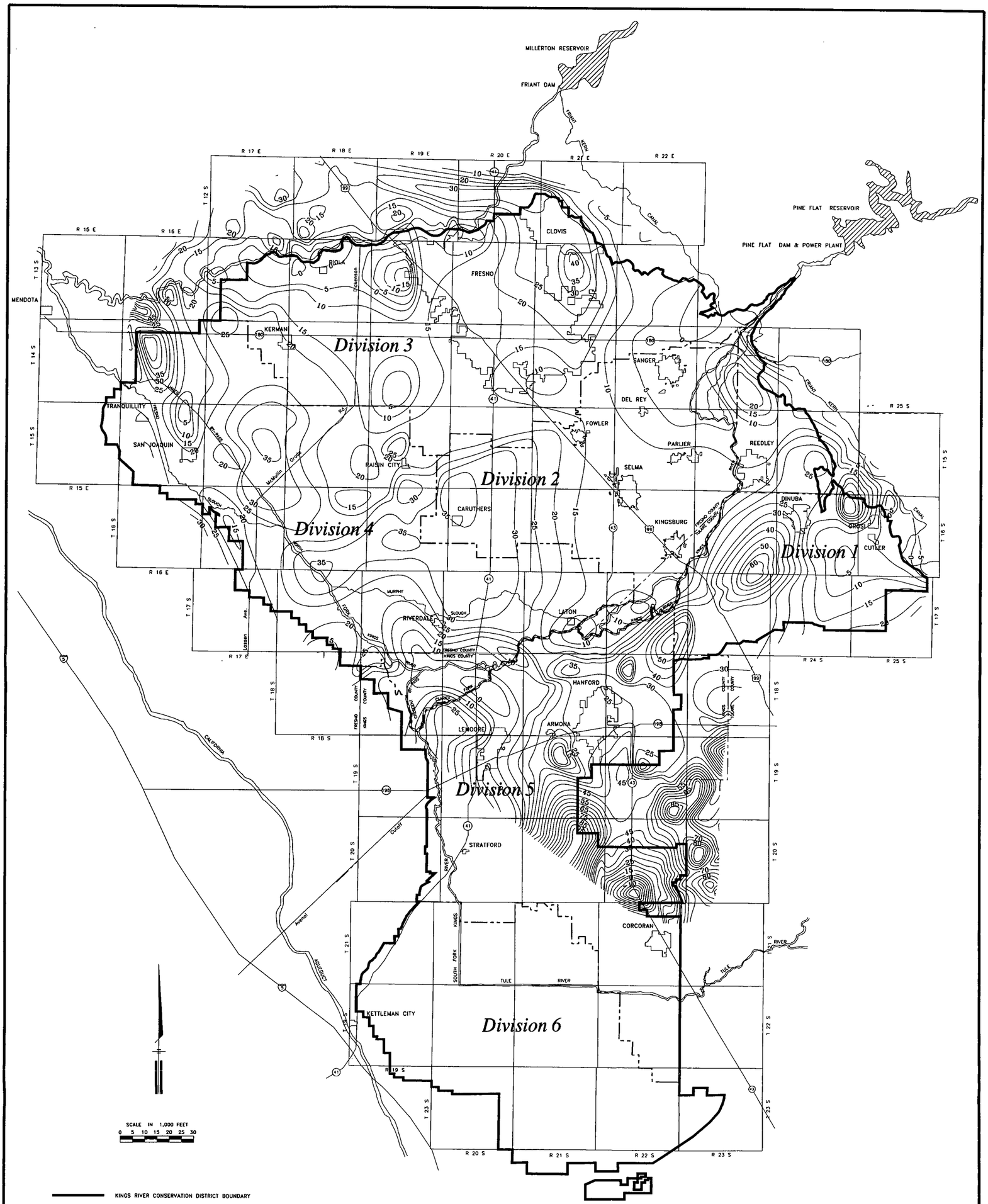
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Change in Groundwater Depth (feet)
Spring 1996 to Sring 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 8



LEGEND

"10"	INDICATES AN INCREASE IN DEPTH
"0"	INDICATES NO CHANGE
"-5"	INDICATES A DECREASE IN DEPTH

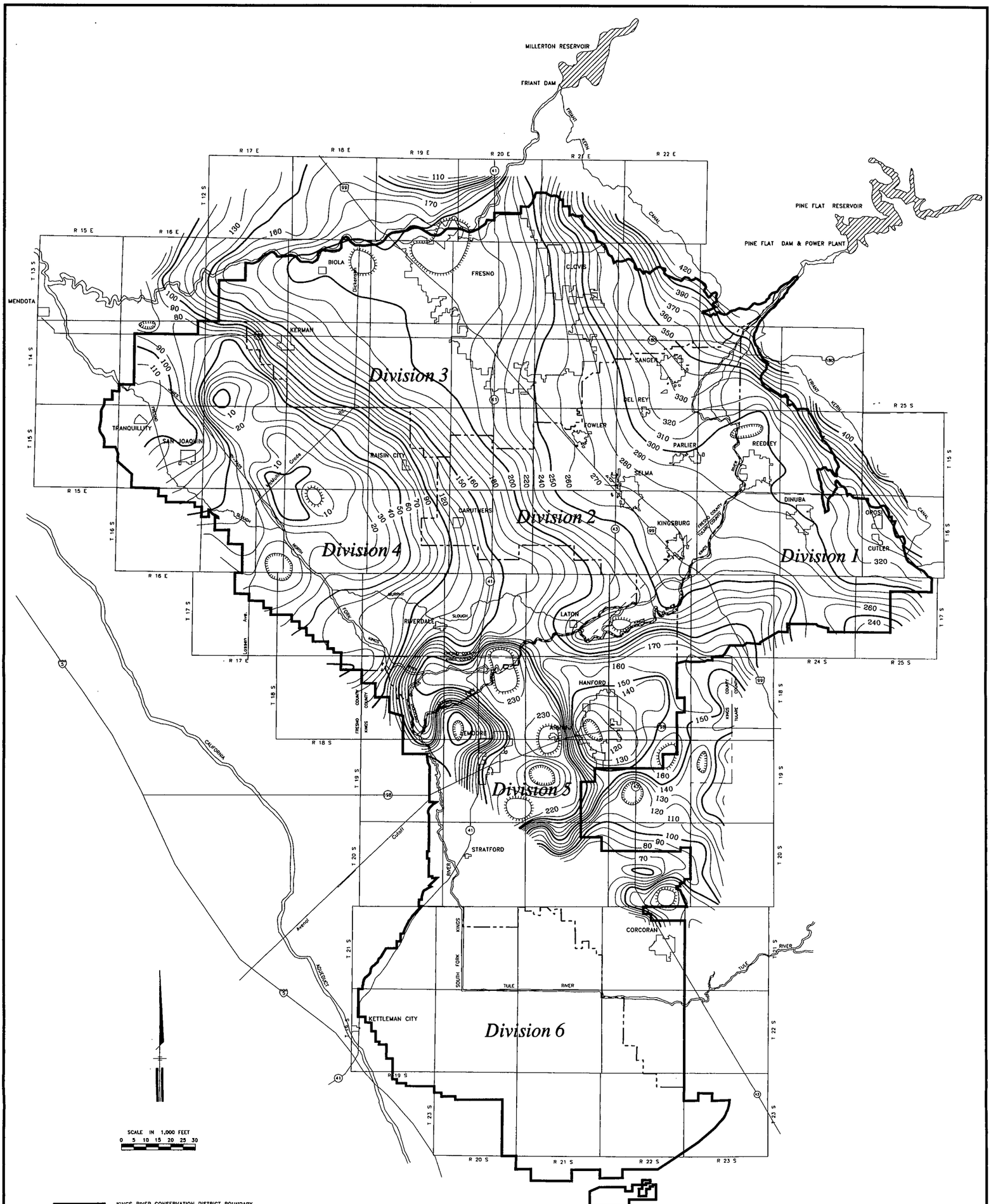
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Change in Groundwater Depth (feet)
Spring 1986 to Spring 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 9



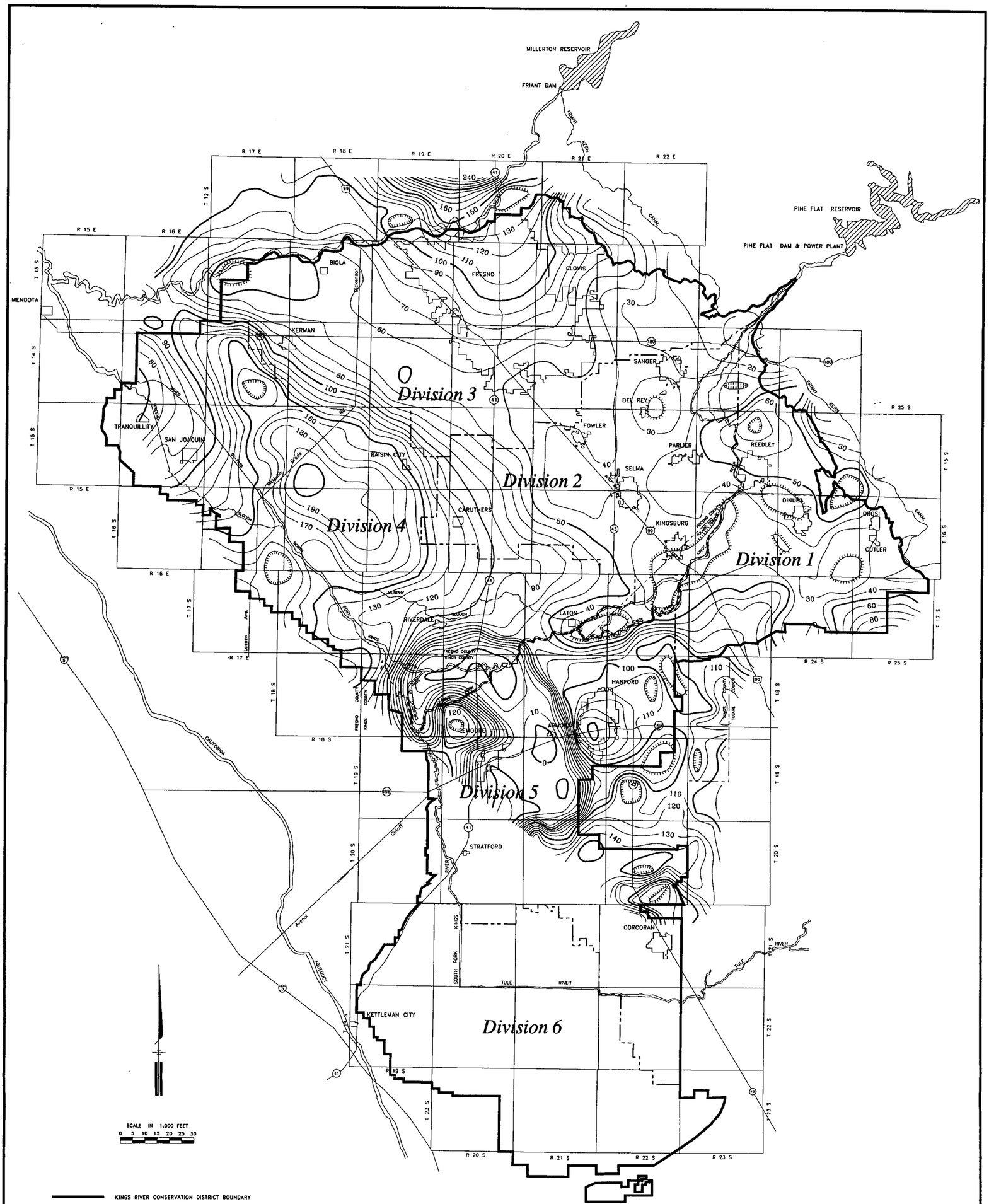
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R Segura
DATE: 12/18/98
SCALE: As Shown
CHECKED:

Groundwater Surface Elevation
(feet above mean M.S.L.)
Fall 1996

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 10



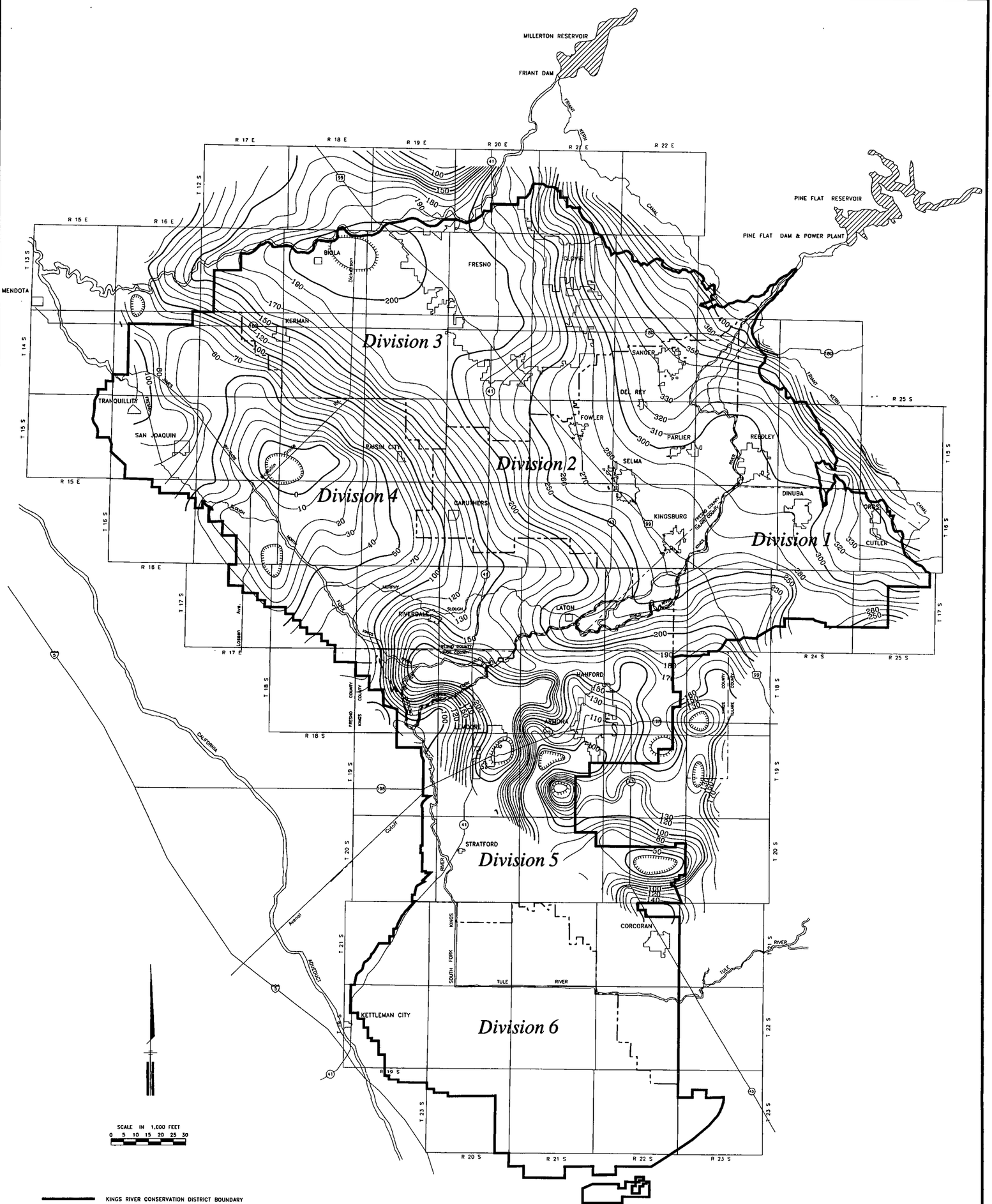
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R Segura
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Depth to Groundwater (feet)
Fall 1996

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 11



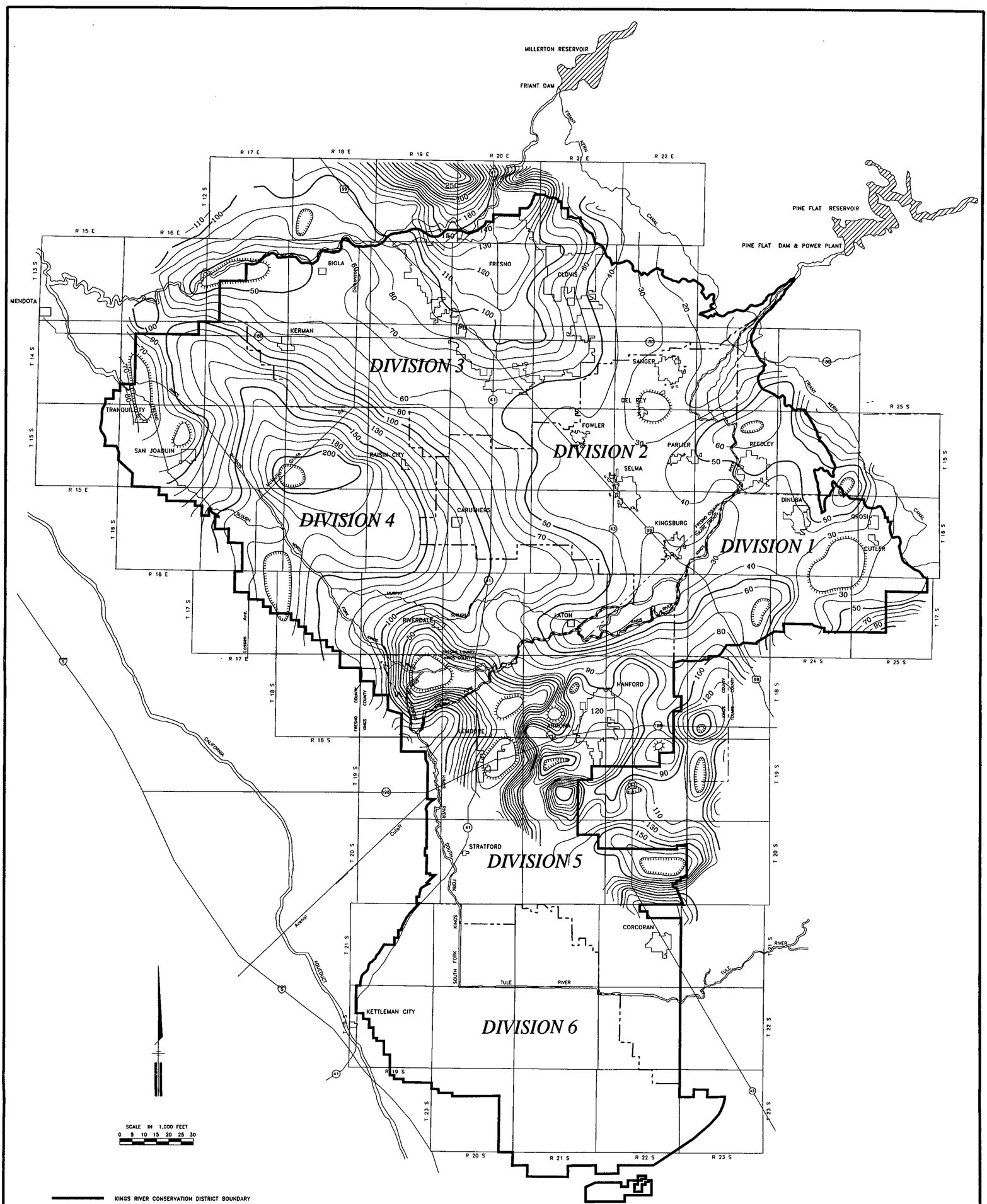
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Groundwater Surface Elevation
(feet above mean M.S.L.)
Fall 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 12



LEGEND

"10" INDICATES AN INCREASE IN DEPTH

"0" INDICATES NO CHANGE

"-5" INDICATES A DECREASE IN DEPTH

MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 10/29/98
SCALE: AS SHOWN
CHECKED:

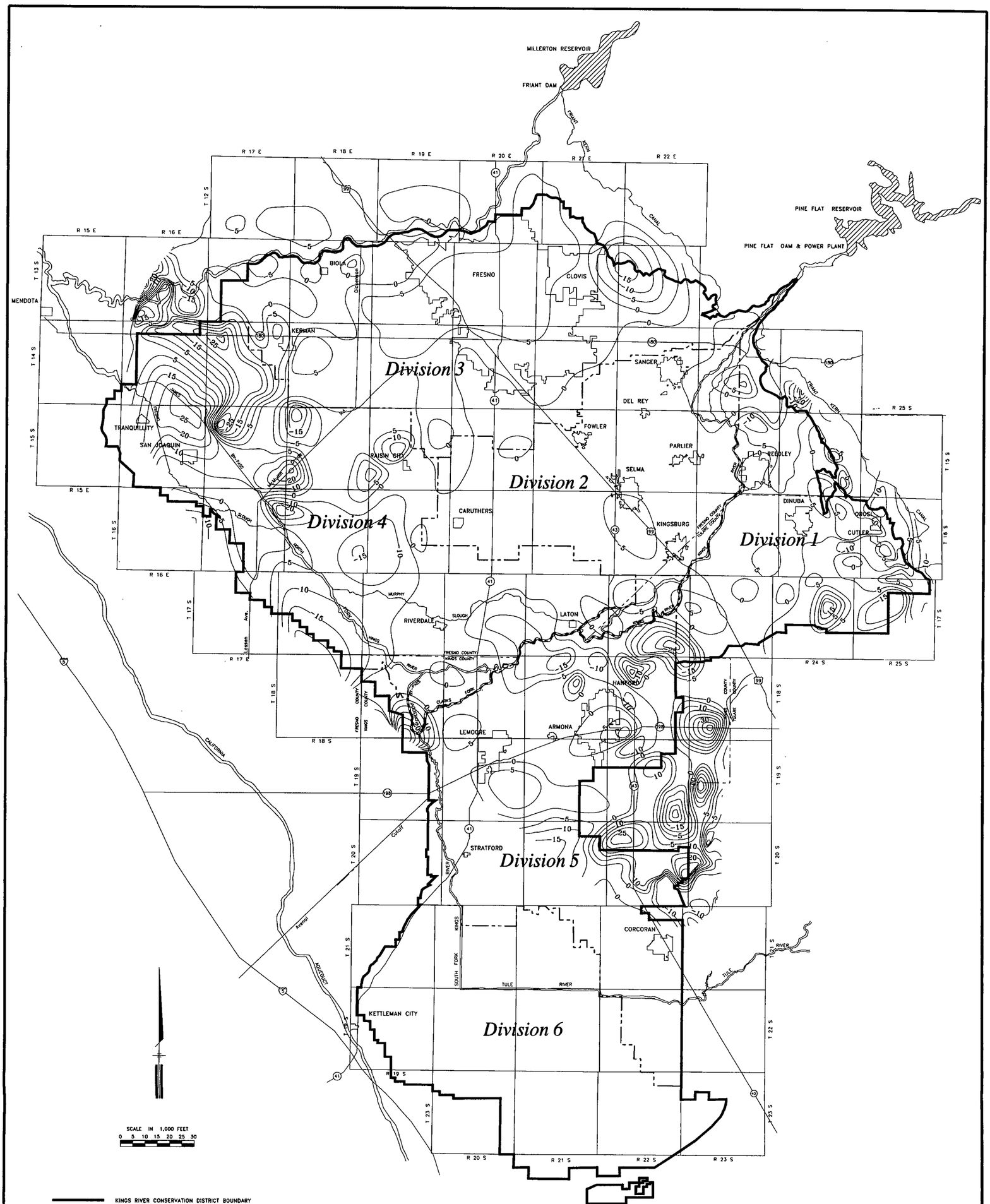
Depth to Groundwater (feet)

Fall 1997

KINGS RIVER CONSERVATION DISTRICT

4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 13



LEGEND

"10" INDICATES AN INCREASE IN DEPTH

"0" INDICATES NO CHANGE

"-5" INDICATES A DECREASE IN DEPTH

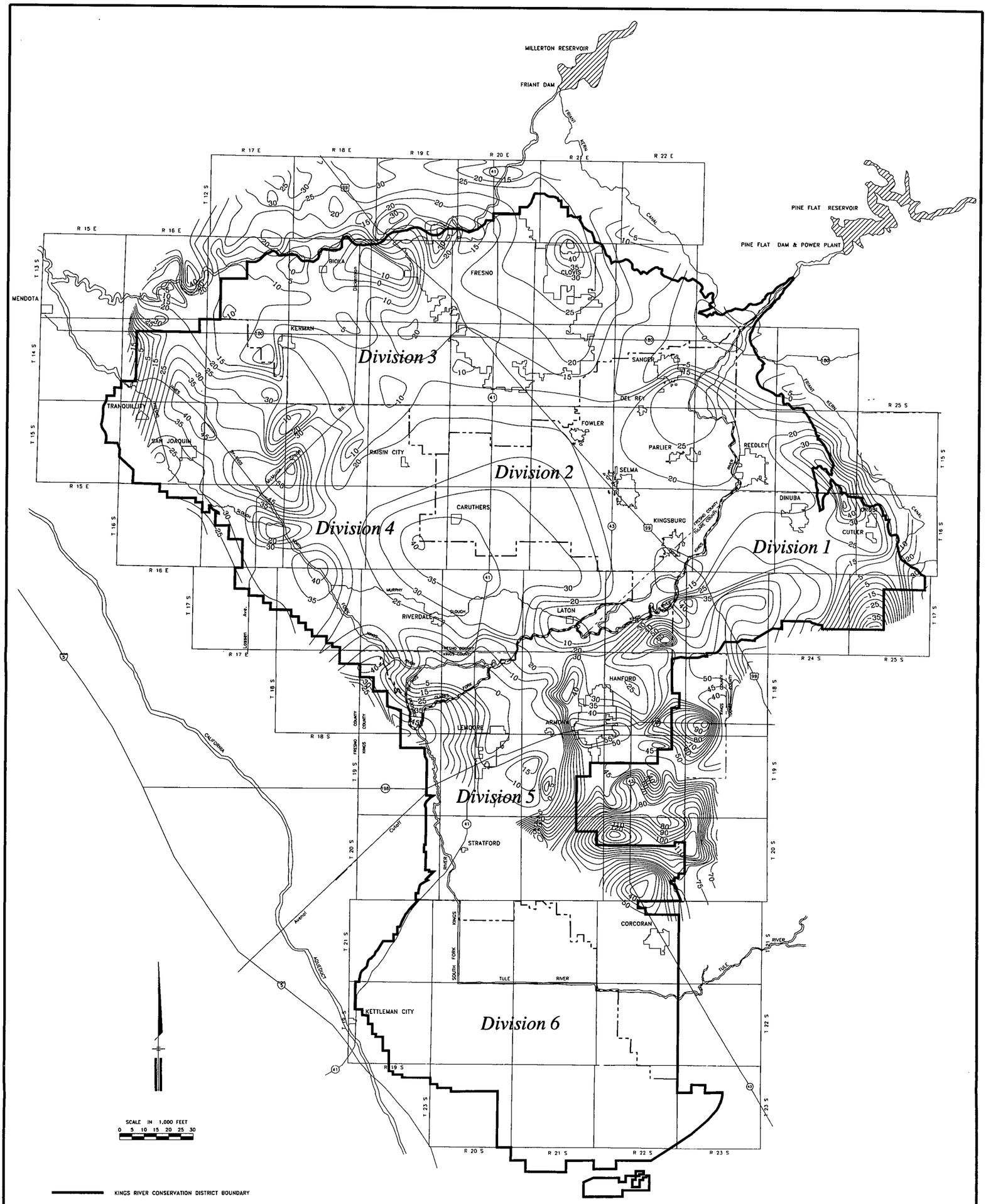
MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Change in Groundwater Depth (feet)
Fall 1996 to Fall 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 14



LEGEND

"10" INDICATES AN INCREASE IN DEPTH

"0" INDICATES NO CHANGE

"-5" INDICATES A DECREASE IN DEPTH

MARK	DATE	REVISION	MARK	DATE	REVISION

DRAWN BY: R SEGURA
DATE: 12/18/98
SCALE: AS SHOWN
CHECKED:

Change in Groundwater Depth (feet)
Fall 1986 to Fall 1997

KINGS RIVER CONSERVATION DISTRICT
4886 E. JENSEN FRESNO, CALIFORNIA, 93725

FIGURE 15

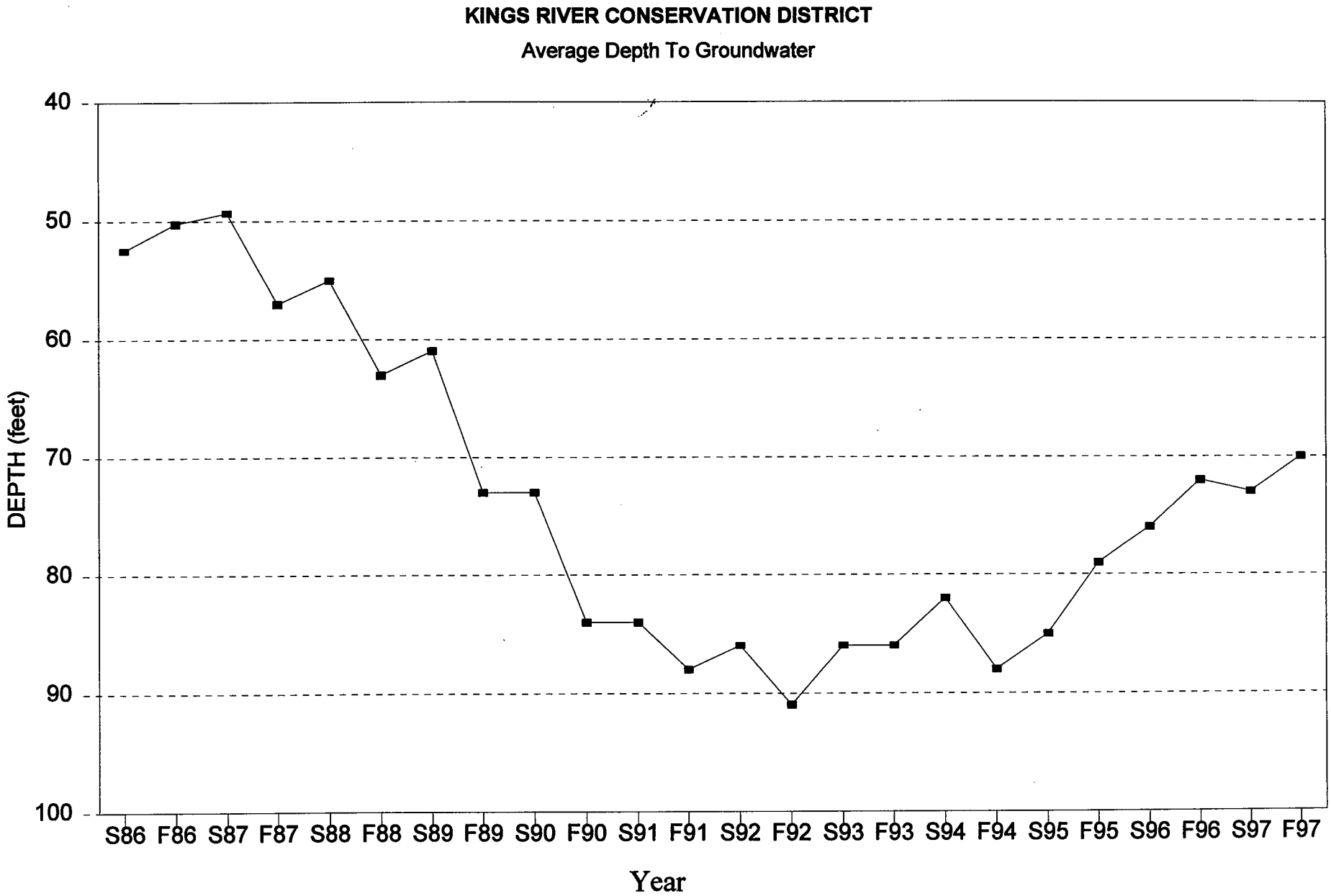
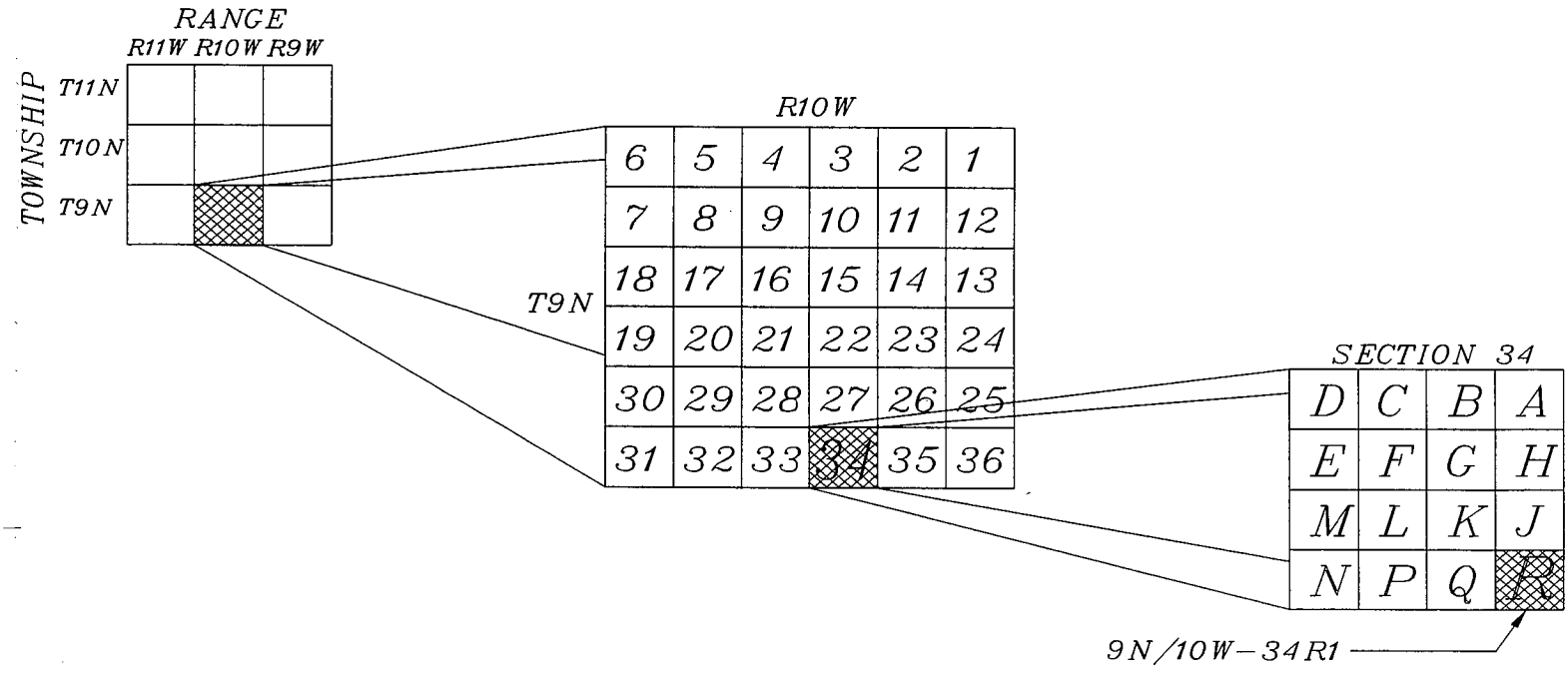

KINGS RIVER CONSERVATION DISTRICT
Average Depth To Groundwater
DEPTH (feet)
40
50
60
70
80
90
100
S86 F86 S87 F87 S88 F88 S89 F89 S90 F90 S91 F91 S92 F92 S93 F93 S94 F94 S95 F95 S96 F96 S97 F97
Year

Figure 16

APPENDIX

Well-Numbering System

Wells are identified and numbered according to their location in the rectangular system for the subdivision of public lands. The identification consists of the township number, north or south; the range number, east or west; and the section number. Each section is further divided into sixteen 40-acre tracts lettered consecutively (except I and O), beginning with 'A' in the northeast corner of the section and progressing in a sinusoidal manner to 'R' in the southeast corner. Within the 40-acre tract, wells are sequentially numbered in the order they are inventoried. The final letter refers to the base line and meridian. In California, there are three base lines and meridians: Humboldt (H), Mound Diablo (M), and San Bernardino (S). All wells in the study area are referenced to the Mount Diablo base line and meridian (M). Wells are abbreviated and written 9N/10W-34R1M. The following diagram shows how the number for well 9N/10W-34R1M is derived.



KINGS RIVER CONSERVATION DISTRICT
GROUNDWATER DATABASE

CONTRIBUTING AGENCIES

AGENCY CODE	AGENCY
5001	U.S. Bureau of Reclamation
5050	Department of Water Resources
5129	Kings County Water District
5200	City of Fresno
5530	Madera Irrigation District
5600	Orange Cove Irrigation District
5601	Stone Corral Irrigation District
5602	Ivanhoe Irrigation District
5603	Kaweah Delta Water Conservation District
5604	Tulare Irrigation District
5609	Lower Tule River Irrigation District
5612	Pixley Irrigation District
5620	James Irrigation District
5621	Tranquillity Soil Conservation District
5622	Garfield Water District
5631	Fresno Irrigation District
5636	Consolidated Irrigation District
5637	Alta Irrigation District

GROUNDWATER DATABASE SUMMARY

SPRING 1997

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
1	5001	0	12	19	3	Q	196.50	193.30	3.20
2	5001	0	12	19	23	K	135.80	130.20	5.60
3	5001	0	12	20	1	H	49.20	49.90	-0.70
4	5001	0	12	20	2	R	35.20	38.20	-3.00
5	5001	0	12	20	17	A	175.20	173.90	1.30
6	5001	0	12	20	18	B	191.70	182.00	9.70
7	5001	0	12	20	32	G	127.80	122.90	4.90
8	5001	0	12	21	20	Q	65.00	70.20	-5.20
9	5001	0	12	21	26	R	49.70	54.60	-4.90
10	5001	0	12	22	21	E	12.20	12.90	-0.70
11	5001	0	12	22	27	G	11.00	23.70	-12.70
12	5001	0	12	22	29	D	20.20	26.80	-6.60
13	5001	0	12	22	29	H	19.80	24.20	-4.40
14	5001	0	12	22	30	N	43.90	47.80	-3.90
15	5001	0	13	16	2	F	85.00	101.50	-16.50
16	5001	0	13	16	8	H	91.00	87.30	3.70
17	5001	0	13	16	15	H	63.30	92.80	-29.50
18	5001	0	13	16	16	D	89.90	108.60	-18.70
19	5001	0	13	16	19	J	66.70	94.70	-28.00
20	5001	0	13	16	19	K	67.20	82.40	-15.20
21	5001	0	13	16	19	P	60.90	94.50	-33.60
22	5001	0	13	16	20	J	68.40	109.00	-40.60
23	5001	0	13	16	26	J	83.70	63.30	20.40
24	5001	0	13	16	27	C	47.00	59.10	-12.10
25	5001	0	13	16	30	A	62.20	106.50	-44.30
26	5001	0	13	16	30	B	62.30	92.70	-30.40
27	5001	0	13	16	32	E	56.30	64.30	-8.00
28	5001	0	13	16	32	F	68.60	65.80	2.80
29	5001	0	13	16	33	F	80.30	67.20	13.10
30	5001	0	13	16	33	L	87.80	66.80	21.00
31	5001	0	13	16	34	D	64.40	68.20	-3.80
32	5001	0	13	16	35	A	79.90	73.30	6.60
33	5001	0	13	16	35	L	93.30	73.00	20.30
34	5001	0	13	17	9	R	31.00	35.90	-4.90
35	5001	0	13	17	11	R	39.30	42.00	-2.70
36	5001	0	13	17	18	J	17.80	21.90	-4.10
37	5001	0	13	17	18	R	17.20	31.40	-14.20
38	5001	0	13	17	23	N	51.20	54.10	-2.90
39	5001	0	13	17	28	H	58.70	74.60	-15.90
40	5001	0	13	17	33	D	69.90	63.10	6.80
41	5001	0	13	17	35	L	72.90	63.40	9.50
42	5001	0	13	18	1	H	69.20	74.10	-4.90
43	5001	0	13	18	2	C	48.00	54.20	-6.20
44	5001	0	13	18	2	P	61.10	63.00	-1.90
45	5001	0	13	18	3	P	53.60	60.70	-7.10
46	5001	0	13	18	7	R	45.80	48.00	-2.20
47	5001	0	13	18	9	B	35.00	47.30	-12.30
48	5001	0	13	18	10	P	51.90	53.40	-1.50
49	5001	0	13	18	14	H	60.80	62.30	-1.50

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
50	5001	0	13	18	15	J	58.40	60.10	-1.70
51	5001	0	13	18	20	C	49.40	49.90	-0.50
52	5001	0	13	18	21	P	50.30	52.80	-2.50
53	5001	0	13	18	22	L	55.20	57.30	-2.10
54	5001	0	13	18	23	R	61.40	63.40	-2.00
55	5001	0	13	18	34	D	59.20	61.70	-2.50
56	5001	0	13	19	16	K	83.90	84.70	-0.80
57	5001	0	13	23	17	D	3.00	8.60	-5.60
58	5001	0	13	23	33	Q	5.20	8.80	-3.60
59	5001	0	13	23	34	M	9.70	12.00	-2.30
60	5001	0	14	16	4	D	68.90	60.90	8.00
61	5001	0	14	16	4	L	70.60	65.50	5.10
62	5001	0	14	16	7	B	44.70	53.50	-8.80
63	5001	0	14	16	7	C	42.60	48.50	-5.90
64	5001	0	14	16	8	J	54.30	56.20	-1.90
65	5001	0	14	23	2	F	7.50	8.00	-0.50
66	5001	0	14	23	11	F	9.00	13.50	-4.50
67	5001	0	14	23	27	C	26.00	19.00	7.00
68	5001	0	14	23	31	P	14.50	18.00	-3.50
69	5001	0	14	23	32	C	14.00	17.00	-3.00
70	5001	0	14	24	17	J	3.00	15.00	-12.00
71	5001	0	14	24	24	H	2.00	19.00	-17.00
72	5001	0	15	18	23	A	155.90	177.10	-21.20
73	5001	0	15	23	24	D	55.00	66.00	-11.00
74	5001	0	15	24	5	A	21.00	29.00	-8.00
75	5001	1	15	24	5	A	21.00	29.00	-8.00
76	5001	0	15	24	5	A	21.00	25.00	-4.00
77	5001	1	15	24	5	A	21.00	25.00	-4.00
78	5001	0	15	24	5	A	21.00	24.00	-3.00
79	5001	1	15	24	5	A	21.00	24.00	-3.00
80	5001	0	15	24	19	H	59.00	61.00	-2.00
81	5001	0	15	24	22	E	45.00	49.00	-4.00
82	5001	0	15	24	35	G	55.00	74.00	-19.00
83	5001	0	16	24	2	P	43.00	48.00	-5.00
84	5001	0	16	24	9	C	52.00	61.00	-9.00
85	5001	0	16	24	14	A	33.00	41.00	-8.00
86	5001	0	16	24	21	B	37.00	43.00	-6.00
87	5001	0	16	24	23	A	18.00	31.00	-13.00
88	5001	0	16	24	24	J	17.00	26.00	-9.00
89	5001	0	16	24	27	A	24.00	33.00	-9.00
90	5001	0	16	24	28	F	35.00	40.00	-5.00
91	5001	0	16	24	33	R	27.50	35.00	-7.50
92	5001	0	16	24	36	D	8.00	16.00	-8.00
93	5001	0	16	25	29	A	28.00	42.00	-14.00
94	5001	1	16	25	29	A	28.00	42.00	-14.00
95	5001	0	16	25	29	A	28.00	39.30	-11.30
96	5001	1	16	25	29	A	28.00	39.30	-11.30
97	5001	0	16	25	31	R	22.00	32.00	-10.00
98	5001	0	16	25	33	A	27.00	38.00	-11.00

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
99	5001	0	16	25	34	D	36.00	36.00	0.00
100	5001	0	17	22	24	J	84.00	71.00	13.00
101	5001	0	17	22	35	B	96.00	92.40	3.60
102	5001	0	17	22	36	J	99.00	97.20	1.80
103	5001	0	17	23	18	D	58.00	58.80	-0.80
104	5001	0	17	24	8	C	42.00	50.90	-8.90
105	5001	0	17	24	15	A	37.00	46.50	-9.50
106	5001	1	17	24	15	A	37.00	46.50	-9.50
107	5001	0	17	24	15	A	37.00	40.00	-3.00
108	5001	1	17	24	15	A	37.00	40.00	-3.00
109	5001	0	17	24	15	A	37.00	25.00	12.00
110	5001	1	17	24	15	A	37.00	25.00	12.00
111	5001	0	17	25	11	H	42.00	49.50	-7.50
112	5001	0	17	25	29	R	88.00	94.00	-6.00
113	5001	0	18	22	35	C	98.00	98.00	0.00
114	5050	0	15	18	15	A	158.00	157.00	1.00
115	5050	0	15	18	24	J	169.00	171.00	-2.00
116	5050	0	15	19	7	Q	126.00	126.00	0.00
117	5050	0	15	19	19	M	162.00	163.00	-1.00
118	5050	0	15	19	21	A	118.00	121.00	-3.00
119	5050	0	15	19	21	C	142.00	145.00	-3.00
120	5050	0	15	19	28	E	152.00	151.00	1.00
121	5050	0	15	19	32	P	170.00	177.00	-7.00
122	5050	0	15	19	33	Q	169.00	170.00	-1.00
123	5050	0	15	19	34	C	140.00	141.00	-1.00
124	5050	0	15	19	36	Q	129.00	116.00	13.00
125	5050	0	16	18	1	J	182.00	184.00	-2.00
126	5050	0	16	18	3	A	186.00	193.00	-7.00
127	5050	0	16	18	3	J	184.00	193.00	-9.00
128	5050	0	16	18	9	F	187.00	187.00	0.00
129	5050	0	16	18	15	F	177.00	187.00	-10.00
130	5050	0	16	18	16	J	160.00	175.00	-15.00
131	5050	0	16	18	25	M	173.00	183.00	-10.00
132	5050	0	16	18	33	Q	149.00	158.00	-9.00
133	5050	0	16	19	9	F	169.00	169.00	0.00
134	5050	0	16	19	12	P	130.00	131.00	-1.00
135	5050	0	16	19	16	R	160.00	163.00	-3.00
136	5050	0	16	19	17	C	177.00	178.00	-1.00
137	5050	0	16	19	21	P	173.00	176.00	-3.00
138	5050	0	16	19	22	Q	159.00	157.00	2.00
139	5050	0	16	19	32	P	168.00	179.00	-11.00
140	5050	0	16	19	34	P	150.00	153.00	-3.00
141	5050	0	17	19	18	K	122.00	131.00	-9.00
142	5050	0	17	20	2	J	81.20	88.00	-6.80
143	5050	0	17	20	4	B	104.80	109.20	-4.40
144	5050	0	17	20	6	M	115.00	122.00	-7.00
145	5050	0	17	20	9	H	96.50	102.20	-5.70
146	5050	0	17	20	11	J	69.30	81.70	-12.40
147	5050	0	17	20	20	D	96.80	103.30	-6.50

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
148	5050	0	17	20	22	P	79.10	83.60	-4.50
149	5050	0	17	20	24	N	71.00	78.00	-7.00
150	5050	0	17	20	33	A	14.30	14.50	-0.20
151	5050	0	17	21	7	J	79.00	92.30	-13.30
152	5050	0	17	21	20	G	48.50	56.60	-8.10
153	5050	0	17	21	36	B	38.60	44.30	-5.70
154	5050	0	17	22	7	A	41.00	45.70	-4.70
155	5050	0	18	18	7	R	175.00	204.00	-29.00
156	5050	0	18	19	1	P	3.90	4.10	-0.20
157	5050	0	18	19	2	F	11.00	11.20	-0.20
158	5050	0	18	19	5	E	125.00	133.00	-8.00
159	5050	0	18	19	5	Q	129.00	132.00	-3.00
160	5050	0	18	19	7	N	144.00	166.00	-22.00
161	5050	0	18	19	7	R	129.00	145.00	-16.00
162	5050	0	18	19	14	E	4.60	4.20	0.40
163	5050	0	18	19	35	J	112.00	119.00	-7.00
164	5050	0	18	20	9	M	6.00	6.00	0.00
165	5050	0	18	20	12	C	78.90	88.50	-9.60
166	5050	0	18	20	17	D	3.70	2.90	0.80
167	5050	0	18	20	19	N	108.00	113.00	-5.00
168	5050	0	18	20	34	N	100.00	102.10	-2.10
169	5050	0	19	19	3	D	94.50	130.00	-35.50
170	5050	0	19	19	4	G	81.00	96.40	-15.40
171	5050	0	19	19	19	K	164.00	183.00	-19.00
172	5050	0	19	20	6	C	102.90	112.00	-9.10
173	5050	0	19	20	6	L	99.20	102.90	-3.70
174	5050	0	19	20	7	F	98.20	106.00	-7.80
175	5050	0	20	19	2	D	144.00	163.00	-19.00
176	5050	0	20	19	2	E	123.00	136.00	-13.00
177	5050	0	20	19	2	J	144.00	166.00	-22.00
178	5050	0	20	19	10	E	148.00	173.00	-25.00
179	5050	0	20	19	10	N	158.00	182.00	-24.00
180	5050	0	20	19	11	E	70.80	78.80	-8.00
181	5050	0	20	19	11	N	146.00	168.00	-22.00
182	5050	0	20	19	15	E	130.00	161.00	-31.00
183	5050	0	20	20	20	L	124.00	147.00	-23.00
184	5050	0	20	20	28	E	118.00	143.00	-25.00
185	5050	0	20	20	29	R	117.10	142.30	-25.20
186	5050	0	20	21	8	C	112.00	134.00	-22.00
187	5050	0	20	21	8	D	113.90	131.00	-17.10
188	5050	0	20	21	24	G	113.70	140.00	-26.30
189	5050	0	20	21	24	H	115.00	140.00	-25.00
190	5050	0	20	22	18	G	111.00	133.00	-22.00
191	5050	0	20	22	18	R	111.00	136.00	-25.00
192	5050	0	20	22	19	J	119.00	142.00	-23.00
193	5050	0	20	22	19	L	121.00	139.00	-18.00
194	5050	0	20	22	19	N	118.00	144.00	-26.00
195	5050	0	20	22	23	P	91.10	111.00	-19.90
196	5050	0	20	22	34	J	44.30	60.90	-16.60

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
197	5050	0	20	22	35	R	43.30	84.60	-41.30
198	5050	0	21	23	18	N	78.70	82.70	-4.00
199	5050	0	23	23	24	J	154.00	173.00	-19.00
200	5050	0	23	23	24	M	166.00	188.00	-22.00
201	5050	0	23	23	24	R	157.00	182.00	-25.00
202	5050	0	23	23	33	R	192.00	211.00	-19.00
203	5050	0	24	22	27	B	150.00	151.00	-1.00
204	5050	0	24	23	15	R	177.00	202.00	-25.00
205	5050	0	24	23	22	R	171.00	195.00	-24.00
206	5129	5	17	21	31	R	70.00	72.00	-2.00
207	5129	5	17	21	32	K	51.00	61.00	-10.00
208	5129	5	17	21	32	P	52.00	64.00	-12.00
209	5129	5	17	21	33	Q	51.00	62.00	-11.00
210	5129	5	17	21	35	C	25.00	37.00	-12.00
211	5129	5	17	22	16	H	23.00	25.00	-2.00
212	5129	5	17	22	16	J	22.00	25.00	-3.00
213	5129	5	17	22	31	A	49.00	60.00	-11.00
214	5129	5	17	22	33	P	82.00	88.00	-6.00
215	5129	5	17	23	7	B	54.00	43.00	11.00
216	5129	5	17	23	8	J	50.00	52.00	-2.00
217	5129	5	17	23	30	A	69.00	75.00	-6.00
218	5129	5	17	23	31	F	70.00	76.00	-6.00
219	5129	5	18	20	1	J	13.00	17.00	-4.00
220	5129	5	18	20	22	J	10.00	11.00	-1.00
221	5129	5	18	20	26	D	7.00	6.00	1.00
222	5129	5	18	20	26	J	10.00	9.00	1.00
223	5129	5	18	21	2	R	87.00	97.00	-10.00
224	5129	5	18	21	3	D	64.00	72.00	-8.00
225	5129	5	18	21	3	J	87.00	94.00	-7.00
226	5129	5	18	21	4	L	66.00	83.00	-17.00
227	5129	5	18	21	5	M	60.00	73.00	-13.00
228	5129	5	18	21	8	J	75.00	103.00	-28.00
229	5129	5	18	21	10	F	93.00	93.00	0.00
230	5129	5	18	21	12	N	94.00	102.00	-8.00
231	5129	5	18	21	15	C	87.00	100.00	-13.00
232	5129	5	18	21	17	F	22.00	22.00	0.00
233	5129	5	18	21	17	H	28.00	27.00	1.00
234	5129	5	18	21	17	N	15.00	18.00	-3.00
235	5129	5	18	21	19	H	18.00	21.00	-3.00
236	5129	5	18	21	30	D	14.00	19.00	-5.00
237	5129	5	18	21	32	A	95.00	97.00	-2.00
238	5129	5	18	21	34	B	99.00	95.00	4.00
239	5129	5	18	22	6	D	77.00	87.00	-10.00
240	5129	5	18	22	6	E	90.00	90.00	0.00
241	5129	5	18	22	8	A	107.00	100.00	7.00
242	5129	5	18	22	8	N	102.00	99.00	3.00
243	5129	5	18	22	16	L	105.00	107.00	-2.00
244	5129	5	18	22	17	Q	104.00	108.00	-4.00
245	5129	5	18	22	19	H	109.00	118.00	-9.00

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SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
246	5129	5	18	22	27	M	90.00	95.00	-5.00
247	5129	5	18	23	15	A	98.00	94.00	4.00
248	5129	5	18	23	21	J	91.00	116.00	-25.00
249	5129	5	18	23	26	L	100.00	142.00	-42.00
250	5129	5	18	23	27	P	118.00	103.00	15.00
251	5129	5	18	23	28	B	90.00	108.00	-18.00
252	5129	5	18	23	32	B	107.00	115.00	-8.00
253	5129	5	18	23	33	C	109.00	126.00	-17.00
254	5129	5	19	20	10	D	10.00	12.00	-2.00
255	5129	5	19	20	22	C	11.00	15.00	-4.00
256	5129	5	19	21	3	B	69.00	63.00	6.00
257	5129	5	19	21	3	J	99.00	101.00	-2.00
258	5129	5	19	21	9	K	8.00	12.00	-4.00
259	5129	5	19	21	11	B	87.00	89.00	-2.00
260	5129	5	19	21	11	L	94.00	99.00	-5.00
261	5129	5	19	21	17	B	104.00	125.00	-21.00
262	5129	5	19	23	10	C	72.00	59.00	13.00
263	5129	5	19	23	10	D	50.00	55.00	-5.00
264	5129	5	20	20	1	G	6.00	7.00	-1.00
265	5129	5	20	21	11	D	104.00	112.00	-8.00
266	5129	5	20	21	11	N	102.00	128.00	-26.00
267	5129	5	20	22	1	Q	111.00	118.00	-7.00
268	5129	5	20	22	2	C	118.00	117.00	1.00
269	5129	5	20	22	20	A	55.00	61.00	-6.00
270	5129	5	20	23	5	J	103.00	112.00	-9.00
271	5129	5	20	23	8	G	121.00	124.00	-3.00
272	5530	0	12	17	1	J	106.60	106.00	0.60
273	5530	0	12	17	2	J	110.00	107.50	2.50
274	5530	0	12	17	3	C	113.20	111.10	2.10
275	5530	0	12	17	3	F	110.60	108.30	2.30
276	5530	0	12	17	4	L	111.10	109.60	1.50
277	5530	0	12	17	6	A	103.30	103.40	-0.10
278	5530	0	12	17	6	R	103.00	103.60	-0.60
279	5530	0	12	17	8	G	102.80	104.00	-1.20
280	5530	0	12	17	8	G	102.80	103.00	-0.20
281	5530	0	12	17	9	J	100.00	98.00	2.00
282	5530	0	12	17	10	H	101.60	102.00	-0.40
283	5530	0	12	17	11	D	101.10	102.40	-1.30
284	5530	0	12	17	11	J	102.10	104.10	-2.00
285	5530	0	12	17	14	F	96.60	97.90	-1.30
286	5530	0	12	17	15	J	99.50	97.50	2.00
287	5530	0	12	17	16	A	90.50	92.00	-1.50
288	5530	0	12	17	20	P	89.20	90.00	-0.80
289	5530	0	12	17	21	H	88.80	89.60	-0.80
290	5530	0	12	17	23	C	93.10	94.20	-1.10
291	5530	0	12	17	24	H	83.90	85.90	-2.00
292	5530	0	12	17	26	A	70.70	69.00	1.70
293	5530	0	12	17	26	C	71.00	71.60	-0.60
294	5530	0	12	17	26	N	69.30	70.10	-0.80

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SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
295	5530	0	12	17	29	H	81.00	82.20	-1.20
296	5530	0	12	17	31	A	80.30	82.00	-1.70
297	5530	0	12	17	32	H	81.00	83.10	-2.10
298	5530	0	12	17	34	A	66.60	76.70	-10.10
299	5530	0	12	17	34	D	65.80	76.10	-10.30
300	5530	0	12	17	34	R	68.70	74.00	-5.30
301	5530	0	12	17	35	R	69.20	72.10	-2.90
302	5530	0	12	17	36	K	67.20	68.00	-0.80
303	5530	0	12	18	3	D	109.00	111.40	-2.40
304	5530	0	12	18	4	C	108.70	111.60	-2.90
305	5530	0	12	18	4	L	98.80	103.30	-4.50
306	5530	0	12	18	5	A	113.60	113.80	-0.20
307	5530	0	12	18	5	C	107.60	111.00	-3.40
308	5530	0	12	18	6	J	103.60	106.80	-3.20
309	5530	0	12	18	7	H	104.40	106.40	-2.00
310	5530	0	12	18	8	Q	91.90	93.80	-1.90
311	5530	0	12	18	9	P	96.30	97.30	-1.00
312	5530	0	12	18	10	D	96.40	98.70	-2.30
313	5530	0	12	18	10	R	94.80	95.70	-0.90
314	5530	0	12	18	12	N	101.80	103.50	-1.70
315	5530	0	12	18	16	A	90.80	92.50	-1.70
316	5530	0	12	18	16	K	95.00	97.20	-2.20
317	5530	0	12	18	17	L	91.10	93.60	-2.50
318	5530	0	12	18	19	H	82.00	87.30	-5.30
319	5530	0	12	18	20	P	78.20	80.10	-1.90
320	5530	0	12	18	21	G	87.00	88.80	-1.80
321	5530	0	12	18	21	H	83.40	88.00	-4.60
322	5530	0	12	18	25	B	91.70	94.80	-3.10
323	5530	0	12	18	25	L	90.10	91.70	-1.60
324	5530	0	12	18	25	M	90.90	92.60	-1.70
325	5530	0	12	18	26	D	90.00	92.40	-2.40
326	5530	0	12	18	26	L	86.50	90.00	-3.50
327	5530	0	12	18	26	R	86.20	89.10	-2.90
328	5530	0	12	18	28	J	84.10	86.10	-2.00
329	5530	0	12	18	30	C	86.10	87.40	-1.30
330	5530	0	12	18	30	D	85.20	88.60	-3.40
331	5530	0	12	18	31	J	85.10	86.40	-1.30
332	5530	0	12	18	33	C	75.20	78.00	-2.80
333	5530	0	12	18	34	L	72.90	75.00	-2.10
334	5530	0	12	18	35	G	78.00	79.50	-1.50
335	5530	0	12	18	36	P	78.10	80.00	-1.90
336	5530	0	12	19	18	P	108.60	113.30	-4.70
337	5530	0	12	19	20	A	105.90	110.60	-4.70
338	5530	0	12	19	20	D	96.00	100.00	-4.00
339	5530	0	12	19	21	B	97.80	101.00	-3.20
340	5530	0	12	19	28	A	96.60	100.00	-3.40
341	5530	0	12	19	28	P	91.00	92.60	-1.60
342	5530	0	12	19	29	A	109.30	113.20	-3.90
343	5530	0	12	19	31	M	85.40	86.60	-1.20

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WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
344	5530	0	13	16	2	C	92.90	105.40	-12.50
345	5530	0	13	16	2	C	92.90	94.00	-1.10
346	5530	0	13	17	2	M	51.20	52.70	-1.50
347	5530	0	13	17	3	H	55.00	58.20	-3.20
348	5530	0	13	17	4	R	49.60	55.10	-5.50
349	5530	0	13	17	5	P	53.60	55.40	-1.80
350	5530	0	13	17	7	A	48.00	48.10	-0.10
351	5530	0	13	17	7	J	46.60	48.10	-1.50
352	5530	0	13	17	8	L	37.80	38.10	-0.30
353	5530	0	13	17	9	A	49.30	55.00	-5.70
354	5530	0	13	18	3	C	61.10	65.00	-3.90
355	5530	0	13	18	4	A	63.90	67.00	-3.10
356	5530	0	13	18	4	B	63.10	65.90	-2.80
357	5530	0	13	18	5	E	61.40	63.60	-2.20
358	5530	0	13	18	5	J	64.00	65.90	-1.90
359	5530	0	13	18	6	F	60.20	62.00	-1.80
360	5530	0	13	18	6	K	59.50	60.90	-1.40
361	5600	0	14	24	21	D	0.80	4.40	-3.60
362	5600	0	14	24	22	L	1.00	4.90	-3.90
363	5600	0	14	24	22	N	14.10	20.90	-6.80
364	5600	0	14	24	28	R	6.40	8.20	-1.80
365	5600	0	14	24	29	C	41.50	45.50	-4.00
366	5600	0	14	24	34	R	12.70	15.40	-2.70
367	5600	0	15	24	11	A	3.60	7.30	-3.70
368	5600	0	15	24	12	G	3.00	5.60	-2.60
369	5600	0	15	24	12	R	4.50	11.40	-6.90
370	5600	0	15	24	23	J	38.60	45.70	-7.10
371	5600	0	15	24	26	B	48.40	57.10	-8.70
372	5600	0	15	25	7	D	5.70	16.70	-11.00
373	5600	0	15	25	7	G	9.30	18.20	-8.90
374	5600	0	15	25	16	R	34.00	30.70	3.30
375	5600	0	15	25	17	D	5.70	19.00	-13.30
376	5600	0	15	25	19	A	31.50	36.90	-5.40
377	5600	0	15	25	19	J	30.60	35.30	-4.70
378	5600	0	15	25	29	A	12.50	18.60	-6.10
379	5600	0	15	25	29	E	8.70	10.00	-1.30
380	5600	0	15	25	31	A	38.00	41.00	-3.00
381	5600	0	15	25	32	J	16.10	24.40	-8.30
382	5600	0	15	25	33	D	26.60	45.10	-18.50
383	5600	0	16	25	4	C	25.70	31.90	-6.20
384	5600	0	16	25	10	J	26.70	43.40	-16.70
385	5600	0	16	25	15	E	28.50	42.20	-13.70
386	5600	0	16	25	22	B	17.00	25.80	-8.80
387	5600	0	16	25	22	E	17.50	27.90	-10.40
388	5601	0	17	25	12	R	39.00	54.50	-15.50
389	5602	0	17	25	25	A	71.20	68.60	2.60
390	5602	0	17	25	26	C	89.70	89.00	0.70
391	5602	0	17	25	26	R	84.20	83.80	0.40
392	5602	0	17	25	27	R	93.00	94.40	-1.40

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
393	5602	0	17	25	35	D	89.60	90.40	-0.80
394	5602	0	17	25	35	E	88.40	89.50	-1.10
395	5602	0	17	25	35	M	87.50	88.90	-1.40
396	5602	0	17	25	36	A	75.60	75.70	-0.10
397	5602	0	17	25	36	G	80.00	79.10	0.90
398	5602	0	17	25	36	M	75.80	77.50	-1.70
399	5602	0	18	25	1	C	77.30	78.40	-1.10
400	5602	0	18	25	1	J	80.90	82.10	-1.20
401	5602	0	18	25	2	D	87.10	90.60	-3.50
402	5602	0	18	25	2	G	79.40	82.00	-2.60
403	5603	5	17	24	27	F	25.50	30.00	-4.50
404	5603	5	18	23	12	B	54.50	70.00	-15.50
405	5603	5	18	23	14	A	84.50	86.00	-1.50
406	5603	5	18	23	33	J	101.00	111.00	-10.00
407	5603	5	18	23	34	A	102.00	120.00	-18.00
408	5603	5	18	23	34	A	102.00	105.00	-3.00
409	5603	5	18	24	4	J	40.00	48.00	-8.00
410	5603	5	18	24	6	H	48.50	53.00	-4.50
411	5603	5	18	24	10	J	52.00	58.00	-6.00
412	5603	5	18	24	17	L	63.50	72.00	-8.50
413	5603	5	18	24	31	C	102.50	36.50	66.00
414	5603	5	18	25	4	H	82.00	89.00	-7.00
415	5603	5	18	25	15	A	62.00	59.00	3.00
416	5603	5	18	25	15	C	59.00	59.00	0.00
417	5603	5	18	25	20	J	64.50	66.00	-1.50
418	5603	5	18	25	22	P	46.50	53.00	-6.50
419	5603	5	18	25	23	J	31.50	33.00	-1.50
420	5603	5	18	25	33	R	76.50	82.00	-5.50
421	5603	5	19	22	1	N	61.00	79.00	-18.00
422	5603	5	19	22	2	K	61.00	80.00	-19.00
423	5603	5	19	22	9	J	56.00	78.00	-22.00
424	5603	5	19	22	17	L	96.00	109.00	-13.00
425	5603	5	19	22	21	C	92.00	122.00	-30.00
426	5603	5	19	22	22	A	88.00	81.00	7.00
427	5603	5	19	22	31	B	78.00	85.50	-7.50
428	5603	5	19	22	34	L	100.00	111.50	-11.50
429	5603	5	19	23	6	H	98.00	104.50	-6.50
430	5603	5	19	23	7	A	99.00	107.50	-8.50
431	5603	5	19	23	10	Q	84.50	100.00	-15.50
432	5603	5	19	24	14	B	88.50	91.00	-2.50
433	5603	5	19	24	18	J	93.50	99.00	-5.50
434	5603	5	19	25	1	P	32.50	37.00	-4.50
435	5603	5	19	25	10	R	52.00	64.50	-12.50
436	5603	5	19	25	16	A	55.50	67.00	-11.50
437	5603	5	19	25	23	D	47.00	57.00	-10.00
438	5603	5	19	25	24	M	38.00	47.00	-9.00
439	5603	5	19	25	34	A	50.50	61.50	-11.00
440	5603	5	19	25	35	B	49.00	53.50	-4.50
441	5603	5	20	21	36	P	124.00	158.00	-34.00

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
442	5603	5	20	22	33	F	59.00	77.00	-18.00
443	5603	5	20	24	25	N	57.00	67.00	-10.00
444	5603	5	20	25	12	A	31.00	58.00	-27.00
445	5603	5	20	25	14	F	62.00	99.00	-37.00
446	5603	5	20	25	14	F	62.00	70.00	-8.00
447	5603	5	20	25	14	F	62.00	65.00	-3.00
448	5603	5	20	25	16	J	58.00	80.00	-22.00
449	5603	5	20	25	21	J	53.00	58.50	-5.50
450	5603	5	20	25	32	Q	67.00	98.10	-31.10
451	5603	5	21	23	3	D	96.00	116.50	-20.50
452	5603	5	21	23	7	J	102.50	110.00	-7.50
453	5603	5	21	23	11	D	103.00	147.50	-44.50
454	5603	5	21	23	12	C	99.00	113.50	-14.50
455	5603	5	21	23	17	M	112.00	137.50	-25.50
456	5603	5	21	23	22	J	79.00	95.00	-16.00
457	5604	0	19	23	19	H	131.00	100.00	31.00
458	5604	0	19	23	21	P	82.00	91.00	-9.00
459	5604	0	19	23	23	D	73.00	81.00	-8.00
460	5604	0	19	23	24	L	80.50	87.00	-6.50
461	5604	0	19	23	25	C	84.00	90.00	-6.00
462	5604	0	19	23	25	L	94.00	91.00	3.00
463	5604	0	19	23	26	B	62.50	67.00	-4.50
464	5604	0	19	23	27	A	60.00	72.00	-12.00
465	5604	0	19	23	27	P	96.00	80.00	16.00
466	5604	0	19	23	30	H	119.00	92.00	27.00
467	5604	0	19	23	31	R	90.00	90.00	0.00
468	5604	0	19	23	32	H	50.00	45.50	4.50
469	5604	0	19	23	34	L	72.50	77.00	-4.50
470	5604	0	19	23	35	H	106.00	114.00	-8.00
471	5604	0	19	24	10	G	116.00	98.00	18.00
472	5604	0	19	24	17	A	107.00	106.00	1.00
473	5604	0	19	24	17	N	93.00	128.00	-35.00
474	5604	0	19	24	18	R	96.50	101.00	-4.50
475	5604	0	19	24	19	L	94.00	99.00	-5.00
476	5604	0	19	24	20	J	104.00	105.00	-1.00
477	5604	0	19	24	22	P	109.00	105.00	4.00
478	5604	0	19	24	23	D	97.00	100.00	-3.00
479	5604	0	19	24	24	A	89.00	90.00	-1.00
480	5604	0	19	24	27	Q	102.00	107.50	-5.50
481	5604	0	19	24	28	H	104.00	107.00	-3.00
482	5604	0	19	24	29	D	109.00	108.00	1.00
483	5604	0	19	24	29	R	101.00	109.00	-8.00
484	5604	0	19	24	30	J	126.00	108.00	18.00
485	5604	0	19	24	31	E	104.50	108.00	-3.50
486	5604	0	19	24	33	H	104.00	108.00	-4.00
487	5604	0	19	24	36	C	134.00	105.00	29.00
488	5604	0	19	24	36	R	127.00	113.00	14.00
489	5604	0	19	25	20	P	41.50	65.00	-23.50
490	5604	0	19	25	29	B	20.00	60.50	-40.50

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
491	5604	0	19	25	30	C	113.00	88.00	25.00
492	5604	0	20	22	1	H	107.00	110.00	-3.00
493	5604	0	20	22	25	R	110.50	120.00	-9.50
494	5604	0	20	23	2	H	89.00	90.00	-1.00
495	5604	0	20	23	3	L	81.00	92.00	-11.00
496	5604	0	20	23	4	F	99.00	110.00	-11.00
497	5604	0	20	23	7	H	148.00	127.00	21.00
498	5604	0	20	23	8	H	110.00	117.00	-7.00
499	5604	0	20	23	9	J	84.00	95.00	-11.00
500	5604	0	20	23	12	A	103.00	105.00	-2.00
501	5604	0	20	23	15	A	126.00	104.00	22.00
502	5604	0	20	23	16	J	96.00	103.00	-7.00
503	5604	0	20	23	17	C	144.00	135.00	9.00
504	5604	0	20	23	18	R	149.00	134.00	15.00
505	5604	0	20	23	19	J	120.00	131.00	-11.00
506	5604	0	20	23	24	L	100.00	105.00	-5.00
507	5604	0	20	23	25	J	101.00	127.00	-26.00
508	5604	0	20	23	26	C	137.00	103.00	34.00
509	5604	0	20	23	26	R	119.00	105.00	14.00
510	5604	0	20	23	27	R	100.50	107.00	-6.50
511	5604	0	20	23	29	J	135.00	117.00	18.00
512	5604	0	20	24	6	A	102.00	106.00	-4.00
513	5604	0	20	24	7	G	133.00	105.00	28.00
514	5604	0	20	24	9	M	99.50	105.00	-5.50
515	5604	0	20	24	14	R	97.00	99.50	-2.50
516	5604	0	20	24	15	P	91.00	95.00	-4.00
517	5604	0	20	24	16	H	113.00	108.00	5.00
518	5604	0	20	24	17	A	95.00	100.50	-5.50
519	5604	0	20	24	17	P	81.00	99.00	-18.00
520	5604	0	20	24	18	F	99.50	107.00	-7.50
521	5604	0	20	24	27	C	67.00	70.00	-3.00
522	5604	0	20	24	28	L	72.00	75.00	-3.00
523	5604	0	20	24	29	B	95.00	95.00	0.00
524	5604	0	20	24	30	J	93.00	96.00	-3.00
525	5604	0	20	24	31	R	122.00	98.00	24.00
526	5604	0	20	24	33	C	101.00	107.00	-6.00
527	5604	0	20	25	6	C	121.00	101.00	20.00
528	5604	0	20	25	18	M	117.00	105.00	12.00
529	5604	0	21	23	3	N	94.50	105.00	-10.50
530	5604	0	21	23	4	A	106.50	107.00	-0.50
531	5604	0	21	23	5	A	107.50	117.00	-9.50
532	5604	0	21	23	5	R	104.50	113.00	-8.50
533	5604	0	21	23	7	H	99.50	108.00	-8.50
534	5604	0	21	23	8	F	126.00	112.00	14.00
535	5604	0	21	23	8	R	98.00	107.00	-9.00
536	5604	0	21	23	10	J	131.00	111.00	20.00
537	5604	0	21	23	14	C	132.00	126.00	6.00
538	5604	0	21	23	21	C	87.00	117.00	-30.00
539	5604	0	21	23	21	C	87.00	105.00	-18.00

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SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
540	5604	0	21	23	22	H	81.00	98.00	-17.00
541	5609	0	20	25	33	J	81.30	85.00	-3.70
542	5609	0	20	25	35	G	84.30	91.00	-6.70
543	5609	0	20	25	36	H	69.00	72.20	-3.20
544	5609	0	21	23	24	R	79.00	84.00	-5.00
545	5609	0	21	23	25	A	73.10	82.10	-9.00
546	5609	0	21	23	31	B	38.90	58.10	-19.20
547	5609	0	21	23	32	K	40.00	59.30	-19.30
548	5609	0	21	23	33	Q	32.00	53.70	-21.70
549	5609	0	21	23	36	J	80.90	90.60	-9.70
550	5609	0	22	23	6	B	28.20	41.00	-12.80
551	5609	0	22	23	7	R	31.30	46.30	-15.00
552	5609	0	22	23	8	A	52.40	81.70	-29.30
553	5609	0	22	23	12	A	102.00	114.00	-12.00
554	5609	0	22	23	16	C	44.80	54.70	-9.90
555	5612	0	23	23	2	A	112.00	118.00	-6.00
556	5620	4	14	16	33	N	44.60	42.10	2.50
557	5620	4	14	16	35	M	63.80	66.90	-3.10
558	5620	4	14	17	28	A	130.30	121.80	8.50
559	5620	4	14	17	36	A	146.60	139.70	6.90
560	5620	4	15	16	1	Q	75.50	78.40	-2.90
561	5620	4	15	16	2	B	66.70	69.60	-2.90
562	5620	4	15	16	25	R	101.50	104.00	-2.50
563	5620	4	15	17	15	J	169.50	159.90	9.60
564	5620	4	15	17	20	C	106.80	106.20	0.60
565	5620	4	15	17	22	J	163.40	155.90	7.50
566	5620	4	15	17	23	A	175.20	165.60	9.60
567	5620	4	15	17	28	K	128.60	131.30	-2.70
568	5620	4	15	17	33	A	142.90	137.40	5.50
569	5620	4	15	18	3	R	143.30	139.20	4.10
570	5620	4	15	18	6	A	130.80	152.20	-21.40
571	5620	4	15	18	7	A	159.30	176.70	-17.40
572	5620	4	15	18	30	L	184.90	185.40	-0.50
573	5620	4	16	17	3	J	158.20	156.70	1.50
574	5620	4	16	17	4	P	130.90	137.50	-6.60
575	5622	3	12	21	17	G	73.50	72.80	0.70
576	5622	3	12	21	17	L	81.10	81.90	-0.80
577	5622	3	12	21	18	B	140.30	139.80	0.50
578	5631	3	12	21	33	P	93.60	89.50	4.10
579	5631	3	12	21	34	D	70.60	67.90	2.70
580	5631	3	13	17	12	J	53.70	40.10	13.60
581	5631	3	13	17	19	H	36.70	39.80	-3.10
582	5631	3	13	17	20	A	41.50	35.70	5.80
583	5631	3	13	17	22	B	42.80	44.40	-1.60
584	5631	3	13	17	25	C	59.10	47.50	11.60
585	5631	3	13	17	32	H	99.10	76.50	22.60
586	5631	3	13	17	34	F	63.00	65.80	-2.80
587	5631	3	13	18	17	A	49.20	48.40	0.80
588	5631	3	13	18	29	C	56.40	50.20	6.20

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WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
589	5631	3	13	18	32	N	66.30	64.20	2.10
590	5631	3	13	19	23	E	83.70	75.50	8.20
591	5631	3	13	20	12	H	114.50	108.90	5.60
592	5631	3	13	21	23	D	54.60	46.20	8.40
593	5631	3	13	21	24	J	34.00	29.30	4.70
594	5631	3	13	22	7	R	31.90	42.60	-10.70
595	5631	3	13	23	30	C	12.60	15.30	-2.70
596	5631	3	14	18	4	A	70.10	64.00	6.10
597	5631	3	14	18	8	J	84.30	71.20	13.10
598	5631	3	14	19	4	R	65.70	62.00	3.70
599	5631	3	14	19	7	D	62.40	59.50	2.90
600	5631	3	14	19	22	R	51.00	39.40	11.60
601	5631	3	14	19	33	D	48.90	55.00	-6.10
602	5631	3	14	19	36	A	61.00	59.90	1.10
603	5631	3	14	20	19	B	69.00	60.40	8.60
604	5631	3	14	20	33	F	55.20	54.80	0.40
605	5631	3	14	20	34	R	52.50	52.20	0.30
606	5631	3	14	21	22	D	54.00	54.30	-0.30
607	5631	3	14	21	29	D	43.80	38.30	5.50
608	5631	3	14	22	3	B	29.50	32.10	-2.60
609	5631	3	14	22	6	A	30.60	36.30	-5.70
610	5631	3	15	19	3	J	74.20	80.20	-6.00
611	5631	3	15	19	14	M	101.90	101.60	0.30
612	5631	3	15	20	9	K	57.60	57.80	-0.20
613	5631	3	15	21	6	C	46.10	47.60	-1.50
614	5631	3	15	21	10	E	39.60	42.80	-3.20
615	5636	2	14	21	25	D	45.00	46.10	-1.10
616	5636	2	14	21	27	B	47.90	44.80	3.10
617	5636	2	14	22	22	N	29.00	32.40	-3.40
618	5636	2	14	22	26	A	30.40	29.90	0.50
619	5636	2	14	22	30	A	34.60	35.20	-0.60
620	5636	2	15	19	12	N	80.40	81.60	-1.20
621	5636	2	15	19	24	N	105.10	103.60	1.50
622	5636	2	15	19	35	R	117.00	116.70	0.30
623	5636	2	15	20	15	D	58.60	60.30	-1.70
624	5636	2	15	20	17	D	70.10	72.80	-2.70
625	5636	2	15	20	25	D	60.10	61.70	-1.60
626	5636	2	15	20	28	A	74.10	74.80	-0.70
627	5636	2	15	21	17	D	37.50	41.10	-3.60
628	5636	2	15	21	35	R	35.70	36.90	-1.20
629	5636	2	15	22	2	C	24.70	26.90	-2.20
630	5636	2	15	22	3	D	16.20	16.30	-0.10
631	5636	2	15	22	6	A	30.70	36.00	-5.30
632	5636	2	15	22	14	A	35.70	35.80	-0.10
633	5636	2	15	22	16	A	32.60	38.00	-5.40
634	5636	2	15	22	23	R	44.90	50.20	-5.30
635	5636	2	15	22	32	N	39.60	45.20	-5.60
636	5636	2	15	22	33	R	37.80	47.00	-9.20
637	5636	2	15	22	36	P	40.90	45.80	-4.90

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WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
638	5636	2	15	23	7	R	54.50	55.60	-1.10
639	5636	2	15	23	21	Q	49.00	50.20	-1.20
640	5636	2	15	23	30	B	46.80	49.20	-2.40
641	5636	2	15	23	31	R	41.50	43.40	-1.90
642	5636	2	15	23	33	P	40.40	34.40	6.00
643	5636	2	16	19	14	A	133.60	133.50	0.10
644	5636	2	16	20	6	A	103.20	103.10	0.10
645	5636	2	16	20	20	N	117.70	118.50	-0.80
646	5636	2	16	20	22	N	96.60	90.80	5.80
647	5636	2	16	21	14	A	38.60	43.20	-4.60
648	5636	2	16	21	18	A	51.30	56.90	-5.60
649	5636	2	16	21	20	N	75.20	78.70	-3.50
650	5636	2	16	21	22	N	60.60	64.50	-3.90
651	5636	2	16	21	23	R	47.70	52.00	-4.30
652	5636	2	16	22	18	A	40.50	46.20	-5.70
653	5636	2	16	22	21	R	32.30	37.60	-5.30
654	5636	2	16	22	23	R	57.10	35.30	21.80
655	5636	2	16	23	18	A	36.90	38.20	-1.30
656	5636	2	17	21	1	C	85.50	59.40	26.10
657	5636	2	17	21	3	C	98.60	80.20	18.40
658	5636	2	17	22	3	C	29.20	30.00	-0.80
659	5637	1	14	23	2	E	7.10	8.00	-0.90
660	5637	1	14	23	14	E	10.00	11.20	-1.20
661	5637	1	14	23	15	C	10.90	12.00	-1.10
662	5637	1	14	23	22	A	17.40	20.10	-2.70
663	5637	1	14	23	25	N	51.80	63.20	-11.40
664	5637	1	14	23	26	E	27.70	34.90	-7.20
665	5637	1	14	23	34	B	30.70	36.80	-6.10
666	5637	1	14	23	36	R	49.40	60.00	-10.60
667	5637	1	14	24	31	P	41.90	50.00	-8.10
668	5637	1	15	23	1	M	55.60	69.80	-14.20
669	5637	1	15	23	12	R	60.70	68.80	-8.10
670	5637	1	15	23	22	B	54.90	58.00	-3.10
671	5637	1	15	23	23	A	53.90	60.00	-6.10
672	5637	0	15	23	24	N	51.90	57.20	-5.30
673	5637	1	15	23	24	N	51.90	57.20	-5.30
674	5637	1	15	23	35	D	43.40	49.80	-6.40
675	5637	1	15	23	36	A	42.90	49.60	-6.70
676	5637	1	15	23	36	P	27.00	33.90	-6.90
677	5637	1	15	24	5	C	44.90	52.00	-7.10
678	5637	1	15	24	6	P	58.60	60.80	-2.20
679	5637	1	15	24	7	Q	59.70	66.60	-6.90
680	5637	1	15	24	16	A	27.90	25.00	2.90
681	5637	1	15	24	16	P	53.00	56.60	-3.60
682	5637	1	15	24	19	D	56.60	64.80	-8.20
683	5637	1	15	24	20	N	52.40	58.90	-6.50
684	5637	1	15	24	22	D	44.90	50.40	-5.50
685	5637	1	15	24	27	R	43.00	49.20	-6.20
686	5637	1	15	24	28	D	50.50	54.90	-4.40

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
687	5637	1	15	24	30	C	52.60	50.80	1.80
688	5637	1	15	24	32	C	48.00	51.20	-3.20
689	5637	1	15	24	33	B	54.20	58.70	-4.50
690	5637	1	16	22	36	R	17.90	17.80	0.10
691	5637	1	16	23	3	A	40.70	43.60	-2.90
692	5637	1	16	23	9	E	20.90	25.70	-4.80
693	5637	1	16	23	15	A	32.80	39.80	-7.00
694	5637	1	16	23	17	R	24.60	29.00	-4.40
695	5637	1	16	23	21	N	29.00	31.90	-2.90
696	5637	1	16	23	22	D	35.00	38.00	-3.00
697	5637	1	16	23	23	E	32.80	37.00	-4.20
698	5637	1	16	23	25	M	34.60	40.00	-5.40
699	5637	1	16	23	27	H	32.00	37.80	-5.80
700	5637	1	16	23	32	B	29.90	34.60	-4.70
701	5637	1	16	23	32	P	34.60	41.90	-7.30
702	5637	1	16	23	33	H	37.80	41.60	-3.80
703	5637	1	16	24	2	B	56.90	69.20	-12.30
704	5637	1	16	24	7	D	32.80	38.90	-6.10
705	5637	1	16	24	8	H	33.00	39.60	-6.60
706	5637	1	16	24	10	D	56.90	59.00	-2.10
707	5637	1	16	24	10	J	50.90	59.00	-8.10
708	5637	1	16	24	12	D	51.60	60.50	-8.90
709	5637	1	16	24	14	H	30.50	41.00	-10.50
710	5637	1	16	24	14	N	29.80	30.60	-0.80
711	5637	1	16	24	16	H	40.60	46.80	-6.20
712	5637	1	16	24	19	C	31.80	37.80	-6.00
713	5637	1	16	24	21	J	37.50	40.00	-2.50
714	5637	1	16	24	23	J	24.20	31.40	-7.20
715	5637	1	16	24	25	L	9.20	15.00	-5.80
716	5637	1	16	24	27	R	19.00	28.90	-9.90
717	5637	1	16	24	28	J	29.20	34.20	-5.00
718	5637	1	16	24	29	A	34.00	40.40	-6.40
719	5637	1	16	24	30	D	29.50	35.20	-5.70
720	5637	1	16	24	30	R	33.80	48.00	-14.20
721	5637	1	16	24	33	M	28.60	21.00	7.60
722	5637	1	16	24	34	M	17.50	33.00	-15.50
723	5637	1	16	24	36	E	9.20	16.00	-6.80
724	5637	1	16	25	7	D	40.20	49.00	-8.80
725	5637	1	16	25	8	D	31.50	40.60	-9.10
726	5637	1	16	25	17	H	25.40	42.60	-17.20
727	5637	1	16	25	19	D	18.00	25.60	-7.60
728	5637	1	16	25	21	P	29.20	34.20	-5.00
729	5637	1	16	25	28	R	31.20	40.00	-8.80
730	5637	1	16	25	31	C	16.80	26.00	-9.20
731	5637	1	16	25	32	C	28.80	38.80	-10.00
732	5637	1	16	25	34	Q	24.00	24.00	0.00
733	5637	1	17	23	1	A	41.60	47.80	-6.20
734	5637	1	17	23	9	B	50.80	54.00	-3.20
735	5637	1	17	23	10	A	40.20	50.40	-10.20

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
736	5637	1	17	23	12	C	51.50	57.00	-5.50
737	5637	1	17	23	15	B	61.50	67.40	-5.90
738	5637	1	17	23	18	E	41.50	48.90	-7.40
739	5637	1	17	23	21	C	64.90	69.60	-4.70
740	5637	1	17	23	30	B	61.90	67.80	-5.90
741	5637	1	17	24	1	B	12.00	21.00	-9.00
742	5637	1	17	24	2	R	18.00	24.60	-6.60
743	5637	1	17	24	3	K	18.00	32.60	-14.60
744	5637	1	17	24	5	B	29.20	36.80	-7.60
745	5637	1	17	24	8	A	28.00	35.10	-7.10
746	5637	1	17	24	17	A	30.80	38.00	-7.20
747	5637	1	17	24	20	A	24.00	32.80	-8.80
748	5637	1	17	25	1	D	22.30	20.00	2.30
749	5637	1	17	25	1	P	18.60	23.00	-4.40
750	5637	1	17	25	3	B	25.00	34.30	-9.30
751	5637	1	17	25	6	A	22.90	30.10	-7.20
752	5637	1	17	25	10	C	42.00	35.30	6.70
753	5637	1	17	25	18	A	50.80	56.80	-6.00
754	5637	1	17	25	18	R	64.00	65.80	-1.80
755	5637	1	17	25	29	D	88.40	90.00	-1.60
756	5637	0	15	24	7	Q	59.70	66.60	-6.90
757	5637	0	15	24	16	A	27.90	25.00	2.90
758	5637	0	15	24	16	P	53.00	56.60	-3.60
759	5637	0	15	24	19	D	56.60	64.80	-8.20
760	5637	0	15	24	20	N	52.40	58.90	-6.50
761	5637	0	15	24	22	D	44.90	50.40	-5.50
762	5637	0	15	24	27	R	43.00	49.20	-6.20
763	5637	0	15	24	28	D	50.50	54.90	-4.40
764	5637	0	15	24	30	C	52.60	50.80	1.80
765	5637	0	15	24	32	C	48.00	51.20	-3.20
766	5637	0	15	24	33	B	54.20	58.70	-4.50
767	5637	0	16	22	36	R	17.90	17.80	0.10
768	5637	0	16	23	3	A	40.70	43.60	-2.90
769	5637	0	16	23	9	E	20.90	25.70	-4.80
770	5637	0	16	23	13	H	29.90	34.00	-4.10
771	5637	0	16	23	15	A	32.80	39.80	-7.00
772	5637	0	16	23	17	R	24.60	29.00	-4.40
773	5637	0	16	23	21	N	29.00	31.90	-2.90
774	5637	0	16	23	22	D	35.00	38.00	-3.00
775	5637	0	16	23	23	E	32.80	37.00	-4.20
776	5637	0	16	23	25	M	34.60	40.00	-5.40
777	5637	0	16	23	27	H	32.00	37.80	-5.80
778	5637	0	16	23	32	B	29.90	34.60	-4.70
779	5637	0	16	23	32	P	34.60	41.90	-7.30
780	5637	0	16	23	33	H	37.80	41.60	-3.80
781	5637	0	16	24	2	B	56.90	69.20	-12.30
782	5637	0	16	24	5	M	31.50	40.10	-8.60
783	5637	0	16	24	7	D	32.80	38.90	-6.10
784	5637	0	16	24	8	H	33.00	39.60	-6.60

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
785	5637	0	16	24	10	D	56.90	59.00	-2.10
786	5637	0	16	24	10	J	50.90	59.00	-8.10
787	5637	0	16	24	12	D	51.60	60.50	-8.90
788	5637	0	16	24	14	H	30.50	41.00	-10.50
789	5637	0	16	24	14	N	29.80	30.60	-0.80
790	5637	0	16	24	16	H	40.60	46.80	-6.20
791	5637	0	16	24	19	C	31.80	37.80	-6.00
792	5637	0	16	24	21	J	37.50	40.00	-2.50
793	5637	0	16	24	23	J	24.20	31.40	-7.20
794	5637	0	16	24	25	L	9.20	15.00	-5.80
795	5637	0	16	24	27	R	19.00	28.90	-9.90
796	5637	0	16	24	28	J	29.20	34.20	-5.00
797	5637	0	16	24	29	A	34.00	40.40	-6.40
798	5637	0	16	24	30	D	29.50	35.20	-5.70
799	5637	0	16	24	30	R	33.80	48.00	-14.20
800	5637	0	16	24	33	M	28.60	21.00	7.60
801	5637	0	16	24	34	M	17.50	33.00	-15.50
802	5637	0	16	24	36	E	9.20	16.00	-6.80
803	5637	0	16	25	7	D	40.20	49.00	-8.80
804	5637	0	16	25	8	D	31.50	40.60	-9.10
805	5637	0	16	25	17	H	25.40	42.60	-17.20
806	5637	0	16	25	19	D	18.00	25.60	-7.60
807	5637	0	16	25	21	P	29.20	34.20	-5.00
808	5637	0	16	25	28	R	31.20	40.00	-8.80
809	5637	0	16	25	31	C	16.80	26.00	-9.20
810	5637	0	16	25	32	C	28.80	38.80	-10.00
811	5637	0	16	25	34	Q	24.00	24.00	0.00
812	5637	0	17	23	1	A	41.60	47.80	-6.20
813	5637	0	17	23	9	B	50.80	54.00	-3.20
814	5637	0	17	23	10	A	40.20	50.40	-10.20
815	5637	0	17	23	12	C	51.50	57.00	-5.50
816	5637	0	17	23	15	B	61.50	67.40	-5.90
817	5637	0	17	23	18	E	41.50	48.90	-7.40
818	5637	0	17	23	21	C	64.90	69.60	-4.70
819	5637	0	17	23	30	B	61.90	67.80	-5.90
820	5637	0	17	24	1	B	12.00	21.00	-9.00
821	5637	0	17	24	2	R	18.00	24.60	-6.60
822	5637	0	17	24	3	K	18.00	32.60	-14.60
823	5637	0	17	24	5	B	29.20	36.80	-7.60
824	5637	0	17	24	8	A	28.00	35.10	-7.10
825	5637	0	17	24	17	A	30.80	38.00	-7.20
826	5637	0	17	24	20	A	24.00	32.80	-8.80
827	5637	0	17	24	20	D	22.70	33.80	-11.10
828	5637	0	17	25	1	D	22.30	20.00	2.30
829	5637	0	17	25	1	P	18.60	23.00	-4.40
830	5637	0	17	25	3	B	25.00	34.30	-9.30
831	5637	0	17	25	6	A	22.90	30.10	-7.20
832	5637	0	17	25	10	C	42.00	35.30	6.70
833	5637	0	17	25	18	A	50.80	56.80	-6.00

KINGS RIVER CONSERVATION DISTRICT
SPRING 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW SPR 97	DEPTH TO GW SPR 96	CHANGE IN DEPTH TO GW SPR 96 TO SPR 97
834	5637	0	17	25	18	R	64.00	65.80	-1.80
835	5637	0	17	25	29	D	88.40	90.00	-1.60

GROUNDWATER DATABASE SUMMARY

FALL 1997

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
1	5001	0	12S	19E	23	K	148.70	153.70	-5.00
2	5001	0	12S	19E	26	C	151.30	153.00	-1.70
3	5001	0	12S	20E	5	P	275.90	271.00	4.90
4	5001	0	12S	20E	17	A	187.60	185.30	2.30
5	5001	0	12S	20E	32	G	135.70	133.50	2.20
6	5001	0	12S	21E	20	Q	68.70	66.80	1.90
7	5001	0	12S	22E	21	E	25.20	21.70	3.50
8	5001	0	12S	22E	27	G	28.20	21.70	6.50
9	5001	0	12S	22E	29	H	23.70	24.30	-0.60
10	5001	0	12S	22E	30	N	43.20	44.20	-1.00
11	5001	0	13S	16E	15	H	71.20	79.90	-8.70
12	5001	0	13S	16E	16	D	99.00	128.20	-29.20
13	5001	0	13S	16E	18	H	89.20	77.80	11.40
14	5001	0	13S	16E	20	J	81.80	102.40	-20.60
15	5001	0	13S	16E	22	B	61.50	74.90	-13.40
16	5001	0	13S	16E	22	F	57.80	37.20	20.60
17	5001	0	13S	16E	22	J	67.50	78.70	-11.20
18	5001	0	13S	16E	29	F	92.30	98.30	-6.00
19	5001	0	13S	16E	30	A	87.20	120.30	-33.10
20	5001	0	13S	16E	32	E	121.80	99.90	21.90
21	5001	0	13S	16E	34	C	81.70	86.60	-4.90
22	5001	0	13S	16E	35	A	84.90	106.70	-21.80
23	5001	0	13S	16E	35	J	95.10	99.60	-4.50
24	5001	0	13S	16E	35	L	95.30	97.60	-2.30
25	5001	0	13S	16E	36	R	99.00	101.80	-2.80
26	5001	0	13S	17E	11	R	37.90	43.80	-5.90
27	5001	0	13S	17E	23	N	56.70	51.80	4.90
28	5001	0	13S	17E	28	H	59.70	61.80	-2.10
29	5001	0	13S	17E	33	D	75.80	73.10	2.70
30	5001	0	13S	17E	35	L	57.40	62.00	-4.60
31	5001	0	13S	18E	1	H	74.30	75.90	-1.60
32	5001	0	13S	18E	2	C	56.30	56.70	-0.40
33	5001	0	13S	18E	2	P	59.20	64.80	-5.60
34	5001	0	13S	18E	3	P	57.80	59.00	-1.20
35	5001	0	13S	18E	7	R	37.80	38.00	-0.20
36	5001	0	13S	18E	9	B	46.50	49.50	-3.00
37	5001	0	13S	18E	10	P	49.30	53.00	-3.70
38	5001	0	13S	18E	15	J	54.80	57.70	-2.90
39	5001	0	13S	18E	20	C	45.30	48.00	-2.70
40	5001	0	13S	18E	21	P	47.00	50.50	-3.50
41	5001	0	13S	18E	22	L	51.50	55.50	-4.00
42	5001	0	13S	18E	23	R	62.60	61.00	1.60
43	5001	0	13S	18E	34	D	55.90	59.30	-3.40
44	5001	0	13S	19E	16	K	86.30	86.70	-0.40
45	5001	0	13S	22E	11	B	12.80	13.10	-0.30
46	5001	0	13S	23E	17	D	10.00	9.70	0.30
47	5001	0	13S	23E	33	Q	8.60	8.00	0.60
48	5001	0	13S	23E	34	M	11.90	11.50	0.40
49	5001	0	14S	16E	3	A	96.50	114.20	-17.70

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
50	5001	0	14S	16E	7	B	69.40	65.60	3.80
51	5001	0	14S	16E	7	C	62.80	66.70	-3.90
52	5001	0	14S	16E	8	J	76.60	74.00	2.60
53	5001	0	14S	17E	1	E	64.80	77.20	-12.40
54	5001	0	14S	17E	5	D	92.80	99.50	-6.70
55	5001	0	14S	17E	8	D	118.80	151.60	-32.80
56	5001	0	14S	17E	14	J	101.70	106.80	-5.10
57	5001	0	14S	23E	2	F	9.50	9.50	0.00
58	5001	0	14S	23E	11	F	21.00	14.50	6.50
59	5001	0	14S	23E	27	C	31.00	43.00	-12.00
60	5001	0	14S	24E	17	J	15.00	19.00	-4.00
61	5001	0	14S	24E	24	H	27.00	22.00	5.00
62	5001	0	15S	18E	23	A	155.80	158.80	-3.00
63	5001	0	15S	23E	2	Q	73.50	87.50	-14.00
64	5001	0	15S	23E	24	N	57.50	55.80	1.70
65	5001	1	15S	23E	24	N	57.50	55.80	1.70
66	5001	0	15S	24E	5	A	23.50	27.00	-3.50
67	5001	0	15S	24E	5	A	23.50	25.80	-2.30
68	5001	0	15S	24E	19	H	53.00	59.50	-6.50
69	5001	0	15S	24E	22	E	52.50	48.00	4.50
70	5001	0	15S	24E	35	G	77.50	61.00	16.50
71	5001	0	16S	16E	9	N	124.10	143.20	-19.10
72	5001	0	16S	16E	14	N	123.90	147.20	-23.30
73	5001	0	16S	24E	2	P	53.00	45.00	8.00
74	5001	0	16S	24E	14	A	43.00	39.00	4.00
75	5001	0	16S	24E	33	R	36.00	32.00	4.00
76	5001	0	16S	25E	17	C	34.00	29.00	5.00
77	5001	0	16S	25E	29	A	43.00	39.00	4.00
78	5001	0	16S	25E	31	R	37.00	31.00	6.00
79	5001	0	16S	25E	33	A	38.00	36.00	2.00
80	5001	0	16S	25E	34	D	38.00	39.00	-1.00
81	5001	0	17S	22E	35	B	79.60	114.00	-34.40
82	5001	0	17S	22E	36	J	78.70	109.00	-30.30
83	5001	0	17S	23E	9	Q	78.10	79.00	-0.90
84	5001	0	17S	24E	8	C	57.30	54.00	3.30
85	5001	0	17S	24E	15	A	46.50	25.60	20.90
86	5001	1	17S	24E	15	A	46.50	25.60	20.90
87	5001	0	17S	25E	11	H	48.50	44.00	4.50
88	5001	0	17S	25E	29	R	11.50	105.00	-93.50
89	5001	0	17S	25E	33	J	145.20	99.00	46.20
90	5001	0	18S	22E	10	C	108.30	122.00	-13.70
91	5001	0	18S	22E	20	D	114.50	119.00	-4.50
92	5001	0	23S	23E	3	C	164.90	146.00	18.90
93	5001	0	24S	23E	5	R	140.80	178.20	-37.40
94	5001	0	24S	23E	22	E	39.50	50.10	-10.60
95	5050	0	15S	18E	15	A	166.00	167.00	-1.00
96	5050	0	15S	18E	24	J	173.00	170.00	3.00
97	5050	0	15S	18E	33	E	208.00	211.00	-3.00
98	5050	0	15S	18E	33	N	205.00	207.00	-2.00

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
99	5050	0	15S	19E	7	Q	131.00	134.00	-3.00
100	5050	0	15S	19E	19	M	166.00	168.00	-2.00
101	5050	0	15S	19E	21	A	126.00	130.00	-4.00
102	5050	0	15S	19E	21	C	134.00	156.00	-22.00
103	5050	0	15S	19E	28	E	155.00	157.00	-2.00
104	5050	0	15S	19E	32	P	177.00	184.00	-7.00
105	5050	0	15S	19E	33	Q	163.00	175.00	-12.00
106	5050	0	15S	19E	34	C	144.00	150.00	-6.00
107	5050	0	16S	18E	1	J	189.00	188.00	1.00
108	5050	0	16S	18E	3	J	190.00	193.00	-3.00
109	5050	0	16S	18E	5	N	192.00	196.00	-4.00
110	5050	0	16S	18E	9	F	191.00	198.00	-7.00
111	5050	0	16S	18E	15	F	188.00	193.00	-5.00
112	5050	0	16S	18E	16	J	172.00	179.00	-7.00
113	5050	0	16S	18E	25	M	172.00	188.00	-16.00
114	5050	0	16S	18E	33	Q	153.00	157.00	-4.00
115	5050	0	16S	19E	9	F	172.00	174.00	-2.00
116	5050	0	16S	19E	12	P	133.00	134.00	-1.00
117	5050	0	16S	19E	16	R	168.00	169.00	-1.00
118	5050	0	16S	19E	17	C	173.00	185.00	-12.00
119	5050	0	16S	19E	21	P	171.00	180.00	-9.00
120	5050	0	16S	19E	22	Q	167.00	164.00	3.00
121	5050	0	16S	19E	34	P	152.00	161.00	-9.00
122	5050	0	17S	20E	2	J	83.10	87.80	-4.70
123	5050	0	17S	20E	4	B	109.00	108.20	0.80
124	5050	0	17S	20E	6	M	122.00	127.00	-5.00
125	5050	0	17S	20E	9	H	99.60	101.80	-2.20
126	5050	0	17S	20E	11	J	71.80	78.50	-6.70
127	5050	0	17S	20E	20	D	99.70	103.50	-3.80
128	5050	0	17S	20E	22	P	72.80	84.20	-11.40
129	5050	0	17S	20E	24	N	66.00	78.00	-12.00
130	5050	0	17S	20E	26	E	82.00	92.00	-10.00
131	5050	0	17S	20E	33	A	12.30	15.10	-2.80
132	5050	0	17S	21E	7	J	84.00	89.20	-5.20
133	5050	0	17S	21E	11	K	60.40	59.10	1.30
134	5050	0	17S	21E	17	J	48.00	55.10	-7.10
135	5050	0	17S	21E	20	G	45.30	52.30	-7.00
136	5050	0	17S	21E	36	B	40.10	41.90	-1.80
137	5050	0	18S	18E	7	R	169.00	181.00	-12.00
138	5050	0	18S	18E	9	E	160.00	188.00	-28.00
139	5050	0	18S	19E	1	P	4.60	4.40	0.20
140	5050	0	18S	19E	5	Q	129.00	137.00	-8.00
141	5050	0	18S	19E	7	N	142.00	157.00	-15.00
142	5050	0	18S	19E	7	P	140.00	143.00	-3.00
143	5050	0	18S	19E	7	R	139.00	140.00	-1.00
144	5050	0	18S	19E	14	E	5.10	6.20	-1.10
145	5050	0	18S	20E	17	D	4.60	4.50	0.10
146	5050	0	18S	20E	19	N	108.00	113.00	-5.00
147	5050	0	19S	19E	3	D	134.00	97.70	36.30

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
148	5050	0	19S	19E	4	G	84.80	105.80	-21.00
149	5050	0	19S	19E	19	K	164.00	178.00	-14.00
150	5050	0	19S	20E	6	C	107.00	114.30	-7.30
151	5050	0	19S	20E	6	L	97.00	101.60	-4.60
152	5050	0	19S	20E	7	F	101.00	106.00	-5.00
153	5050	0	20S	19E	2	D	125.00	145.00	-20.00
154	5050	0	20S	19E	2	E	118.00	130.00	-12.00
155	5050	0	20S	19E	2	J	127.00	151.00	-24.00
156	5050	0	20S	19E	10	E	137.00	157.00	-20.00
157	5050	0	20S	19E	10	N	143.00	167.00	-24.00
158	5050	0	20S	19E	11	N	131.00	153.00	-22.00
159	5050	0	20S	19E	15	E	113.00	140.00	-27.00
160	5050	0	20S	20E	20	L	112.00	125.90	-13.90
161	5050	0	20S	20E	23	A	6.40	7.00	-0.60
162	5050	0	20S	20E	28	E	194.00	322.00	-128.00
163	5050	0	20S	20E	28	E	108.00	128.00	-20.00
164	5050	0	20S	20E	29	R	110.00	128.00	-18.00
165	5050	0	20S	20E	30	J	112.00	133.00	-21.00
166	5050	0	20S	20E	34	B	110.00	130.00	-20.00
167	5050	0	20S	21E	8	C	126.00	139.00	-13.00
168	5050	0	20S	21E	8	D	126.00	141.00	-15.00
169	5050	0	20S	21E	16	M	128.00	145.00	-17.00
170	5050	0	20S	21E	24	G	143.00	144.00	-1.00
171	5050	0	20S	21E	24	H	142.00	143.00	-1.00
172	5050	0	20S	22E	18	R	142.00	145.00	-3.00
173	5050	0	20S	22E	19	J	146.00	144.00	2.00
174	5050	0	20S	22E	19	L	143.00	144.00	-1.00
175	5050	0	20S	22E	19	N	144.00	145.00	-1.00
176	5050	0	20S	22E	23	P	88.00	101.90	-13.90
177	5050	0	20S	22E	34	J	49.50	61.80	-12.30
178	5050	0	20S	22E	35	R	71.40	84.00	-12.60
179	5050	0	20S	22E	36	H	97.40	111.80	-14.40
180	5050	0	21S	21E	6	J	107.00	116.00	-9.00
181	5050	0	21S	21E	11	D	123.00	132.00	-9.00
182	5050	0	24S	22E	27	B	154.00	159.00	-5.00
183	5050	0	24S	23E	22	R	153.00	234.00	-81.00
184	5129	5	17S	21E	27	L	23.00	25.90	-2.90
185	5129	5	17S	21E	31	R	61.00	74.00	-13.00
186	5129	5	17S	21E	32	K	59.00	65.00	-6.00
187	5129	5	17S	21E	32	P	53.00	66.00	-13.00
188	5129	5	17S	21E	33	Q	52.00	62.00	-10.00
189	5129	5	17S	21E	35	C	27.00	28.00	-1.00
190	5129	5	17S	22E	16	H	32.00	43.00	-11.00
191	5129	5	17S	22E	16	J	28.00	31.00	-3.00
192	5129	5	17S	22E	24	E	44.00	46.00	-2.00
193	5129	5	17S	22E	30	A	27.00	24.00	3.00
194	5129	5	17S	22E	31	A	52.00	56.00	-4.00
195	5129	5	17S	22E	31	M	64.00	67.00	-3.00
196	5129	5	17S	22E	33	P	87.00	108.00	-21.00

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
197	5129	5	17S	22E	35	N	70.00	80.00	-10.00
198	5129	5	17S	23E	7	B	37.00	38.00	-1.00
199	5129	5	17S	23E	8	J	56.00	57.00	-1.00
200	5129	5	17S	23E	30	A	73.00	75.70	-2.70
201	5129	5	17S	23E	31	F	74.00	82.00	-8.00
202	5129	5	18S	20E	26	D	5.00	8.00	-3.00
203	5129	5	18S	21E	1	C	71.00	87.00	-16.00
204	5129	5	18S	21E	3	D	57.00	76.00	-19.00
205	5129	5	18S	21E	3	J	91.00	98.00	-7.00
206	5129	5	18S	21E	4	L	70.00	88.00	-18.00
207	5129	5	18S	21E	5	M	61.00	74.00	-13.00
208	5129	5	18S	21E	8	J	80.00	88.00	-8.00
209	5129	5	18S	21E	10	F	92.00	96.00	-4.00
210	5129	5	18S	21E	10	R	109.00	95.00	14.00
211	5129	5	18S	21E	12	N	95.00	99.00	-4.00
212	5129	5	18S	21E	16	F	30.00	32.00	-2.00
213	5129	5	18S	21E	17	F	21.00	26.00	-5.00
214	5129	5	18S	21E	17	H	25.00	29.00	-4.00
215	5129	5	18S	21E	17	N	12.00	16.00	-4.00
216	5129	5	18S	21E	19	H	14.00	20.00	-6.00
217	5129	5	18S	21E	21	H	105.00	108.00	-3.00
218	5129	5	18S	21E	27	B	102.00	105.90	-3.90
219	5129	5	18S	21E	28	B	29.00	31.60	-2.60
220	5129	5	18S	21E	30	D	13.00	17.00	-4.00
221	5129	5	18S	21E	34	B	118.00	123.00	-5.00
222	5129	5	18S	22E	3	B	79.00	76.00	3.00
223	5129	5	18S	22E	3	M	93.00	82.50	10.50
224	5129	5	18S	22E	6	D	78.00	83.00	-5.00
225	5129	5	18S	22E	6	E	88.00	99.00	-11.00
226	5129	5	18S	22E	8	A	129.00	106.00	23.00
227	5129	5	18S	22E	8	N	100.00	106.00	-6.00
228	5129	5	18S	22E	16	L	110.00	113.00	-3.00
229	5129	5	18S	22E	17	Q	112.00	126.00	-14.00
230	5129	5	18S	22E	19	H	114.00	117.00	-3.00
231	5129	5	18S	22E	24	D	93.00	91.30	1.70
232	5129	5	18S	22E	27	M	93.00	102.00	-9.00
233	5129	5	18S	23E	4	Q	112.00	116.50	-4.50
234	5129	5	18S	23E	15	A	116.00	122.00	-6.00
235	5129	5	18S	23E	21	J	122.00	136.10	-14.10
236	5129	5	18S	23E	26	L	110.00	122.60	-12.60
237	5129	5	18S	23E	27	P	118.00	126.50	-8.50
238	5129	5	18S	23E	28	B	123.00	106.30	16.70
239	5129	5	18S	23E	32	B	174.00	129.30	44.70
240	5129	5	18S	23E	34	A	118.00	112.30	5.70
241	5129	5	19S	20E	10	D	10.00	12.00	-2.00
242	5129	5	19S	20E	12	A	9.00	10.00	-1.00
243	5129	5	19S	20E	22	C	15.00	10.00	5.00
244	5129	5	19S	21E	2	F	130.00	125.80	4.20
245	5129	5	19S	21E	3	B	81.00	83.90	-2.90

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
246	5129	5	19S	21E	3	M	14.00	15.40	-1.40
247	5129	5	19S	21E	10	D	10.00	12.00	-2.00
248	5129	5	19S	21E	11	B	110.00	113.80	-3.80
249	5129	5	19S	21E	20	N	19.00	8.30	10.70
250	5129	5	19S	21E	20	R	6.00	5.00	1.00
251	5129	5	19S	21E	25	J	119.00	113.10	5.90
252	5129	5	19S	21E	31	Q	6.00	7.00	-1.00
253	5129	5	19S	21E	32	J	14.00	18.00	-4.00
254	5129	5	19S	22E	20	A	137.00	152.10	-15.10
255	5129	5	19S	22E	36	E	101.00	130.80	-29.80
256	5129	5	19S	23E	8	J	102.00	105.00	-3.00
257	5129	5	19S	23E	10	C	82.00	93.00	-11.00
258	5129	5	19S	23E	10	D	72.00	79.00	-7.00
259	5129	5	20S	21E	11	D	129.00	141.80	-12.80
260	5129	5	20S	21E	11	N	140.00	147.80	-7.80
261	5129	5	20S	22E	2	C	110.00	126.10	-16.10
262	5129	5	20S	23E	5	J	100.00	117.00	-17.00
263	5129	3	20S	23E	8	G	109.00	135.00	-26.00
264	5530	0	12S	17E	1	J	110.40	114.00	-3.60
265	5530	0	12S	17E	2	J	110.50	112.70	-2.20
266	5530	0	12S	17E	3	C	114.20	116.60	-2.40
267	5530	0	12S	17E	3	F	112.00	115.20	-3.20
268	5530	0	12S	17E	4	L	120.50	120.60	-0.10
269	5530	0	12S	17E	6	A	108.60	110.70	-2.10
270	5530	0	12S	17E	6	R	114.70	117.30	-2.60
271	5530	0	12S	17E	8	G	108.30	111.80	-3.50
272	5530	0	12S	17E	9	J	105.80	106.60	-0.80
273	5530	0	12S	17E	10	H	105.60	108.00	-2.40
274	5530	0	12S	17E	11	D	105.10	107.20	-2.10
275	5530	0	12S	17E	11	J	104.00	105.70	-1.70
276	5530	0	12S	17E	14	F	100.00	102.20	-2.20
277	5530	0	12S	17E	15	J	97.60	99.60	-2.00
278	5530	0	12S	17E	16	A	95.00	98.50	-3.50
279	5530	0	12S	17E	20	P	95.80	97.40	-1.60
280	5530	0	12S	17E	21	H	95.20	96.00	-0.80
281	5530	0	12S	17E	23	C	94.90	97.30	-2.40
282	5530	0	12S	17E	24	H	90.10	91.00	-0.90
283	5530	0	12S	17E	26	A	75.10	84.00	-8.90
284	5530	0	12S	17E	26	C	73.20	84.50	-11.30
285	5530	0	12S	17E	26	N	77.20	86.10	-8.90
286	5530	0	12S	17E	29	H	87.40	94.10	-6.70
287	5530	0	12S	17E	31	A	85.60	87.60	-2.00
288	5530	0	12S	17E	32	H	85.40	87.10	-1.70
289	5530	0	12S	17E	34	A	73.50	76.80	-3.30
290	5530	0	12S	17E	34	D	72.90	76.80	-3.90
291	5530	0	12S	17E	34	R	71.60	75.90	-4.30
292	5530	0	12S	17E	35	R	74.10	74.90	-0.80
293	5530	0	12S	17E	36	K	72.90	76.80	-3.90
294	5530	0	12S	18E	3	D	118.20	116.40	1.80

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
295	5530	0	12S	18E	4	C	115.40	115.20	0.20
296	5530	0	12S	18E	4	L	104.10	104.30	-0.20
297	5530	0	12S	18E	5	A	119.40	119.60	-0.20
298	5530	0	12S	18E	5	C	111.80	114.10	-2.30
299	5530	0	12S	18E	6	J	111.10	113.10	-2.00
300	5530	0	12S	18E	7	H	109.00	109.20	-0.20
301	5530	0	12S	18E	8	Q	95.90	96.20	-0.30
302	5530	0	12S	18E	9	P	98.20	98.70	-0.50
303	5530	0	12S	18E	10	D	99.10	98.90	0.20
304	5530	0	12S	18E	10	R	97.40	96.70	0.70
305	5530	0	12S	18E	12	N	111.40	110.40	1.00
306	5530	0	12S	18E	16	A	93.30	94.00	-0.70
307	5530	0	12S	18E	16	K	100.10	101.70	-1.60
308	5530	0	12S	18E	17	L	94.90	95.20	-0.30
309	5530	0	12S	18E	19	H	86.60	88.30	-1.70
310	5530	0	12S	18E	20	P	83.10	90.70	-7.60
311	5530	0	12S	18E	21	G	95.80	97.20	-1.40
312	5530	0	12S	18E	21	H	86.80	87.50	-0.70
313	5530	0	12S	18E	25	B	100.90	96.80	4.10
314	5530	0	12S	18E	25	L	93.90	94.80	-0.90
315	5530	0	12S	18E	25	M	92.60	94.70	-2.10
316	5530	0	12S	18E	26	D	93.10	94.10	-1.00
317	5530	0	12S	18E	26	L	90.80	90.90	-0.10
318	5530	0	12S	18E	26	R	93.60	95.20	-1.60
319	5530	0	12S	18E	28	J	93.90	94.60	-0.70
320	5530	0	12S	18E	30	C	93.80	94.90	-1.10
321	5530	0	12S	18E	30	D	88.10	94.80	-6.70
322	5530	0	12S	18E	31	J	89.40	96.60	-7.20
323	5530	0	12S	18E	33	C	88.80	95.80	-7.00
324	5530	0	12S	18E	34	L	73.40	75.60	-2.20
325	5530	0	12S	18E	35	G	81.80	82.40	-0.60
326	5530	0	12S	18E	36	P	80.20	81.00	-0.80
327	5530	0	12S	19E	18	P	112.30	117.10	-4.80
328	5530	0	12S	19E	20	A	107.60	112.20	-4.60
329	5530	0	12S	19E	20	D	100.70	102.20	-1.50
330	5530	0	12S	19E	21	B	101.80	102.60	-0.80
331	5530	0	12S	19E	28	A	107.80	107.20	0.60
332	5530	0	12S	19E	28	P	98.30	98.80	-0.50
333	5530	0	12S	19E	29	A	124.60	122.20	2.40
334	5530	0	12S	19E	31	M	96.30	96.10	0.20
335	5530	0	13S	16E	2	C	104.10	100.70	3.40
336	5530	0	13S	17E	2	M	53.70	58.20	-4.50
337	5530	0	13S	17E	3	H	59.60	62.10	-2.50
338	5530	0	13S	17E	4	R	54.20	59.00	-4.80
339	5530	0	13S	17E	5	P	74.50	74.60	-0.10
340	5530	0	13S	17E	7	A	60.40	66.00	-5.60
341	5530	0	13S	17E	7	J	52.70	56.00	-3.30
342	5530	0	13S	17E	8	L	39.70	39.90	-0.20
343	5530	0	13S	17E	9	A	54.00	57.10	-3.10

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
344	5530	0	13S	18E	3	C	63.20	66.90	-3.70
345	5530	0	13S	18E	4	A	64.90	67.20	-2.30
346	5530	0	13S	18E	4	B	64.00	67.30	-3.30
347	5530	0	13S	18E	5	E	61.20	64.00	-2.80
348	5530	0	13S	18E	5	J	61.70	66.10	-4.40
349	5530	0	13S	18E	6	F	58.10	62.90	-4.80
350	5530	0	13S	18E	6	K	58.10	62.80	-4.70
351	5600	0	14S	24E	21	D	5.80	4.00	1.80
352	5600	0	14S	24E	22	L	1.60	4.50	-2.90
353	5600	0	14S	24E	22	N	15.10	21.80	-6.70
354	5600	0	14S	24E	28	R	8.00	6.00	2.00
355	5600	0	14S	24E	29	K	39.50	71.50	-32.00
356	5600	0	14S	24E	34	R	6.50	15.50	-9.00
357	5600	0	15S	24E	11	A	5.50	11.70	-6.20
358	5600	0	15S	24E	12	G	4.50	5.50	-1.00
359	5600	0	15S	24E	12	H	10.30	14.50	-4.20
360	5600	0	15S	24E	12	R	5.50	8.50	-3.00
361	5600	0	15S	24E	14	H	26.00	27.80	-1.80
362	5600	0	15S	24E	23	J	39.50	42.50	-3.00
363	5600	0	15S	24E	26	B	59.60	52.20	7.40
364	5600	0	15S	24E	36	F	80.50	82.70	-2.20
365	5600	0	15S	25E	7	D	1.30	16.80	-15.50
366	5600	0	15S	25E	7	G	3.50	21.00	-17.50
367	5600	0	15S	25E	16	R	33.00	30.40	2.60
368	5600	0	15S	25E	17	D	13.00	19.80	-6.80
369	5600	0	15S	25E	19	A	34.50	42.60	-8.10
370	5600	0	15S	25E	19	J	38.70	38.80	-0.10
371	5600	0	15S	25E	29	A	13.00	22.20	-9.20
372	5600	0	15S	25E	29	E	7.50	10.50	-3.00
373	5600	0	15S	25E	31	A	41.80	42.50	-0.70
374	5600	0	15S	25E	32	F	32.50	44.50	-12.00
375	5600	0	15S	25E	32	J	20.60	28.00	-7.40
376	5600	0	15S	25E	33	D	28.60	37.90	-9.30
377	5600	0	16S	25E	4	C	22.40	30.00	-7.60
378	5600	0	16S	25E	15	E	33.50	40.20	-6.70
379	5600	0	16S	25E	22	B	15.50	22.80	-7.30
380	5600	0	16S	25E	22	E	16.20	16.00	0.20
381	5601	0	17S	25E	12	R	47.90	48.00	-0.10
382	5602	0	17S	25E	25	A	74.50	74.10	0.40
383	5602	0	17S	25E	26	C	93.20	92.80	0.40
384	5602	0	17S	25E	26	R	88.90	86.00	2.90
385	5602	0	17S	25E	27	R	99.00	101.70	-2.70
386	5602	0	17S	25E	35	D	94.20	95.50	-1.30
387	5602	0	17S	25E	35	E	93.10	92.20	0.90
388	5602	0	17S	25E	35	M	89.00	88.80	0.20
389	5602	0	17S	25E	36	A	80.80	81.30	-0.50
390	5602	0	17S	25E	36	G	81.40	81.30	0.10
391	5602	0	17S	25E	36	M	77.30	79.30	-2.00
392	5602	0	18S	25E	1	C	79.80	79.00	0.80

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
393	5602	0	18S	25E	1	J	81.10	83.40	-2.30
394	5602	0	18S	25E	2	D	90.10	91.00	-0.90
395	5602	0	18S	25E	2	G	82.30	82.10	0.20
396	5603	5	17S	24E	34	B	64.00	32.00	32.00
397	5603	5	18S	22E	32	J	129.00	117.50	11.50
398	5603	5	18S	23E	2	Q	79.00	82.00	-3.00
399	5603	5	18S	23E	12	B	83.00	86.00	-3.00
400	5603	5	18S	23E	14	A	97.50	110.00	-12.50
401	5603	5	18S	23E	33	J	106.00	110.00	-4.00
402	5603	5	18S	24E	4	J	52.00	54.50	-2.50
403	5603	5	18S	24E	10	J	64.00	63.50	0.50
404	5603	5	18S	24E	17	L	68.00	69.00	-1.00
405	5603	5	18S	24E	31	C	99.00	91.00	8.00
406	5603	5	18S	25E	4	H	85.00	89.50	-4.50
407	5603	5	18S	25E	5	E	83.00	79.00	4.00
408	5603	5	18S	25E	15	A	60.00	58.00	2.00
409	5603	5	18S	25E	15	C	59.00	62.00	-3.00
410	5603	5	18S	25E	19	H	73.00	72.00	1.00
411	5603	5	18S	25E	20	J	64.00	66.00	-2.00
412	5603	5	18S	25E	23	J	34.50	37.00	-2.50
413	5603	5	18S	25E	33	R	76.50	82.00	-5.50
414	5603	5	19S	22E	1	N	73.50	75.00	-1.50
415	5603	5	19S	22E	2	K	63.00	66.50	-3.50
416	5603	5	19S	22E	9	J	82.00	73.00	9.00
417	5603	5	19S	22E	10	R	84.00	70.00	14.00
418	5603	5	19S	22E	16	A	83.00	80.00	3.00
419	5603	5	19S	22E	17	L	96.00	94.00	2.00
420	5603	5	19S	22E	21	C	134.00	126.00	8.00
421	5603	5	19S	22E	22	A	93.00	87.00	6.00
422	5603	5	19S	22E	23	A	103.50	98.00	5.50
423	5603	5	19S	22E	24	B	93.00	106.00	-13.00
424	5603	5	19S	22E	30	D	82.50	84.00	-1.50
425	5603	5	19S	22E	31	B	106.00	113.00	-7.00
426	5603	5	19S	22E	34	L	119.50	111.00	8.50
427	5603	5	19S	23E	7	A	133.00	132.00	1.00
428	5603	5	19S	23E	10	Q	96.00	99.00	-3.00
429	5603	5	19S	23E	12	L	101.00	98.00	3.00
430	5603	5	19S	24E	18	J	116.50	109.50	7.00
431	5603	5	19S	24E	31	K	104.00	106.00	-2.00
432	5603	5	19S	25E	1	P	34.00	39.00	-5.00
433	5603	5	19S	25E	2	A	35.50	38.00	-2.50
434	5603	5	19S	25E	10	R	56.50	57.00	-0.50
435	5603	5	19S	25E	16	A	61.50	62.00	-0.50
436	5603	5	19S	25E	23	D	54.00	61.00	-7.00
437	5603	5	19S	25E	24	M	37.50	43.50	-6.00
438	5603	5	19S	25E	34	A	50.00	60.00	-10.00
439	5603	5	19S	25E	35	B	53.50	56.50	-3.00
440	5603	5	20S	21E	36	P	148.00	145.00	3.00
441	5603	5	20S	22E	7	A	168.00	136.00	32.00

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
442	5603	5	20S	22E	14	C	161.00	147.00	14.00
443	5603	5	20S	22E	23	M	186.00	156.00	30.00
444	5603	5	20S	22E	24	R	185.00	150.00	35.00
445	5603	5	20S	22E	27	A	63.00	73.50	-10.50
446	5603	5	20S	22E	28	H	162.50	151.50	11.00
447	5603	5	20S	22E	33	F	70.00	73.50	-3.50
448	5603	5	20S	22E	36	A	100.50	112.00	-11.50
449	5603	5	20S	24E	24	H	153.00	120.00	33.00
450	5603	5	20S	24E	25	N	55.00	58.50	-3.50
451	5603	5	20S	25E	1	A	43.00	44.50	-1.50
452	5603	5	20S	25E	3	R	60.00	75.00	-15.00
453	5603	5	20S	25E	12	A	37.00	51.00	-14.00
454	5603	5	20S	25E	14	F	71.00	81.00	-10.00
455	5603	5	20S	25E	16	J	77.50	87.50	-10.00
456	5603	5	20S	25E	21	J	52.00	71.00	-19.00
457	5603	5	20S	25E	23	H	94.00	100.00	-6.00
458	5603	5	21S	23E	2	A	116.50	119.00	-2.50
459	5603	5	21S	23E	3	D	106.50	102.50	4.00
460	5603	5	21S	23E	7	J	119.00	108.50	10.50
461	5603	5	21S	23E	11	D	137.00	139.00	-2.00
462	5603	5	21S	23E	17	M	145.50	150.00	-4.50
463	5603	5	21S	23E	22	J	81.00	98.00	-17.00
464	5604	0	19S	23E	19	H	147.00	108.00	39.00
465	5604	0	19S	23E	21	P	80.00	88.00	-8.00
466	5604	0	19S	23E	23	D	72.50	80.00	-7.50
467	5604	0	19S	23E	24	L	82.00	86.00	-4.00
468	5604	0	19S	23E	25	C	84.00	92.00	-8.00
469	5604	0	19S	23E	25	L	90.00	91.00	-1.00
470	5604	0	19S	23E	26	B	59.50	62.00	-2.50
471	5604	0	19S	23E	27	A	63.50	67.00	-3.50
472	5604	0	19S	23E	27	P	78.00	63.00	15.00
473	5604	0	19S	23E	30	H	114.00	93.00	21.00
474	5604	0	19S	23E	34	L	78.50	70.00	8.50
475	5604	0	19S	23E	35	H	72.00	126.00	-54.00
476	5604	0	19S	24E	17	N	130.00	115.00	15.00
477	5604	0	19S	24E	18	R	112.00	117.00	-5.00
478	5604	0	19S	24E	22	P	102.00	105.50	-3.50
479	5604	0	19S	24E	23	D	95.50	99.00	-3.50
480	5604	0	19S	24E	24	A	81.00	91.00	-10.00
481	5604	0	19S	24E	25	D	96.00	102.00	-6.00
482	5604	0	19S	24E	27	Q	110.00	115.00	-5.00
483	5604	0	19S	24E	28	H	109.00	111.00	-2.00
484	5604	0	19S	24E	29	D	108.00	127.00	-19.00
485	5604	0	19S	24E	29	R	130.00	104.00	26.00
486	5604	0	19S	24E	30	J	134.00	116.00	18.00
487	5604	0	19S	24E	31	E	117.00	124.00	-7.00
488	5604	0	19S	24E	33	H	112.00	120.50	-8.50
489	5604	0	19S	25E	19	B	73.00	78.00	-5.00
490	5604	0	19S	25E	29	B	48.00	49.00	-1.00

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
491	5604	0	20S	22E	1	H	107.00	121.00	-14.00
492	5604	0	20S	22E	25	R	115.00	117.00	-2.00
493	5604	0	20S	23E	2	H	80.00	100.00	-20.00
494	5604	0	20S	23E	3	L	82.00	85.00	-3.00
495	5604	0	20S	23E	4	F	95.00	108.00	-13.00
496	5604	0	20S	23E	7	H	150.00	144.00	6.00
497	5604	0	20S	23E	8	H	108.00	116.00	-8.00
498	5604	0	20S	23E	9	J	85.00	95.00	-10.00
499	5604	0	20S	23E	11	L	89.00	102.50	-13.50
500	5604	0	20S	23E	12	A	96.50	100.00	-3.50
501	5604	0	20S	23E	15	A	86.00	103.00	-17.00
502	5604	0	20S	23E	16	J	93.00	98.00	-5.00
503	5604	0	20S	23E	17	C	137.00	140.00	-3.00
504	5604	0	20S	23E	18	R	165.00	139.00	26.00
505	5604	0	20S	23E	19	J	118.00	129.00	-11.00
506	5604	0	20S	23E	21	B	103.00	111.00	-8.00
507	5604	0	20S	23E	24	L	100.00	106.00	-6.00
508	5604	0	20S	23E	25	J	119.00	143.00	-24.00
509	5604	0	20S	23E	26	R	96.00	115.00	-19.00
510	5604	0	20S	23E	27	D	97.00	108.00	-11.00
511	5604	0	20S	23E	27	R	87.00	107.00	-20.00
512	5604	0	20S	23E	29	J	108.00	123.00	-15.00
513	5604	0	20S	24E	4	E	112.50	114.00	-1.50
514	5604	0	20S	24E	6	A	110.00	115.00	-5.00
515	5604	0	20S	24E	7	G	103.00	116.50	-13.50
516	5604	0	20S	24E	9	M	103.00	107.50	-4.50
517	5604	0	20S	24E	14	R	102.00	112.00	-10.00
518	5604	0	20S	24E	16	H	125.00	134.00	-9.00
519	5604	0	20S	24E	17	A	97.00	105.00	-8.00
520	5604	0	20S	24E	17	P	80.00	114.00	-34.00
521	5604	0	20S	24E	18	F	112.50	125.00	-12.50
522	5604	0	20S	24E	20	M	86.00	92.00	-6.00
523	5604	0	20S	24E	27	C	67.00	73.00	-6.00
524	5604	0	20S	24E	28	L	73.00	75.00	-2.00
525	5604	0	20S	24E	29	B	104.00	113.00	-9.00
526	5604	0	20S	24E	30	J	93.00	98.00	-5.00
527	5604	0	20S	24E	31	R	90.00	96.00	-6.00
528	5604	0	20S	24E	33	C	66.00	118.00	-52.00
529	5604	0	20S	25E	6	C	99.00	102.50	-3.50
530	5604	0	20S	25E	18	M	115.50	127.00	-11.50
531	5604	0	21S	23E	3	N	91.00	97.00	-6.00
532	5604	0	21S	23E	4	A	100.50	129.00	-28.50
533	5604	0	21S	23E	5	A	108.00	115.00	-7.00
534	5604	0	21S	23E	5	R	104.00	115.00	-11.00
535	5604	0	21S	23E	7	H	97.00	122.00	-25.00
536	5604	0	21S	23E	8	F	130.00	123.00	7.00
537	5604	0	21S	23E	8	R	91.00	110.00	-19.00
538	5604	0	21S	23E	10	J	100.00	102.00	-2.00
539	5604	0	21S	23E	14	C	136.00	137.00	-1.00

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
540	5604	0	21S	23E	21	C	76.00	93.00	-17.00
541	5604	0	21S	23E	22	H	76.00	94.00	-18.00
542	5609	0	20S	25E	33	J	99.50	119.60	-20.10
543	5609	0	20S	25E	35	G	88.90	100.20	-11.30
544	5609	0	20S	25E	36	H	71.50	80.70	-9.20
545	5609	0	21S	23E	24	R	72.00	86.40	-14.40
546	5609	0	21S	23E	25	A	66.60	81.90	-15.30
547	5609	0	21S	23E	31	B	30.80	45.70	-14.90
548	5609	0	21S	23E	32	K	33.10	43.30	-10.20
549	5609	0	21S	23E	33	Q	34.20	49.50	-15.30
550	5609	0	21S	23E	36	J	73.80	87.80	-14.00
551	5609	0	22S	23E	2	D	30.10	45.20	-15.10
552	5609	0	22S	23E	6	B	24.40	33.70	-9.30
553	5609	0	22S	23E	7	R	33.20	51.70	-18.50
554	5609	0	22S	23E	8	A	42.60	84.00	-41.40
555	5609	0	22S	23E	12	A	100.10	117.30	-17.20
556	5609	0	22S	23E	16	C	40.30	56.00	-15.70
557	5612	0	23S	23E	2	A	154.00	160.00	-6.00
558	5620	4	14S	16E	35	M	103.80	74.90	28.90
559	5620	4	14S	17E	28	A	140.30	177.70	-37.40
560	5620	4	14S	17E	33	A	151.10	172.00	-20.90
561	5620	4	14S	17E	35	A	162.50	173.70	-11.20
562	5620	4	14S	17E	36	A	146.90	145.70	1.20
563	5620	4	14S	18E	18	E	94.10	99.20	-5.10
564	5620	4	15S	16E	1	Q	116.10	84.60	31.50
565	5620	4	15S	16E	2	B	102.90	76.60	26.30
566	5620	4	15S	16E	25	R	111.10	106.80	4.30
567	5620	4	15S	16E	28	A	82.30	78.70	3.60
568	5620	4	15S	16E	28	A	82.30	78.60	3.70
569	5620	4	15S	16E	28	A	82.30	76.70	5.60
570	5620	4	15S	16E	29	N	94.10	80.20	13.90
571	5620	4	15S	17E	2	B	161.10	155.10	6.00
572	5620	4	15S	17E	18	B	120.30	98.10	22.20
573	5620	4	15S	17E	20	C	124.80	110.50	14.30
574	5620	4	15S	17E	22	J	176.90	169.80	7.10
575	5620	4	15S	17E	23	A	190.20	189.90	0.30
576	5620	4	15S	17E	28	K	155.40	142.90	12.50
577	5620	4	15S	17E	33	A	158.80	149.60	9.20
578	5620	4	15S	17E	35	N	169.90	155.80	14.10
579	5620	4	15S	18E	3	R	145.00	145.10	-0.10
580	5620	4	15S	18E	4	A	129.00	128.90	0.10
581	5620	4	15S	18E	7	A	155.10	174.80	-19.70
582	5620	4	15S	18E	17	C	170.90	181.60	-10.70
583	5620	4	15S	18E	30	L	219.20	191.70	27.50
584	5620	4	16S	16E	2	M	110.00	111.30	-1.30
585	5620	4	16S	17E	3	J	159.70	159.90	-0.20
586	5620	0	16S	17E	4	P	137.40	136.40	1.00
587	5622	0	12S	21E	17	G	77.20	76.40	0.80
588	5622	0	12S	21E	17	L	90.00	84.80	5.20

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
589	5622	0	12S	21E	18	A	142.20	135.20	7.00
590	5622	0	12S	21E	18	B	138.20	127.30	10.90
591	5631	3	12S	21E	33	P	99.00	86.70	12.30
592	5631	3	12S	21E	34	D	74.00	69.90	4.10
593	5631	3	13S	17E	12	J	43.50	45.90	-2.40
594	5631	3	13S	17E	19	H	49.10	43.00	6.10
595	5631	3	13S	17E	20	A	40.00	38.50	1.50
596	5631	3	13S	17E	22	B	41.80	44.30	-2.50
597	5631	3	13S	17E	25	C	53.50	50.50	3.00
598	5631	3	13S	17E	32	H	74.40	81.00	-6.60
599	5631	3	13S	17E	34	F	69.00	63.90	5.10
600	5631	3	13S	18E	10	C	52.70	54.70	-2.00
601	5631	3	13S	18E	11	J	69.10	60.60	8.50
602	5631	3	13S	18E	17	A	54.00	49.70	4.30
603	5631	3	13S	18E	25	B	69.00	63.00	6.00
604	5631	3	13S	18E	29	C	53.80	50.10	3.70
605	5631	3	13S	18E	32	N	59.40	63.20	-3.80
606	5631	3	13S	19E	23	E	86.70	79.80	6.90
607	5631	3	13S	20E	12	H	117.50	112.30	5.20
608	5631	3	13S	21E	23	D	47.60	48.50	-0.90
609	5631	3	13S	22E	7	R	36.00	54.80	-18.80
610	5631	3	13S	23E	30	C	14.00	16.00	-2.00
611	5631	3	14S	18E	2	B	56.10	60.70	-4.60
612	5631	3	14S	18E	4	A	61.70	62.50	-0.80
613	5631	3	14S	18E	8	J	79.30	69.30	10.00
614	5631	3	14S	19E	4	R	72.90	63.70	9.20
615	5631	3	14S	19E	7	D	56.10	59.80	-3.70
616	5631	3	14S	19E	22	R	54.10	52.80	1.30
617	5631	3	14S	19E	33	D	55.20	59.20	-4.00
618	5631	3	14S	19E	36	A	61.50	59.90	1.60
619	5631	3	14S	20E	33	F	53.30	56.40	-3.10
620	5631	3	14S	20E	34	R	50.50	51.30	-0.80
621	5631	3	14S	21E	22	D	59.40	55.10	4.30
622	5631	3	14S	21E	29	D	49.10	44.20	4.90
623	5631	3	14S	22E	3	B	29.50	29.40	0.10
624	5631	3	14S	22E	6	A	35.80	33.20	2.60
625	5631	3	15S	19E	3	J	80.50	78.50	2.00
626	5631	3	15S	19E	14	M	103.20	102.80	0.40
627	5631	3	15S	20E	9	K	59.30	57.60	1.70
628	5631	3	15S	21E	6	C	46.70	47.00	-0.30
629	5631	2	15S	21E	10	E	37.50	40.80	-3.30
630	5636	2	14S	21E	25	D	44.90	46.50	-1.60
631	5636	2	14S	21E	27	B	47.50	48.50	-1.00
632	5636	2	14S	22E	14	B	27.70	29.20	-1.50
633	5636	2	14S	22E	22	N	26.80	30.00	-3.20
634	5636	2	14S	22E	26	A	30.50	30.20	0.30
635	5636	2	14S	22E	30	A	31.80	35.20	-3.40
636	5636	2	15S	19E	12	N	79.50	80.80	-1.30
637	5636	2	15S	19E	24	N	108.10	107.00	1.10

KINGS RIVER CONSERVATION DISTRICT
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WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
638	5636	2	15S	19E	35	R	119.00	118.70	0.30
639	5636	2	15S	20E	15	D	58.20	59.00	-0.80
640	5636	2	15S	20E	17	D	72.70	72.40	0.30
641	5636	2	15S	20E	25	D	59.30	61.30	-2.00
642	5636	2	15S	20E	28	A	75.00	75.50	-0.50
643	5636	2	15S	21E	14	A	38.40	42.80	-4.40
644	5636	2	15S	21E	17	D	36.40	38.90	-2.50
645	5636	2	15S	21E	35	R	33.90	38.70	-4.80
646	5636	2	15S	22E	2	C	22.50	24.10	-1.60
647	5636	2	15S	22E	3	D	11.10	14.50	-3.40
648	5636	2	15S	22E	6	A	29.80	33.00	-3.20
649	5636	2	15S	22E	16	A	28.70	32.60	-3.90
650	5636	2	15S	22E	23	R	44.60	47.40	-2.80
651	5636	2	15S	22E	32	N	35.30	40.00	-4.70
652	5636	2	15S	22E	33	R	36.20	40.30	-4.10
653	5636	2	15S	22E	36	P	42.00	42.40	-0.40
654	5636	2	15S	23E	7	R	56.70	56.40	0.30
655	5636	2	15S	23E	21	Q	46.80	50.20	-3.40
656	5636	2	15S	23E	30	B	46.40	47.90	-1.50
657	5636	2	15S	23E	31	R	41.50	42.00	-0.50
658	5636	2	15S	23E	33	P	34.10	35.20	-1.10
659	5636	2	16S	20E	6	A	104.50	104.60	-0.10
660	5636	2	16S	20E	20	N	118.70	120.60	-1.90
661	5636	2	16S	20E	22	N	97.70	99.80	-2.10
662	5636	2	16S	20E	23	R	82.30	85.30	-3.00
663	5636	2	16S	21E	6	A	36.60	40.00	-3.40
664	5636	2	16S	21E	14	A	34.70	39.30	-4.60
665	5636	2	16S	21E	18	A	48.30	52.80	-4.50
666	5636	2	16S	21E	20	N	76.80	79.90	-3.10
667	5636	2	16S	21E	22	N	60.10	63.20	-3.10
668	5636	2	16S	22E	18	A	38.30	45.20	-6.90
669	5636	2	16S	22E	19	R	37.60	41.70	-4.10
670	5636	2	16S	22E	21	R	27.70	33.20	-5.50
671	5636	2	16S	22E	23	R	31.50	34.10	-2.60
672	5636	2	16S	23E	18	A	36.90	37.30	-0.40
673	5636	2	17S	21E	1	C	57.20	61.60	-4.40
674	5636	2	17S	21E	3	C	74.70	77.00	-2.30
675	5636	2	17S	22E	3	C	24.90	29.60	-4.70
676	5637	1	14S	23E	2	E	9.00	8.00	1.00
677	5637	1	14S	23E	14	E	12.00	13.00	-1.00
678	5637	1	14S	23E	15	C	12.90	12.70	0.20
679	5637	1	14S	23E	22	A	25.00	21.80	3.20
680	5637	1	14S	23E	25	N	59.50	56.70	2.80
681	5637	1	14S	23E	26	E	31.40	35.00	-3.60
682	5637	1	14S	23E	34	B	35.00	34.60	0.40
683	5637	1	14S	23E	36	R	49.00	55.80	-6.80
684	5637	1	14S	24E	31	P	56.00	48.80	7.20
685	5637	1	15S	23E	1	M	68.00	65.60	2.40
686	5637	1	15S	23E	12	R	59.00	65.70	-6.70

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
687	5637	1	15S	23E	22	B	57.50	57.80	-0.30
688	5637	1	15S	23E	23	A	53.00	56.90	-3.90
689	5637	1	15S	23E	35	D	48.00	46.70	1.30
690	5637	1	15S	23E	36	A	37.00	46.80	-9.80
691	5637	1	15S	23E	36	P	31.00	31.80	-0.80
692	5637	1	15S	24E	5	C	44.90	51.60	-6.70
693	5637	1	15S	24E	6	P	59.00	62.70	-3.70
694	5637	1	15S	24E	16	A	37.00	32.80	4.20
695	5637	1	15S	24E	16	P	53.20	55.80	-2.60
696	5637	1	15S	24E	19	D	52.70	56.70	-4.00
697	5637	1	15S	24E	20	N	51.00	54.70	-3.70
698	5637	1	15S	24E	22	D	48.00	47.60	0.40
699	5637	1	15S	24E	27	R	41.40	46.60	-5.20
700	5637	1	15S	24E	28	D	52.10	54.70	-2.60
701	5637	1	15S	24E	30	C	39.40	52.60	-13.20
702	5637	1	15S	24E	32	C	50.90	55.70	-4.80
703	5637	1	15S	24E	33	B	51.90	57.50	-5.60
704	5637	1	16S	22E	36	R	19.40	21.20	-1.80
705	5637	1	16S	23E	3	A	41.00	42.70	-1.70
706	5637	1	16S	23E	9	E	23.00	22.80	0.20
707	5637	1	16S	23E	15	A	34.70	35.00	-0.30
708	5637	1	16S	23E	17	R	27.00	27.70	-0.70
709	5637	1	16S	23E	21	N	25.20	28.00	-2.80
710	5637	1	16S	23E	22	D	34.80	35.60	-0.80
711	5637	1	16S	23E	23	E	32.90	34.30	-1.40
712	5637	1	16S	23E	25	M	26.00	37.60	-11.60
713	5637	1	16S	23E	27	H	34.00	37.00	-3.00
714	5637	1	16S	23E	31	L	18.00	25.60	-7.60
715	5637	1	16S	23E	32	B	34.00	35.50	-1.50
716	5637	1	16S	23E	32	P	34.90	38.60	-3.70
717	5637	1	16S	23E	33	H	37.90	40.00	-2.10
718	5637	1	16S	24E	2	B	64.40	66.50	-2.10
719	5637	1	16S	24E	5	M	33.00	35.50	-2.50
720	5637	1	16S	24E	7	D	34.90	35.50	-0.60
721	5637	1	16S	24E	8	H	36.00	39.70	-3.70
722	5637	1	16S	24E	10	J	55.30	60.40	-5.10
723	5637	1	16S	24E	12	D	51.50	58.60	-7.10
724	5637	1	16S	24E	14	N	27.00	30.80	-3.80
725	5637	1	16S	24E	16	H	44.70	45.70	-1.00
726	5637	1	16S	24E	19	C	32.60	35.00	-2.40
727	5637	1	16S	24E	20	A	37.70	45.60	-7.90
728	5637	1	16S	24E	21	J	31.20	37.70	-6.50
729	5637	1	16S	24E	23	J	10.00	24.40	-14.40
730	5637	1	16S	24E	25	L	10.90	10.60	0.30
731	5637	1	16S	24E	27	R	18.20	24.00	-5.80
732	5637	1	16S	24E	28	J	27.00	33.80	-6.80
733	5637	1	16S	24E	29	A	30.80	37.00	-6.20
734	5637	1	16S	24E	30	D	29.90	31.70	-1.80
735	5637	1	16S	24E	30	R	34.70	34.60	0.10

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
736	5637	1	16S	24E	33	M	25.40	31.60	-6.20
737	5637	1	16S	24E	34	M	17.20	27.70	-10.50
738	5637	1	16S	24E	36	E	9.20	10.60	-1.40
739	5637	1	16S	25E	7	D	40.70	46.20	-5.50
740	5637	1	16S	25E	8	D	26.50	39.80	-13.30
741	5637	1	16S	25E	17	H	27.90	37.60	-9.70
742	5637	1	16S	25E	19	D	19.20	23.60	-4.40
743	5637	1	16S	25E	19	L	19.00	26.60	-7.60
744	5637	1	16S	25E	21	D	32.20	38.80	-6.60
745	5637	1	16S	25E	21	P	17.10	33.50	-16.40
746	5637	1	16S	25E	28	R	30.00	40.80	-10.80
747	5637	1	16S	25E	31	C	18.80	20.90	-2.10
748	5637	1	16S	25E	32	C	28.00	38.80	-10.80
749	5637	1	17S	23E	1	A	43.00	46.90	-3.90
750	5637	1	17S	23E	9	B	50.90	51.80	-0.90
751	5637	1	17S	23E	10	A	53.00	47.30	5.70
752	5637	1	17S	23E	12	C	49.40	54.20	-4.80
753	5637	1	17S	23E	15	B	61.00	63.60	-2.60
754	5637	1	17S	23E	18	E	54.00	46.50	7.50
755	5637	1	17S	23E	21	C	72.40	71.60	0.80
756	5637	1	17S	23E	30	B	64.60	68.80	-4.20
757	5637	1	17S	24E	1	B	14.80	15.80	-1.00
758	5637	1	17S	24E	2	R	14.40	22.00	-7.60
759	5637	1	17S	24E	3	K	17.20	24.80	-7.60
760	5637	1	17S	24E	5	B	27.00	31.30	-4.30
761	5637	1	17S	24E	8	A	25.00	31.80	-6.80
762	5637	1	17S	24E	16	A	23.00	30.00	-7.00
763	5637	1	17S	24E	17	A	29.70	36.60	-6.90
764	5637	1	17S	24E	20	A	28.00	34.00	-6.00
765	5637	1	17S	24E	20	D	27.00	35.70	-8.70
766	5637	1	17S	25E	1	P	25.00	23.00	2.00
767	5637	1	17S	25E	3	B	34.00	25.60	8.40
768	5637	1	17S	25E	6	A	21.00	26.50	-5.50
769	5637	1	17S	25E	10	C	25.50	45.60	-20.10
770	5637	1	17S	25E	18	A	47.50	61.60	-14.10
771	5637	1	17S	25E	18	R	57.80	75.80	-18.00
772	5637	0	15S	24E	5	C	44.90	51.60	-6.70
773	5637	0	15S	24E	6	P	59.00	62.70	-3.70
774	5637	0	15S	24E	7	Q	58.00	63.50	-5.50
775	5637	0	15S	24E	16	A	37.00	32.80	4.20
776	5637	0	15S	24E	16	P	53.20	55.80	-2.60
777	5637	0	15S	24E	19	D	52.70	56.70	-4.00
778	5637	0	15S	24E	20	N	51.00	54.70	-3.70
779	5637	0	15S	24E	22	D	48.00	47.60	0.40
780	5637	0	15S	24E	27	R	41.40	46.60	-5.20
781	5637	0	15S	24E	28	D	52.10	54.70	-2.60
782	5637	0	15S	24E	30	C	39.40	52.60	-13.20
783	5637	0	15S	24E	32	C	50.90	55.70	-4.80
784	5637	0	15S	24E	33	B	51.90	57.50	-5.60

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
785	5637	0	16S	22E	36	R	19.40	21.20	-1.80
786	5637	0	16S	23E	3	A	41.00	42.70	-1.70
787	5637	0	16S	23E	9	E	23.00	22.80	0.20
788	5637	0	16S	23E	13	H	29.40	31.80	-2.40
789	5637	0	16S	23E	15	A	34.70	35.00	-0.30
790	5637	0	16S	23E	17	R	27.00	27.70	-0.70
791	5637	0	16S	23E	21	N	25.20	28.00	-2.80
792	5637	0	16S	23E	22	D	34.80	35.60	-0.80
793	5637	0	16S	23E	23	E	32.90	34.30	-1.40
794	5637	0	16S	23E	25	M	26.00	37.60	-11.60
795	5637	0	16S	23E	27	H	34.00	37.00	-3.00
796	5637	0	16S	23E	31	L	18.00	25.60	-7.60
797	5637	0	16S	23E	32	B	34.00	35.50	-1.50
798	5637	0	16S	23E	32	P	34.90	38.60	-3.70
799	5637	0	16S	23E	33	H	37.90	40.00	-2.10
800	5637	0	16S	24E	2	B	64.40	66.50	-2.10
801	5637	0	16S	24E	5	M	33.00	35.50	-2.50
802	5637	0	16S	24E	7	D	34.90	35.50	-0.60
803	5637	0	16S	24E	8	H	36.00	39.70	-3.70
804	5637	0	16S	24E	10	J	55.30	60.40	-5.10
805	5637	0	16S	24E	12	D	51.50	58.60	-7.10
806	5637	0	16S	24E	14	H	30.00	37.50	-7.50
807	5637	0	16S	24E	14	N	27.00	30.80	-3.80
808	5637	0	16S	24E	16	H	44.70	45.70	-1.00
809	5637	0	16S	24E	19	C	32.60	35.00	-2.40
810	5637	0	16S	24E	20	A	37.70	45.60	-7.90
811	5637	0	16S	24E	21	J	31.20	37.70	-6.50
812	5637	0	16S	24E	23	J	10.00	24.40	-14.40
813	5637	0	16S	24E	25	L	10.90	10.60	0.30
814	5637	0	16S	24E	27	R	18.20	24.00	-5.80
815	5637	0	16S	24E	28	J	27.00	33.80	-6.80
816	5637	0	16S	24E	29	A	30.80	37.00	-6.20
817	5637	0	16S	24E	30	D	29.90	31.70	-1.80
818	5637	0	16S	24E	30	R	34.70	34.60	0.10
819	5637	0	16S	24E	33	M	25.40	31.60	-6.20
820	5637	0	16S	24E	34	M	17.20	27.70	-10.50
821	5637	0	16S	24E	36	E	9.20	10.60	-1.40
822	5637	0	16S	25E	7	D	40.70	46.20	-5.50
823	5637	0	16S	25E	8	D	26.50	39.80	-13.30
824	5637	0	16S	25E	17	H	27.90	37.60	-9.70
825	5637	0	16S	25E	19	D	19.20	23.60	-4.40
826	5637	0	16S	25E	19	L	19.00	26.60	-7.60
827	5637	0	16S	25E	21	D	32.20	38.80	-6.60
828	5637	0	16S	25E	21	P	17.10	33.50	-16.40
829	5637	0	16S	25E	28	R	30.00	40.80	-10.80
830	5637	0	16S	25E	31	C	18.80	20.90	-2.10
831	5637	0	16S	25E	32	C	28.00	38.80	-10.80
832	5637	0	16S	25E	34	Q	21.00	24.60	-3.60
833	5637	0	17S	22E	25	A	64.60	69.80	-5.20

KINGS RIVER CONSERVATION DISTRICT
FALL 1997 GROUNDWATER SUMMARY

WELL NO.	AGENCY CODE	KRCD DIVISION	T	R	S	LC	DEPTH TO GW FALL 97	DEPTH TO GW FALL 96	CHANGE IN DEPTH TO GW FALL 96 TO FALL 97
834	5637	0	17S	22E	25	J	77.90	76.60	1.30
835	5637	0	17S	23E	1	A	43.00	46.90	-3.90
836	5637	0	17S	23E	9	B	50.90	51.80	-0.90
837	5637	0	17S	23E	10	A	53.00	47.30	5.70
838	5637	0	17S	23E	12	C	49.40	54.20	-4.80
839	5637	0	17S	23E	15	B	61.00	63.60	-2.60
840	5637	0	17S	23E	18	E	54.00	46.50	7.50
841	5637	0	17S	23E	21	C	72.40	71.60	0.80
842	5637	0	17S	23E	30	B	64.60	68.80	-4.20
843	5637	0	17S	24E	1	B	14.80	15.80	-1.00
844	5637	0	17S	24E	2	R	14.40	22.00	-7.60
845	5637	0	17S	24E	3	K	17.20	24.80	-7.60
846	5637	0	17S	24E	5	B	27.00	31.30	-4.30
847	5637	0	17S	24E	8	A	25.00	31.80	-6.80
848	5637	0	17S	24E	16	A	23.00	30.00	-7.00
849	5637	0	17S	24E	17	A	29.70	36.60	-6.90
850	5637	0	17S	24E	20	A	28.00	34.00	-6.00
851	5637	0	17S	24E	20	D	27.00	35.70	-8.70
852	5637	0	17S	25E	1	D	20.60	24.30	-3.70
853	5637	0	17S	25E	1	P	25.00	23.00	2.00
854	5637	0	17S	25E	3	B	34.00	25.60	8.40
855	5637	0	17S	25E	6	A	21.00	26.50	-5.50
856	5637	0	17S	25E	10	C	25.50	45.60	-20.10
857	5637	0	17S	25E	18	A	47.50	61.60	-14.10
858	5637	0	17S	25E	18	R	57.80	75.80	-18.00
859	5637	0	17S	25E	29	D	88.00	95.60	-7.60

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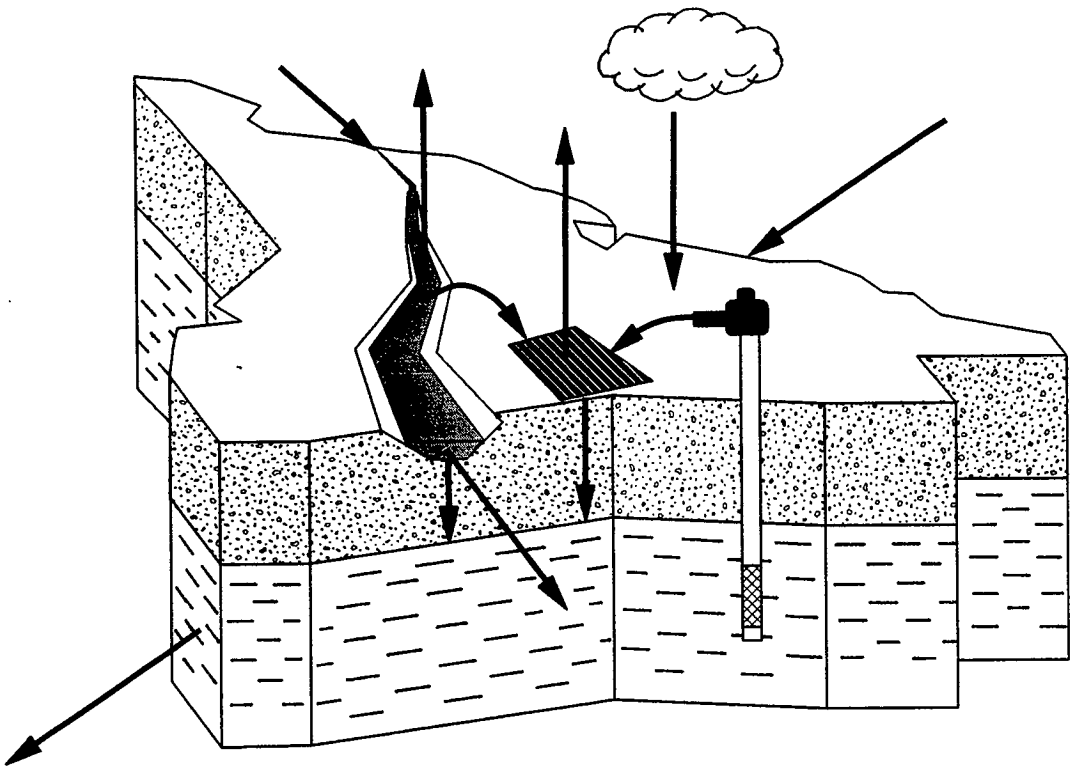
ALTA IRRIGATION DISTRICT

GROUNDWATER STUDY



KRCD

Kings River Conservation District

December 1992

ALTA IRRIGATION DISTRICT

GROUNDWATER STUDY

Prepared by the

KINGS RIVER CONSERVATION DISTRICT

December 1992

R92-0077.R4

EXECUTIVE SUMMARY

A study was conducted of the groundwater resources of Alta Irrigation District (Alta) located on the east side of California's San Joaquin Valley. The objectives of the analysis are to:

- Characterize the flow of Alta's groundwater
- Quantify the amount of groundwater entering and leaving Alta's boundary
- Identify areas within Alta that will experience critically low groundwater volume
- Determine the long-term effect of continued *overdraft**
- Determine the effects of proposed reallocation of district surface water
- Determine effectiveness of Alta's active and passive recharge system
- Determine the effects of a wide-spread increase in *irrigation efficiency**
- Determine the effects of lining or piping all of Alta's canals

These issues were addressed with a district-wide *water balance** (including subsurface flows) and a comprehensive numerical *groundwater/surface water model**. The study/calibration period was 1962 through 1991. The model was calibrated to historical groundwater levels and stream flows. Model projections were made for 10 and 30 year periods under various future weather scenarios.

A large amount of groundwater flows into Alta's eastern boundary on a routine basis. Groundwater within Alta generally flows to the south, heading to the southwest towards the Kings River (resulting in *accretion**) when the water table is high, and to the southeast away from the Kings River when groundwater levels are low (resulting in channel seepage). Alta's water table will continue to experience large fluctuations as a result of a varying surface water supply.

The average groundwater velocity around Alta's boundary is one foot per day.

Alta's delivery system, consisting of several hundred miles of unlined canals, acts as a very effective recharge facility. The Kings River is a vital part of Alta's groundwater recharge ability.

Areas with shallow aquifer properties will likely continue to experience groundwater shortages, especially in dry years.

Model runs indicate that Alta's groundwater overdraft may be reduced in the future. This is likely due to an increase in groundwater inflow resulting from overall lower groundwater levels and a projected reduction in water consumption resulting from increased urbanization.

A proposed plan to reallocate Alta's surface water during years of extreme shortage would result in no significant adverse impacts to groundwater supplies.

A wide-spread increase in irrigation efficiency would have little effect on the quantity of Alta's groundwater, but would likely help in maintaining groundwater quality and conserving energy.

Lining or piping all of Alta's canals would have a negligible effect on groundwater levels.

*These terms are defined in a Glossary given in Appendix A.

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Glossary of Terms

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Alta Historical Groundwater Elevation Maps

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INTRODUCTION

ALTA IRRIGATION DISTRICT

The Alta Irrigation District (Alta) is located on the east side of the San Joaquin Valley southeast of the City of Fresno. The district encompasses a land area of approximately 130,000 acres in parts of Fresno, Tulare, and Kings Counties. The district is bounded roughly by the Kings River on the west and the Sierra Nevada Foothills on the east (Figure 1).

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.

Kings River water was first diverted to the Alta area in the early 1880's by private land companies. The Alta Irrigation District was created in 1888 by local landowners to help ensure a reliable and equitable source of irrigation water.

Alta's annual entitlement of Kings River water has ranged from 38,700 to 253,300 acre-feet (Alta, 1990), with an average annual diversion of 160,000 acre-feet. Alta typically diverts a relatively steady flow rate of about 700 cubic-feet per second (cfs) starting in May for a period of 28 to 195 days (Alta, 1990). The volume and duration of Alta's diversion is a function of their water rights and the yearly runoff from the Kings River. Kings River runoff can fluctuate greatly from year to year, and the watershed is prone to periods of drought.

GEOLOGY

The geology of the Alta area is typical of the east side of the San Joaquin Valley. Alta's surface topography is fairly flat with the exception of the depressions of the Kings River and smaller streams, and the protrusion of Smith Mountain (Figure 2).

Alta's soils vary from heavy clays near its eastern boundary to course sands near the Kings River. Numerous small streams meandered through the Alta area prior to conversion to agriculture. The presence of the large flows of the Kings River and the lesser flows of the intermittent streams has resulted in interwoven unconsolidated alluvial fans throughout most of Alta. Multiple layers of varying textured material has resulted in vertical *heterogeneity** and in some locations relatively low *vertical hydraulic conductivity**. *Horizontal hydraulic conductivity** and *specific yield** vary throughout the district (Figures 3 & 4).

*These terms are defined in a Glossary given in Appendix A.

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2

Figure 1
Location of Alta Irrigation District

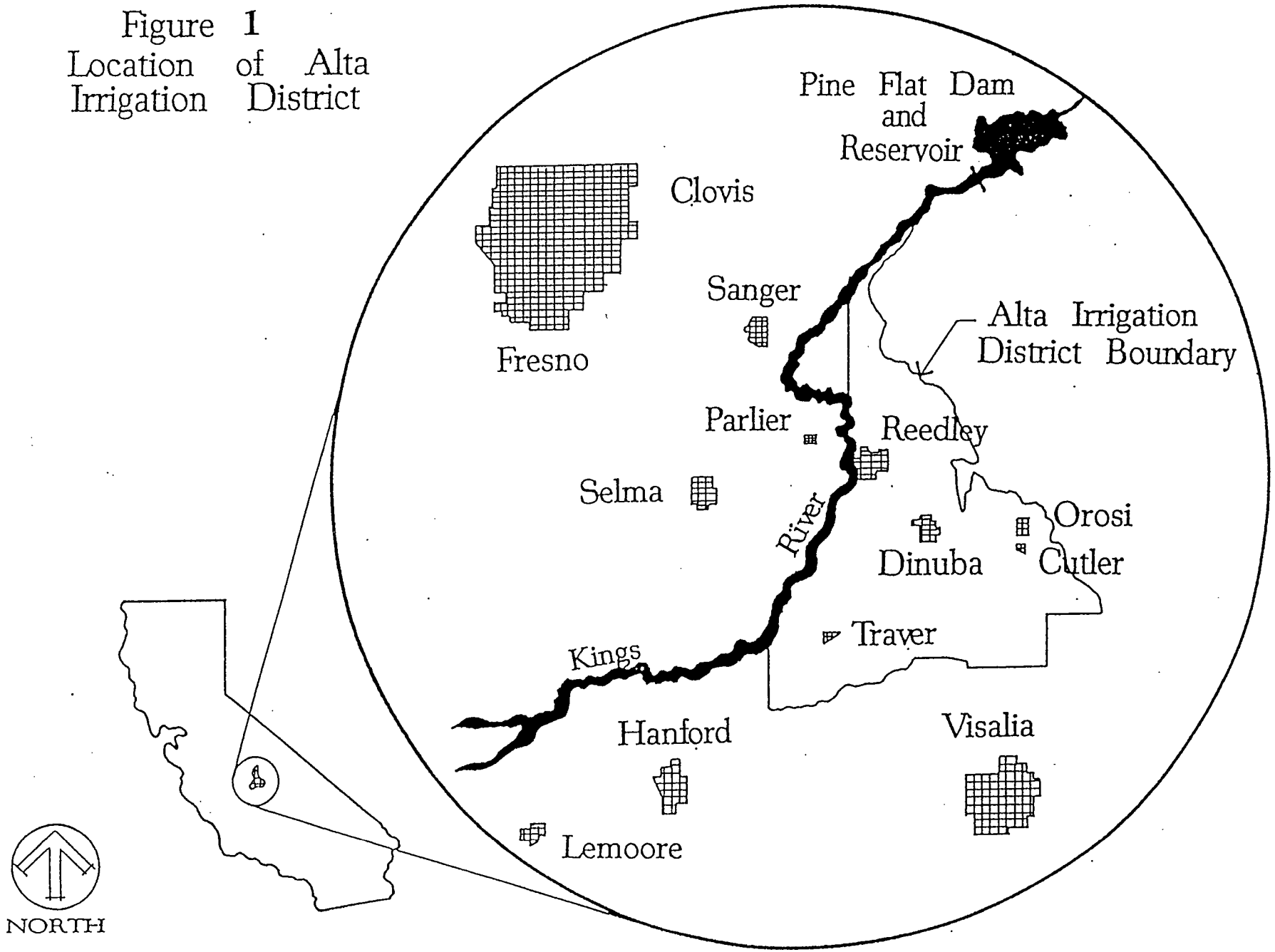


Figure 2
Alta Ground Surface Elevations in Feet

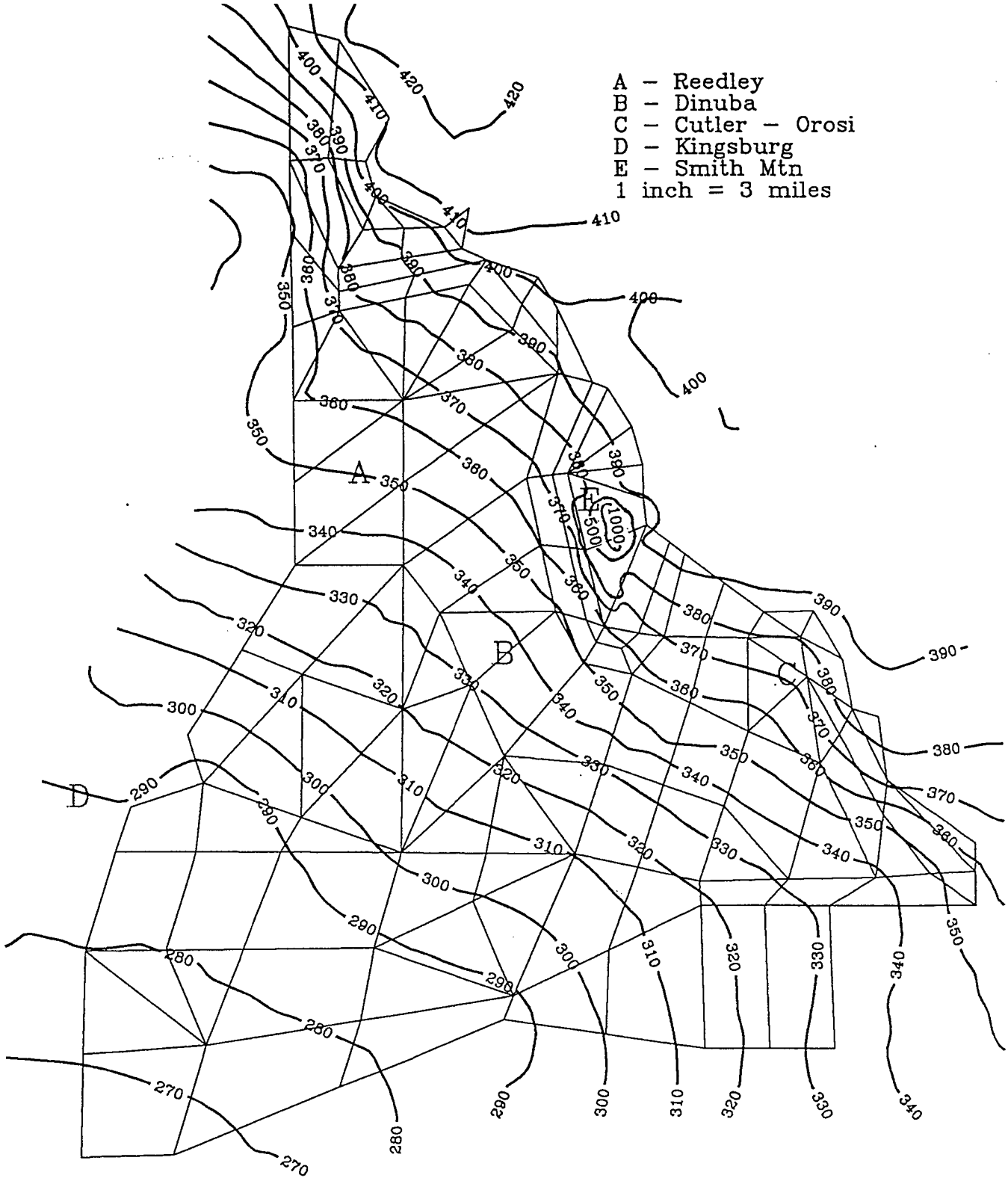


Figure 3
Alta Horizontal Hydraulic Conductivity in Feet per Day

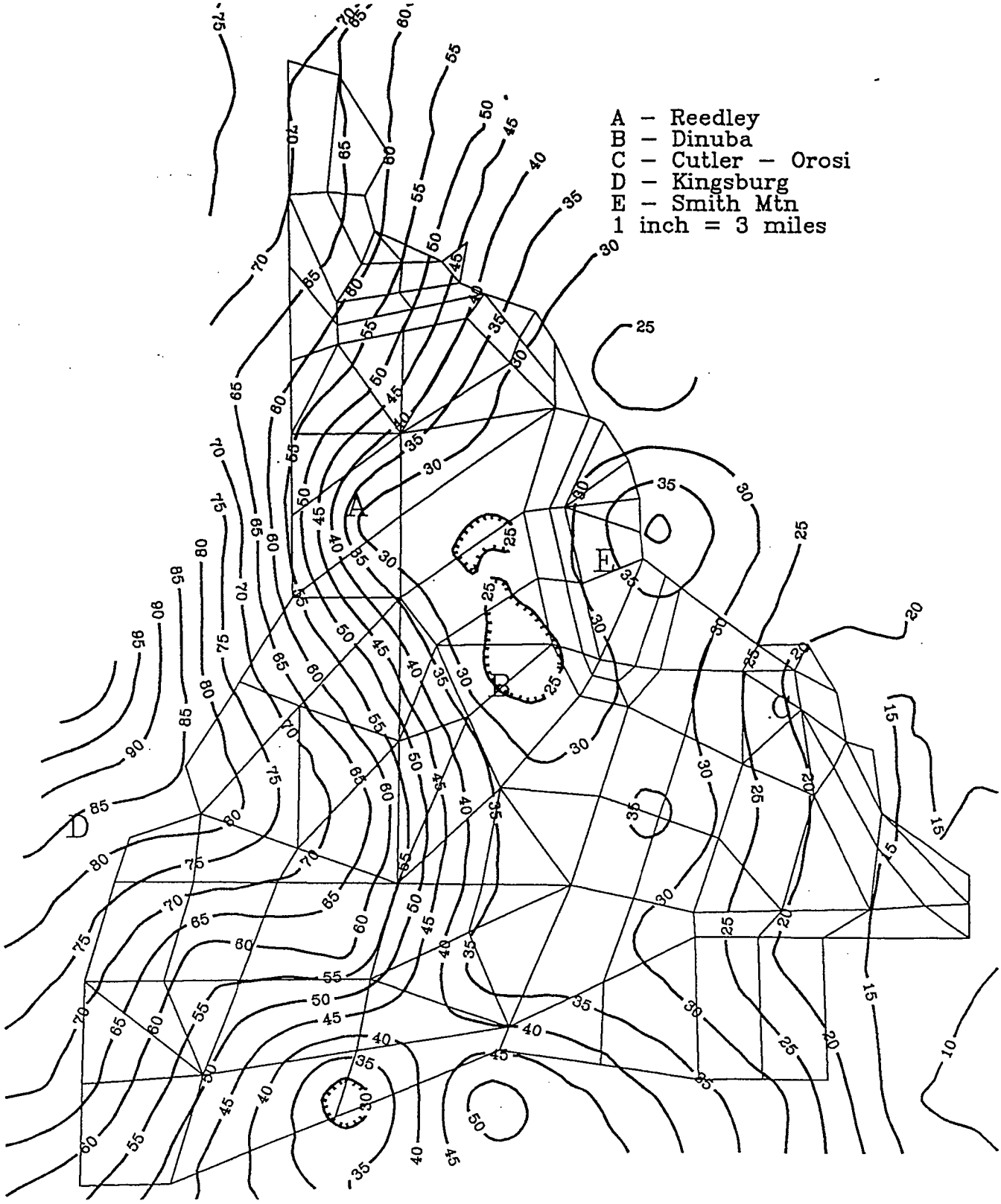
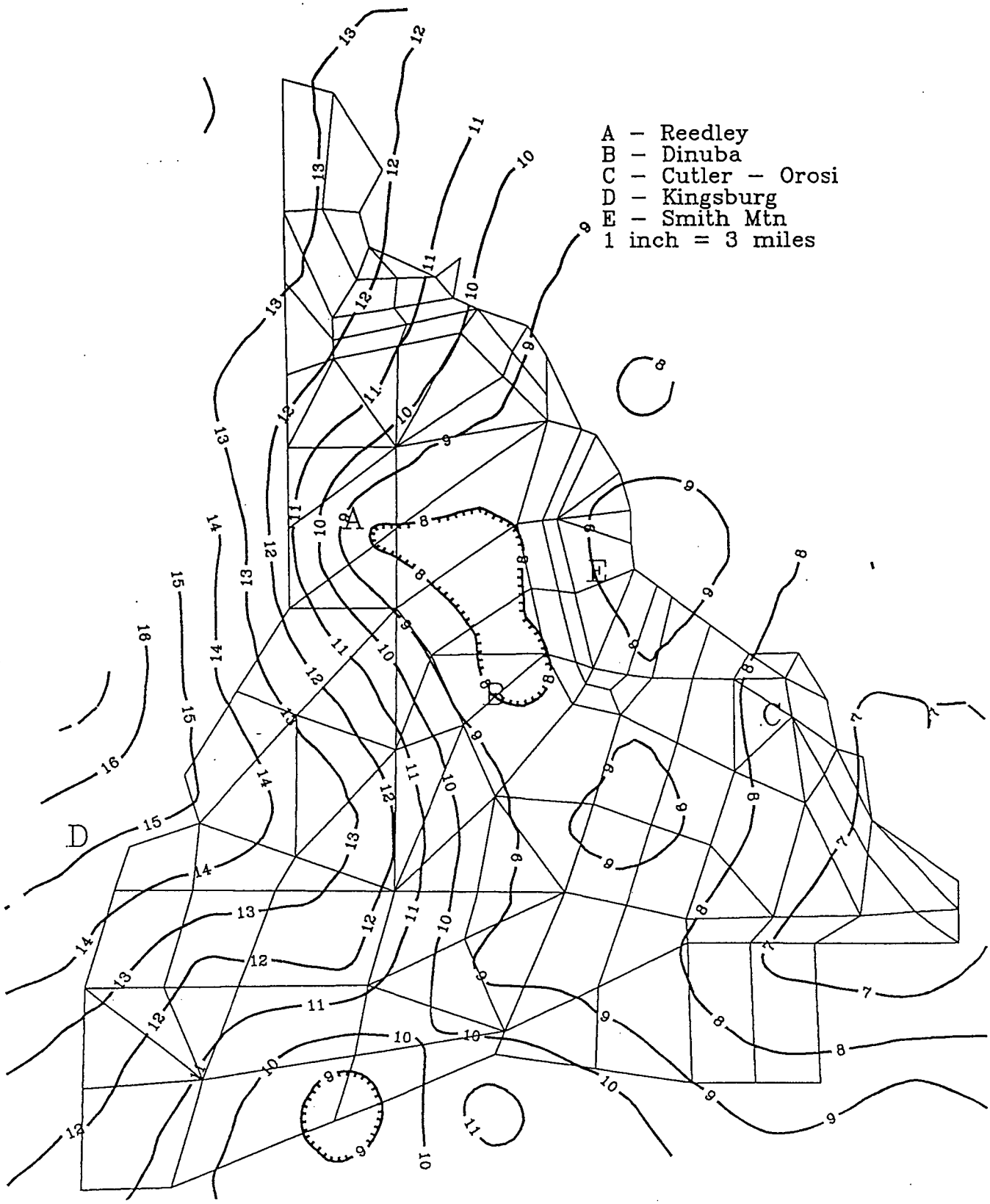


Figure 4
Alta Specific Yield in Percent



The alluvial fans have created an effective aquifer system that has yielded large quantities of groundwater to pumping and has demonstrated the ability to recharge through active and passive means. Recharge occurs through stream beds, lateral inflow from east of the district, direct precipitation, spreading basins, canal seepage, and deep percolation of irrigation water. The Kings River provides recharge only in years when the surrounding water table is low. In many years, groundwater *accretion** increases the flow of the Kings River along Alta's boundary.

Below the alluvial formation lies a consolidated pre-Tertiary granitic basement complex that yields very little groundwater (Figure 5). This complex is tapped by wells only on the far eastern edge of the district.

Pumping yield varies significantly throughout Alta. Near the foothills, where the depth to bedrock is small, the volume of water yielded by aquifers is extremely limited. When regional groundwater levels are low, groundwater may become unavailable to growers on the eastern edge. In the western and southwestern portions of the district the aquifer is thicker, approaching 6,000 feet.

GROUNDWATER ELEVATIONS

The groundwater elevation in Alta has fluctuated widely in the past. In the early 1900's, Alta's water table sometimes approached the ground surface. After the advent of the vertical turbine pump in the 1930's, the district experienced a shift in cropping pattern toward more permanent crops that required more quantity and a more reliable supply of water.

The increased water demands and pumping have led to a long-term *groundwater overdraft**. During periods of drought, large decline of the water table is experienced. During wet periods, the water table recovers (Figure 7).

The Alta area receives average precipitation of less than 12 inches per year yielding a useable volume of water of less than 70,000 acre-feet on average. Combined with an average annual surface entitlement of approximately 160,000 acre-feet and crop demand of about 260,000 acre-feet, Alta farmers must rely on a secondary source of irrigation water, even in average water years.

The shortfall in surface supply is routinely made up by groundwater pumping. Steady pumping over a period of several decades has resulted in groundwater overdraft. In periods of drought, the rate of water table decline is intensified.

Figure 5
Alta Aquifer: Section A-A'

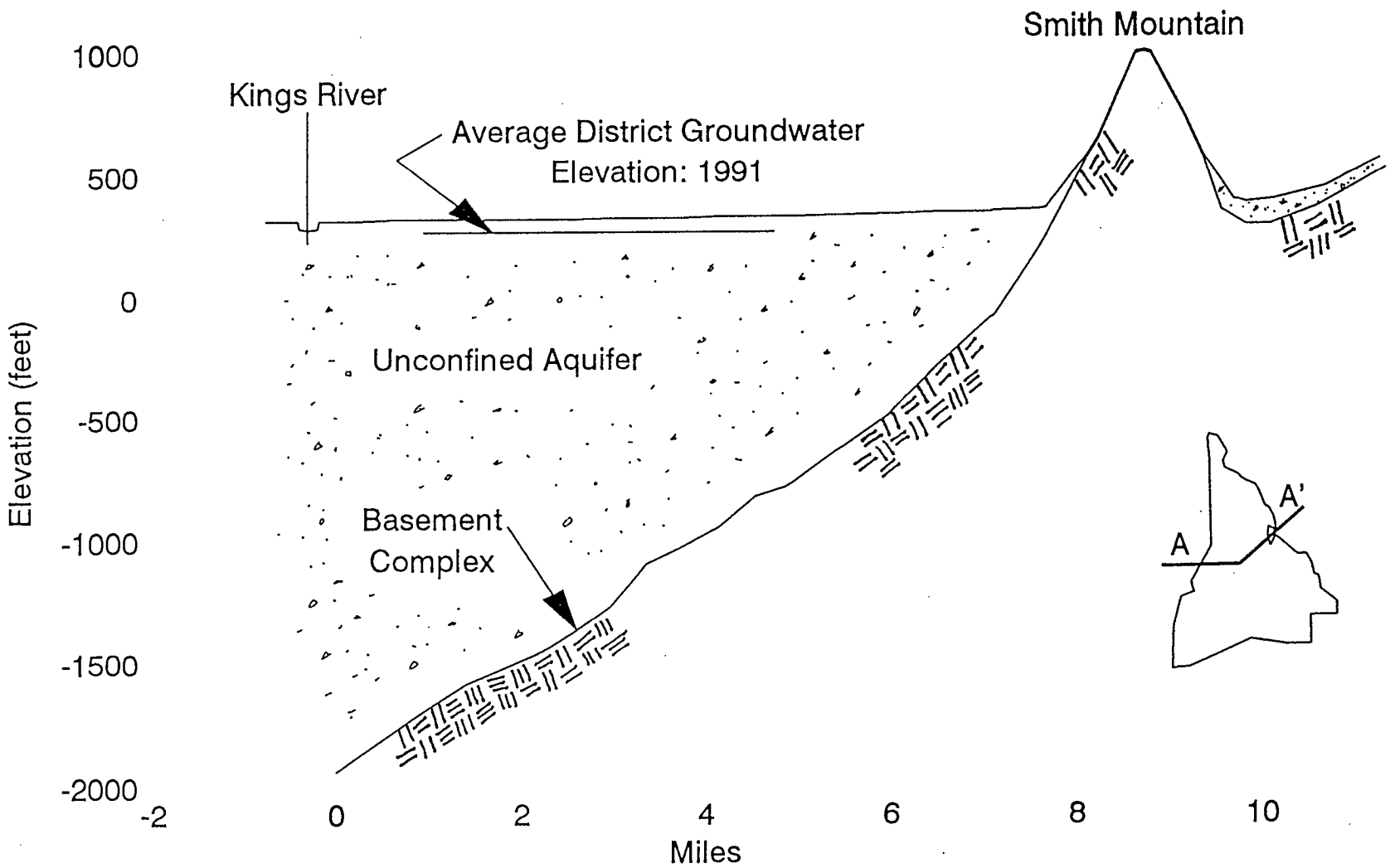


Figure 6
Alta Bedrock Elevation in Feet

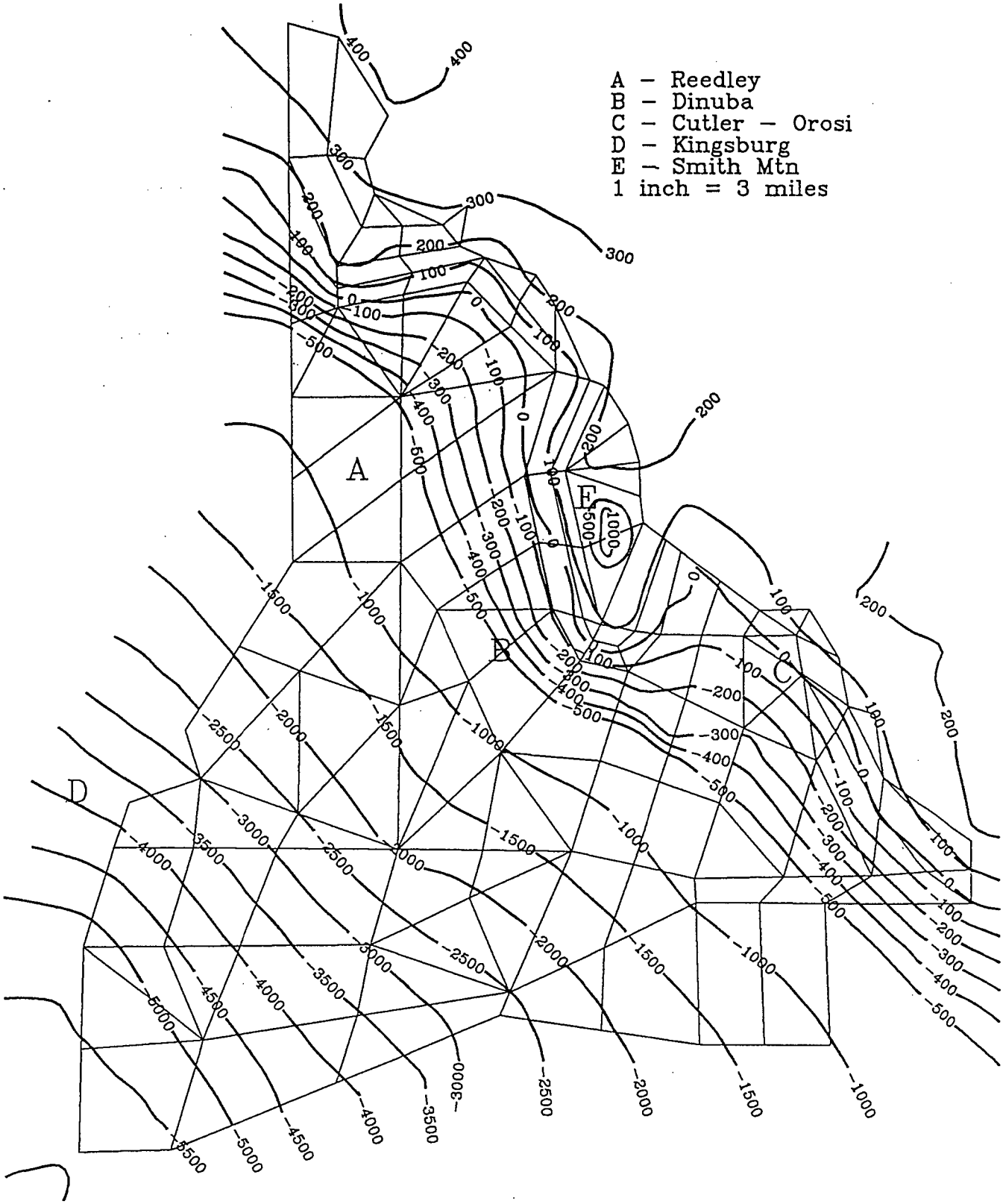
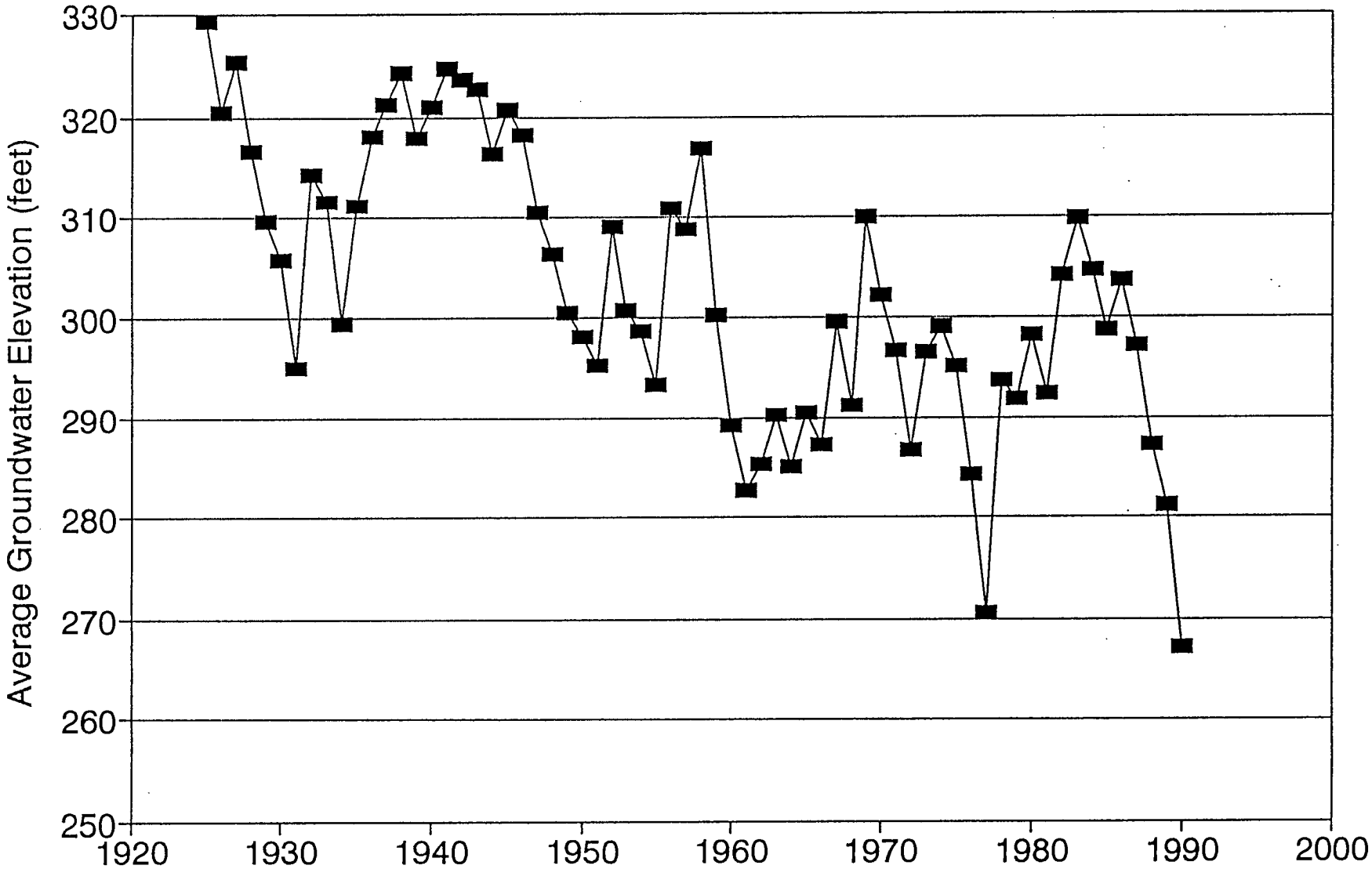


Figure 7
Average Alta Groundwater Elevation



ALTA WATER MANAGEMENT STUDIES

During the recent consecutive dry years of 1987 through 1992, groundwater shortages have occurred in many locations throughout the district. Shortages appear to be most prevalent near the foothills (eastern boundary) where the aquifer tends to be more shallow.

In early 1991, the assistance of the Kings River Conservation District (KRCD) was enlisted to study Alta's surface and subsurface water resources. The purpose of these studies is to quantify Alta's distribution system losses and model the underlying groundwater flow to predict the severity of future shortfalls.

KRCD staff intends to address these topics through a completed surface water study (KRCD, 1991a) and this groundwater study. The results of the surface water analyses were an integral prerequisite to the groundwater modeling effort.

This study provides an analysis of the groundwater resources lying beneath Alta Irrigation District. The flow, extent, and availability of groundwater and the spacial variability of aquifers is extremely complex. To analyze and verify these properties, a district-wide *water balance** and a comprehensive *groundwater/surface water model** were prepared.

The objectives of these analyses are to:

- Characterize the flow of Alta's groundwater
- Quantify the amount of groundwater entering and leaving Alta's boundary
- Identify areas within Alta that will experience critically low groundwater volume
- Determine the long-term effect of continued *overdraft**
- Determine the effects of proposed reallocation of district surface water
- Determine effectiveness of Alta's active and passive recharge system
- Determine the effects of a wide-spread increase in *irrigation efficiency**
- Determine the effects of lining or piping all of Atla's canals

METHODS

WATER BALANCE

A water balance was computed to gain an independent computation of the surface and groundwater flow into and out of Alta. The data gained from the balance was used to help check and calibrate the *groundwater model*, to verify many of the aquifer properties and to gain a general understanding of the overall water flow of the district.

Inflow and Outflow

The water balance included the following inflow components:

- Net surface water
- Effective rainfall
- Effective storm runoff
- *Subsurface flow*

The outflow elements included:

- Subsurface flow
- Evapotranspiration

Net surface water is defined as the difference between the total water diverted through the Alta headgate and the water which is lost to evaporation, evapotranspiration of bank vegetation, and spillage (KRCD, 1991a).

Effective Rainfall was estimated from precipitation records obtained from Alta. The effective rainfall for each month was estimated to be either zero or the monthly rainfall less one inch, whichever is greater (Bachman, 1992).

Stormwater Flow is the amount of water that flows out of the adjacent small watersheds and infiltrates into the ground within Alta's boundary. This water source was estimated for Sand and Cottonwood Creeks. Limited data was available on the flow of these streams, so a correlation relationship was developed between the flow of the streams and the flow in the Kings River.

It was assumed that of the estimated flow of the creeks, 75 percent of Sand Creek and 30 percent of Cottonwood Creek would infiltrate within Alta's boundary.

Subsurface flow was computed from the measured groundwater elevations inside and outside of Alta's boundary. The groundwater gradient, aquifer thickness, and *hydraulic conductivity** was computed at 102 locations around the district boundary every six months for the calibration study period (1962 through 1991). The *subsurface inflow** and outflow was computed using this information and Darci's Law. The direction of the groundwater flow was determined from the computed gradient.

Evapotranspiration was computed using historical reference evapotranspiration from the Parlier station of the California Irrigation Management Information Service (CIMIS, 1962-1991) and accepted crop coefficients. The cropping pattern used for the computation was derived from Alta's cropping records and cropping patterns from the Department of Water Resources. Water use of riparian land was assumed to be equivalent to that of well-watered grass. Water use of native land was assumed to be equivalent to grain. Water use of urban vegetation land was assumed to be equivalent to that of well-watered grass.

Mass Balance

The *mass balance** of the district was computed on an annual time step based on the following equation:

dSto = Inflow - Outflow

where

dSto = the change in storage over the time period

Inflow = the annual inflow

Outflow = the annual outflow

The change in storage was computed using the following two methods:

- As the difference between inflow and outflow
- From average specific yield and the change in average groundwater elevation

Initially, the mass balance equation did not balance over a yearly period or over the 30-year period. To check for a balanced equation, the two different values of change in storage were compared. To balance the equation over the 30-year period, all of the inflows (with the exception of the surface water allotment) were increased by 12 percent and the outflows were reduced by 12 percent. The resulting mass balance did not balance on a yearly basis.

NUMERICAL GROUNDWATER MODEL

The Alta Groundwater Study utilized a numerical groundwater model to analyze the complex system of surface and subsurface water that is common to the Alta area.

A numerical model is a tool used to approximate complex physical systems. A model is a simplified representation of reality and can never fully describe the real world. In modeling groundwater flow it is important to appreciate that groundwater systems are complex and cannot be completely comprehended or defined. The goal of this modeling approach is to develop the most complete approximation of actual conditions.

A numerical groundwater model was chosen for the Alta Groundwater project because it was the best tool for meeting the specific data needs of Alta. Alta required general information on the extent of groundwater availability beneath the district, the flow of groundwater into and out of the district, the interaction of surface water and groundwater, the effects of extended drought

periods on areas overlying low yield aquifers, the effects of improved irrigation efficiency, and the effects of proposed surface water reallocation on the district as a whole. It was determined that these complicated issues could only be analyzed adequately with an analytical model.

There are several groundwater models available commercially. Many have features that might have been helpful to the Alta project. The model chosen for this project is called the Integrated Groundwater/Surface Water Model (*IGSM*) and was written by a water resources consultant employed by James M. Montgomery Consulting Engineers of Sacramento (JMM, 1990). The model was written under contract to the U.S. Bureau of Reclamation for analysis of the groundwater flow of the California Central Valley and is considered in the public domain.

The IGSM was chosen primarily because it provides a comprehensive tool that combines the surface and subsurface water systems. With most groundwater models, a separate surface model would have to be developed prior to using the groundwater model.

MODELING PERIOD

Calibration Period

The calibration period chosen was October 1962 through October 1991. The beginning of this period was chosen because approximately 30 years were required for adequate calibration (Yoon, 1992), and 1962 was the first year of near-normal flows in the Kings River following two drought years. The end of the calibration period was chosen because it was the most recent date of much of the data required in the model.

Projection Period

Short-Range Projections were done for a period of ten years (1992 through 2001). It was felt that the model would give fairly accurate localized results for this period.

Long-Range Projections were conducted for a thirty-year period. To gain some insight into the long-term effects of continued groundwater overdraft. The long-range projections are considered accurate on a regional (district-wide) basis only.

HISTORICAL DATA COLLECTION

The numerical groundwater model is very data intensive. The following section describes the sources of input data used for the model and the *data file* that each set of data is stored in for use by the model.

Model Boundary and Element Grid

The Alta Irrigation District was described mathematically through the use of a modeling grid that consists of 121 triangular and quadrilateral elements (Figure 8). The vertices of the elements are called nodes. These nodes are the points through which the computer model routes groundwater flow. Alta was described using 121 such nodes (Figure 9).

The grid was developed so that the element boundaries were aligned in the approximate direction of groundwater flow. The elements were also selected to be smaller in areas where aquifer conditions are changing more rapidly.

The grid was laid out on a district map by hand and then digitized using a large digitizing tablet and a computer aided drafting program. The digitized coordinates of the nodes were converted to a horizontal reference plane that shares its origin with Zone 4 of the California Coordinate System.

The model boundary did not correspond exactly to Alta's district boundary (Figure 10). This is because it is not practical to adjust the boundary to accurately portray many of the curves and bends of the actual boundary. The greatest departure from the actual boundary is in the northern tip of Alta where the district boundary expands in a finger-shaped portion that encompasses the head gate of the 76 Canal and the upper reaches of the Alta Main Canal. To include this "finger" portion of the district in the modeling grid would introduce significant instability to the model.

The groundwater elements were grouped into 12 regions (Figure 11). All of the elements within a region must have the same irrigation efficiency, land use percentages (See Land Use section), evapotranspiration rate, surface water supply, pumping and cropping pattern. The regions were chosen primarily to isolate differences in water allotment and cropping pattern (Table 1).

The model grid, elements, and node coordinates are described in data files ALTELEM.DAT and ALTXY.DAT (KRCD, 1992).

Stratigraphy

The *stratigraphy** of the aquifer underlying Alta was described as a single-layer unconfined aquifer. The thickness of the aquifer was determined at each node point. Thickness was computed as the difference between the ground surface elevation and the elevation of the bedrock. Ground surface elevation was read from USGS 7.5 minute quadrangle maps. Bedrock elevation was estimated from Carlson (1990). The stratigraphy data is given in the file ALTSTRA.DAT (KRCD, 1992).

Figure 8
Alta Groundwater Model Elements

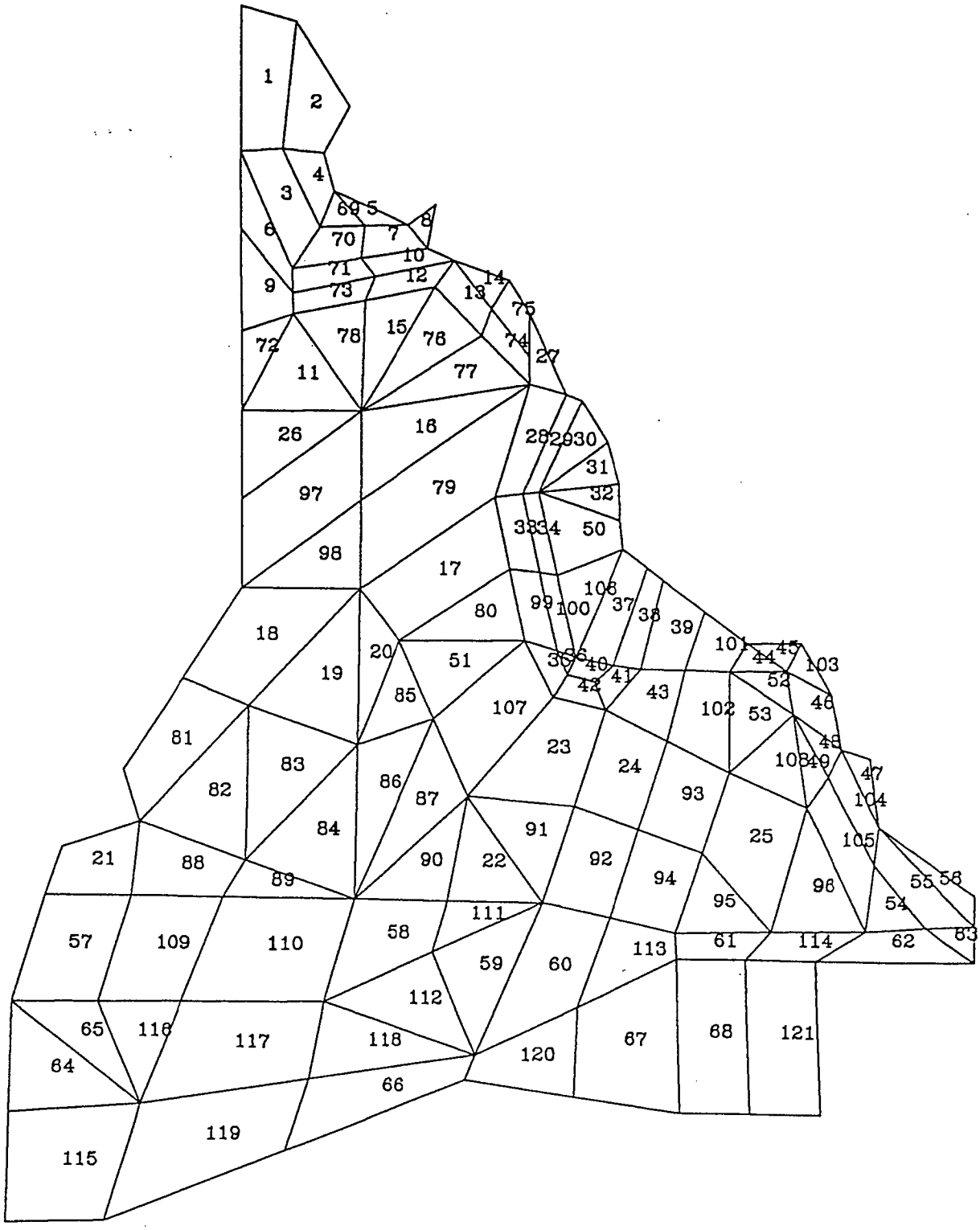


Figure 9
Alta Groundwater Model Nodes

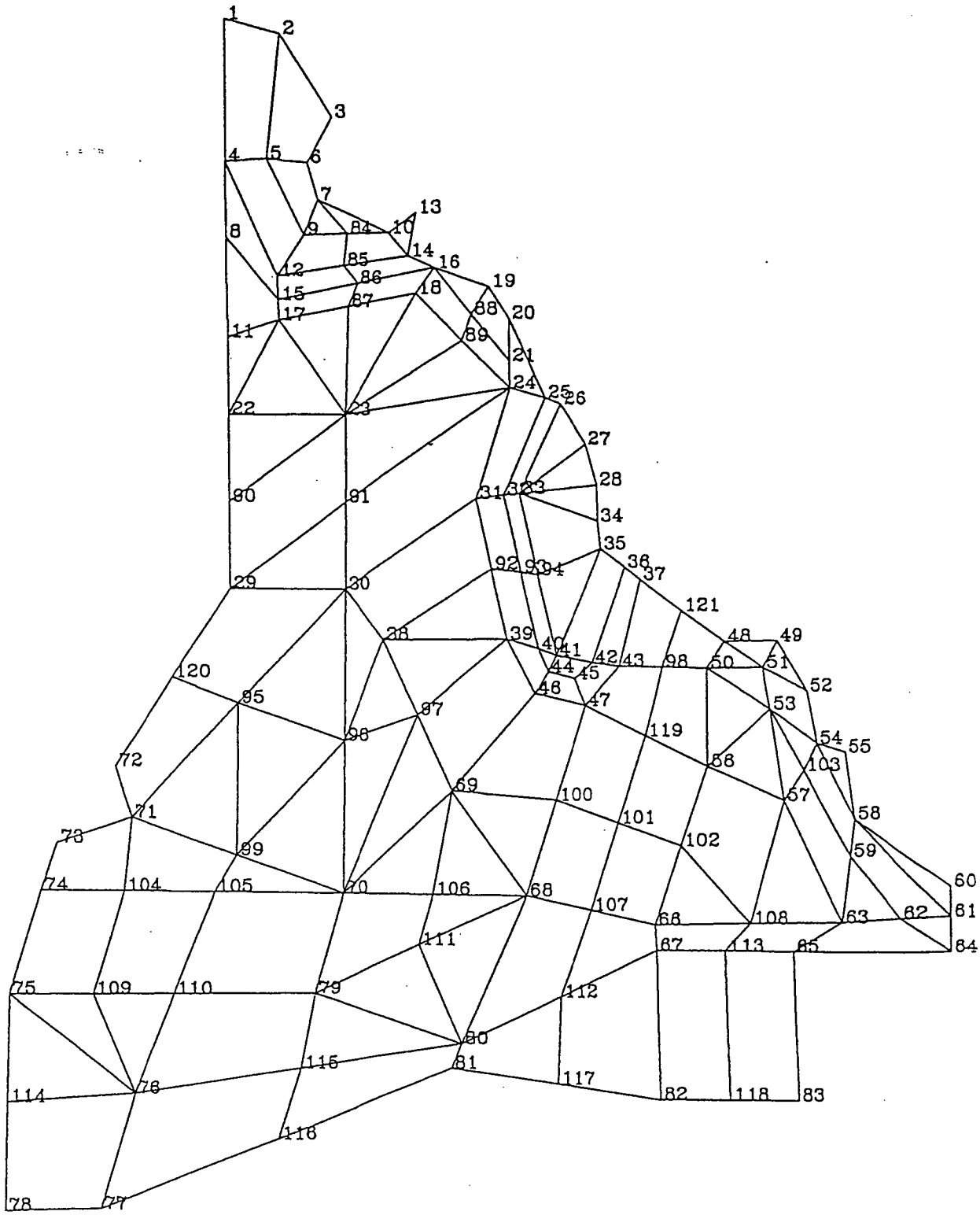


Figure 10
Alta Boundary and Groundwater Model Grid

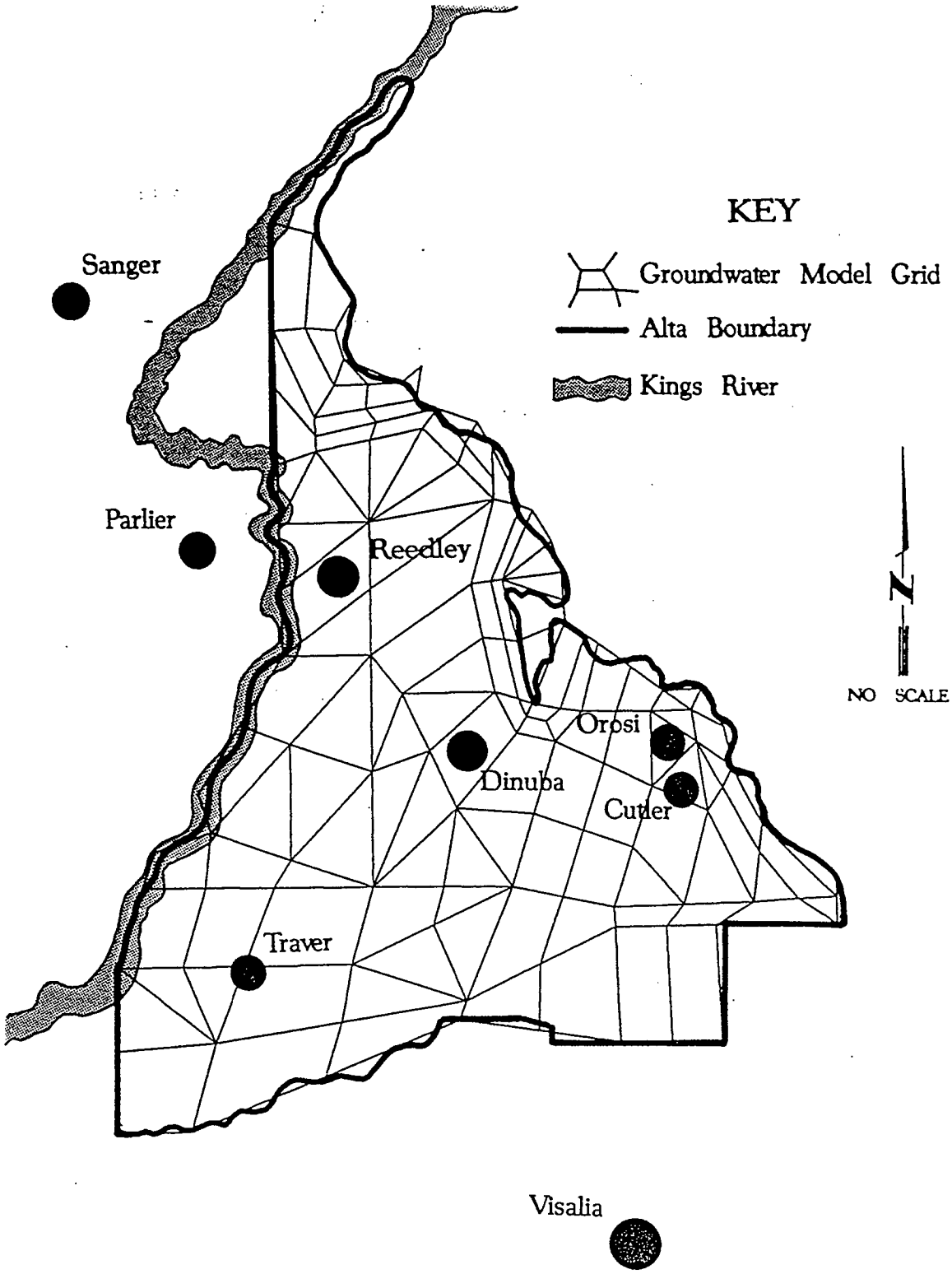


Figure 11
Alta Groundwater Model Regions

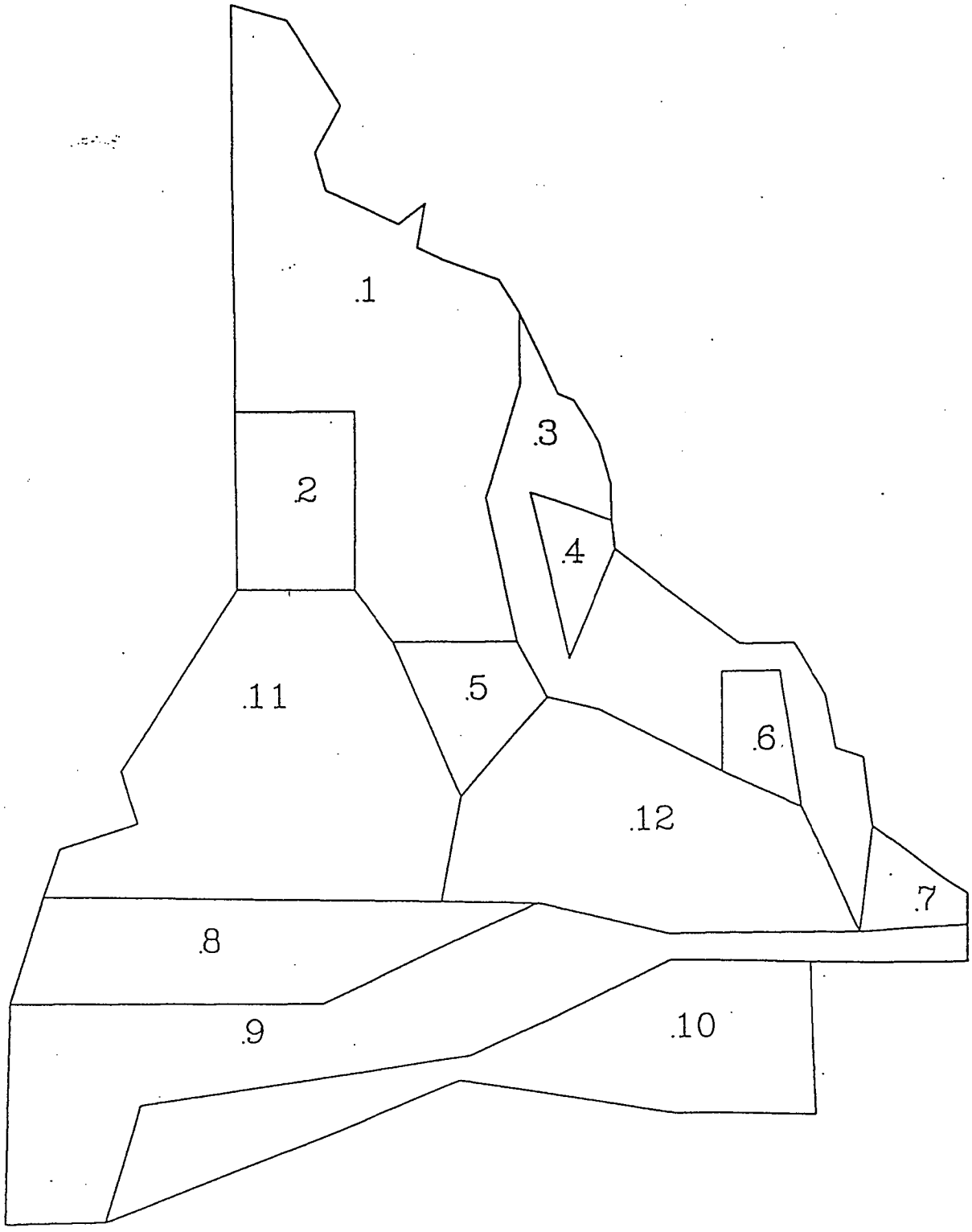


Table 1 Description of Alta Model Regions		
Region	Water Allotment	Land Use & Cropping Pattern
1	100%	Mostly fruit trees & other permanent crops
2	100%	City of Reedley & surrounding area
3	100%	Mostly citrus & other permanent crops
4	0%	Smith Mountain: partially cropped
5	100%	City of Dinuba & surrounding area
6	100%	Cutler/Orosi & surrounding area
7	50%	Mostly citrus & other permanent crops
8	75%	Mostly permanent but some annual crops
9	35%	Mix of permanent and annual crops
10	10%	Mostly annual but some permanent crops
11	100%	Mostly fruit trees and other permanent crops
12	100%	Mostly fruit trees and other permanent crops

Streams

The characteristics of significant waterways were delineated for the groundwater model. Portions of the following waterways were described:

- Kings River
- Peoples Ditch and Lakelands Canal
- Wahtoke Creek and East Branch Canal
- Sand Creek
- Cottonwood Creek

Cross sections of the waterways were determined at several points from as-built drawings of bridges or from surveying. Elevations were determined from county surveying monuments.

Pertinent stream data was developed for each stream node. The stream nodes correspond to groundwater nodes that lie close to the actual stream bed (Figure 12). A total of 49 stream nodes were used to describe these waterways.

At each stream node, a rating table was developed that included six values each of depth, *wetted perimeter* and flow rate. The minimum depth and flow for each table was zero. At zero flow, the wetted perimeter might not be zero. The maximum flow in each table was chosen to be the maximum value expected in the stream.

Wetted perimeter was computed using the survey data. Flow rate was computed using survey data, apparent slope between surveyed points, and Manning's Equation (Flammer, 1981). Values of Manning's roughness coefficient ranged from 0.04 to 0.05 for the Kings River and 0.035 to 0.15 for Sand Creek. Manning's roughness coefficient was set to 0.035 for both East Branch Canal and Cottonwood Creek. The maximum flow for each stream node was not allowed to be less than the maximum flow of the upstream node(s) unless a known spill, delivery, or bifurcation existed.

For streams that were known to have frequent overbank conditions or that had channel cross sections that appeared to be too small to carry maximum upstream flows, the maximum depth and wetted perimeter were estimated based on an assumed overbank condition. The wetted perimeter was estimated to be the width of the flooded area for 1969 (Tulare County, 1971). The maximum depth was assumed to be 1.0 feet above the apparent stream bank.

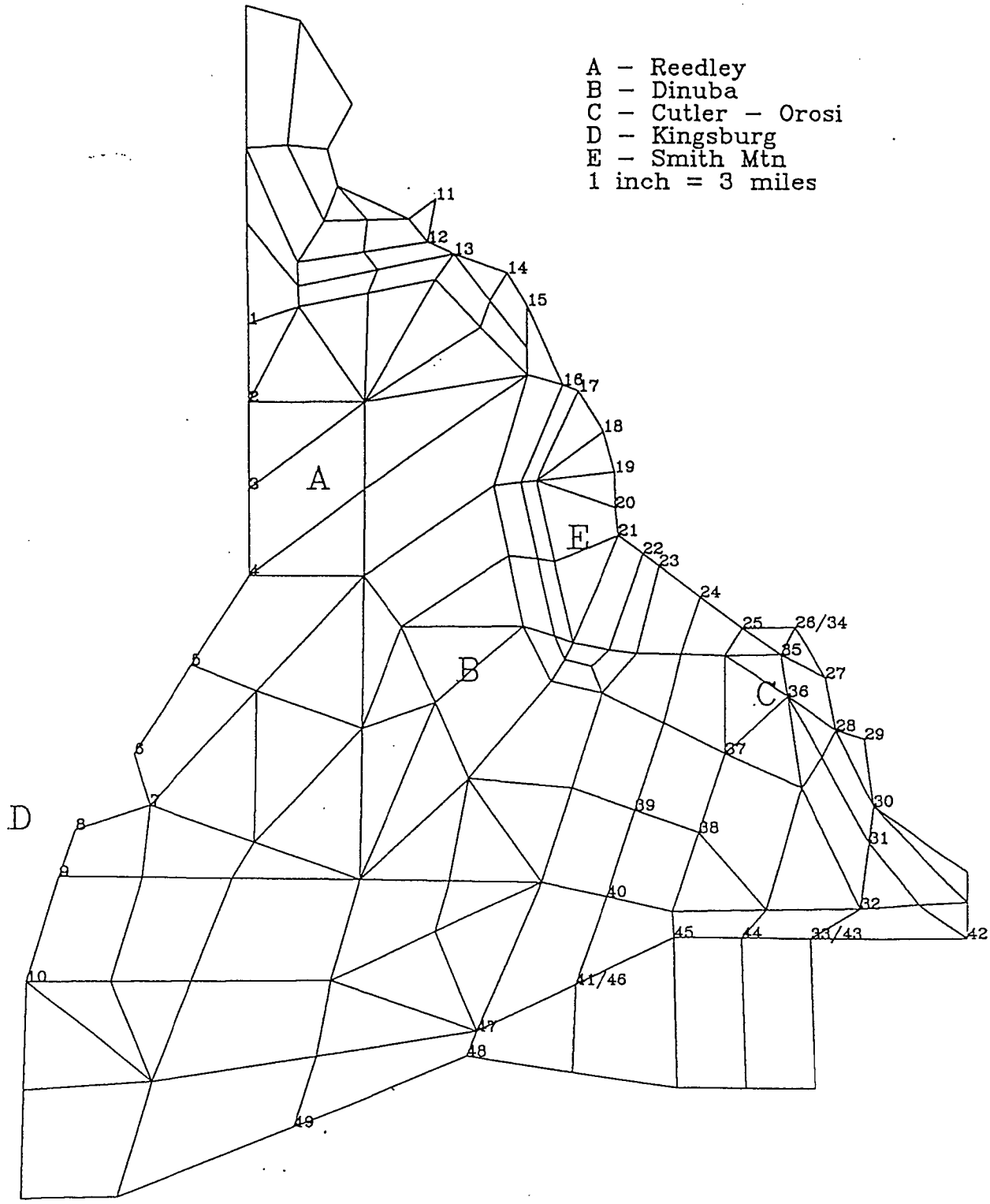
The flows in all of the streams except the Kings River were computed by the IGSM based on the recorded rainfall and the area of the appropriate small watershed (see Small Watershed section). The flow of the Kings River is given in the data file ALTINFL.DAT (KRCD, 1992) and was gathered from Kings River Water Association (KRWA, 1960-1991).

The hydraulic conductivity and thickness of stream beds is given in the data file ALTPARM.DAT in the Stream Bed Parameters section (KRCD, 1992). The remaining stream characteristics are described in the data file ALTSTRM.DAT (KRCD, 1992).

Precipitation

Monthly precipitation values were obtained from Alta's records from their rain gauge located in their district yard in the City of Dinuba. These values were checked for consistency with recorded rain values from Kearney Agricultural Center in Parlier (UCCE, 1965-90) and the Orange Cove Station (NOAA, 1982).
The IGSM has a rainfall weighting factor that allows data from a single rain gauge to be used

Figure 12
Alta Groundwater Model Stream Nodes



over a wide area. The precipitation within Alta was assumed to be relatively uniform, so a weighting factor of unity was used for all model elements. For small watersheds, rainfall weighting factors were estimated from *isohyets** (Tulare County, 1971).

Rainfall station number and weighting factors for model elements are given in the data file ALTCHRC.DAT (KRCD, 1992). Rainfall station number and weighting factors for the small watersheds are given in the Small Watershed Data section of the file ALTPARM.DAT (KRCD, 1992). Monthly rainfall values are given in the file ALTPRCP.DAT (KRCD, 1992).

Soils and Surface Drainage

The U.S.D.A. Soil Conservation Service (SCS) has mapped the soils in and around Alta and classified them for their use in agriculture and for their effect on storm runoff (SCS, 1940; SCS, 1971). Within the Alta boundary, there are approximately 90 different named soils. The SCS has described the texture and upper profile of these soils down to approximately 5 feet below the ground surface. These soils have also been classified by the SCS into four Hydrologic Soil Groups based on their permeability and tendency to yield storm runoff. The four groups are identified as **a, b, c,** and **d** with **a** being the most permeable.

The IGSM uses the four hydrologic soil groups in its *root zone** water balance and runoff calculations and refers to types **a, b, c** and **d** as 1, 2, 3 and 4 respectively. The percentage of each of the soil types in each modeling element was measured with a planimeter. The weighted average soil type for each element is computed as follows:

$$Asoil = (A1 * 1 + A2 * 2 + A3 * 3 + A4 * 4) / A$$

where

Asoil = the weighted average soil type

A1 = the area of land with soil type 1 in the element

A2 = the area of land with soil type 2 in the element

A3 = the area of land with soil type 3 in the element

A4 = the area of land with soil type 4 in the element

A = the total area of the element

The surface drainage pattern for Alta was determined from inspection of 7.5 minute USGS

quadrangle maps for each element. The IGSM utilizes this information in the form of the stream node number to which each element drains.

The soils and surface drainage information is given in file ALTCHRC.DAT (KRCD, 1992).

Aquifer Properties

The properties of the aquifer beneath Alta were delineated for each modeling node. The hydraulic conductivity and specific yield values used in the model were developed by the Department of Water Resources (DWR) for each quarter-township within Alta from well drillers logs (DWR, 1981). Values of these properties were estimated for the Alta groundwater nodes through use of a surface modeling computer program (Golden, 1989). The final values of hydraulic conductivity and specific yield were refined as part of the calibration process (Figures 13 and 14).

*Specific Storage** was assumed to be insignificant for all groundwater nodes because the aquifer beneath Alta is unconfined (Yoon, 1992). If Alta's aquifer were confined, specific storage might be significant.

*Leakance** was assumed to be 0.02 for all groundwater nodes because the basement complex beneath Alta's aquifer is primarily granitic bedrock (Yoon, 1992).

Values of hydraulic conductivity, specific yield, specific storage, and leakance are given in the Aquifer-Option 3 section of the data file ALTPARM.DAT (KRCD, 1992).

Vadose Zone

The thickness of the vadose zone is computed by the IGSM for each month based on the ground surface elevation and the elevation of the water table. The *effective porosity** of the vadose zone was assumed to be equal to the specific yield at each groundwater node (Yoon, 1992).

The vertical hydraulic conductivity of the vadose zone was assumed to be 1 foot per day (Yoon, 1992). An analysis showed that model results were insensitive to this value (see Sensitivity Analysis section).

Values of effective porosity and vertical hydraulic conductivity for the vadose zone are given in the Vadose Zone-Option 3 section of the data file ALTPARM.DAT (KRCD, 1992).

The *field capacity** of the root zone was determined for each model element by the following equation:

$$FC = (A1 * 0.04 + A2 * 0.08 + A3 * 0.12 + A4 * 0.17) / A$$

Figure 13
Values of Horizontal Hydraulic Conductivity
Used in the Alta Groundwater Model in Feet per Day

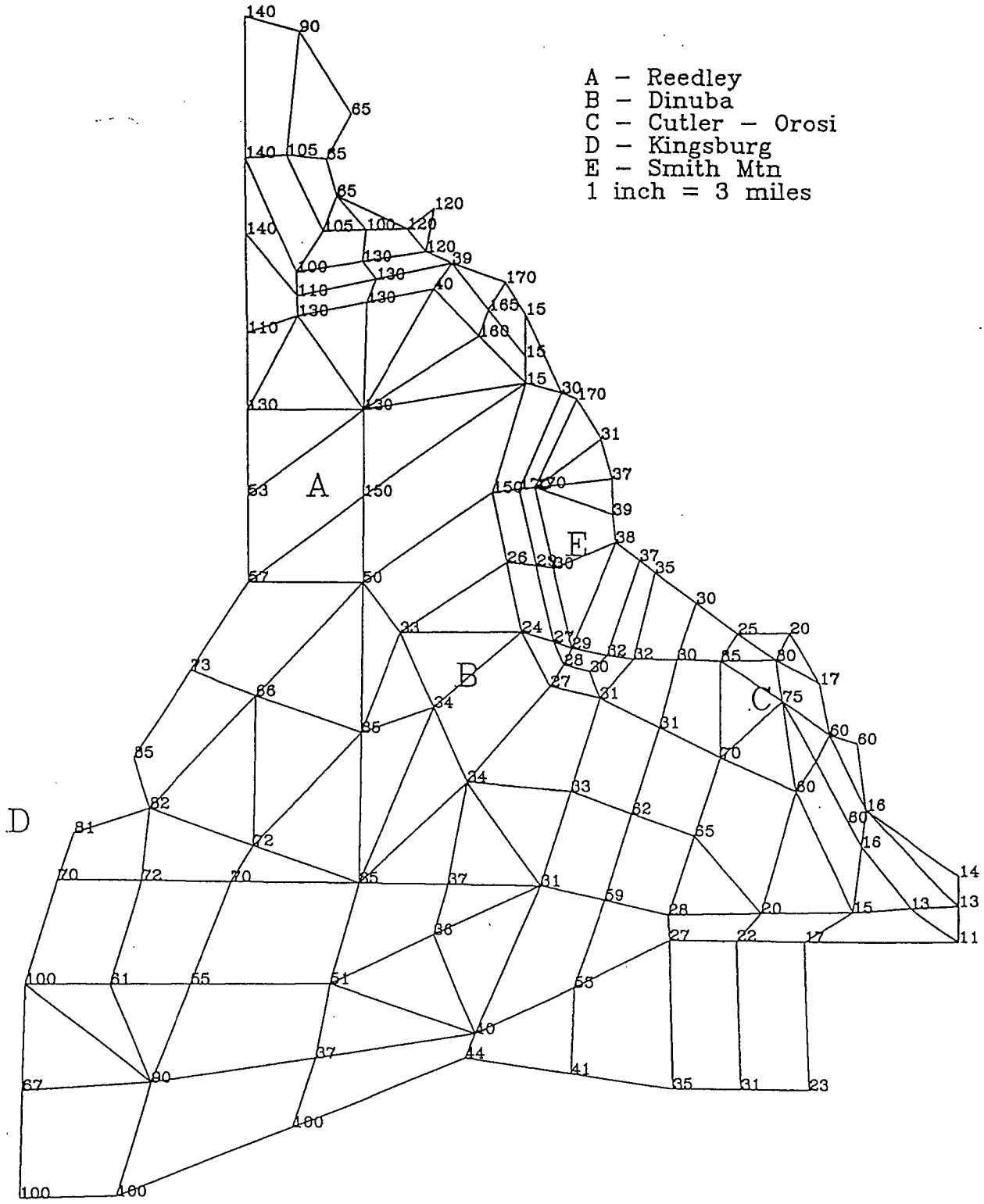
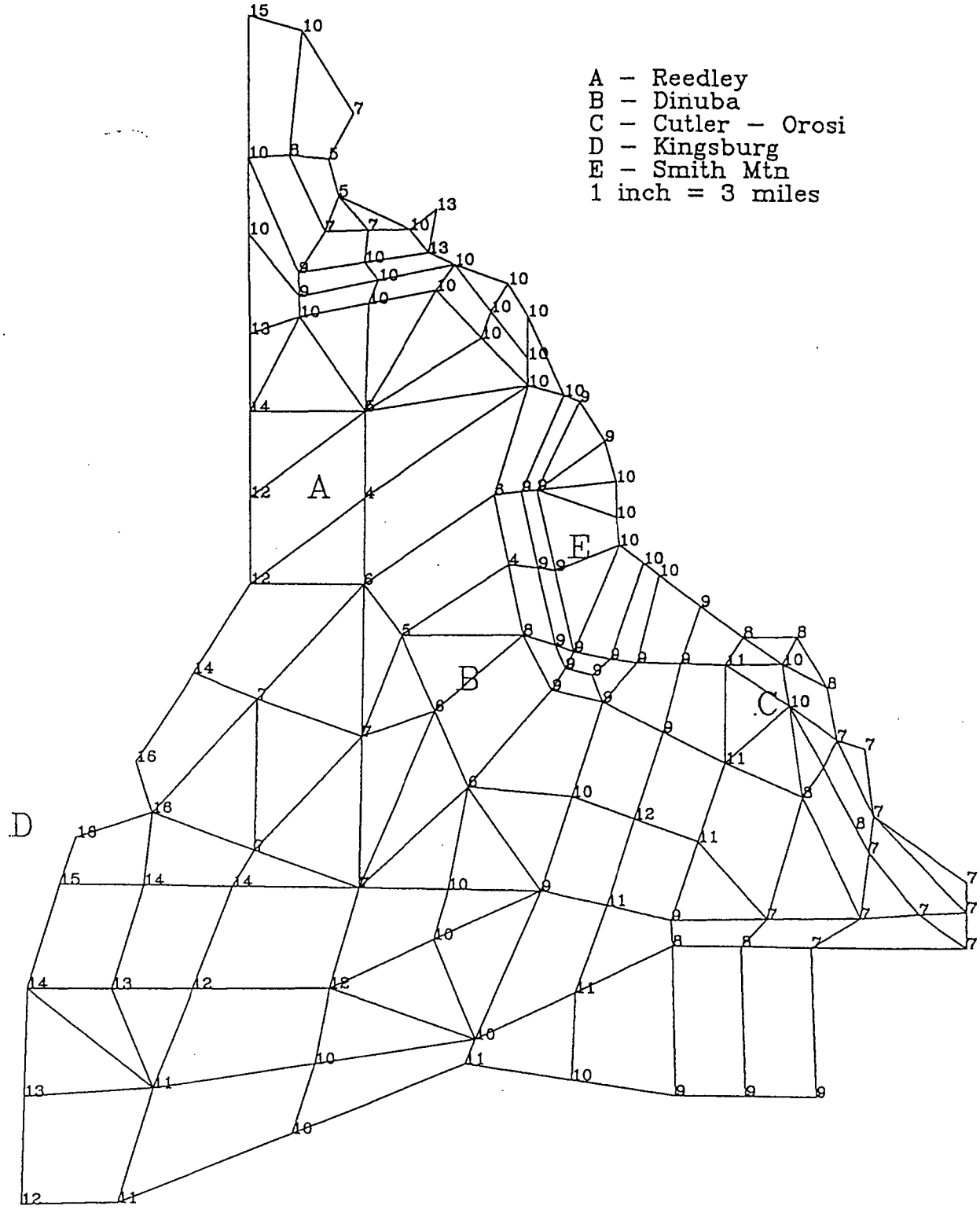


Figure 14
Values of Specific Yield Used in the
Alta Groundwater Model in Percent



where

FC = the average field capacity of the element in inches per foot

A1 = the area of land with soil type 1 in the element

A2 = the area of land with soil type 2 in the element

A3 = the area of land with soil type 3 in the element

A4 = the area of land with soil type 4 in the element

A = the total area of the element

The SCS runoff curve number was determined for each region and land use type (see Land Use section) using guidelines set by the SCS TR55 method (SCS, 1986).

Values of available water holding capacity and runoff curve number are given in the Soil Moisture Parameters section of the data file ALTPARM.DAT (KRCD, 1992). Values of root zone depth are given in the Water Use Parameters section of the data file ALTPARM.DAT (KRCD, 1992).

Small Watersheds

The following small watersheds east of Alta were modeled to account for surface and subsurface inflow:

- Wahtoke Creek
- Navelencia Creek
- Granite Hill Creek
- Unnamed: lying between Granite Hill Creek and Surprise Creek
- Surprise Creek
- Hills Valley Creek
- Wooten Creek
- Orange Cove Drain
- Unnamed: lying between Orange Cove Drain and Sand Creek
- Sand Creek
- Negro Creek
- Long Creek
- Cottonwood Creek

The area of each small watershed was determined with a planimeter and verified by comparison

to the Tulare County Flood Control Master Plan (Tulare County, 1971). The runoff curve number was determined using guidelines set by the SCS TR55 method (SCS, 1986).

The fraction of percolated water that enters the Alta model boundary from the small watersheds was determined as part of the calibration process (see Calibration section).

The remaining small watershed parameters are given in the file ALTPARM.DAT in the Small Watershed Data section (KRCD, 1992). The watershed areas and corresponding stream node are given in the file ALTBOND.DAT in the Small Watersheds section (KRCD, 1992).

Boundary Conditions

The IGSM is capable of accurately computing the flow of surface water and groundwater within the model boundary. The flow across and near the boundary can only be determined accurately if the conditions just beyond the boundary are known.

To estimate the groundwater elevation just outside of the Alta model boundary, the Central Valley Groundwater surface Water Model (*CVGSM*) was used (JMM, 1990). The CVGSM area covers the San Joaquin and Sacramento Valley including Alta and the surrounding area.

The groundwater elevation was computed by the CVGSM at 51 locations, each lying one mile outside the Alta boundary. Although the groundwater elevation at each of these points is given for each month of the modeling period, the aquifer thickness at the boundary near each point is given as a time independent value. The thickness value for each of the 51 points was determined by averaging the area along the boundary over the 30-year calibration period.

The outside water table elevations and other boundary condition data is given in the file ALTBOND.DAT (KRCD, 1992).

The boundary condition is further enhanced by the surface and subsurface flows computed from the small watersheds (see Small Watersheds section).

Pumping

Agricultural Pumping was determined for each model region for each month of the modeling period by the following equation:

$$Pump = ET/IE - SW - ER$$

where

Pump = monthly pumping for the region

ET = the estimated monthly evapotranspiration of the region (see Evapotranspiration section)

IE = the estimated monthly irrigation efficiency (see Irrigation Efficiency section)

SW = the monthly surface water delivery to the region (see Surface Water Diversion section)

ER = the monthly effective rainfall of the region (see Water Balance-Inflow and Outflow section)

The volume of water pumped is given by region in the file ALTPUMP.DAT. The distribution of pumping by element within the regions is given in the Groundwater Sink section of the file ALTSPEC.DAT (KRCD, 1992).

Urban Pumping was estimated from historical records of pumping and population obtained from the cities of Reedley and Dinuba. The most complete records available for pumping were from the City of Reedley. Using these values, a per capita pumping rate was determined for each month of the year (Reedley, 1991b). Per capita values were compared to records from the City of Dinuba (Dinuba, 1991) and found to be reasonable for representing that community. Pumping values were computed for each city and for the Cutler/Orosi area as the product of the cities population (Reedley, 1991a) and the corresponding per capita value.

Surface Water Diversion and Canal Seepage

The surface water diversion to Alta is well documented by the Kings River Water Association (KRWA, 1962-1991). Alta's district diversion was divided up into the following:

- Farm delivery
- Canal seepage
- Evaporation from canal water surface
- Evapotranspiration of canal bank vegetation
- Operational spill

The values of these items were quantified for wet and dry years as part of an earlier surface water study for Alta (KRCD, 1991a). The canal seepage was determined as a fraction of the net district diversion. The farm delivery values were determined for each groundwater element and is given as a fraction of net district diversion the Surface Water Diversions Specifications section in the file ALTSPEC.DAT.

Net district diversion is defined as the sum of the farm delivery and canal seepage portion of the total district diversion. The total farm delivery was 75.7 percent of the net diversion. The canal

seepage was 24.3 percent of net diversion. Net district diversion for each month of the modeling period is given in the data file ALTSWDV.DAT (KRCD, 1992). The farm delivery values were distributed among the elements based on Alta's policy of inter-district water allotment.

The fraction of net diversion that is delivered to an individual element is given by:

$$D_i = Al_i * Ag_i \; / \; \sum_{n}^{i=1} (Al_i * Ag_i)$$

where

D_i = fraction of net diversion delivered to element i

Al_i = the water allotment for element i

Ag_i = the area of agricultural land in element i

n = the total number of elements (121)

Initial Conditions

The groundwater elevation at each node and soil moisture condition must be defined at the beginning of the modeling period. The initial groundwater elevation was determined from historical well readings (Alta, 1962-1970; KDWCD, 1962-1970; USBR, 1962-1970). Values were estimated for the groundwater nodes using a surface modeling program (Golden, 1989).

The initial soil moisture conditions were estimated to be as follows:

- 10% for agricultural land
- 40% for urban land
- 1% for native land
- 40% for riparian land

These values are based on judgement. The agricultural values are relatively low because it was common practice on the east side of the San Joaquin Valley to apply a minimum or no post harvest irrigation during the early 1960's.

The initial conditions are given in the file ALTINIT.DAT (KRCD, 1992).

Land Use

The following four types of land use are defined for the model area:

- Agricultural
- Urban
- Native
- Riparian

The number of acres of each land use type within each model element was measured with a planimeter from DWR crop maps for the years 1958 and 1986 (DWR, 1958; 1985; 1986; 1988).

DWR's crop maps delineate different crops, native, and urban areas. The native areas adjacent to the Kings River and Wahtoke creek were assumed to be riparian vegetation.

The cropping pattern within each of the twelve modeling regions was determined from a number of one-square-mile sample blocks within each region. The following crop types were delineated:

- Pasture
- Alfalfa
- Sugar beet
- Field crops
- Rice
- Truck crops
- Tomatos
- Walnuts & almonds
- Farmsteads & dairies
- Fruit
- Grains
- Vineyard
- Cotton
- Corn
- Citrus & olives

The cropping pattern was checked using two different methods.

The first check involved driving around Alta and visually verifying that the cropping patterns for each region seemed correct. (Slight adjustments were made based on on-site judgement).

The second check involved comparing the sum of the acres of each crop from each region to the cropping pattern collected by Alta's staff. The patterns for each region for each year from 1962 to 1988 were adjusted to match Alta's records.

Land use designation is given in the data file ALTLND.DAT; cropping pattern is given in the file ALTCRP.DAT (KRCD, 1992).

Irrigation Efficiency

Irrigation efficiencies were developed for each month of the growing season. These values were determined from a minimum of published data (Gohring et al, 1990; SJVDP, 1987; Westlands, 1985) and a great deal of judgment.

The average seasonal irrigation efficiency was assumed to be 65 percent. During the mid-season, the irrigation efficiency was increased to 95 percent based on the observation of typical practices in Alta and the apparent common occurrence of mid-season deficit irrigation. The early-season irrigation efficiency was reduced to as low as 25 percent based on observations of over-irrigation during spring months and typically high pre-irrigation of annual crops.

Irrigation efficiency for each crop and month of the year are given in the data file ALTDEM.DAT (KRCD, 1992).

Evapotranspiration

The evapotranspiration rate of each crop type for each month of a typical year was computed from the following equation:

$$ETc = ETo * Kc$$

where

ETc = monthly evapotranspiration for the crop

ETo = average monthly reference evapotranspiration from the California Irrigation Management Information System: Parlier Station (CIMIS, 1992).

Kc = crop coefficient

Values of Kc were derived from a comparison of accepted crop evapotranspiration rates and historical reference evapotranspiration (KRCD, 1991b).

Groundwater Elevation

Historical groundwater elevations are required to compare the predictions of the model during the calibration process. Groundwater elevations from approximately 180 wells were obtained for the fall and spring from 1962 through 1991 (Alta, 1962-1970, KDWCD, 1962-1970; USBR, 1962-1970; USBR, 1970-1991). The overlapping databases resulted in from 50 to 220 well readings for each time period. The low number of well readings occurred in the years 1971 and 1977.

A representation of the historical groundwater elevations is given in Appendix B.

CALIBRATION

Calibration of the groundwater model is required because of inherent uncertainty in the collected data. Through calibration, the data is refined. During the calibration process, the model is used to predict the groundwater elevations and stream flow rates for a period in the past. The predicted values are compared to known values, and input parameters are adjusted. This process is repeated until the predicted values are satisfactorily close to the known values.

The Alta groundwater study used the site-specific version of the IGSM for the detailed analysis and the valley-wide CVGSM for boundary conditions.

Central Valley Model

The calibration of the central valley groundwater model was previously performed by its author (JMM, 1990). KRCD's objective in calibrating the CVGSM was to refine the accuracy of the model for the area in and surrounding Alta Irrigation District.

Small Watersheds were adjusted to reduce the amount of subsurface water that enters the model area. The amount of flow from the small watersheds was reduced significantly.

Recoverable Losses, Agricultural Pumping and Surface Water Diversions: Recoverable losses are used by the IGSM to describe the contribution to the groundwater table from canal seepage. Surface water diversions are used by the IGSM to represent deliveries of irrigation district water. The IGSM allows surface water diversions to be specified for a particular region. Recoverable loss can be assigned to a specific element.

In the original CVGSM (as received from JMM 1990), a surface water diversion was made to the single model region that contained both Alta and Consolidated Irrigation Districts. Because these two districts have very different water entitlements, the following steps were used to redistribute the specified diversion within Alta and Consolidated:

- Agricultural pumping was increased to be equal to the consumptive demand of each model element

- Surface water diversion was set to zero in the model
- Recoverable loss was set to be equal to the sum of the actual surface delivery and the canal seepage
- New recoverable loss values were distributed among Alta and Consolidated to more accurately represent their different water allotments

In this way, the pumping and deep percolation values of the district would be larger than normal, but the increased pumping would ensure that the model did not compute a water stress for the crops. The surface deliveries can be thought of as being delivered directly to the underlying aquifer, and delivered to the field indirectly through pumping. This maintains the correct mass balance in each irrigation district.

Alta Groundwater Model

The Alta groundwater model was calibrated so that the difference between the average groundwater elevations for the calibration run and for historical levels was less than five feet during the fall of all years of the calibration period (Figure 15). Because of the way that subsurface flow from small watersheds enters the district, the spring water table elevations are slightly off. For this reason, only fall values were used in interpreting results of the model.

Although the average groundwater elevation was within five feet of historical values, a small number of localized areas within the model area were as much as 20 feet different than historical levels. The 1969 model prediction was the closest, with only a small area deviating from the historical values (Figure 16). The 1985 model prediction was one of the worst, with a large area having a deviation from historical of up to 10 feet and a few areas deviating as much as 20 feet (Figure 17).

Although the model results may deviate slightly from the historical values, the model was considered to be adequately calibrated. To achieve this level of calibration, several input parameters were adjusted.

Specific Yield values were increased five percent for the entire Alta area and for individually specified nodes. The specific yield of the nodes lying along *historical creeks* were increased by as much as 50 percent from the original values (see Specific Yield in the Methods section). The specific yield of nodes along the eastern boundary was decreased slightly to account for variability in the shallow aquifer.

Hydraulic Conductivity was increased along historical creeks by as much as three times the original values (see Hydraulic Conductivity in the Methods section). The increased values were generally reduced along the length of the creek with the highest values occurring near the eastern

Figure 15
Comparison of Historical and Predicted Groundwater Elevations

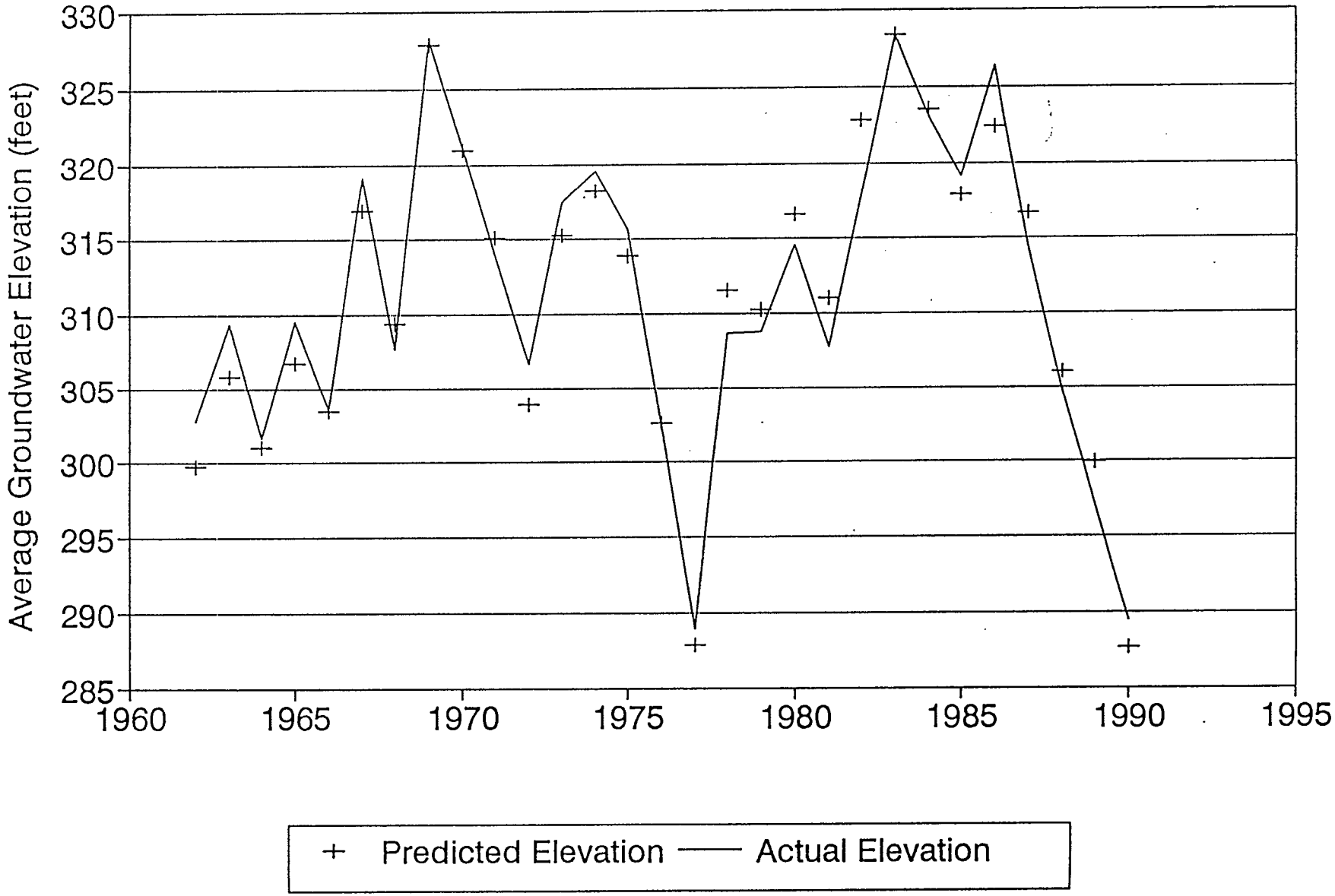


Figure 16

Difference Between Historical and Predicted Groundwater Elevations in Feet: 1969

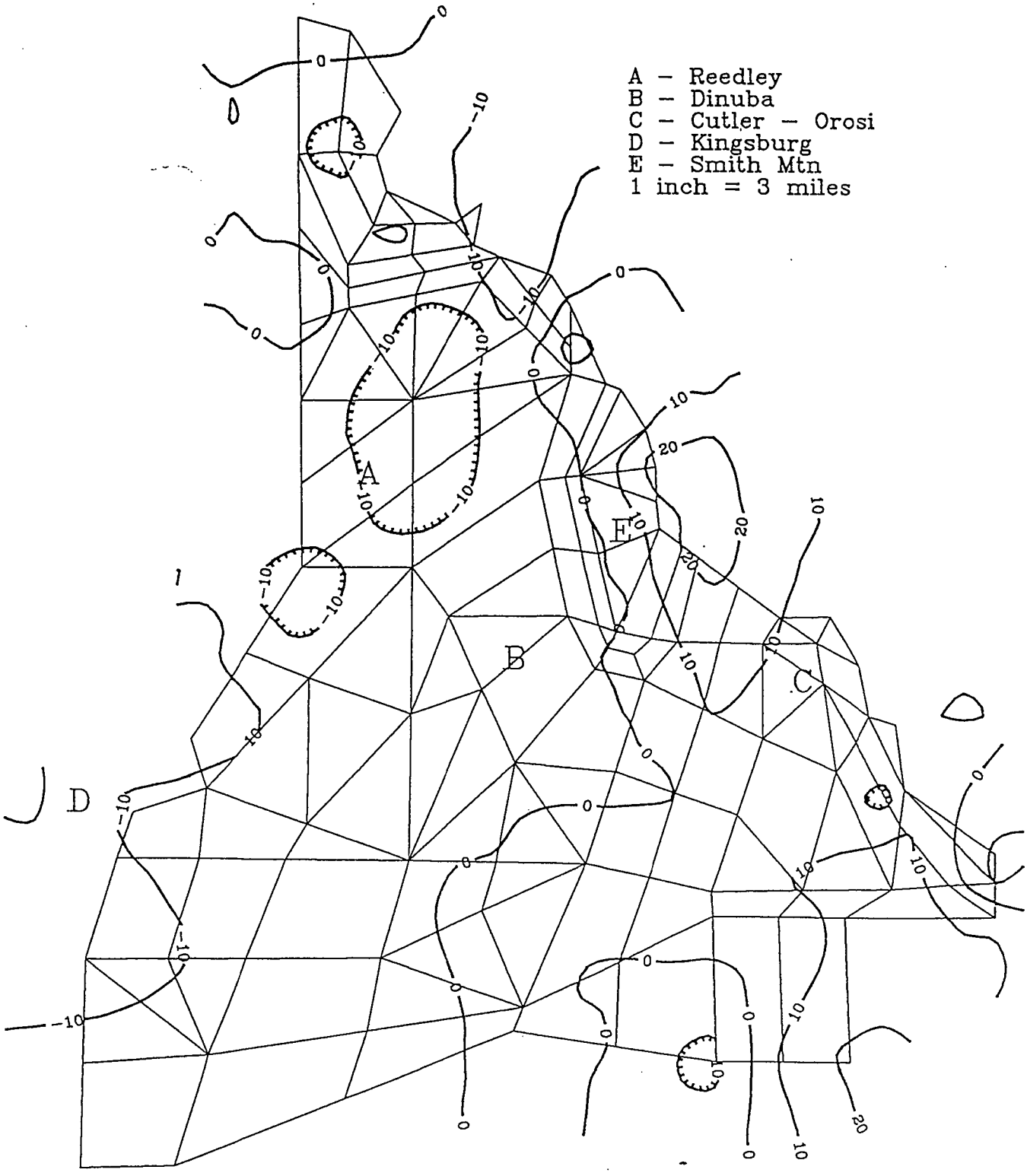
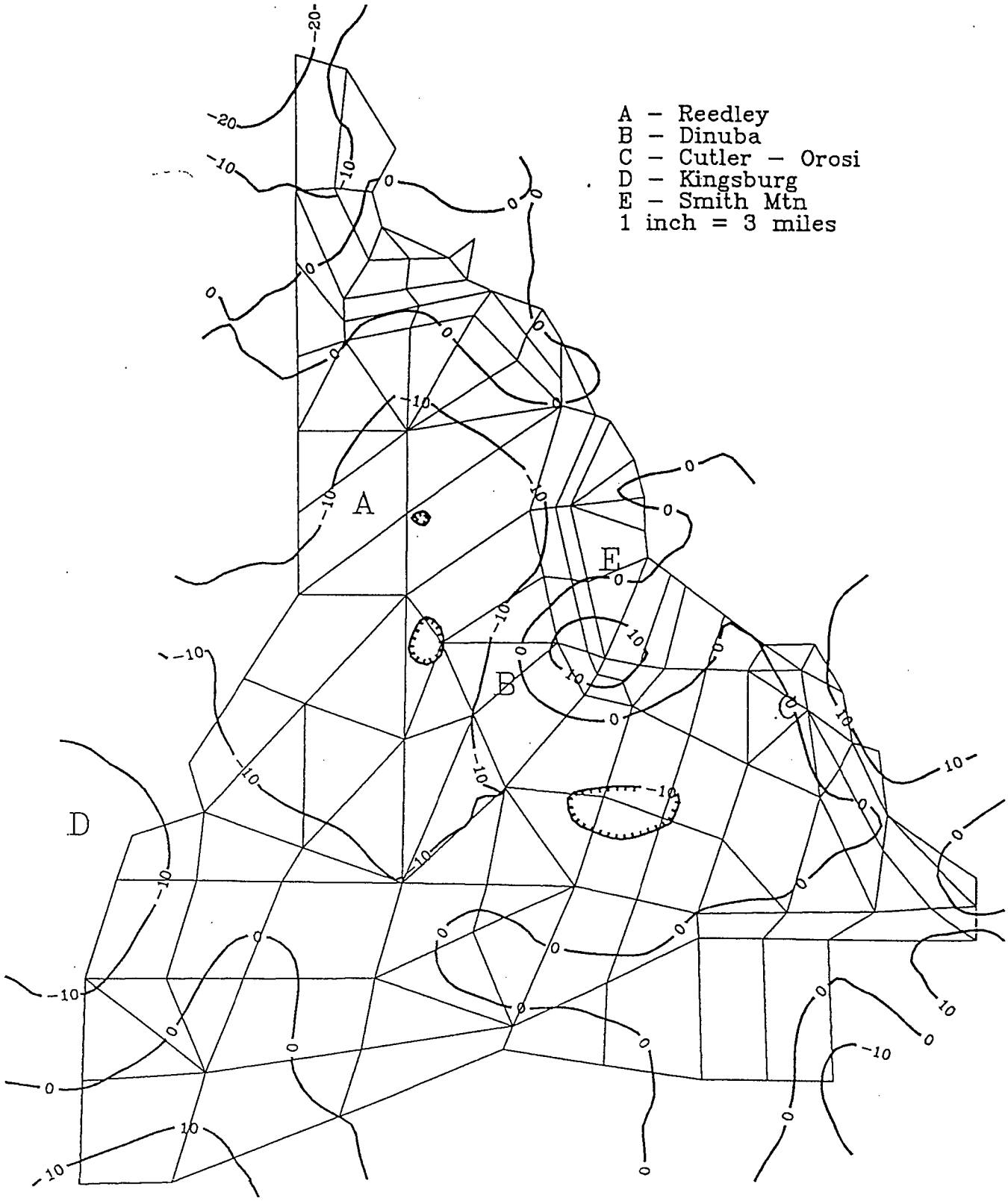


Figure 17
Difference Between Historical and Predicted Groundwater Elevations in Feet: 1985



boundary. Small decreases in the hydraulic conductivity were made along the eastern boundary to match the apparent subsurface flow entering that boundary. This change is considered justified because the original hydraulic conductivity data was based on the average for each quarter-township; and the boundary areas were significantly shallower than the average of most quarter-townships.

Recoverable Loss values were adjusted for individual elements to eliminate localized differences between the calibration predictions and the historical values. The adjustments were made near the urban areas and where one part of a region has significantly different surface soil type or irrigation practice. The adjustment was typically made by either doubling or halving the relative weight of the recharge within a region.

Evapotranspiration was adjusted by crop. Typically annual crops were increased slightly and permanent crops were reduced slightly.

Small Watersheds parameters were adjusted to match the amount of water entering the eastern edge of the model region. The quantity of subsurface water that enters the model area from the small watersheds that do not have direct subsurface connection with the model boundary (such as Cottonwood Creek drainage) was reduced. The quantity of subsurface water from small watersheds that are adjacent to the model boundary (such as Sand Creek drainage) was increased.

Stream Bed Hydraulic Conductivity was reduced for all stream nodes except five nodes in the Kings River bottom. The balance of the nodes were adjusted based on the typical material of the area in the vicinity of the stream channels. Most of these channels are man-made and maintained with construction materials consisting of available materials at the site.

Stream Bed Thickness was changed for the Lakeland Canal only. The stream bed was made significantly thicker because this channel is an excavated manmade canal.

PROJECTION CRITERIA

Projection Runs

The time dependant inputs to the groundwater model, such as precipitation and stream flow must be estimated for the projection periods. Eleven projection runs were made (Table 2). Each of the projection runs was designed to analyze a specific aspect of Alta's groundwater resources.

Run 1 (10 Dry Years) provided a prediction of Alta's groundwater table after a continued drought of 10 years.

Table 2 Description of Projection Runs for Alta Groundwater Model	
Run No.	Description
1	10 Dry Years
2	10 Average Years
3	10 Average Years with High Irrigation Efficiency
4	10 Wet Years
5	Alternate Wet & Dry Years for 10 Years
6	10 Critical Years
7	10 Critical Years with Reallocated Surface Water
8	Alternate 2 Wet & 1 Critical for 9 Years
9	Alternate 2 Wet & 1 Critical for 9 Years with Reallocated Surface Water
10	30 Average Years
11	Historic Data Repeated for 30 Years
12	Lining/Piping Canals

Run 2 (10 Average Years) provided an estimate of the conditions that could be expected if average weather conditions were experienced over the next ten years. This run also provided a base for comparing Run 3.

Run 3 (High Irrigation Efficiency) is identical to Run 2 except that the irrigation efficiency throughout Alta was increased. This was done to investigate the effect that a wide-spread increase in irrigation efficiency would have on Alta's groundwater resources. Such an increase in irrigation efficiency might be the result of improved on-farm irrigation management.

Run 4 (10 Wet Years) gave the result of ten wet years to illustrate the effectiveness of groundwater recharge within Alta. In addition to a few artificial recharge basins owned and operated by Alta, the district experiences passive recharge through deep percolation of irrigation water and through canal seepage.

Run 5 (Alternate Wet and Dry) is an analysis of alternate wet and dry years. This run was designed to determine the effectiveness of cyclical recharge and recovery of Alta's aquifer and to determine if the effect of the wet/dry cycle is similar to the long-term effect of average conditions (Run 2).

Run 6 (10 Critical Years) presents the worst case hydrologic scenario for Alta in which 10 critically dry years would be experienced. This run was designed to determine which areas would be hit the hardest, and how deep the water table would drop under severe conditions. This run also provided a base for comparing the results of Run 7.

Run 7 (Critical with Reallocation) is identical to Run 6 except that Alta's surface water supply was reallocated within the district. This run was designed to analyze the effect of Alta's proposed groundwater management plan.

Run 8 (Alternate Wet and Critical) is similar to Run 5 in that it analyzes the effect of alternate wet and critically dry years. This run was designed to determine the effectiveness of cyclical recharge and recovery of Alta's aquifer and to determine if the effect of the wet/dry cycle is similar to that of average conditions (Run 2). This run also provided a base for comparing Run 9.

Run 9 (Wet and Critical with Reallocation) is identical to Run 8 except that Alta's surface water supply was reallocated within the district. This run was designed to analyze the effect of Alta's proposed groundwater management plan in critical years.

Run 10 (30 Average Years) provides a long-term projection of Alta's water table. The level of confidence in the land use projections over the 30-year period is much lower than for the 10-year projection of Runs 1 through 9. The results of this run should be interpreted only on a regional (district-wide) scale.

Run 11 (Repeat 30 Historical Years) is a projection using the same weather and stream flow data that was experienced for the years 1962 through 1991. This projection provides a long-term look at how the district water table might respond to a typical cyclical weather pattern. As with Run 10, this projection should only be interpreted on a regional scale and will serve to give some insight into the long-term groundwater overdraft.

This run also serves to give some insight into the long-term effect of Alta's groundwater overdraft.

Run 12 (Lining/Piping Canals) is identical to Run 11 except that canal seepage is reduced to one-sixth the previous levels; farm deliveries were increased by a proportional amount; and the length of the irrigation season was increased. This projection provides a simulation of the effects

of lining or piping all of Alta's canals. With this scenario, less water would be seeped through canals and more would be delivered to farms. On-farm delivery rates were maintained and the delivery season was extended.

Run 12 assumes that adequate storage exists to extend the irrigation season and deliver the water that would be consumed through canal lining. An operations analysis of Pine Flat Dam would be required to confirm this assumption. Such an analysis was not conducted as part of this groundwater study.

Wet, Average, and Dry Years

For the projections, dry and wet years were defined by approximately one *standard deviation** below and above Alta's historical average diversion, respectively (Table 3). Values of district diversion, monthly rainfall, and Kings River flow were used for the year of record that most closely matched the approximate criteria. For example, Alta's average annual diversion is approximately 158,359 acre-feet. In 1966, Alta's diversion was approximately 153,852 acre-feet. No other recorded diversion was as close to the average. The monthly diversion, rain, and other weather factors from 1966 were used to represent the average condition. Likewise, the years of 1982 and 1972 were used to represent the wet and dry years respectively.

Table 3
Definition of Water Years
Used for Model Projections

Year Type	Approximate Criteria	Year Used	Annual District Diversion (Acre-Feet)
Wet	1 Standard Deviation Above Average	1982	230,000
Average	Average	1966	160,000
Dry	1 Standard Deviation Below Average	1972	86,000
Critical	-------	---	20,000

Critical Year

The critical year was defined to be a year with a district diversion of 20,000 acre-feet. This value was given by Alta's staff as the probable trigger for surface water reallocation as part of their proposed groundwater management plan (Kapheim, 1992). There are no recorded annual diversions that were considered close to 20,000 acre-feet. The monthly flow in the Kings River and monthly district diversion used to represent the critical year were interpolated from the flows of 1924 and 1931 which had diversions of 14,990 and 28,870 respectively.

The monthly rainfall used for the critical year was that experienced in 1977, the driest year of the modeling period.

Boundary Conditions and Land Use

The boundary conditions used for all of the projections were based on the groundwater elevations given by the CVGSM (valley-wide model). For each of the model runs, comparable weather and flow files were created for the CVGSM. The weather and flow parameters were adjusted only for the Kings River and the small watersheds adjacent to Alta. The water deliveries were adjusted only for Alta and the land adjacent to Alta to reflect each projection run.

The cropping patterns for the projections were held constant at 1991 levels. The urban acreage (Reedley, Dinuba, and Cutler/Orosi) was linearly interpolated and extrapolated by the IGSM based on the areas of 1966, 1986, and 1991 (Figure 18). Pumping in these areas was estimated based on per capita water use and population. The population of these three urban areas was extrapolated from known population figures between 1960 and 1990 (Figure 19).

Pumping

The agricultural pumping used for the projections was based on the evapotranspiration, irrigation efficiency, effective rainfall, and monthly surface water deliveries. The values of surface deliveries are discussed above. The evapotranspiration was based on the average crop water use and the cropping patterns discussed above. The irrigation efficiency and effective rainfall were computed based on the values and equations discussed previously.

Increased Irrigation Efficiency

For Run 3, the irrigation efficiency was increased to 85 percent for all crops and time periods. For all other runs, the average irrigation efficiency was approximately 65 percent.

Figure 18
Urban Area Functions used in Alta Groundwater Model

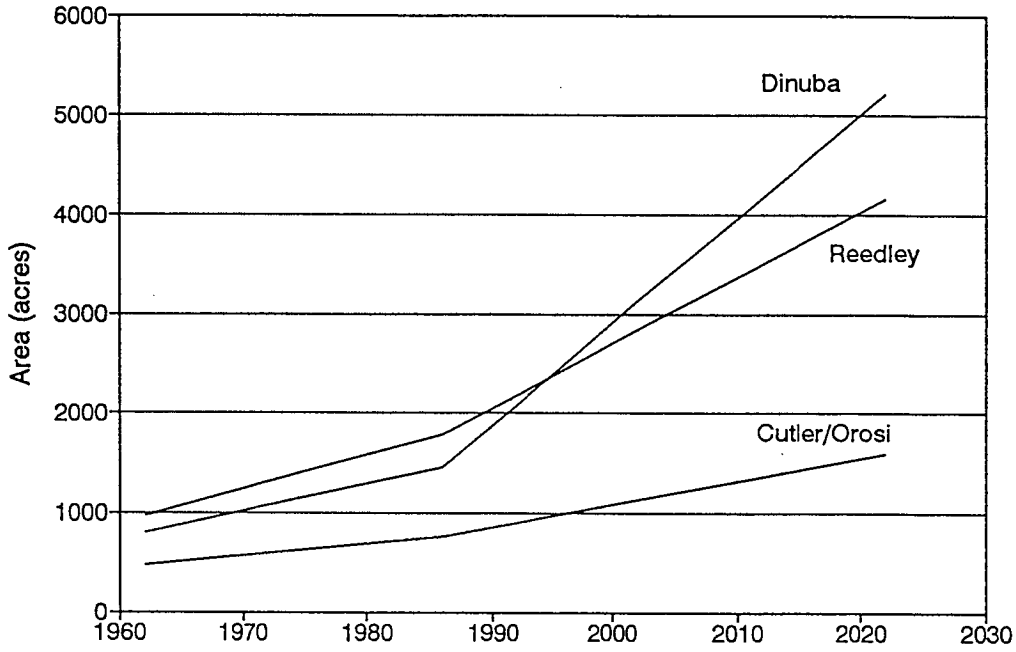
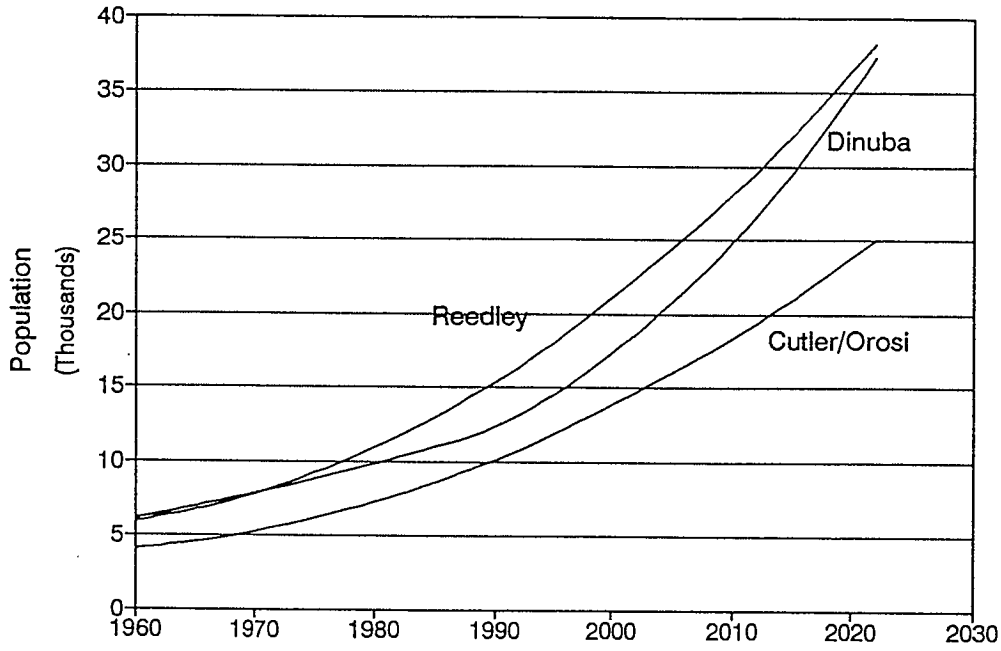


Figure 19
Urban Population Functions used in Alta Groundwater Model



Reallocated Surface Water

Alta's surface water was reallocated for Runs 7 and 9 based on their proposed groundwater management plan (Kapheim, 1992). The reallocation was designed to occur whenever Alta's annual entitlement was less than 20,000 acre-feet. Under the reallocation scheme, Alta's farmland located approximately south of Reedley and west of Dinuba would not receive surface water from the irrigation district for the projections, Regions 1, 3, 4, 5, 6, 7, and 12 received surface water; Regions 2, 8, 9, 10 and 11 did not receive surface water under the reallocation scheme (Figure 11, Page 20). This division of the district was determined based on the availability of groundwater and the ability to deliver a small amount of surface water (Kapheim, 1992). It was assumed that the entire 20,000 acre-foot diversion would occur in June. Under the proposed groundwater plan, the growers receiving surface water would pay an increased assessment that would be used to partially reimburse the growers who received no surface water for their pumping costs.

SENSITIVITY ANALYSIS

PURPOSE

The purpose of the sensitivity analysis is to determine which model input parameters have the greatest effect on the model output. The model is considered to be sensitive to those parameters that cause the greatest effect on the output.

Parameters that appear to have little effect on the model results can be assumed to be accurate enough for this modeling analysis. Parameters that cause wide changes in the model results should be carefully checked to ensure that their values are precise.

Parameters Tested

An analysis was conducted to test the sensitivity of the model to the following input parameters:

- Specific yield
- Horizontal hydraulic conductivity
- Vertical hydraulic conductivity
- Surface water diversion
- Irrigation efficiency
- Bedrock depth
- Evapotranspiration
- Boundary flow area

To conduct the sensitivity analysis, values of each tested parameter were adjusted. The model was run with the adjusted values, and the model results were compared to a base case. The base case was the output of the model from the best calibration run. Some parameters were adjusted up and down by a percentage for their test runs. Other parameters were adjusted up and down by a fixed quantity.

The results of the analysis were compared using Alta's average groundwater elevation.

Results

The results of the sensitivity analysis are summarized in Table 4.

Table 4 Summary of Sensitivity Analysis	
Input Parameter	Sensitivity
Specific yield	Moderate
Horizontal hydraulic conductivity	Moderate
Vertical hydraulic conductivity	Very Low
Surface water diversion	High
Irrigation efficiency	Low
Bedrock depth	Very Low
Evapotranspiration	Very High
Boundary flow area	Very Low

Specific Yield was tested for sensitivity by adjusting all node values 50 percent high and 50 percent low. The high values of specific yield were very sensitive, deviating from the base by as much as 20 feet in the dry years. Conversely, the high specific yield values diverged up to 10 feet from the base in wet years. This is apparently because of the large changes in water table elevation that are experienced in dry years. It appears that when the specific yield is incorrect, the model will not make accurate predictions of groundwater elevations in dry years (Figure 20).

Horizontal Hydraulic Conductivity was tested by adjusting all node values 50 percent high and 50 percent low. The model was found to be moderately sensitive to these changes, and to be slightly more sensitive during dry years (Figure 21).

Vertical Hydraulic Conductivity was tested with a base value of 1.0 feet per day, a low value of 0.1 feet per day, and a high value of 2.0 feet per day. The model was found to be very insensitive to this parameter (Figure 22).

Surface Water Diversion was tested by increasing and decreasing Alta's diversion by 20 percent. The model was found to be sensitive to this parameter, with results deviating from the base as much as 10 feet (Figure 23).

Irrigation Efficiency was tested in two different ways: by using values of irrigation efficiency of 45 percent, 65 percent, and 85 percent for all crops and months (Figure 24a); and by changing the values of irrigation efficiency up and down by 25 percent (Figure 24b). For the second case,

Figure 20
Sensitivity of Model Output to Specific Yield

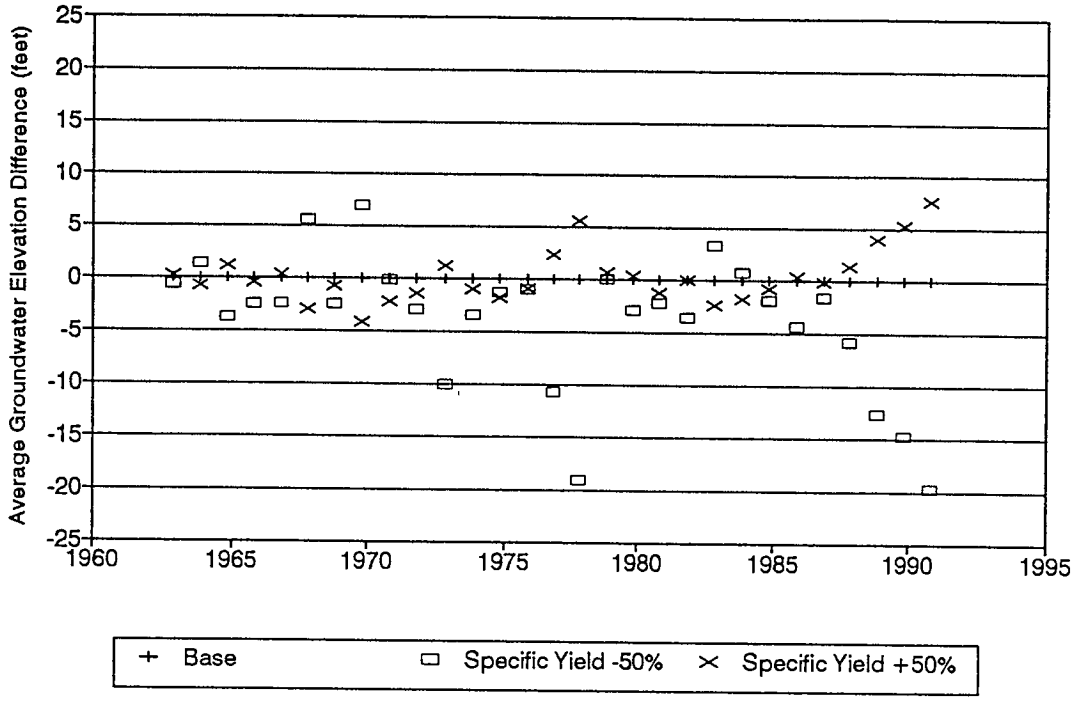


Figure 21
Sensitivity of Model Output to Horizontal Hydraulic Conductivity

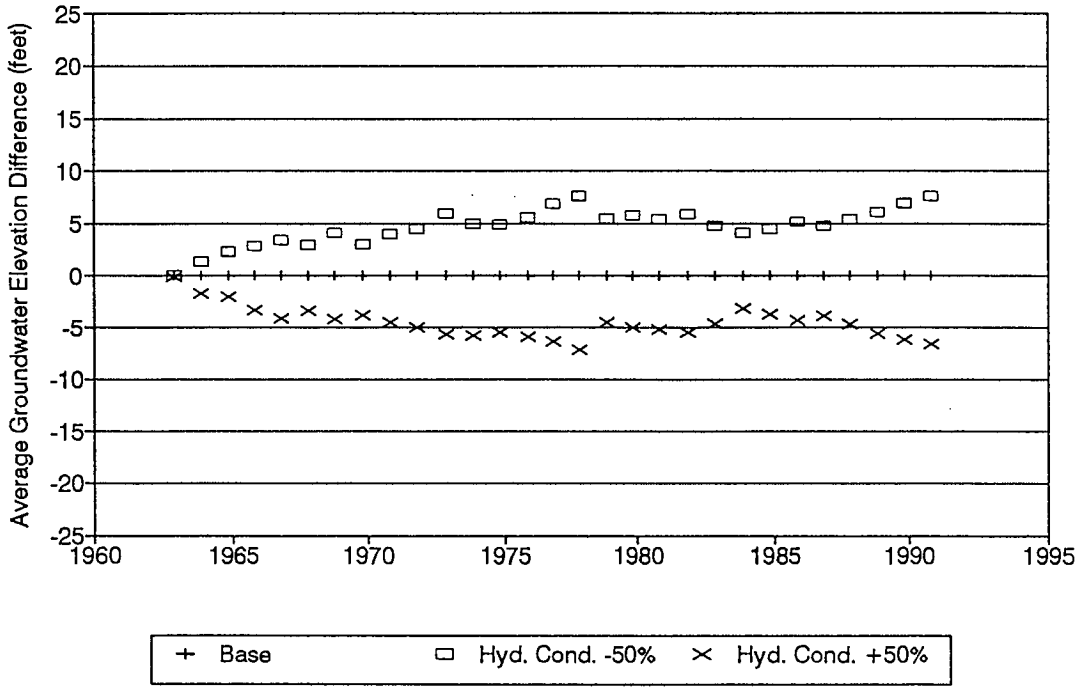


Figure 22
Sensitivity of Model Output to Vertical Hydraulic Conductivity

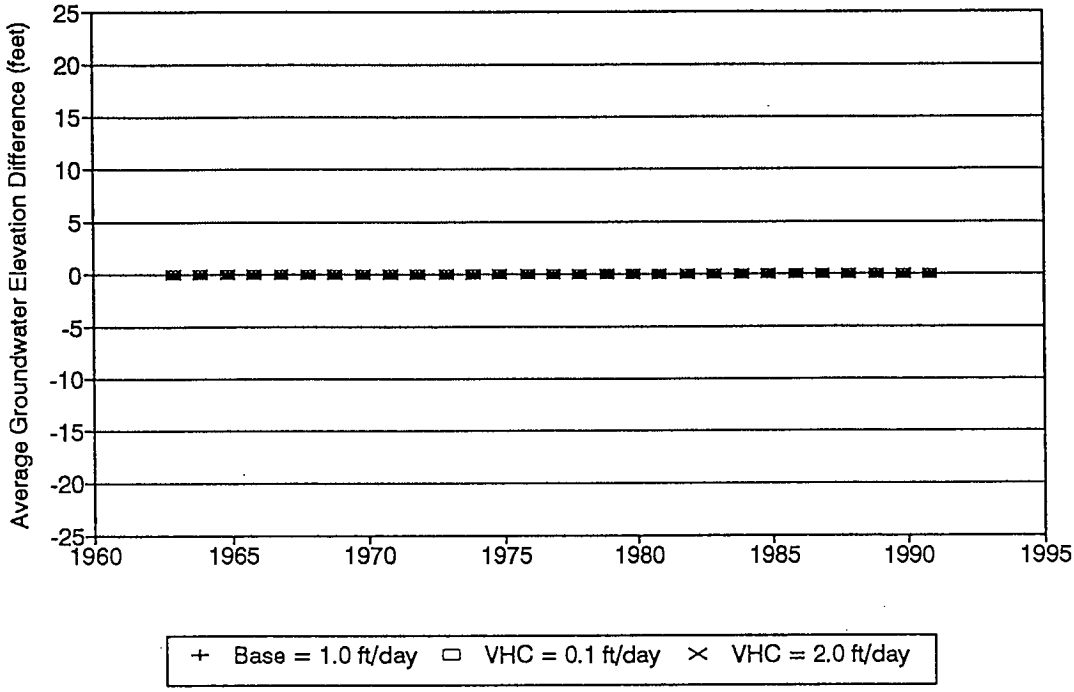


Figure 23
Sensitivity of Model Output to Surface Water Diversion

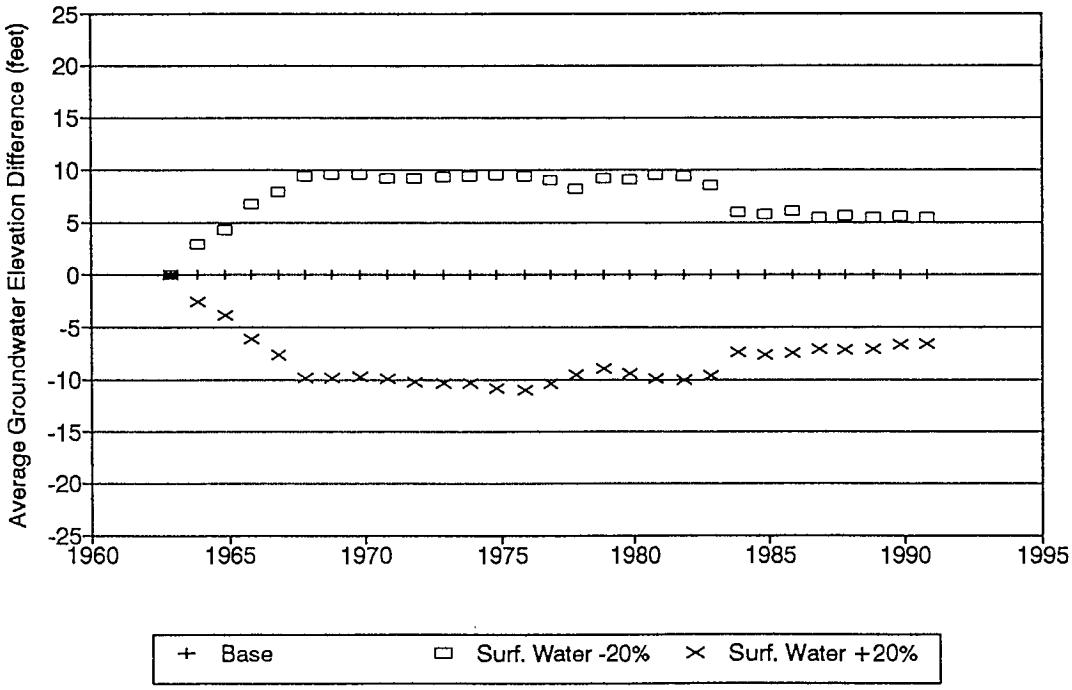


Figure 24a
Sensitivity of Model Output to Irrigation Efficiency

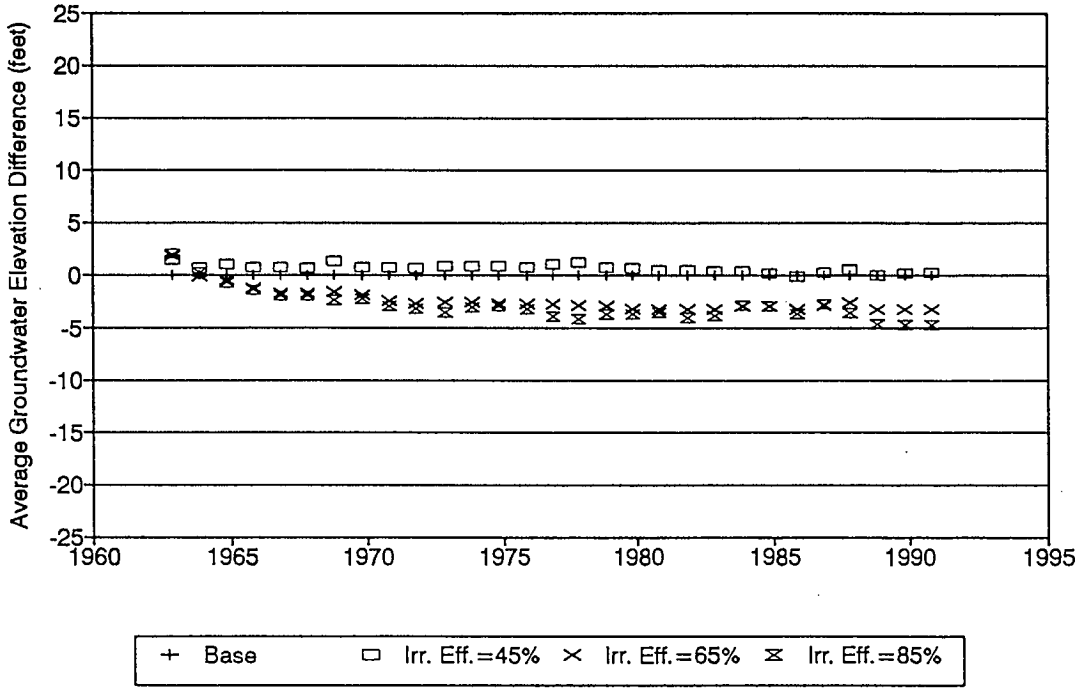
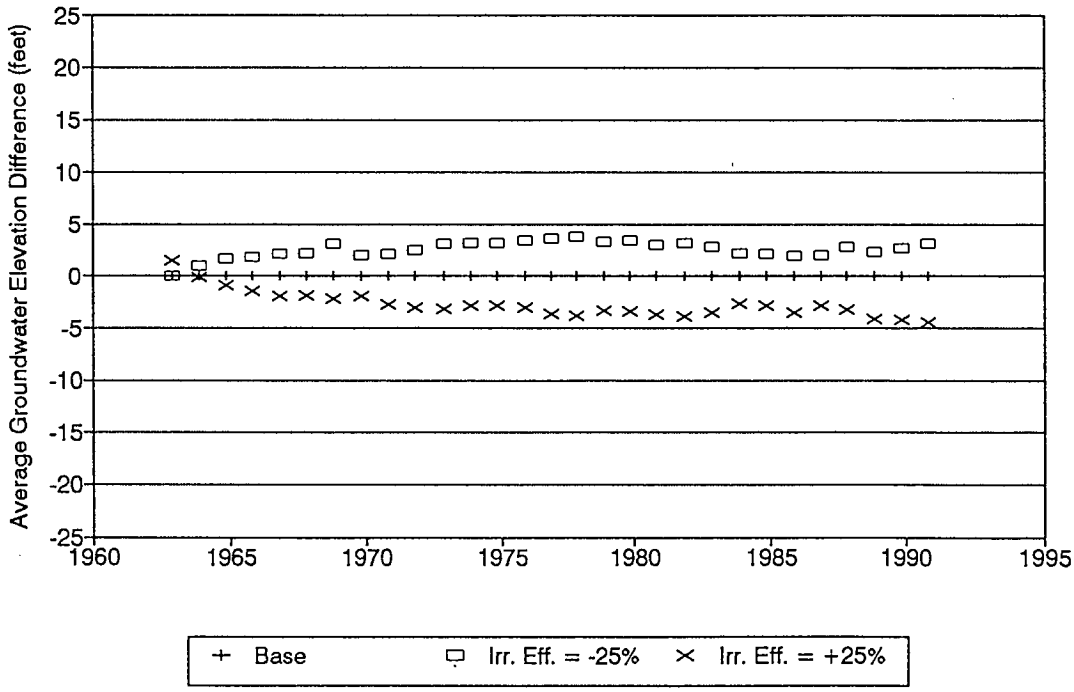


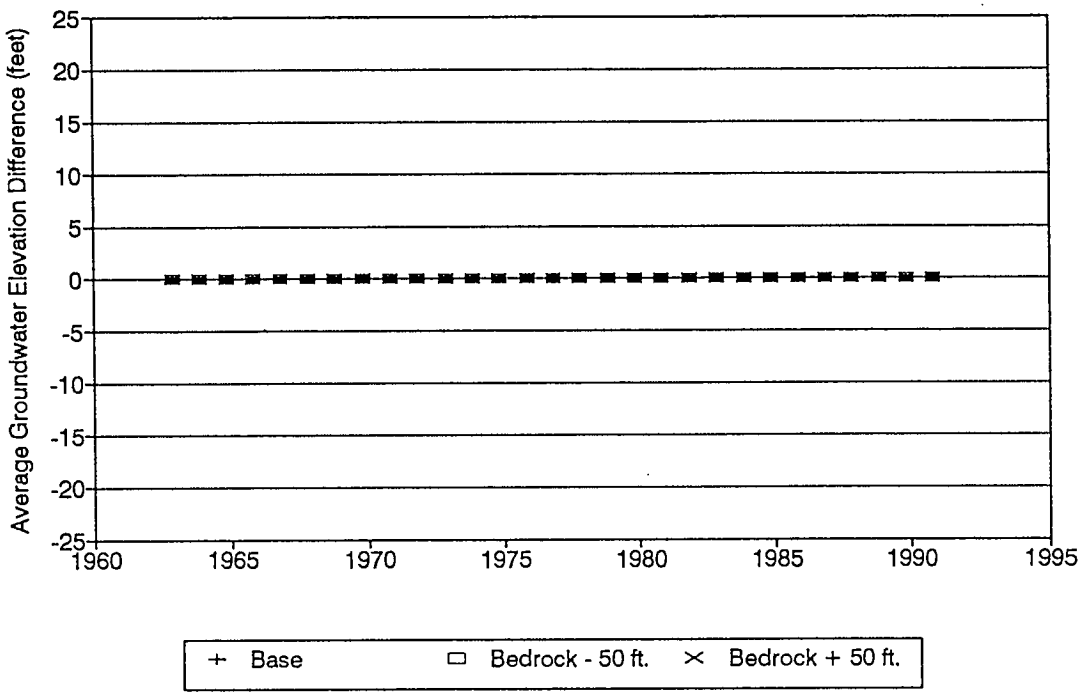
Figure 24b
Sensitivity of Model Output to Irrigation Efficiency



irrigation efficiency was not allowed to be less than 20 percent or greater than 95 percent. The model was found to be only slightly sensitive to irrigation efficiency.

Bedrock Depth was tested by raising and lowering the bedrock by 50 feet. When raising the bedrock, the potential exists for the bedrock to set at an elevation higher than the ground surface. In this case, the bedrock elevation was set equal to the ground surface elevation. The model was found to be very insensitive to this parameter (Figure 25).

Figure 25
Sensitivity of Model Output to Bedrock Depth



Evapotranspiration was tested by raising and lowering the values by 25 percent. The model was found to be highly sensitive to this parameter, with deviations from the base approaching 25 feet (Figure 26).

Boundary Flow Area was tested by increasing and decreasing the boundary flow area by 20 percent. The model was found to be very insensitive to this parameter (Figure 27).

Figure 26
Sensitivity of Model Output to Evapotranspiration

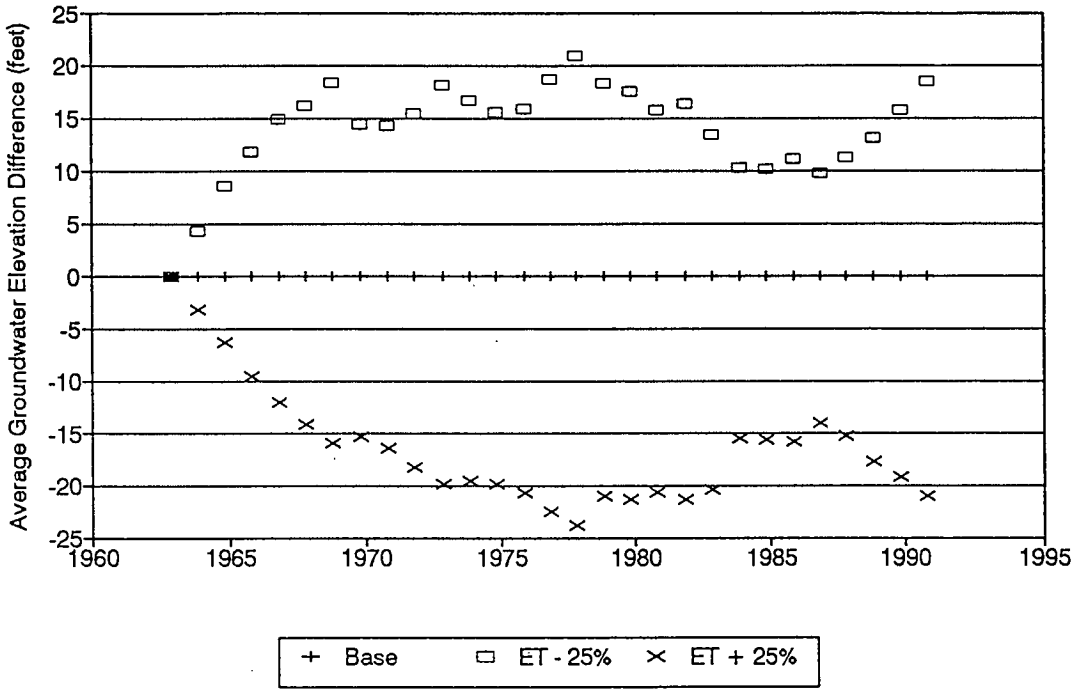
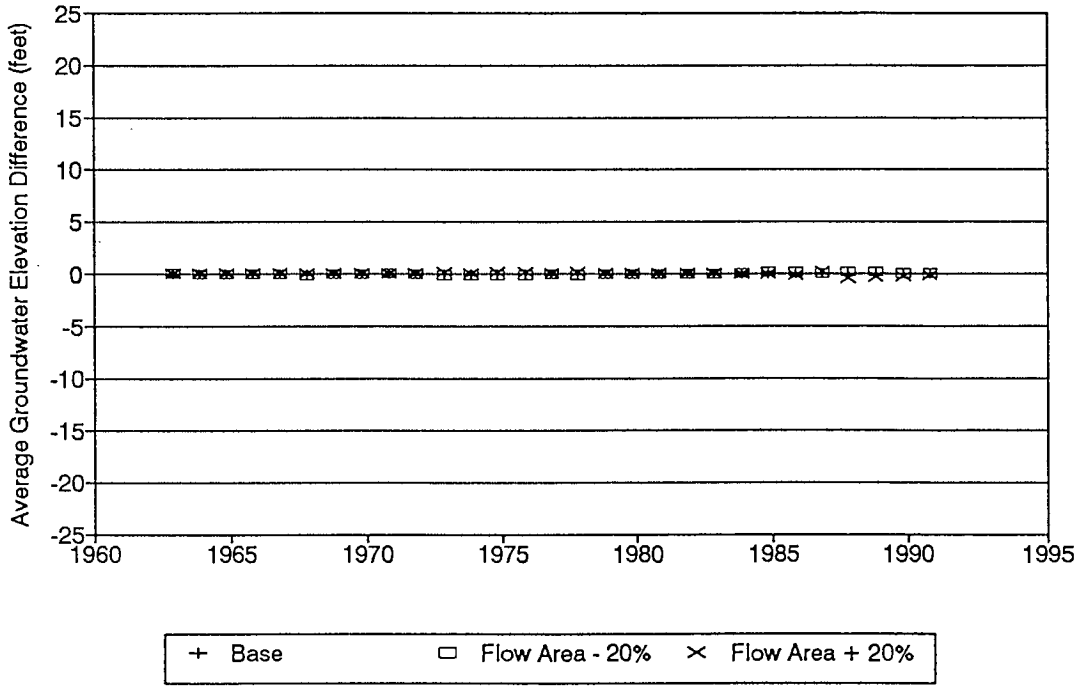


Figure 27
Sensitivity of Model Output to Boundary Flow Area



RESULTS

WATER BALANCE

The computed values of the water balance are given in Table 5.

Inflow

The values of inflow shown in Table 5 are given with a positive sign indicating a gain of water to Alta.

Net Surface Water tends to be the largest inflow source, but fluctuates drastically. Over the 30-year study period this parameter was computed to range from approximately 38,210 acre-feet in 1977 to approximately 262,915 acre-feet in 1967. The average surface water diversion over the 30-year calibration period is 157,636 acre-feet.

Effective Rainfall was computed to range from approximately 8,105 acre-feet in 1977 to approximately 197,545 acre-feet in 1969. The average value of effective rainfall was computed to be 66,151 acre-feet.

Stormwater Inflow is typically the smallest inflow source, with computed values ranging from approximately 52 acre-feet in 1977 to approximately 36,530 acre-feet in 1983. The average value of this parameter was computed to be 6,169 acre-feet.

Subsurface Flow has the least amount of variability, although it does range from 29,634 acre-feet in 1970 to 111,508 acre-feet in 1977. The average subsurface inflow was estimated to be 69,275.

Total Inflow was computed as the sum of the net surface water, effective rainfall, stormwater and subsurface inflow. This value varied from 120,500 acre-feet in 1961 to 524,631 acre-feet in 1969 with an average of 299,231.

Outflow

The values of outflow shown in Table 5 are given with a negative sign indicating a loss of water to Alta.

Subsurface Flow was estimated to range from 23,118 acre-feet in 1972 to 74,688 acre-feet in 1976 with an average of 43,869.

Table 5
Alta Water Balance

	Inflow					Outflow			Storage Change			
Year	Net Surface Water (ac-ft)	Effective Rainfall (ac-ft)	Storm-Water Inflow (ac-ft)	Subsurface Flow (ac-ft)	Total (ac-ft)	Subsurface Flow (ac-ft)	Evapo-transpiration (ac-ft)	Total (ac-ft)	Water Balance Method (ac-ft)	Elevation Method (ac-ft)	Difference (%)	Difference (ac-ft)
1961	45,615	32,662	345	41,878	120,500	(48,943)	(244,928)	(293,870)	(173,370)	(116,682)	(49)	56,688
1962	219,317	83,833	5,105	50,521	358,775	(32,391)	(245,293)	(277,685)	81,091	116,331	30	35,240
1963	199,757	78,752	3,615	44,799	326,922	(56,565)	(248,761)	(305,326)	21,596	74,650	71	53,054
1964	123,804	27,944	1,444	52,521	205,713	(40,154)	(252,275)	(292,429)	(86,716)	(104,880)	17	(18,164)
1965	223,590	43,670	3,925	58,829	330,014	(43,513)	(247,938)	(291,451)	38,563	94,437	59	55,874
1966	151,820	32,541	2,072	45,195	231,629	(42,020)	(243,131)	(285,151)	(53,522)	(71,910)	26	(18,388)
1967	262,915	107,422	11,415	65,696	447,449	(23,435)	(245,199)	(268,634)	178,815	180,771	1	1,956
1968	93,325	14,275	1,751	41,559	150,910	(29,047)	(247,790)	(276,837)	(125,927)	(137,147)	8	(11,221)
1969	240,893	197,545	20,122	66,071	524,631	(30,148)	(252,440)	(282,588)	242,043	265,771	9	23,728
1970	165,835	45,606	4,593	29,634	245,668	(38,555)	(257,601)	(296,156)	(50,488)	(78,537)	36	(28,049)
1971	136,270	40,646	3,125	59,254	239,295	(29,784)	(256,977)	(286,761)	(47,466)	(96,181)	51	(48,715)
1972	85,628	17,178	552	54,865	158,222	(23,118)	(255,889)	(279,008)	(120,786)	(96,181)	(26)	24,605
1973	209,368	121,092	9,143	87,451	427,054	(68,029)	(262,117)	(330,146)	96,908	124,269	22	27,360
1974	205,430	65,808	6,107	108,693	386,038	(43,872)	(268,326)	(312,198)	73,840	29,738	(148)	(44,102)
1975	171,814	30,969	3,016	80,586	286,384	(47,806)	(266,955)	(314,762)	(28,377)	(57,299)	50	(28,921)
1976	42,808	50,324	705	83,363	177,200	(74,688)	(265,696)	(340,384)	(163,184)	(171,920)	5	(8,736)
1977	38,210	8,105	52	111,508	157,875	(69,216)	(266,241)	(335,457)	(177,582)	(137,452)	(29)	40,131
1978	203,175	187,021	18,480	95,873	504,549	(43,990)	(266,177)	(310,166)	194,382	206,061	6	11,678
1979	196,636	48,993	5,716	80,935	332,280	(42,403)	(266,490)	(308,893)	23,387	11,216	(109)	(12,171)
1980	236,452	82,502	9,967	98,476	427,397	(40,939)	(266,996)	(307,935)	119,462	74,182	(61)	(45,280)
1981	143,659	54,437	2,997	77,928	279,022	(38,001)	(268,220)	(306,221)	(27,199)	(76,640)	65	(49,442)
1982	215,789	97,865	7,415	86,065	407,133	(33,565)	(269,720)	(303,285)	103,848	117,548	12	13,701
1983	207,941	163,915	36,530	69,888	478,274	(30,507)	(271,813)	(302,320)	175,954	140,309	(25)	(35,646)
1984	203,450	38,227	5,622	75,539	322,837	(55,167)	(274,072)	(329,239)	(6,402)	(57,322)	89	(50,921)
1985	168,571	35,444	3,025	52,004	259,044	(45,557)	(273,979)	(319,536)	(60,492)	(46,996)	(29)	13,496
1986	212,589	99,438	12,669	57,927	382,623	(53,195)	(273,974)	(327,169)	55,454	81,488	32	26,034
1987	119,720	41,251	1,317	54,954	217,242	(54,159)	(276,720)	(330,879)	(113,637)	(134,174)	15	(20,536)
1988	58,556	62,300	1,516	56,523	178,895	(52,721)	(280,241)	(332,961)	(154,067)	(131,879)	(17)	22,188
1989	88,622	46,211	1,820	96,030	232,683	(37,187)	(279,460)	(316,647)	(83,963)	(104,506)	20	(20,542)
1990	57,515	28,549	922	93,672	180,658	(47,383)	(279,230)	(326,613)	(145,955)	(109,915)	(33)	36,041
Sum	4,729,072	1,984,526	185,082	2,078,237	8,976,917	(1,316,059)	(7,874,649)	(9,190,708)	(213,790)	(212,851)		
Min	38,210	8,105	52	29,634	120,500	(74,688)	(280,241)	(340,384)	(177,582)	(171,920)		
Max	262,915	197,545	36,530	111,508	524,631	(23,118)	(243,131)	(268,634)	242,043	265,771		
Avg	157,636	66,151	6,169	69,275	299,231	(43,869)	(262,488)	(306,357)	(7,126)	(7,095)		

Evapotranspiration (E.T.) was computed to vary from 243,131 acre-feet in 1966 to 280,241 acre-feet in 1988. The average value was 262,488 acre-feet. The value of evapotranspiration varied slightly, and showed a slight increase in magnitude over time due to cropping pattern changes.

Total Outflow was computed as the sum of the evapotranspiration and subsurface outflow. This value varied from 268,634 acre-feet in 1967 to 340,384 acre-feet in 1976 with an average of 306,357.

Storage Change

Change in groundwater storage was computed using two different methods: by taking the difference between the computed inflow and outflow; and by multiplying the change in average groundwater elevation by the average specific yield of Alta.

Water Balance Method: The storage change computed from the difference of the water balance inflows and outflows ranged from a decrease in storage of 177,582 acre-feet (shown in Table 5 with a negative sign) to an increase in storage of 242,043 acre-feet; with an average decrease of 7,126 acre-feet.

Elevation Method: The storage change computed from the groundwater elevations ranged from a decrease in storage of 171,920 acre-feet (shown in Table 5 with a negative sign) to an increase in storage of 265,771 acre-feet; with an average decrease of 7,095 acre-feet.

Difference: The difference between the results of tend to be fairly large from year to year. The total volume of groundwater computed by the two methods over the 30-year period is very close.

Net Groundwater Flow and Overdraft

The subsurface flow of water that enters and exits Alta's boundary fluctuates from year to year. In most cases, the inflow exceeds the outflow, although the outflow is greater in some years. The difference of the average groundwater inflow (69,275 acre-feet) and outflow (43,869 acre-feet) is a net increase of 25,406 acre-feet.

The water balance indicates that the long-term groundwater overdraft (over the 30-year study period) is approximately 7,100 acre-feet per year (See Average Storage Change, Table 5). This value corresponds to a drop in water table of approximately 0.5 feet. And is relatively low compared to Alta's average surface water inflow of approximately 158,000 acre-feet.

Although the volume of groundwater lying between Alta's water table and bedrock may be several million acre-feet, much of that would not be economical to pump because of extreme depth below the ground surface.

GROUNDWATER MODEL PROJECTIONS

The groundwater model projections indicate changes in the regional water table beneath Alta based on the different weather scenarios. One of the results presented is the area that is subjected to critical groundwater levels. For this discussion, an area is said to have critical groundwater if the static water table is less than 100 feet above the bedrock. Because of the localized variability in the bedrock elevation and aquifer properties, an area with a water table depth of less than 25 feet above the bedrock should be considered dry.

In this results section, reference is made to the groundwater conditions at the start of the projection period. Figure 28 provides the groundwater elevation for Alta in 1991. Figure 29 gives the water table height above the bedrock formation in 1991. This can be thought of as the thickness of the groundwater layer. Figure 30 shows the depth to groundwater in 1991. This is the static pumping level for Alta's growers.

Run 1 (10 Dry Years)

After a series of ten dry years Alta's average groundwater elevation decreases approximately 35 feet (Figure 31). The rate of decline is large at first, but the groundwater level approaches an equilibrium elevation. Initially, the groundwater volume beneath Alta drops at a rate of about 70 thousand acre-feet per year (KAF/yr). By the year 2001, the storage change is 20 KAF/yr (Figure 32). This is because as Alta's water table drops, the contribution to groundwater from the Kings River increases. The other groundwater inputs and outputs stay approximately the same for the 10 years. The Kings River seepage increases because as the water table adjacent to the river drops, the gradient from the river increases (Figure 33).

The direction of groundwater flow in the southeast corner of Alta changes from southwest in 1991 to southeast in 2001 as a groundwater develops in the Orosi area. The general flow of groundwater shifts from the Kings River to the Orosi area (Figure 34).

The area of land experiencing critical groundwater increases slightly in the northeast portion of the district, but the critical area expands significantly just north of Smith Mountain and near the Orosi area. The water table south of Smith Mountain drops approximately 100 feet over the projection period (Figure 35).

The area of land that has a water table between 100 and 50 feet above bedrock is 3870 acres. The area with groundwater thickness of 50 to 25 feet is 3190 acres. The area with groundwater less than 25 feet above bedrock is 670 acres. Table 6 compares the above results with the initial critical area for 1990.

Figure 28
Groundwater Elevation in Feet: Fall 1991

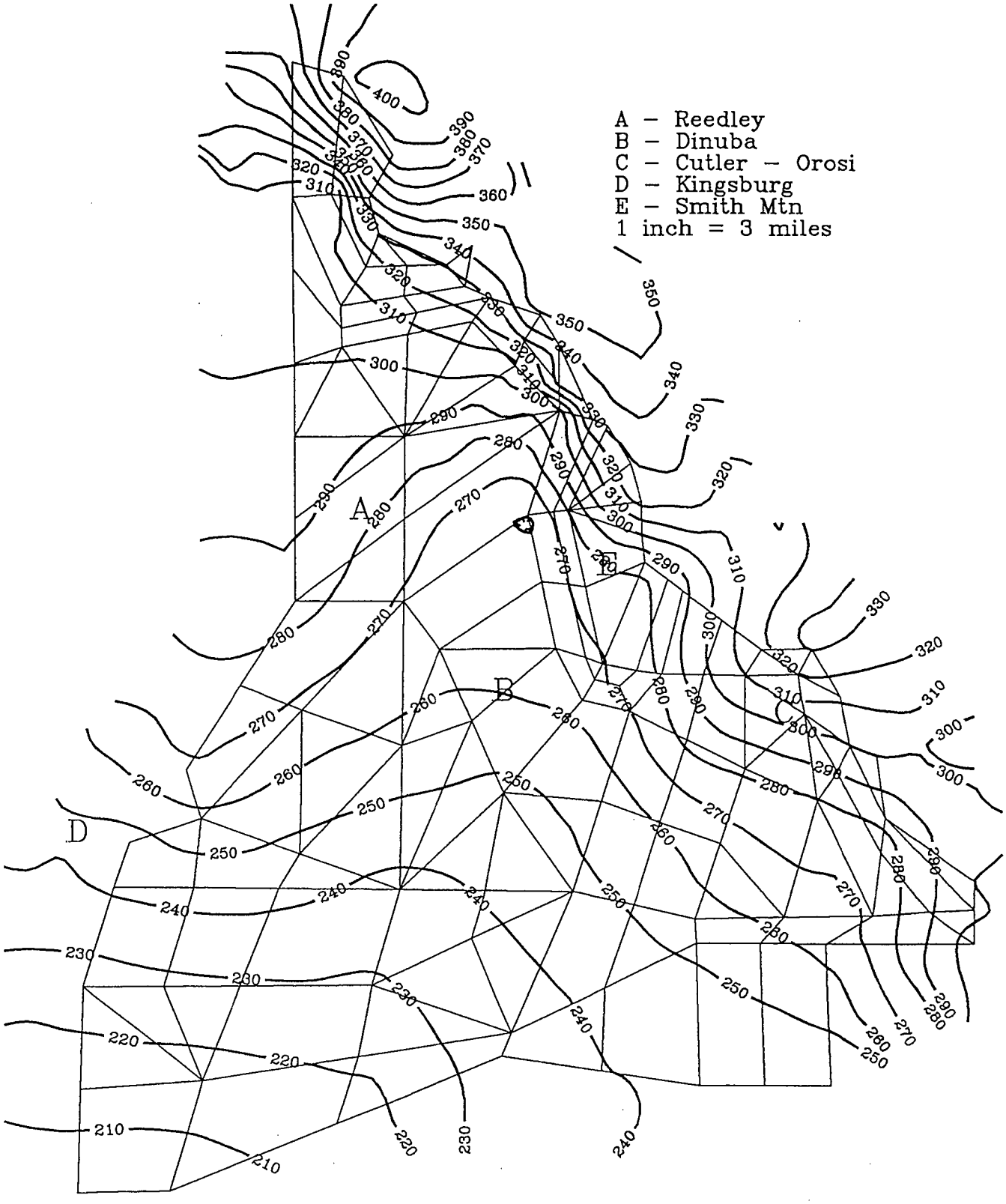


Figure 29
Water Table Height above Bedrock at 250 feet or Less: Fall 1991

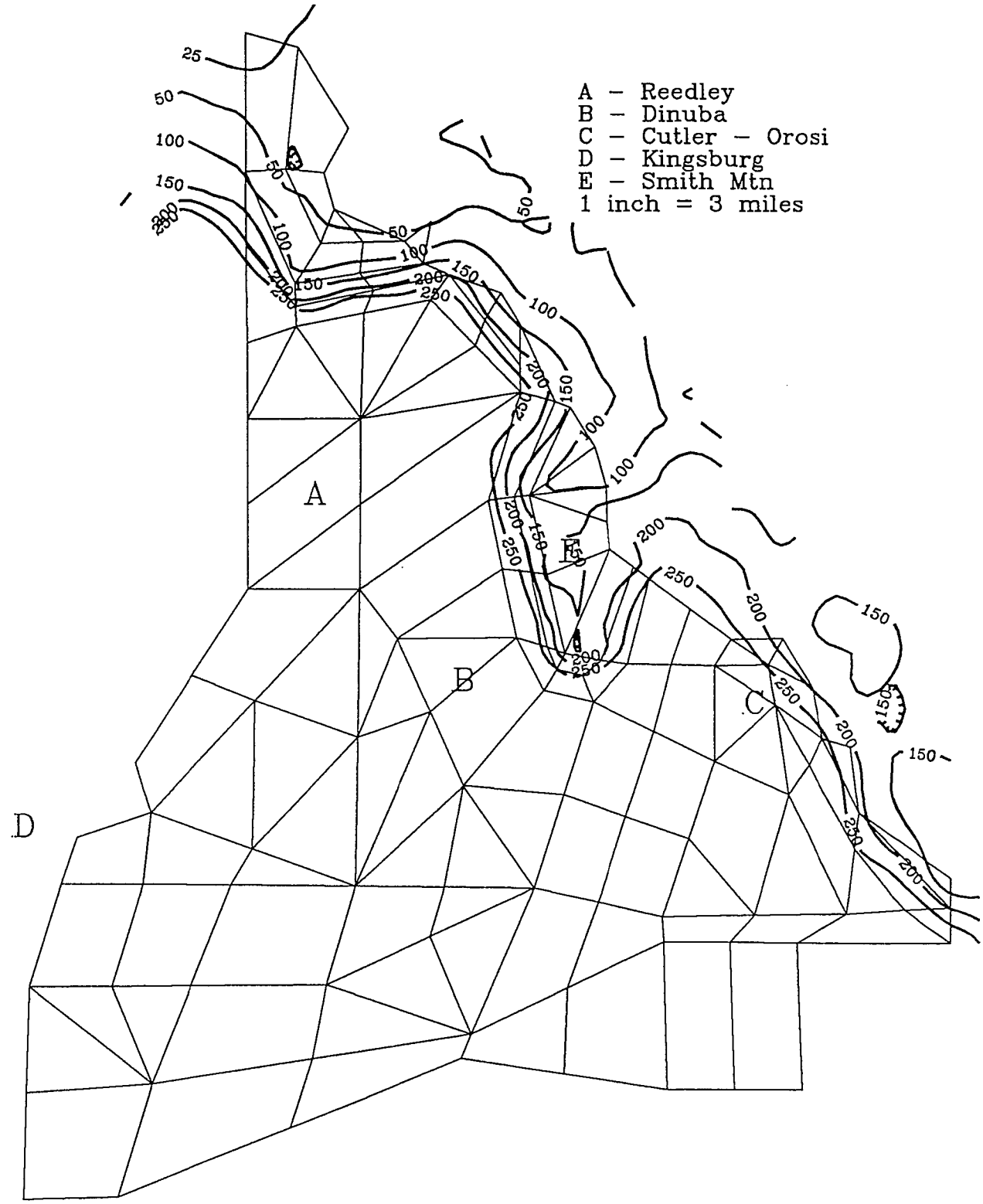


Figure 30
Depth to Groundwater in Feet: Fall 1991

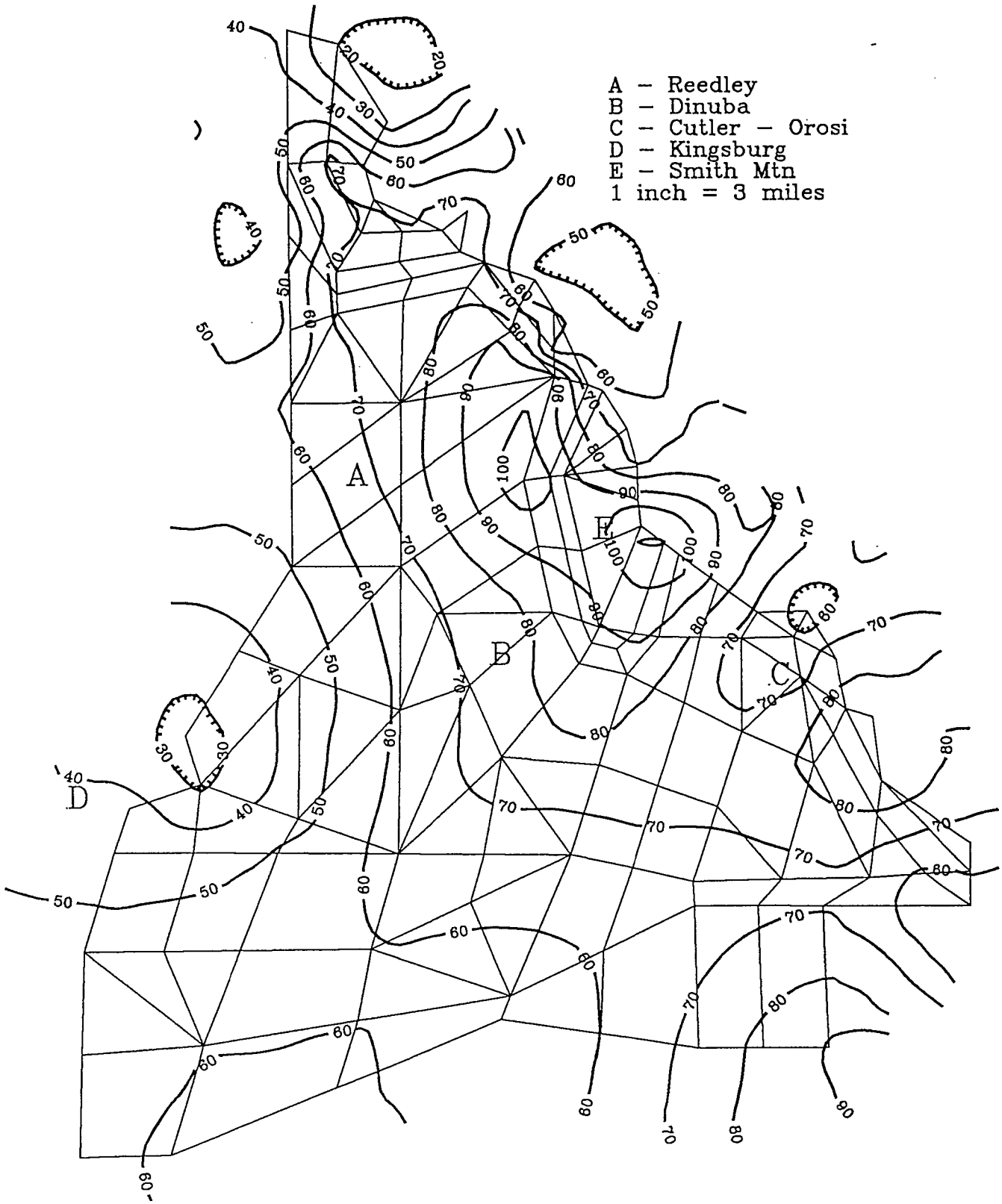


Figure 31
Average Groundwater Elevation for Projections 1, 2, 3 and 4

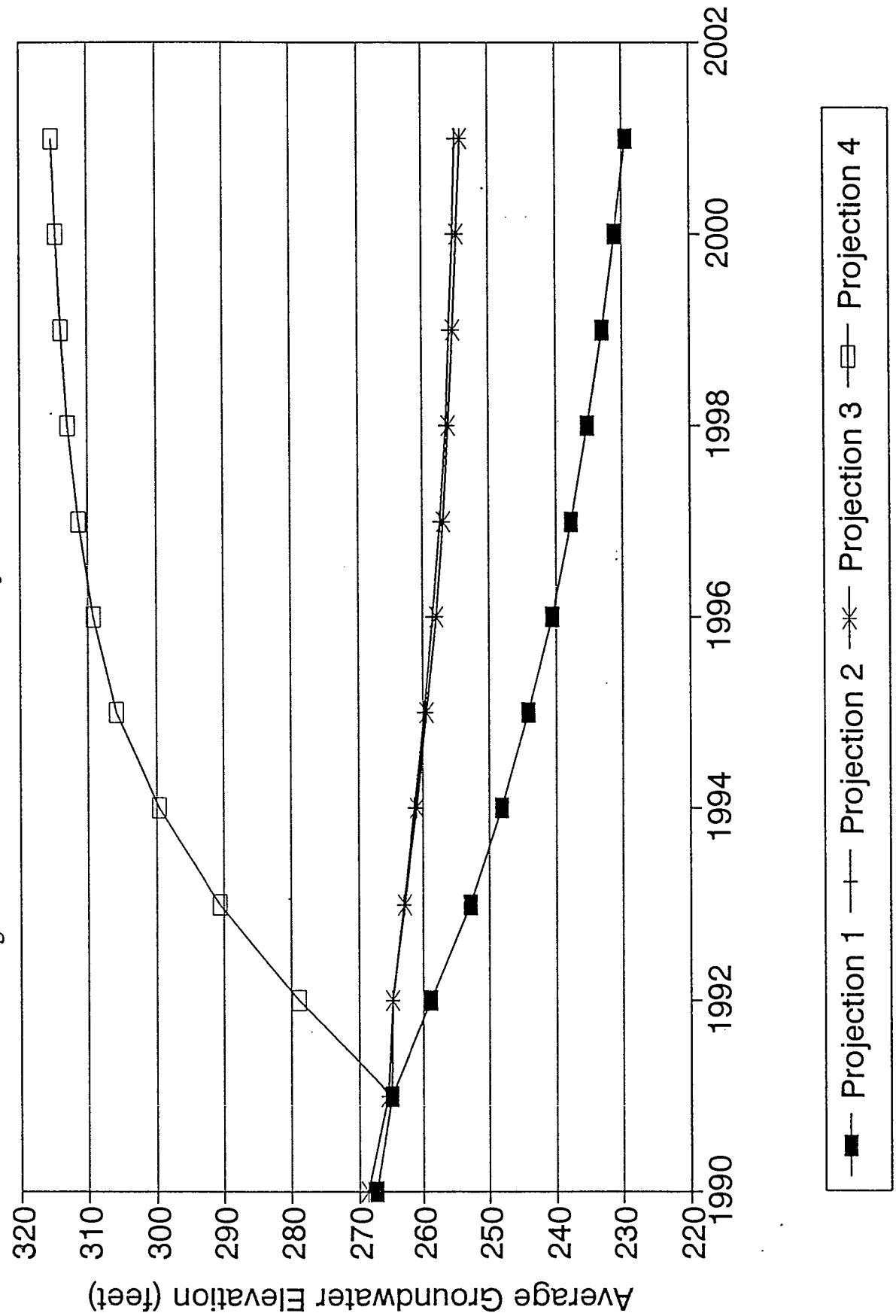


Figure 32
Groundwater Budget: Projection 1

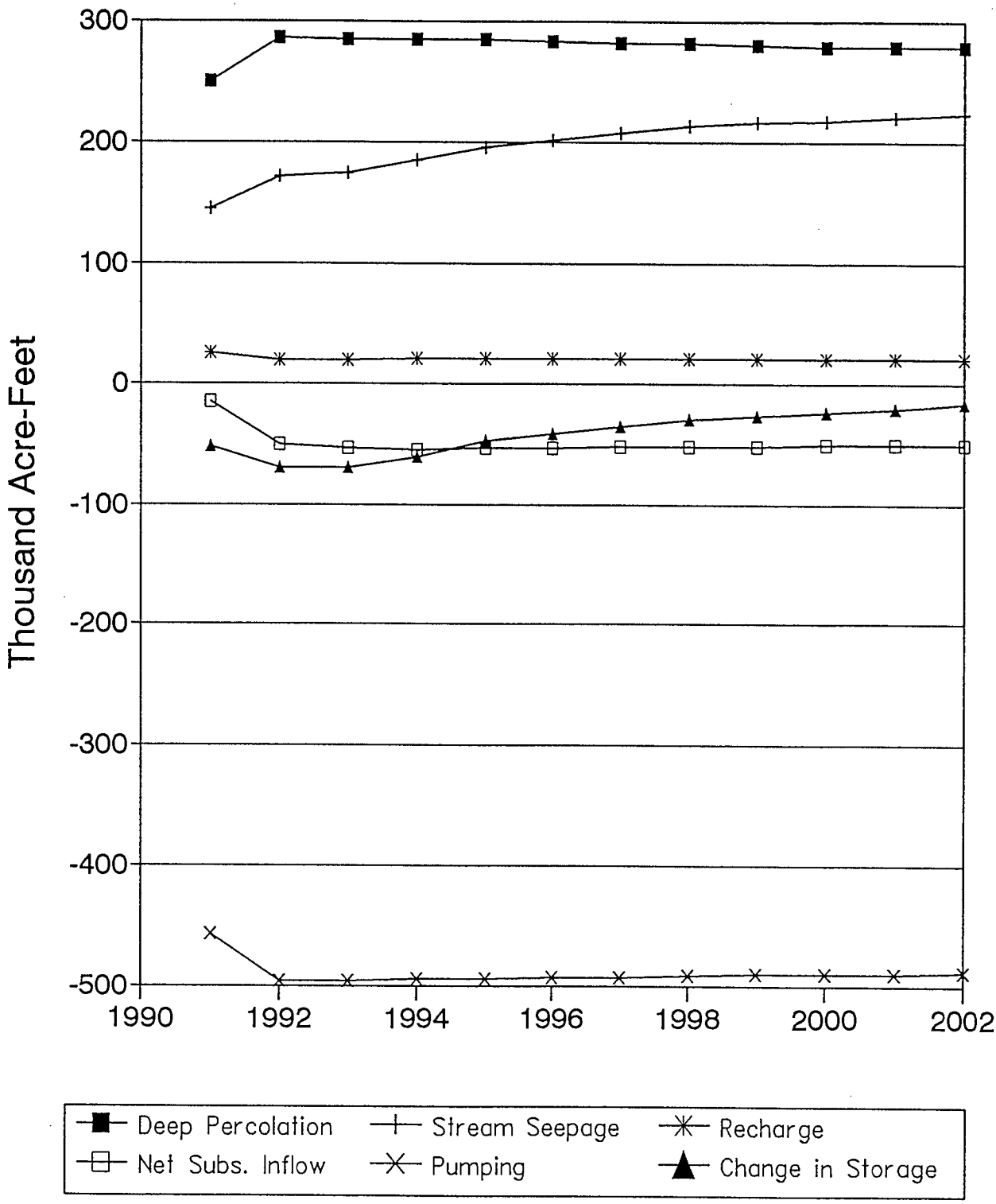


Figure 33
Groundwater Elevation: Projection 1, Section B-B'

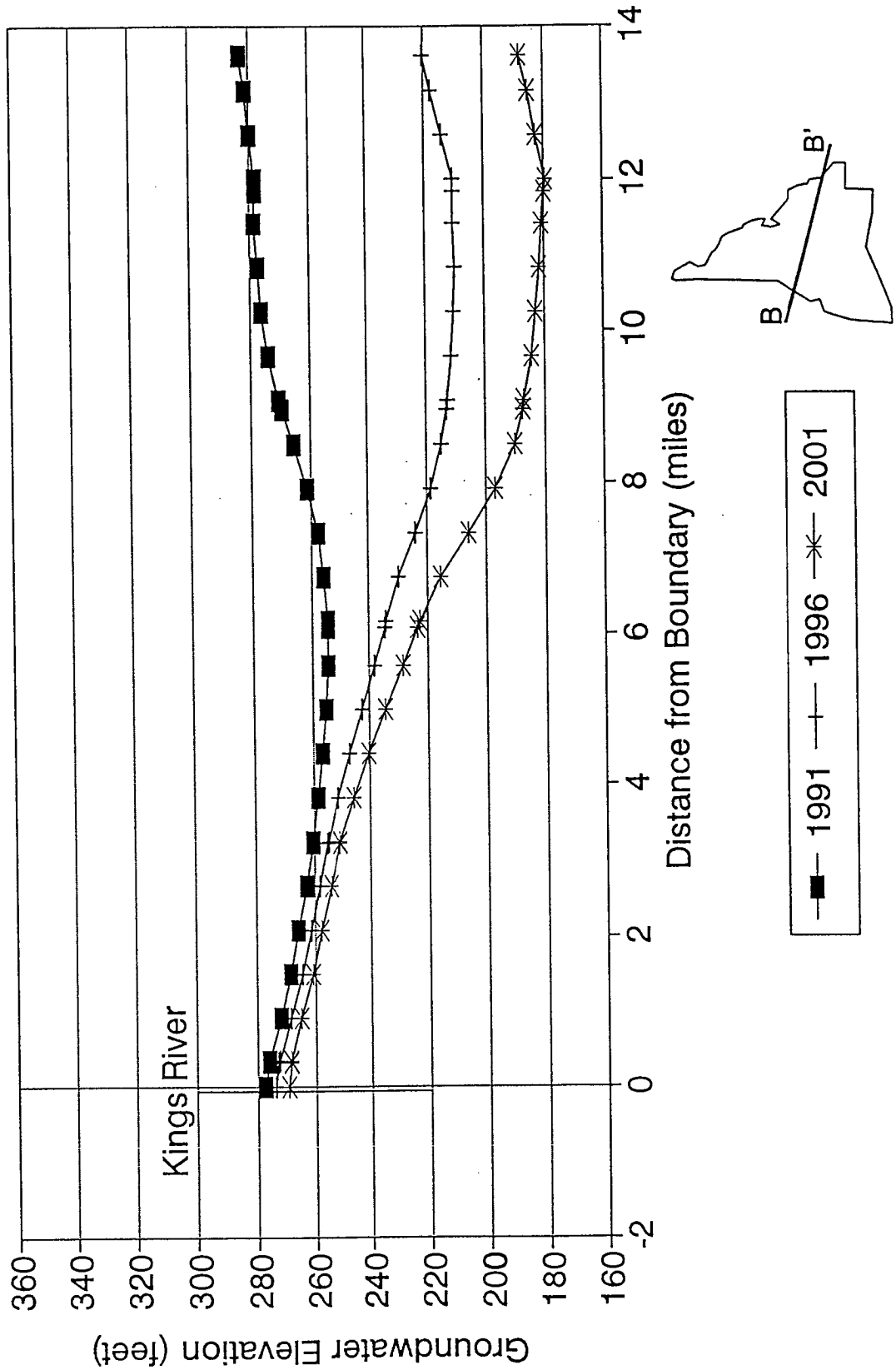


Figure 34
Groundwater Elevation in Feet: Projection 1, Fall 2001

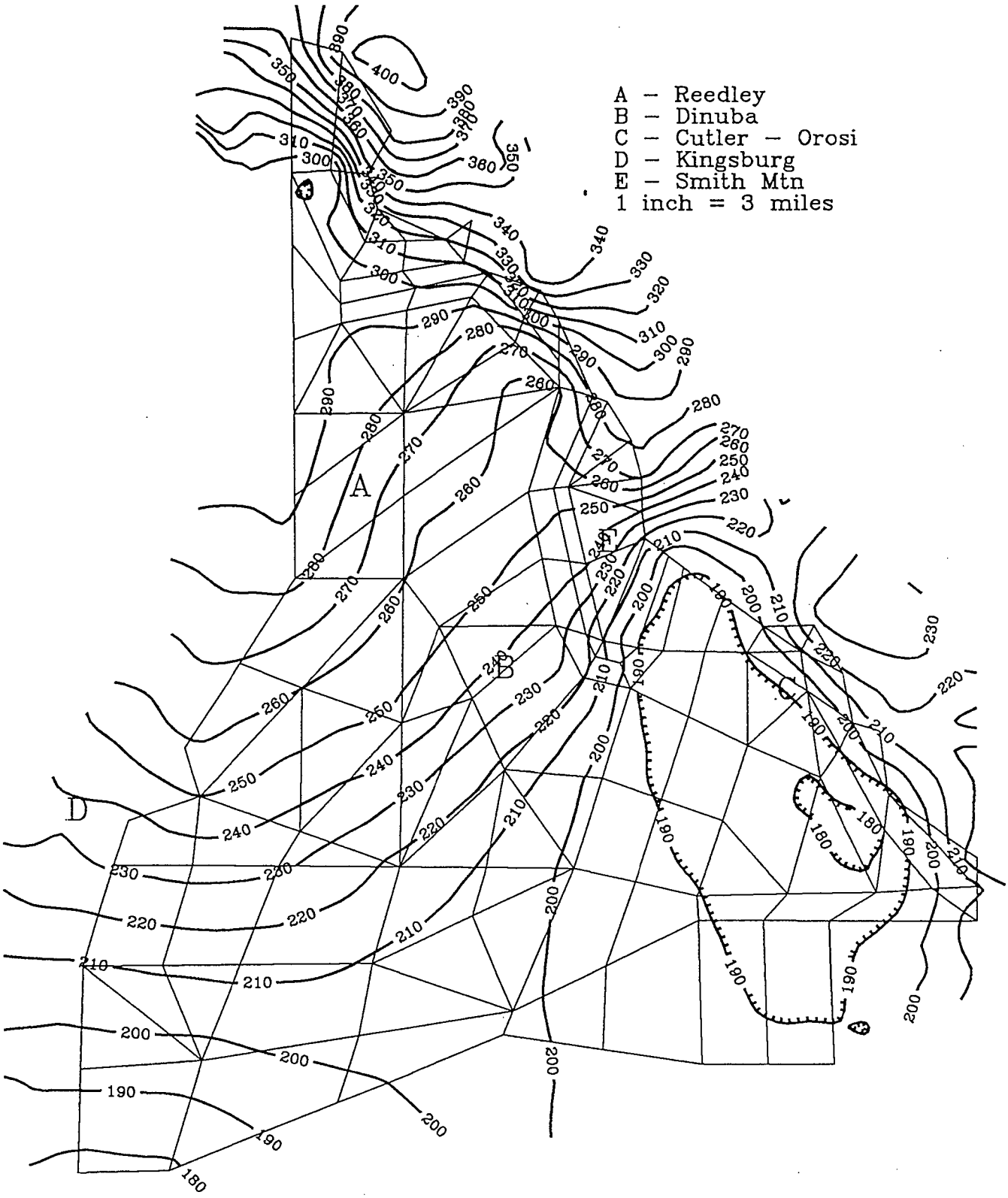


Figure 35
Water Table Height above Bedrock at 250 Feet or Less: Projection 1, Fall 2001

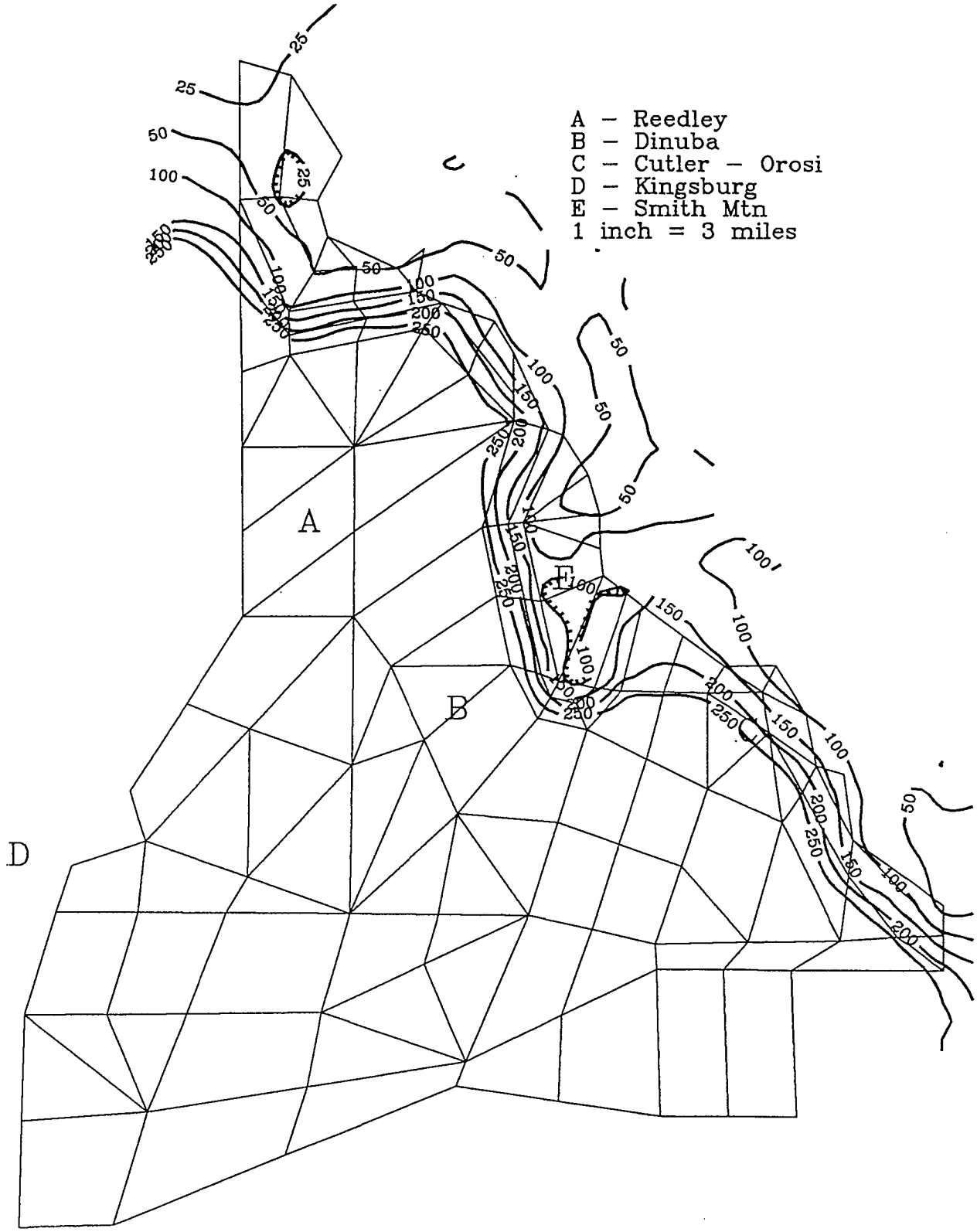


Table 6
Areal Extent of Critical Groundwater Supply

Year	Projection Run	Between [a] 100 and 50 feet	Between [b] 50 and 25 feet	Less than [c] 25 feet	Total Less [d] than 100 feet
1990	Initial	2471	2978	357	5806
2001	1	3871	3191	668	7730
2001	2	3704	2097	236	6036
2001	3	4545	2782	570	7897
2001	4	2546	847	0	3393
2001	5	2500	2056	300	4856
2001	6	7678	4689	5628	17994
2001	7	6791	5587	5086	17464
2001	8	1786	2143	271	4199
2001	9	2500	1740	328	4568
2021	10	3525	2771	536	6831
2020	11	1970	2143	230	4343
2020	12	2902	1875	179	4956
1977	N/A	2506	2143	271	4919
1983	N/A	2592	1878	311	4781

Notes:

[a] The acres of land with water table between 100 and 50 feet above bedrock.
[b] The acres of land with water table between 50 and 25 feet above bedrock.
[c] The acres of land with water table less than 25 feet above bedrock.
[d] The total acres with water table less than 100 feet above bedrock.

The maximum depth to groundwater is approximately 200 feet after the 10 dry years. This water table depth is experienced near the Orosi area. Most of Alta experiences a drop in static pumping level of 10 to 30 feet after the successive dry years (Figure 36).

Run 2 (10 Average Years)

Alta's average groundwater elevation after ten average years is approximately twelve feet lower (Figure 31, Page 58). The rate of decline decreases with time and approaches an equilibrium elevation. Initially, the groundwater volume beneath Alta drops at a rate of about 19 KAF/yr. By the year 2001, the storage drop is about 5 KAF/yr (Figure 37). This is because as Alta's water table drops, the contribution to groundwater from the Kings River increases. The other groundwater inputs and outputs stay approximately the same for the 10 years. The Kings River seepage increases because as the water table adjacent to the river drops, the gradient from the river increases.

The direction of groundwater flow in the southeast corner of Alta changes from southwest in 1991 to southeast in 2001 as a groundwater depression develops in the Orosi area. The general flow of groundwater changes from the Kings River to the Orosi area (Figure 38).

The area of critical groundwater does not change significantly for this run (Figure 39). The area of land that has water table between 100 and 50 feet above bedrock is 3700 acres. The area with groundwater thickness of 50 to 25 feet is 2100 acres. The area with groundwater less than 25 feet is 240 acres (Table 6, Page 63).

The maximum depth to groundwater is approximately 140 feet after the 10 average years. This water table depth is experienced near the Orosi area. Most of Alta experiences a very slight drop in static pumping level of 10 to 30 feet after the successive average years (Figure 40).

Run 3 (High Irrigation Efficiency)

The general groundwater changes experienced from Run 3 are almost identical to Run 2 (Figure 41). The difference between these runs is that Run 3 had a higher overall irrigation efficiency. The average water table depth for Run 3 is only slightly higher than Run 2 (Figure 31, Page 58).

The major difference between these two runs is that Run 3 resulted in significantly less pumping and deep percolation than Run 2 (Figure 42). Average pumping over the 10-year study period was 442 KAF/yr and 241 KAF/yr for Runs 2 and 3, respectively. The average deep percolation over this period was 284 KAF/yr and 82 KAF/yr for Runs 2 and 3, respectively.

Figure 36
Depth to Groundwater in Feet: Projection 1, Fall 2001

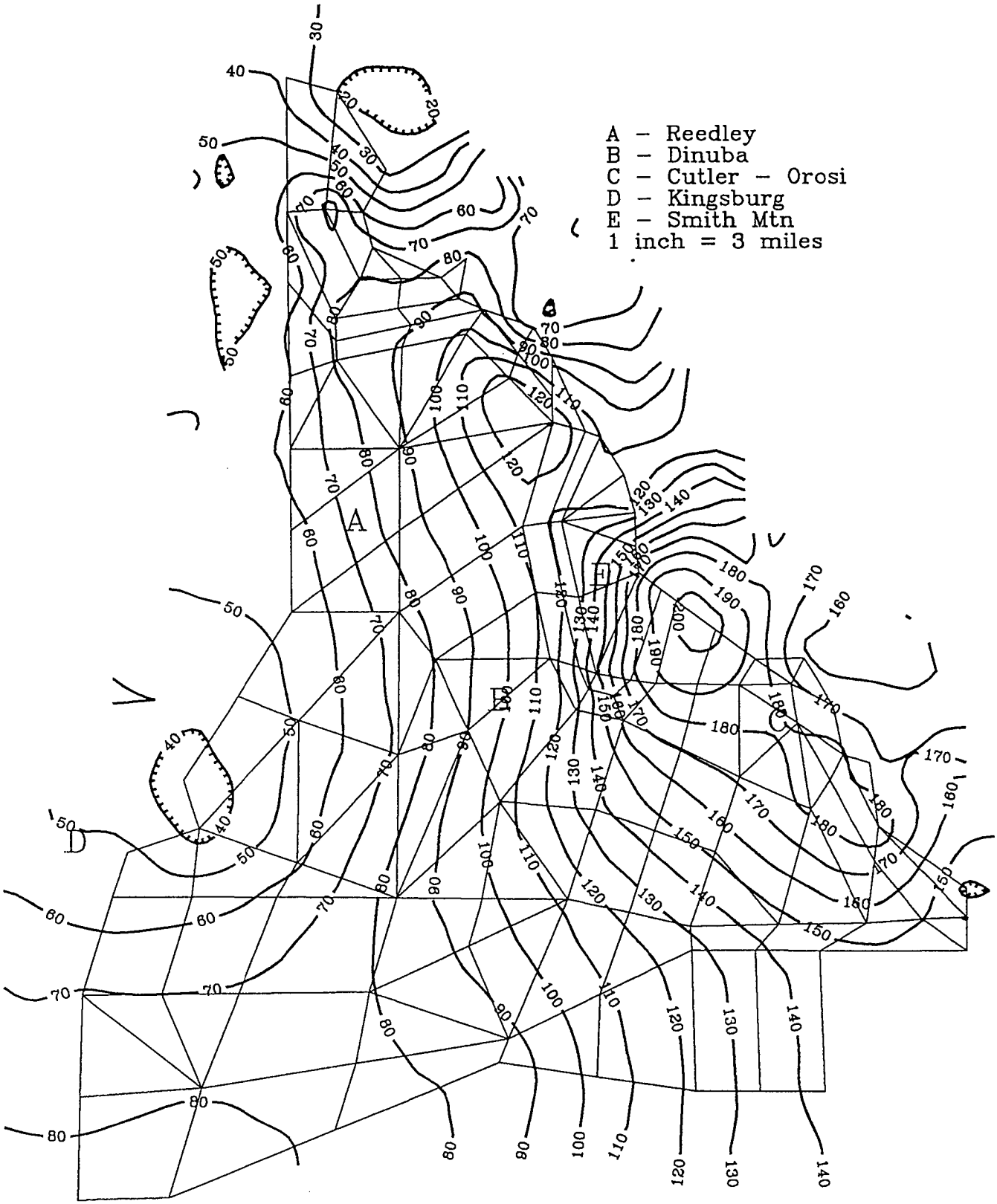


Figure 37
Groundwater Budget: Projection 2

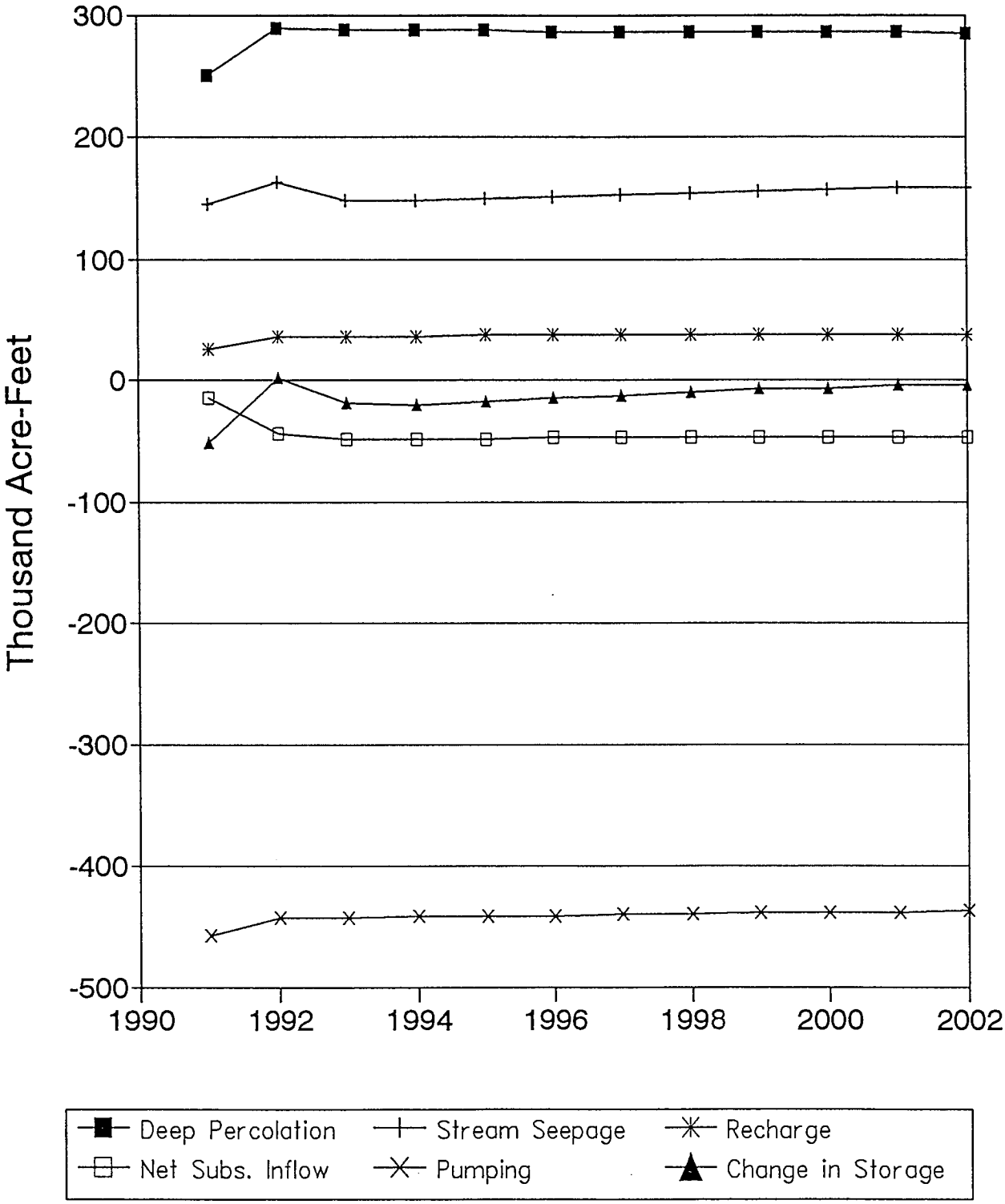


Figure 38
Groundwater Elevation in Feet: Projection 2, Fall 2001

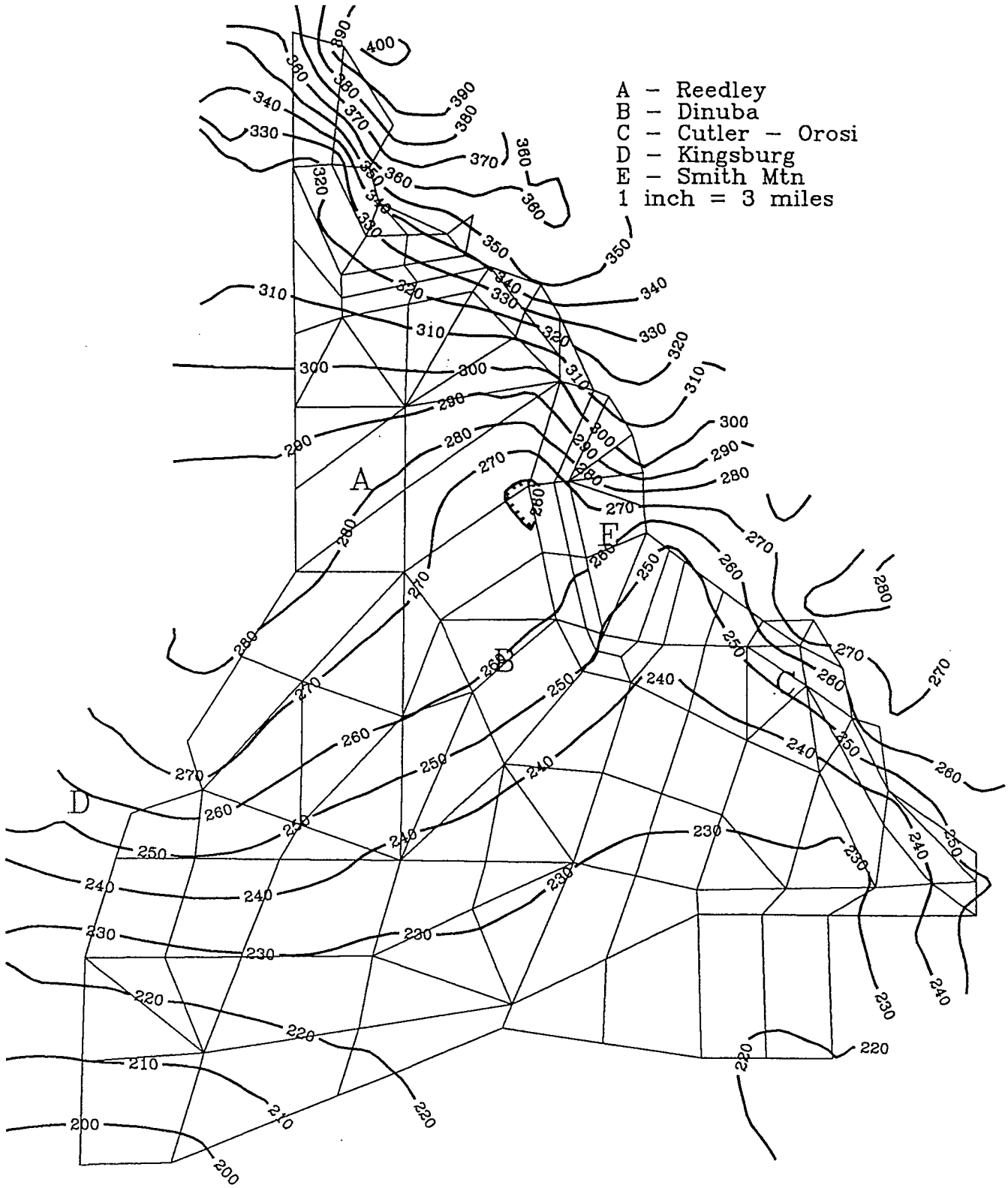


Figure 39
Water Table Height above Bedrock in 250 Feet or Less: Projection 2, Fall 2001

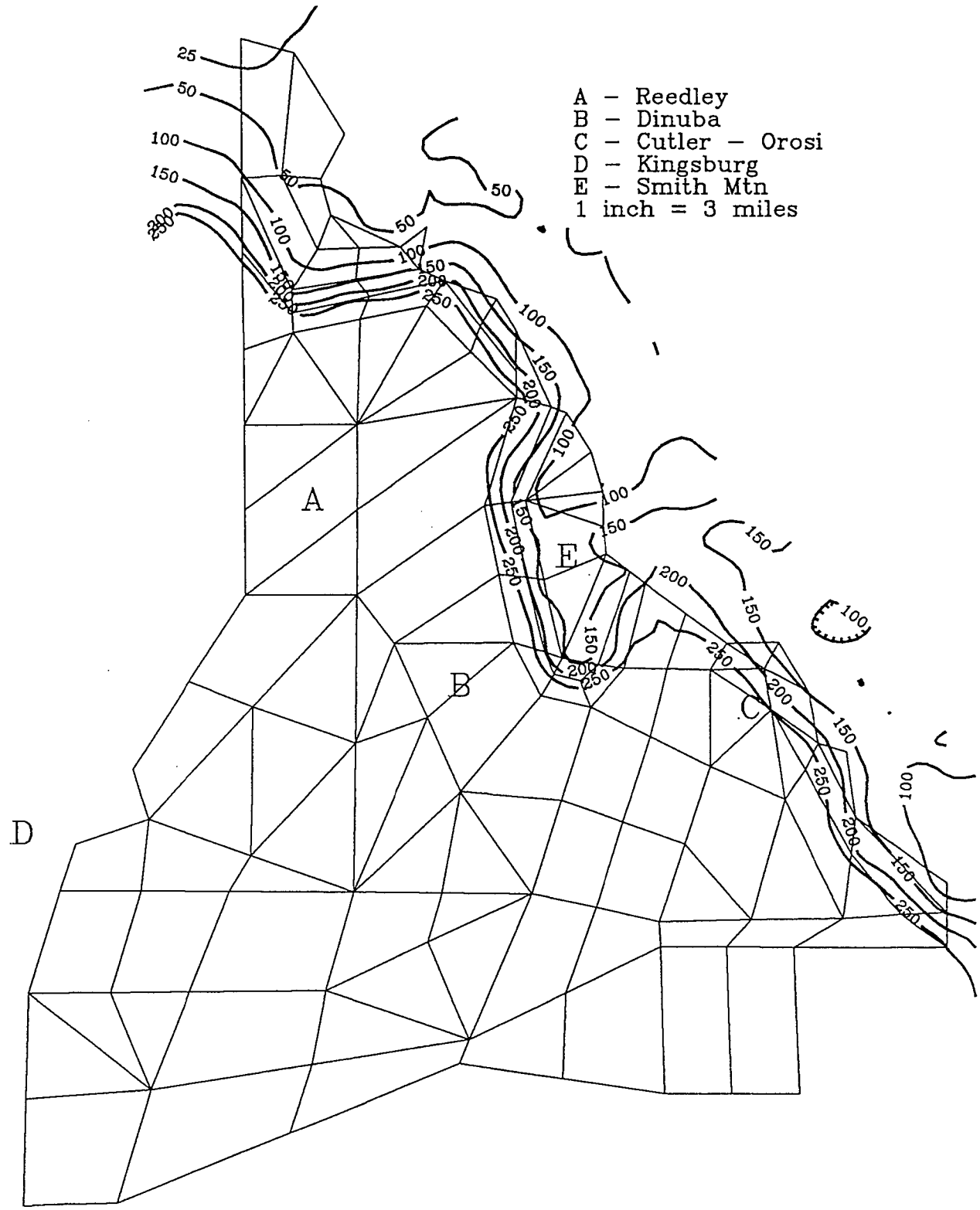


Figure 40
Depth to Groundwater in Feet: Projection 2, Fall 2001

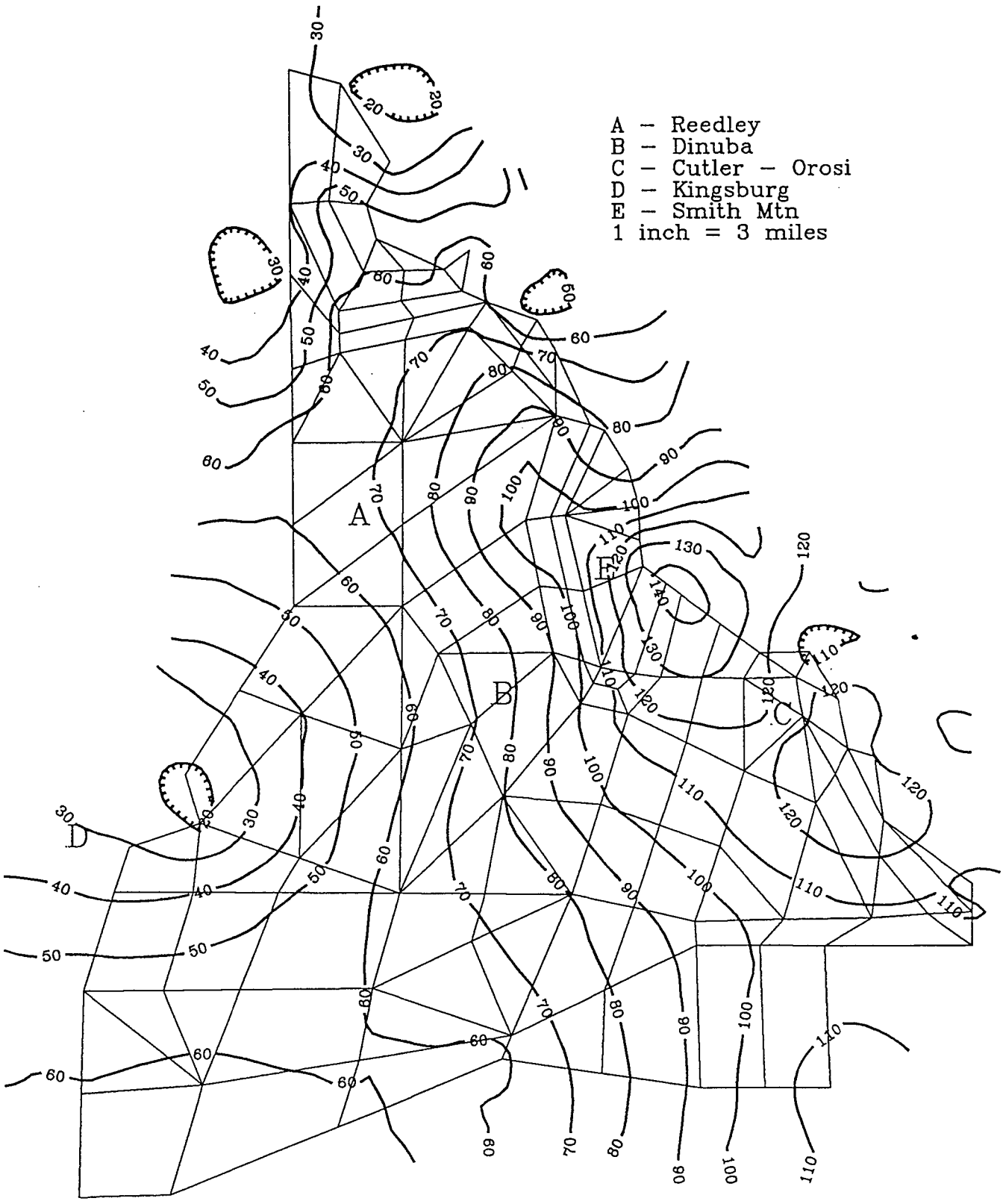


Figure 41
Difference in Groundwater Elevations between Projections 2 and 3 in Feet: Fall 2001

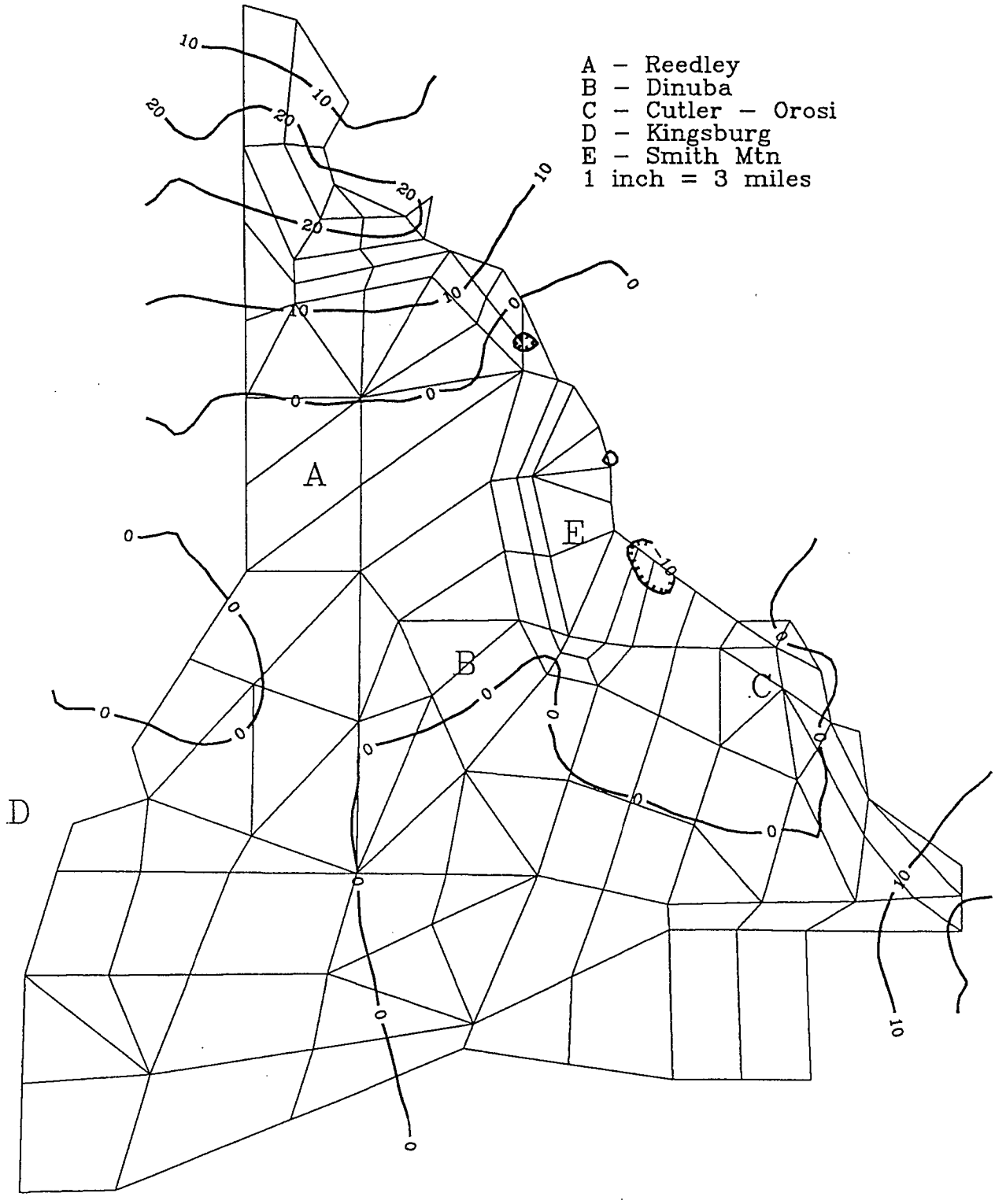
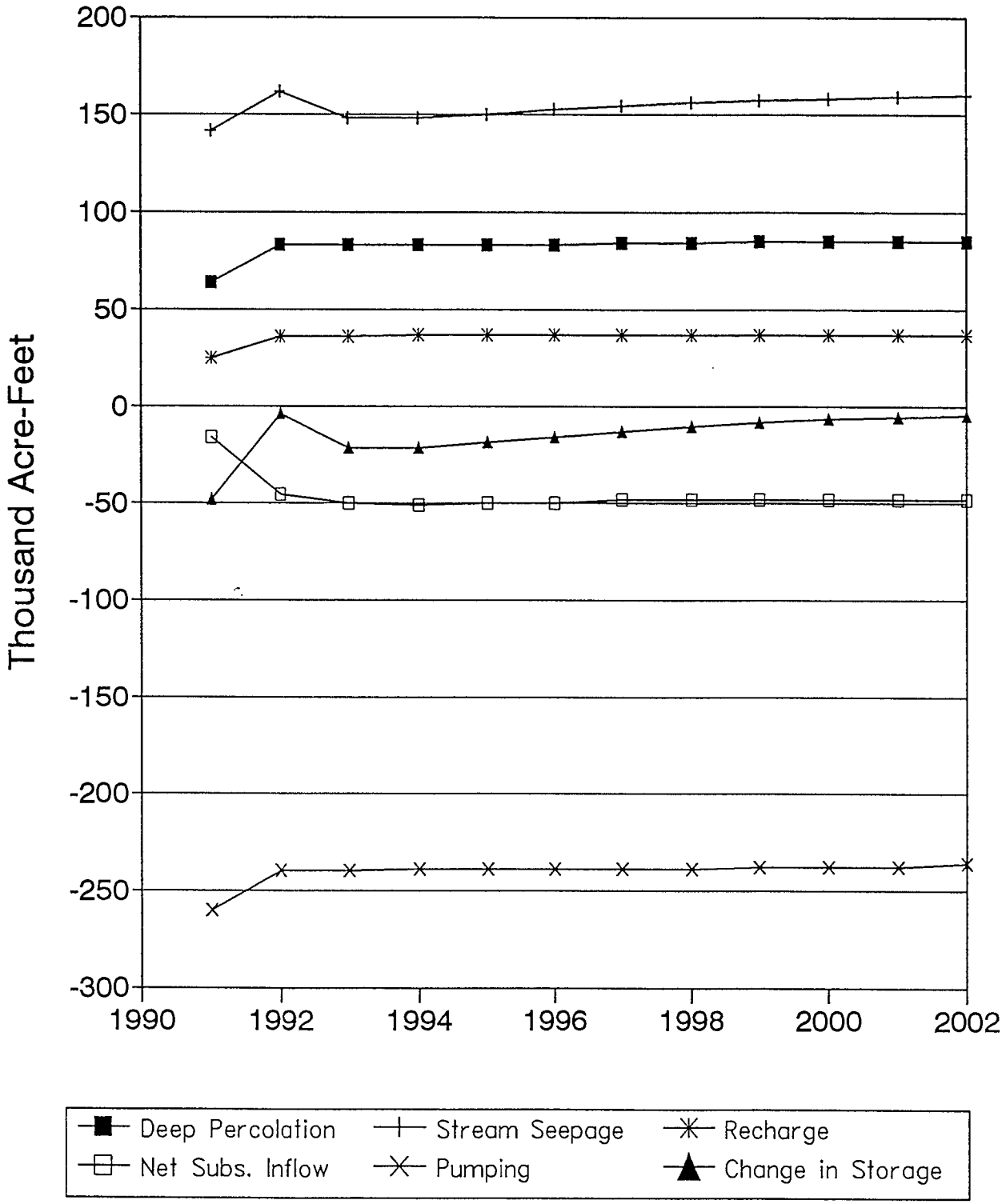


Figure 42
Groundwater Budget: Projection 3



Run 4 (10 Wet Years)

Alta's average groundwater elevation after ten wet years is approximately 45 feet higher (Figure 31, Page 58). This is because as Alta's water table rises, the seepage from the Kings River changes from a contribution to a loss (Figure 43). The other groundwater inputs and outputs stay approximately the same for the 10 years. The Kings River seepage changes because as the water table adjacent to the river rises, the gradient from the river is reversed (Figure 44).

The direction of groundwater flow in the central western portion of Alta changes from southeast in 1991 to southwest in 2001 as a slight groundwater mound develops in the center of the district and the characteristic groundwater hole west of Smith Mountain is filled (Figure 45).

The area of critical groundwater almost disappears after the successive wet years. Some critical areas are visible only in the northern tip of the district (Figure 46). The area of land that has water table between 100 and 50 feet above bedrock is 2550 acres. The area with groundwater thickness of 50 to 25 feet is 850 acres. There were no areas with groundwater less than 25 feet.

The maximum depth to groundwater is approximately 60 feet after the 10 wet years and is experienced near Reedley. South of Orosi, the water table appears to rise to the ground surface (Figure 47). Most of Alta experiences a 30 to 50 foot rise in static pumping lift after the successive wet years.

Run 5 (Alternate Wet and Dry)

The alternating wet and dry years of Run 5 resulted in the same average surface water entitlement as Run 2. Although Run 2 resulted in a decrease in water table elevation, Run 5 showed an increase of approximately 13 feet after the ten alternating years (Figure 48). Except subsurface inflow, the average values of the groundwater budget are approximately the same for the two runs.

For Run 2, subsurface inflow was relatively constant at about 48 KAF/yr. For Run 5, the subsurface inflow in dry years is approximately 7 KAF/yr, and in wet years approximately 44 KAF/yr; resulting in an average subsurface inflow of 26 KAF/yr (Figure 49). This indicates that Alta gains more water from surrounding districts in wet years than it loses to surrounding districts in dry years.

The average pumping for Run 5 is 417 KAF/yr. This is less than the average pumping for Run 2, which is 442 KAF/yr. It appears that the pumping is less for Run 5 because during the dry years, surface water is not delivered early in the year (usually not until mid-May) when the irrigation efficiency is assumed to be low. Because the majority of the surface water is applied in the summer months when the irrigation efficiency is high, less pumping is required.

Figure 43
Groundwater Budget: Projection 4

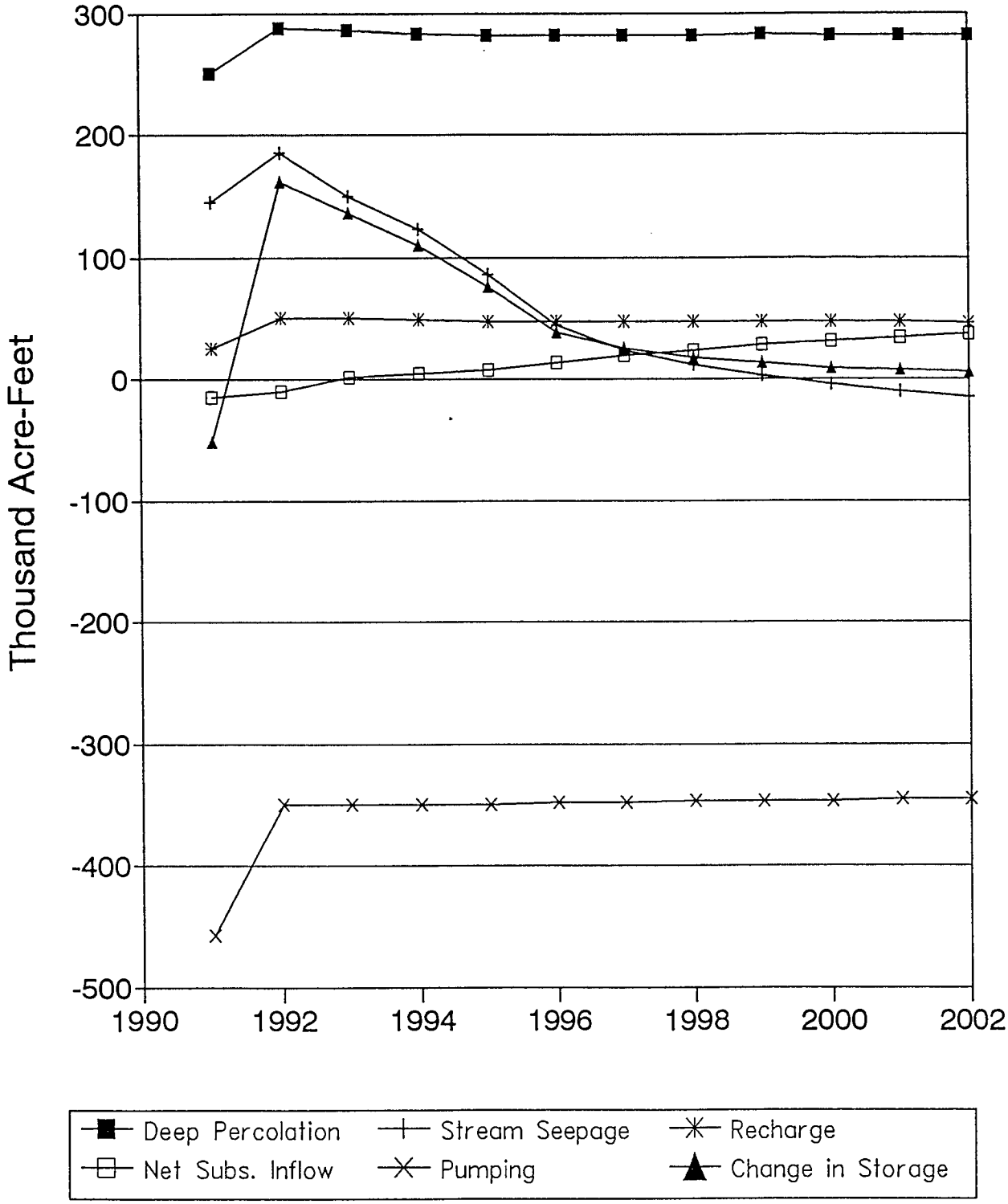


Figure 44
Groundwater Elevation: Projection 4, Section B-B'

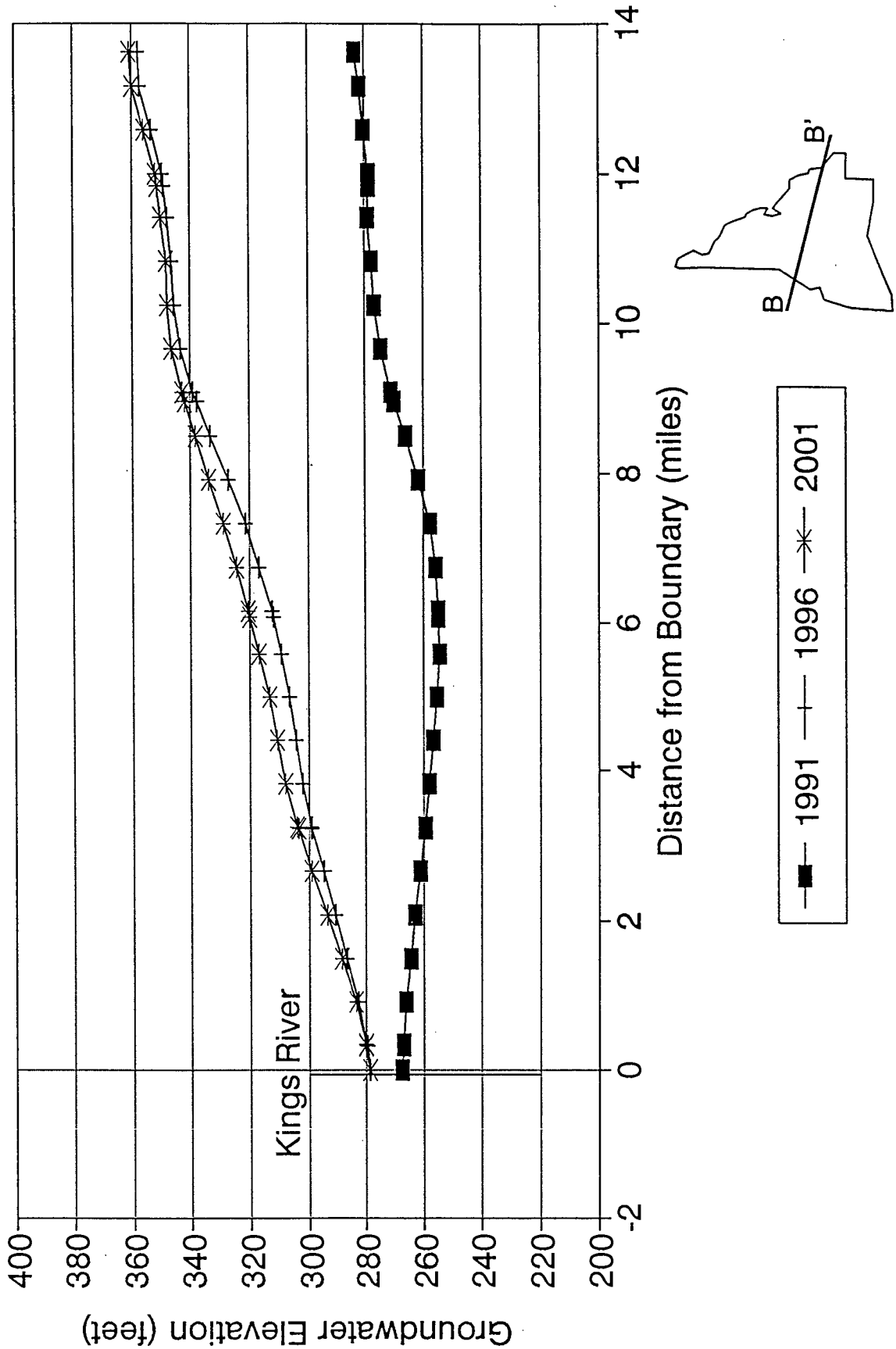


Figure 45
Groundwater Elevation in Feet: Projection 4, Fall 2001

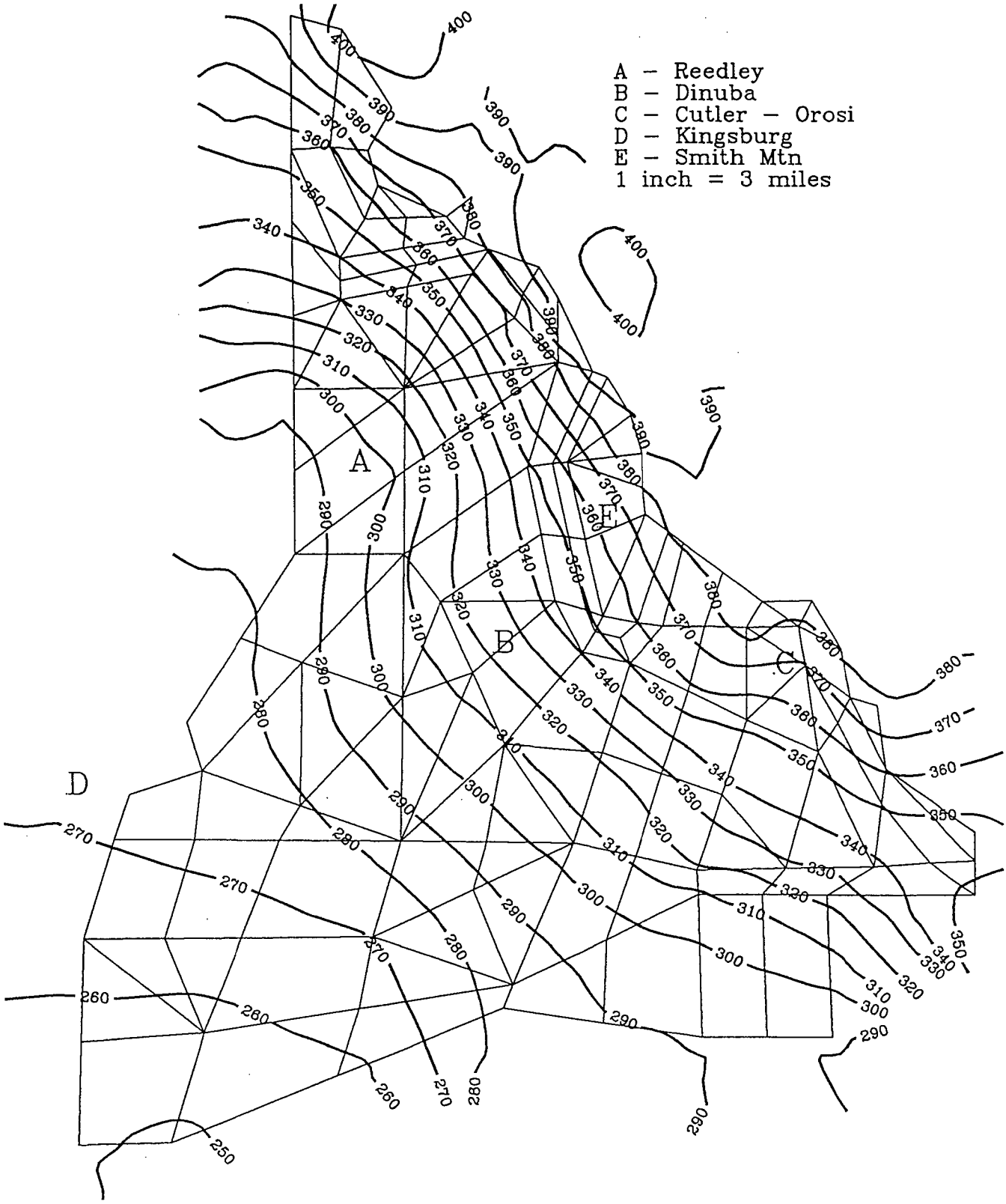


Figure 46
Water Table Height above Bedrock at 250 Feet or Less: Projection 4, Fall 2001

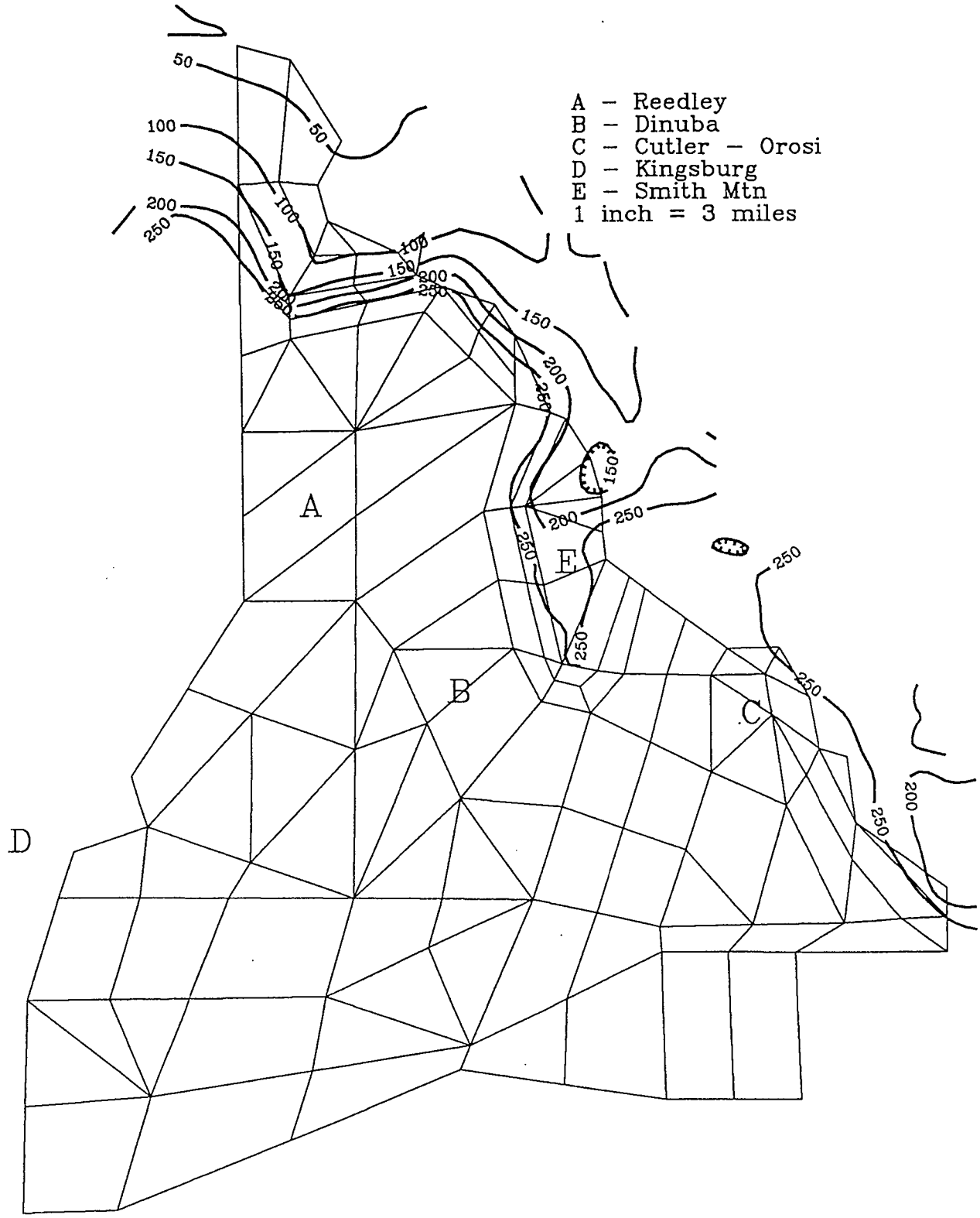


Figure 47
Depth to Groundwater in Feet: Projection 4, Fall 2001

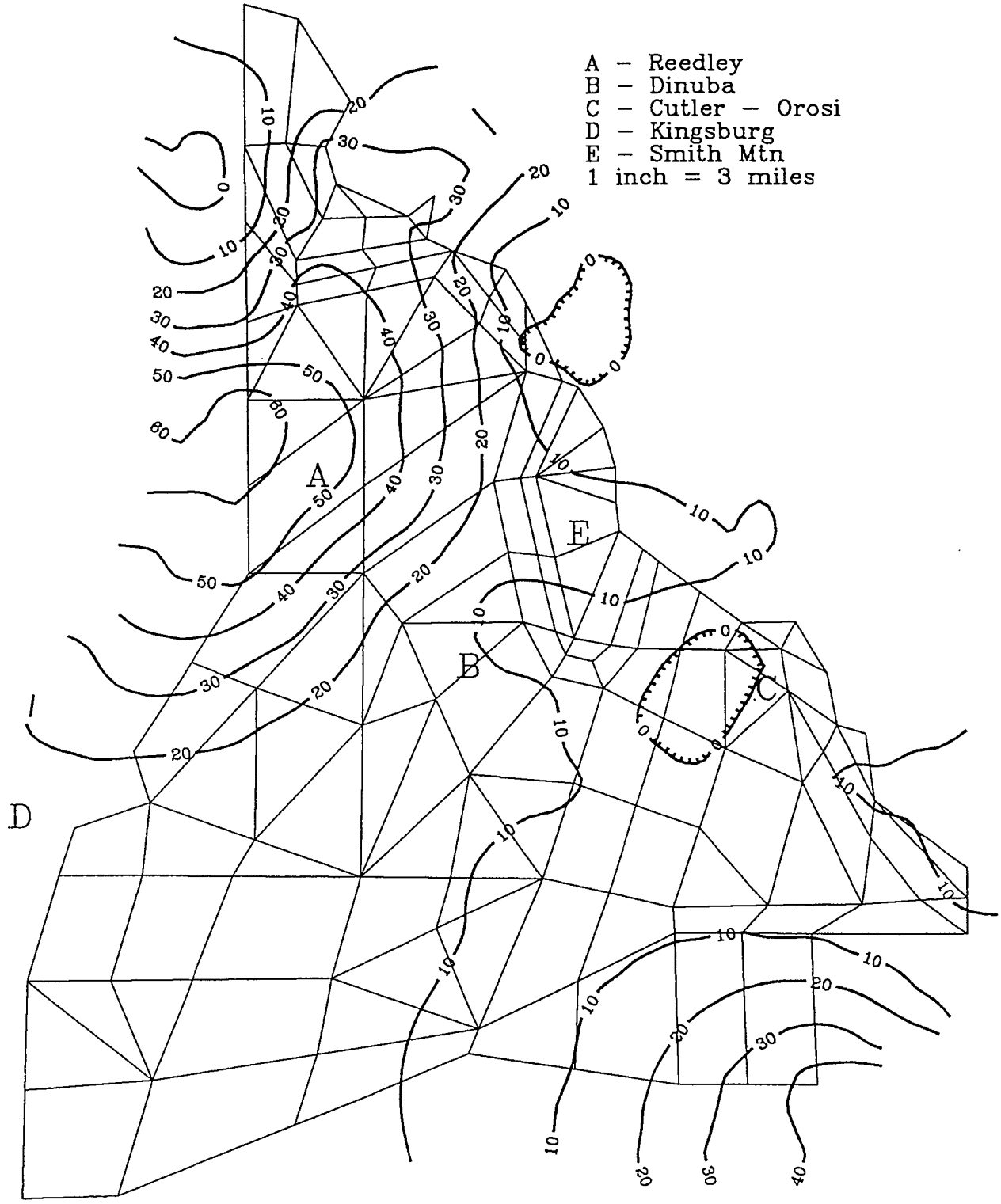


Figure 48
Average Groundwater Elevation: Projections 2, 5, 8 and 9

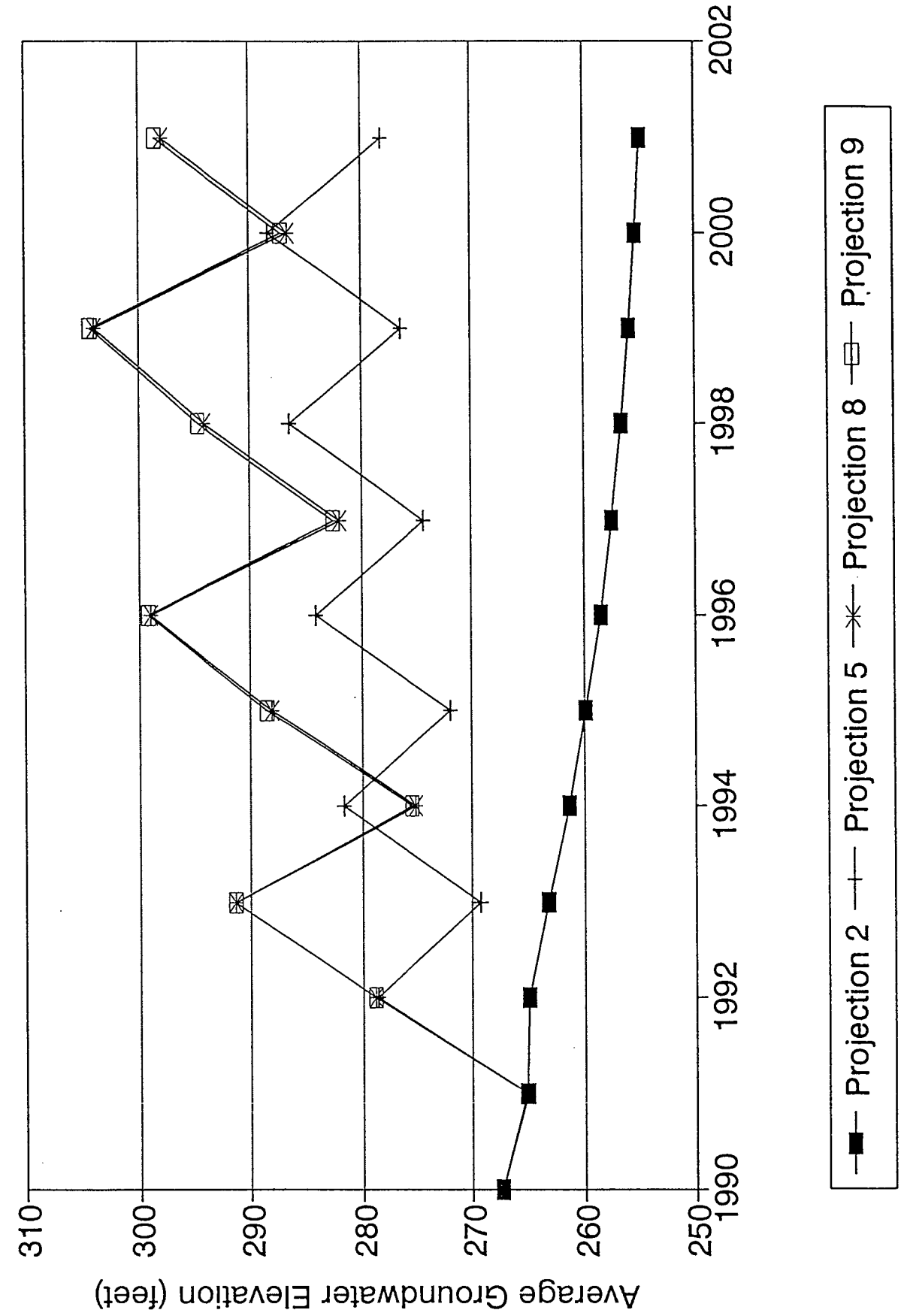
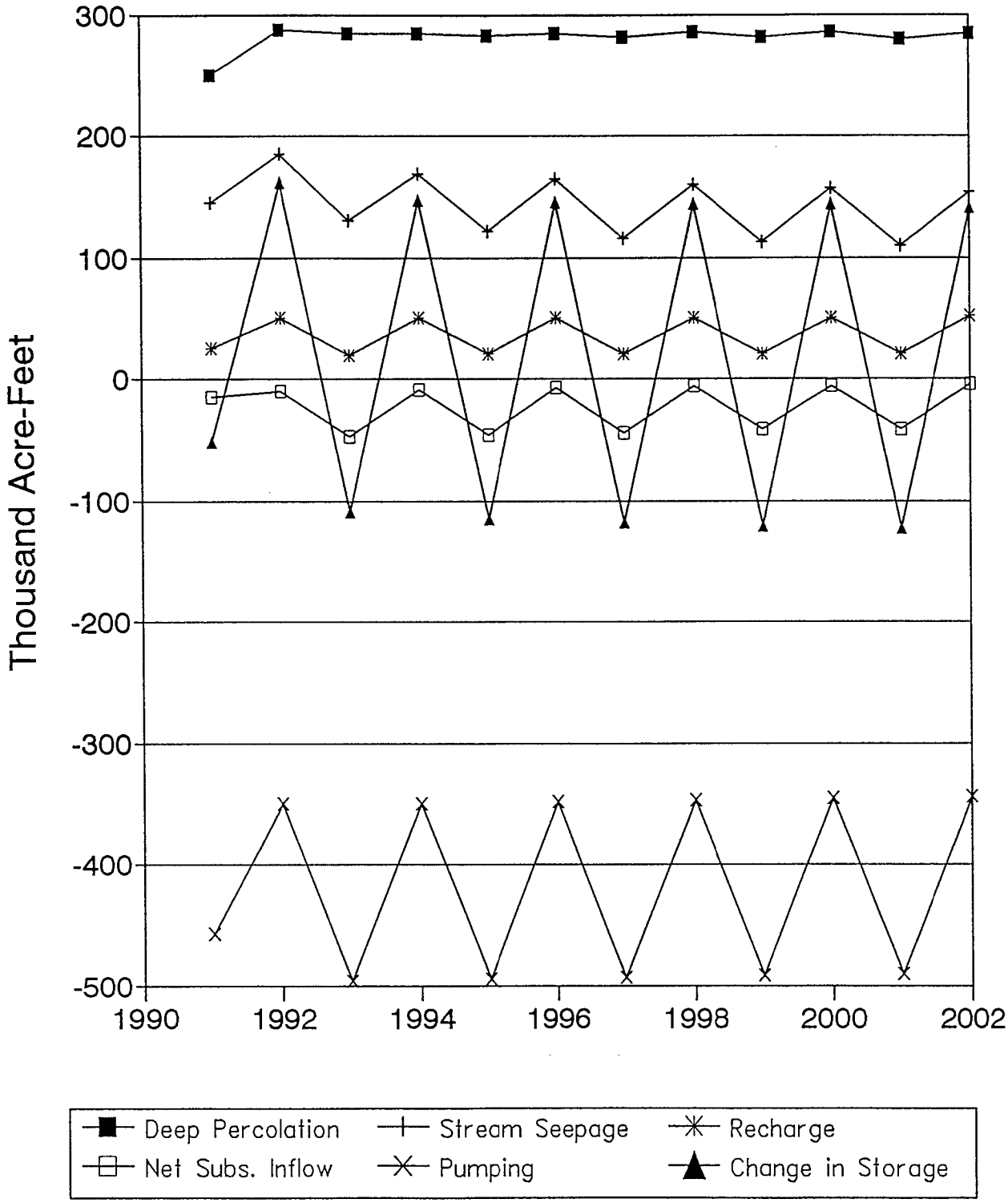


Figure 49
Groundwater Budget: Projection 5



Run 6 (10 Critical Years)

Alta's average groundwater elevation after ten critical years is approximately 140 feet lower (Figure 50). Deep percolation, pumping, and recharge remain fairly constant during the projection period. Subsurface flow changes from a *net inflow** of about 50 KAF/yr to a net outflow of about 150 KAF/yr. The seepage from streams rapidly drops to nearly zero during the study period, apparently due to the nearly dry conditions of the area streams in critical years (Figure 51).

After ten critical years, groundwater flows into Alta from almost every direction (Figures 52 and 53). A large groundwater depression develops in the center of the district and is most prominent southeast of Smith Mountain (Figure 54). The area of critical groundwater increases drastically along the east edge of Alta (Figure 55). The area of land that has water table between 100 and 50 feet above bedrock is 7680 acres. The area with groundwater thickness of 50 to 25 feet is 4690 acres. The area with groundwater less than 25 feet is 5630 acres (Table 6, Page 63). The maximum depth to groundwater is approximately 300 feet after the 10 critical years. This water table depth is experienced southeast of Smith Mountain. Most of Alta experiences a drop in static pumping level of 10 to 17 feet after each successive critical year (Figure 56).

Run 7 (Critical with Reallocation)

Run 7 is identical to Run 6 except that Run 7 has surface water reallocated to the northeastern part of Alta. As a result of the reallocation, the regional groundwater elevation and distribution is not changed significantly (Figure 50, Page 81). There are localized changes in the shallow aquifer zone along the east part of the district (Figure 57).

The total acres with water table less than 100 feet above bedrock is approximately the same as for Run 6 at 17,500 acres. However, the number of acres with water table less than 25 feet above bedrock is less at 5100 acres. The area of land that has water table between 100 and 50 feet above bedrock is 6790 acres. The area with groundwater thickness of 50 to 25 feet is 5590 acres.

The reallocation slows the decline of groundwater along the eastern edge for approximately five years (Figure 58). However, after 10 years the groundwater level throughout the district is nearly identical to that for Run 6 (Figure 59).

Run 8 (Alternate Wet and Critical)

The cycle of two wet and one critical year of Run 8 resulted in the same average surface water entitlement as Run 2. Although Run 2 resulted in a decrease in water table elevation, Run 8 showed an increase of approximately 37 feet after the ten alternating years (Figure 48, Page 78).

Figure 50
Average Groundwater Elevation: Projections 2, 6 and 7

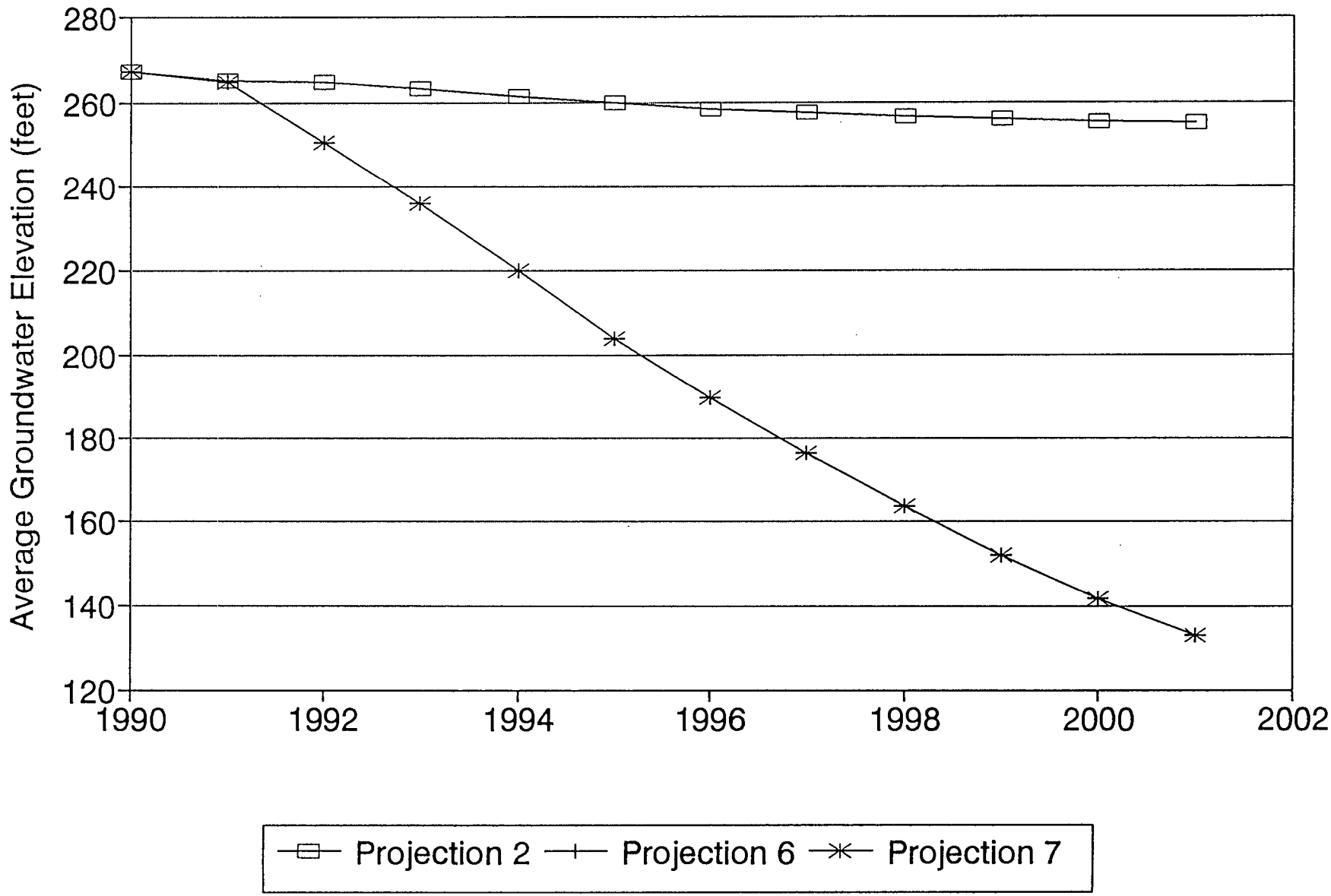


Figure 51
Groundwater Budget: Projection 6

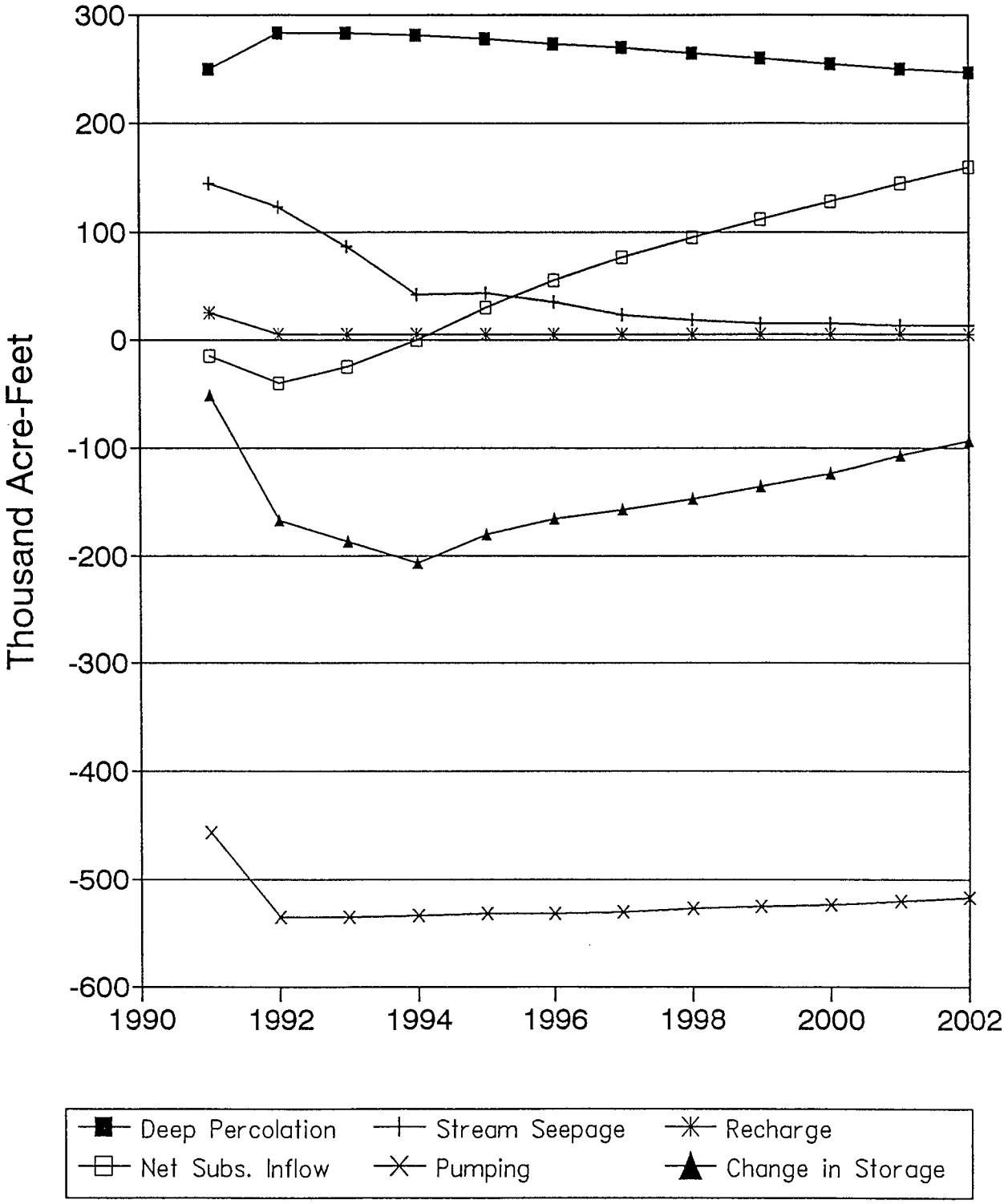


Figure 52
Groundwater Elevation: Projection 6, Section C-C'

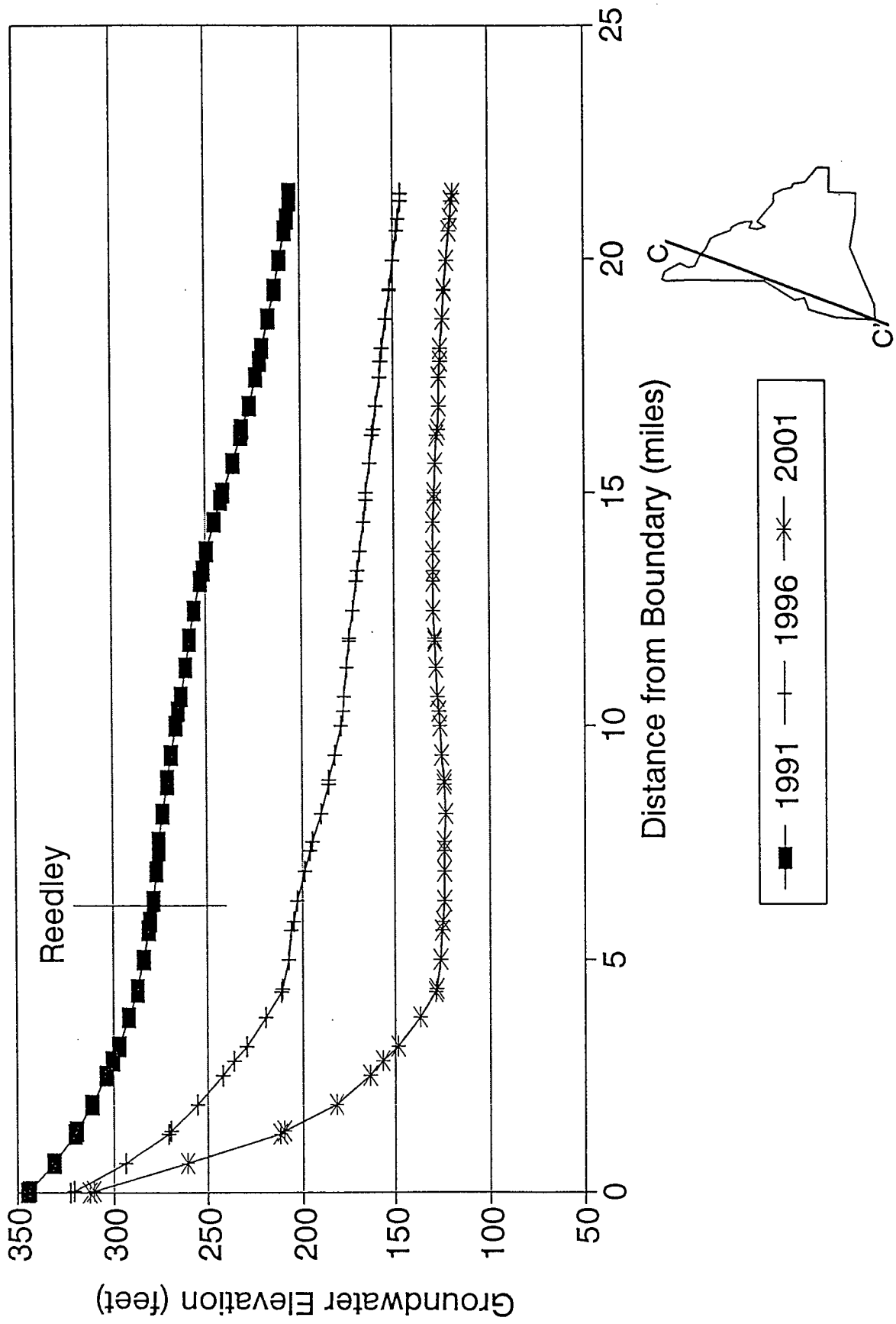


Figure 53
Groundwater Elevation: Projection 6, Section D-D'

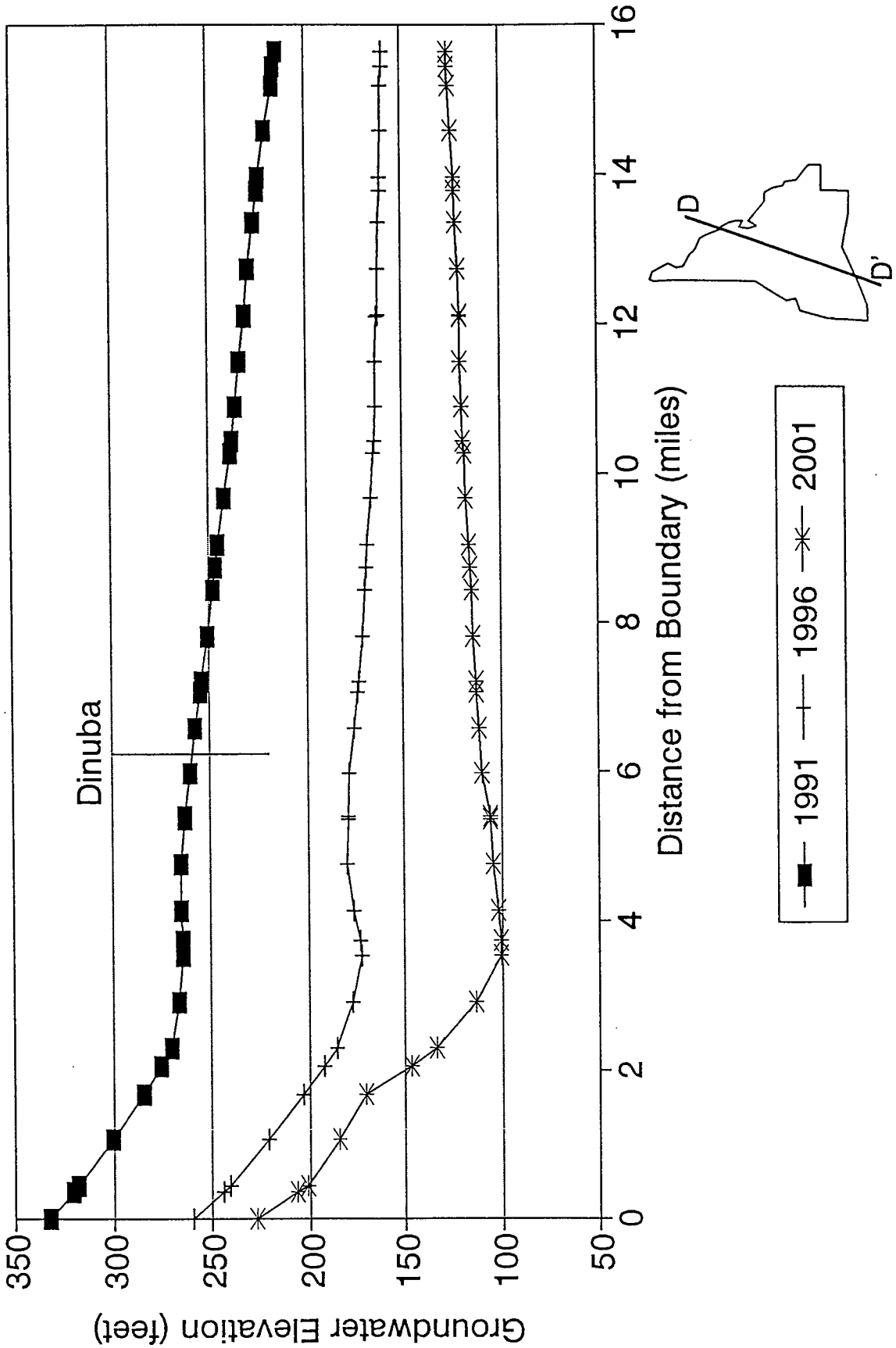


Figure 54
Groundwater Elevation in Feet: Projection 6, Fall 2001

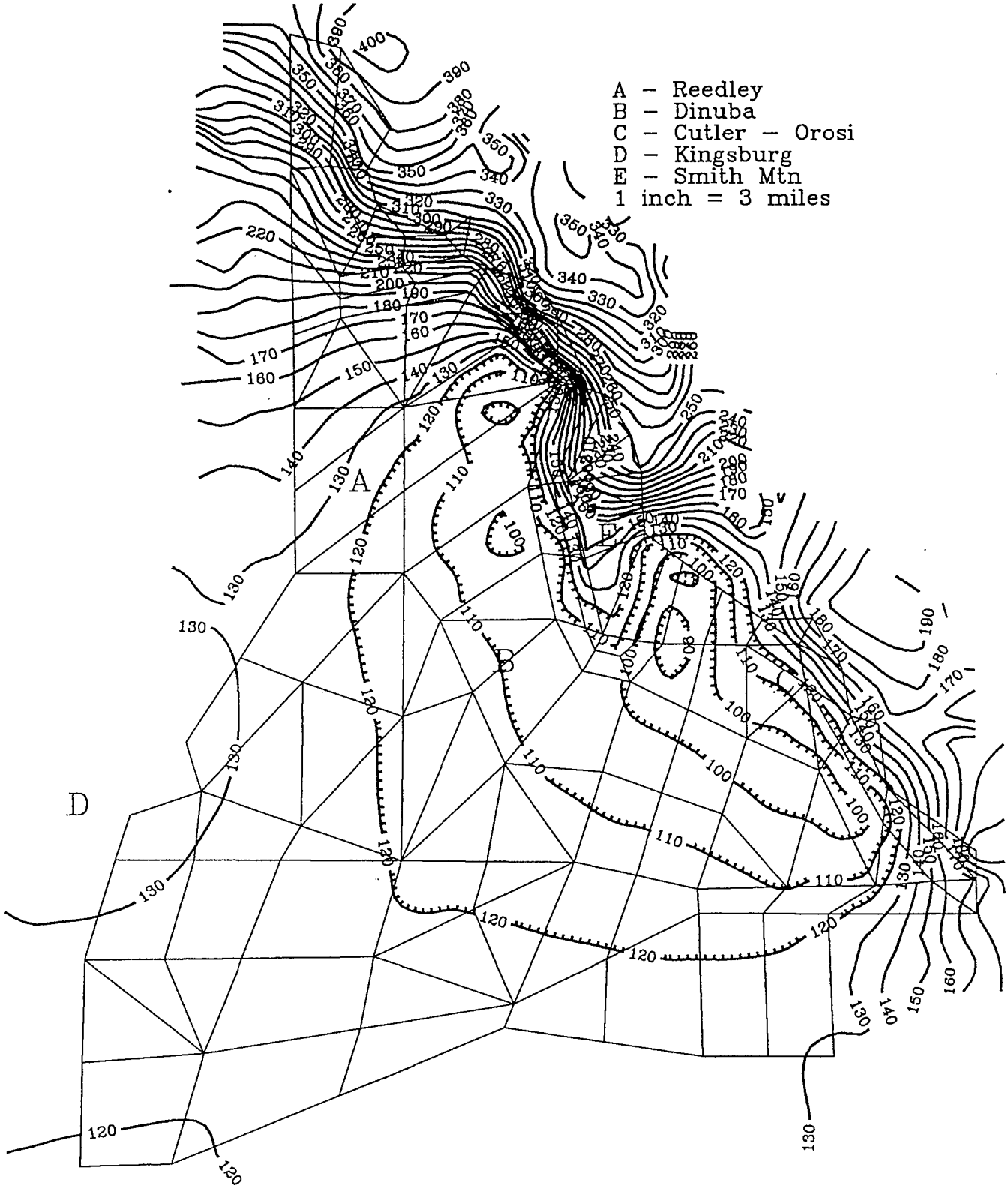


Figure 55
Water Table Height above Bedrock at 250 Feet or Less: Projection 6, Fall 2001

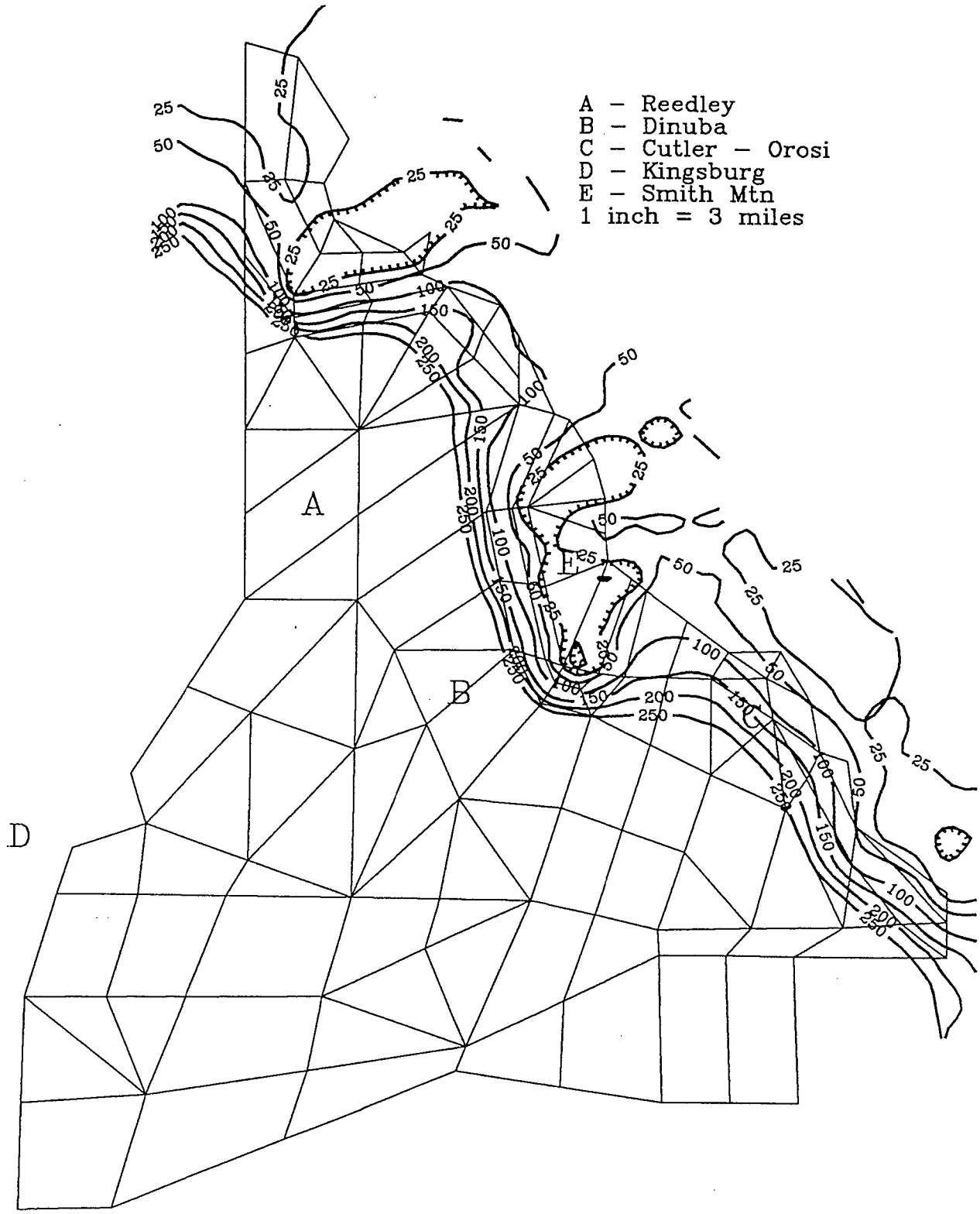


Figure 56
Depth to Groundwater in Feet: Projection 6, Fall 2001

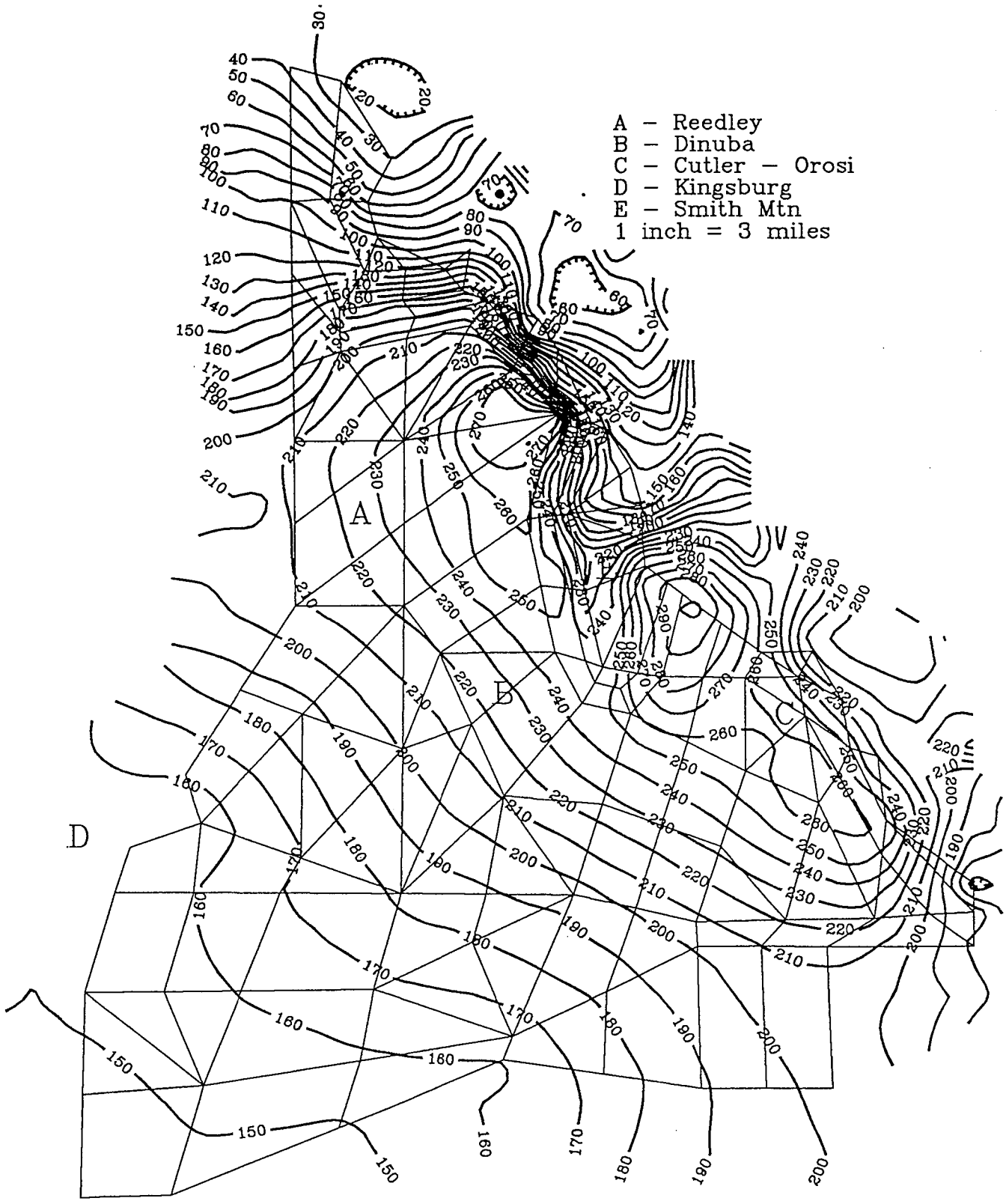


Figure 57
Difference in Groundwater Elevation between Projections 6 and 7 in Feet: Fall 2001

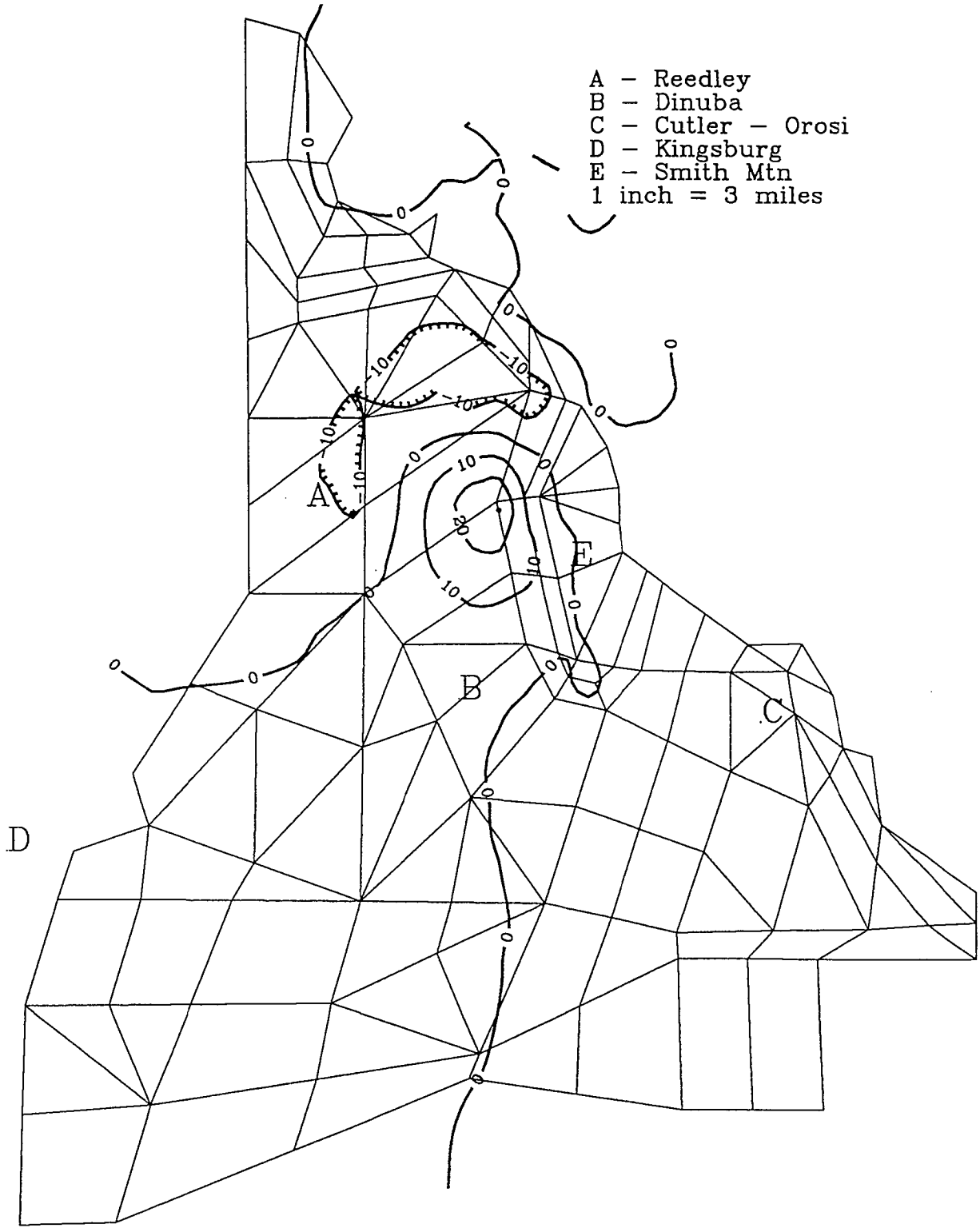


Figure 58
Groundwater Elevation in Feet: Projection 7, Fall 1996

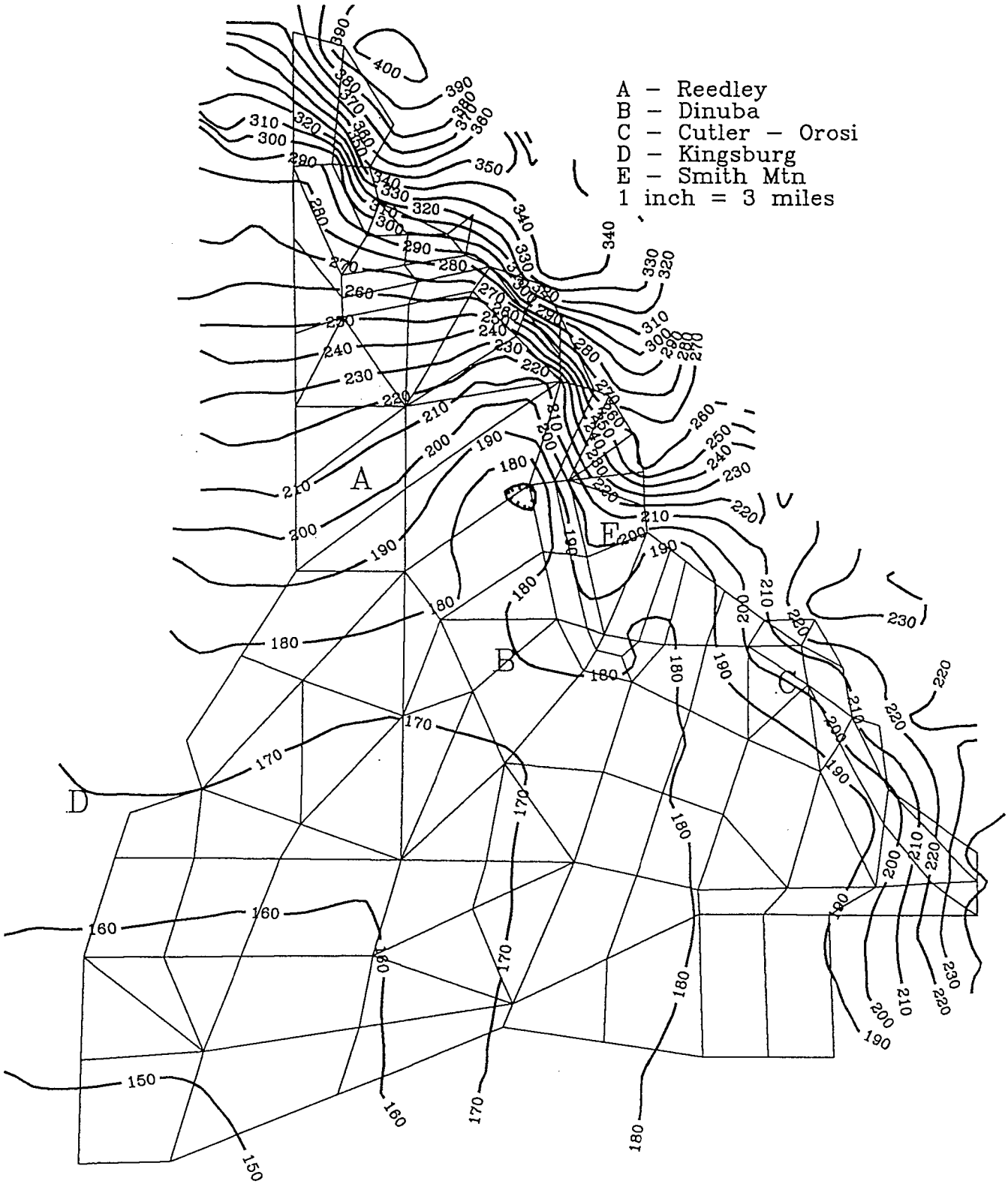
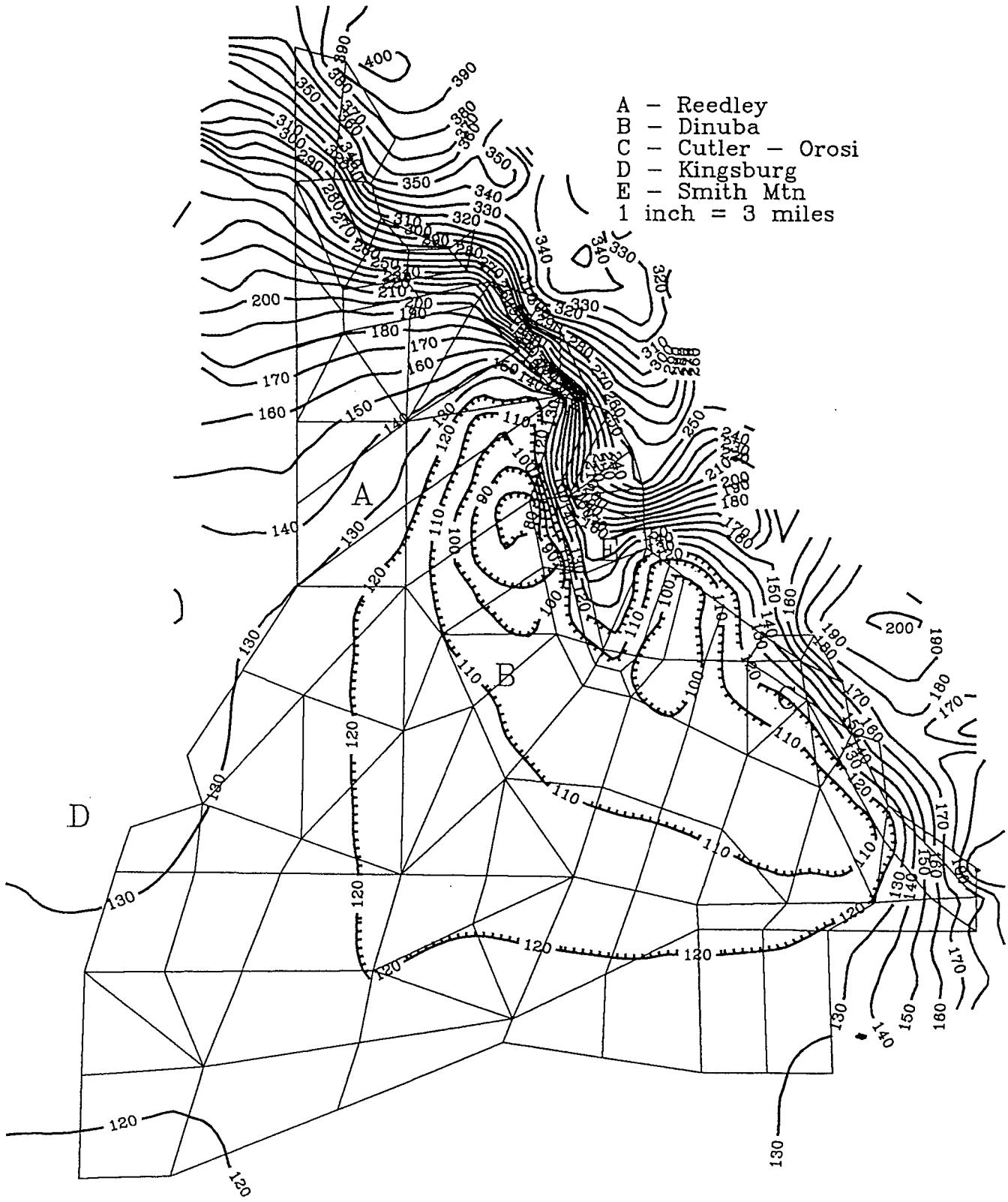


Figure 59
Groundwater Elevation in Feet: Projection 7, Fall 2001



The average values of the groundwater budget are approximately the same for the two runs except subsurface inflow and pumping.

For Run 2 subsurface inflow was relatively constant at about 48 KAF/yr. For Run 8, the subsurface inflow in critical years is approximately 44 KAF/yr, and in wet years in approximately 2 KAF/yr; resulting in an average subsurface inflow of 16 KAF/yr. (Figure 60). The average pumping for Alta is about 442 KAF/yr for Run 2 and about 403 KAF/yr for Run 8. It appears that the pumping is less for Run 8 because during the dry years, surface water is not delivered early in the season when the irrigation efficiency is assumed to be low. Because all of the surface water is applied in June when the irrigation efficiency is high, less pumping is required.

Run 9 (Wet and Critical with Reallocation)

Run 9 is identical to Run 8 except that Run 9 has surface water reallocated to the northeastern part of Alta during the critical years. As a result of the reallocation, the regional groundwater elevation and distribution is not changed significantly (Figure 48, Page 78). There are localized changes in the shallow aquifer zone along the east part of the district (Figure 61).

The total acres with water table less than 100 feet above bedrock is approximately the same as for Run 8 at 4570 acres (Figure 62). However, the number of acres with water table less than 50 feet above bedrock is less at 2070 acres. The area of land that has water table between 100 and 50 feet above bedrock is 2500 acres. The area with groundwater thickness of 50 to 25 feet is 1740 acres. The area with groundwater less than 25 feet is 330 acres (Figure 6, Page 63).

The reallocation appears to alleviate some of the groundwater problems in the shallow aquifer zone, but has a negligible effect on the rest of the district.

Run 10 (30 Average Years)

Run 10 gave a longer term look at the groundwater trends of Alta. The results of this run should not be considered accurate on a localized basis. However, this run can give an indication of regional trends.

The average groundwater elevation change after approximately 16 years is downward, dropping approximately 14 feet. After the year 2007, the average trend is slightly upward, rising 3 feet by the year 2021 (Figure 63).

This suggests that Alta's overdraft may be decreasing over this time period. This appears to be caused by the following two factors:

Figure 60
Groundwater Budget: Projection 8

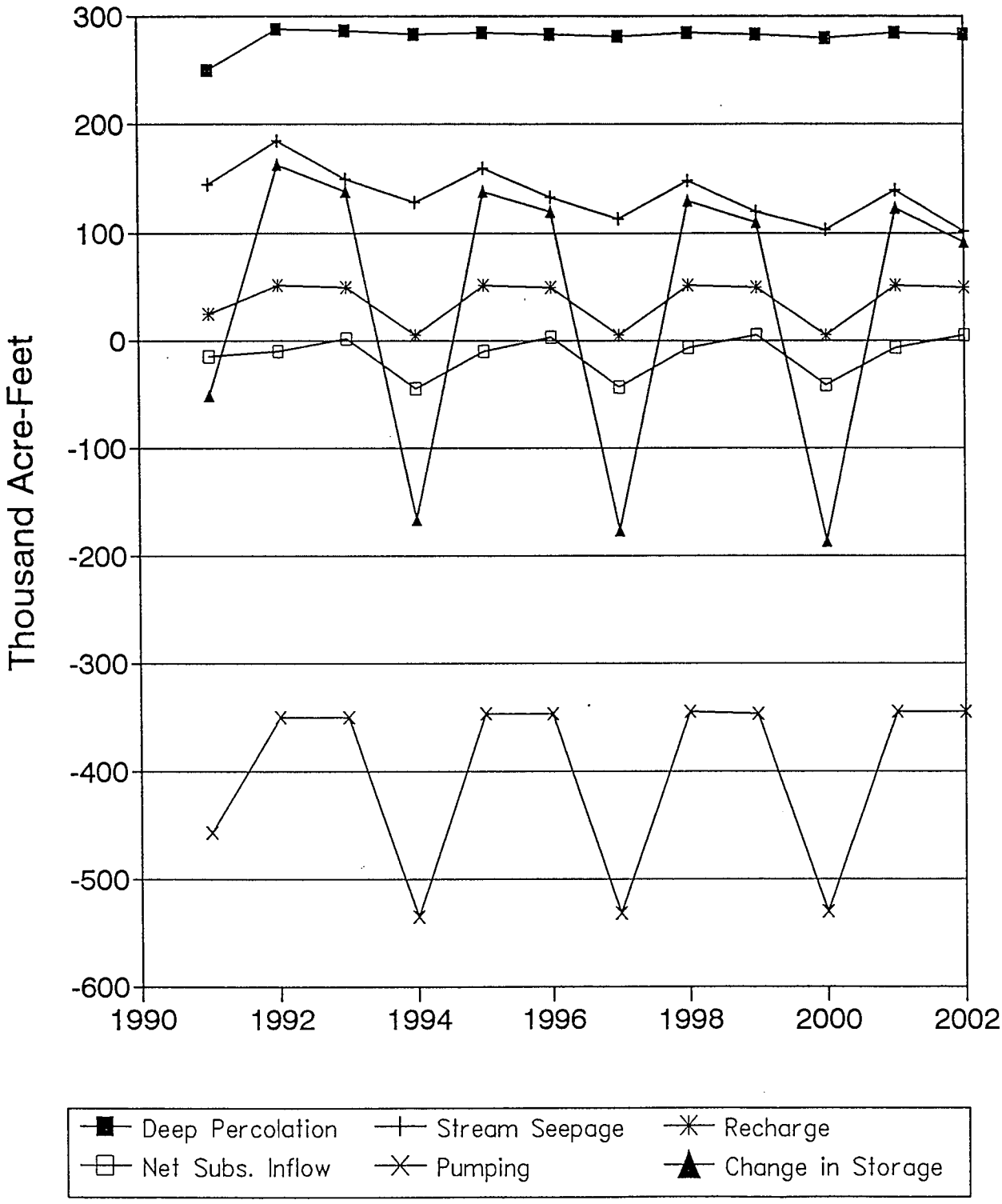


Figure 61
Difference in Groundwater Elevation between Projection 8 and 9 in Feet: Fall 2001

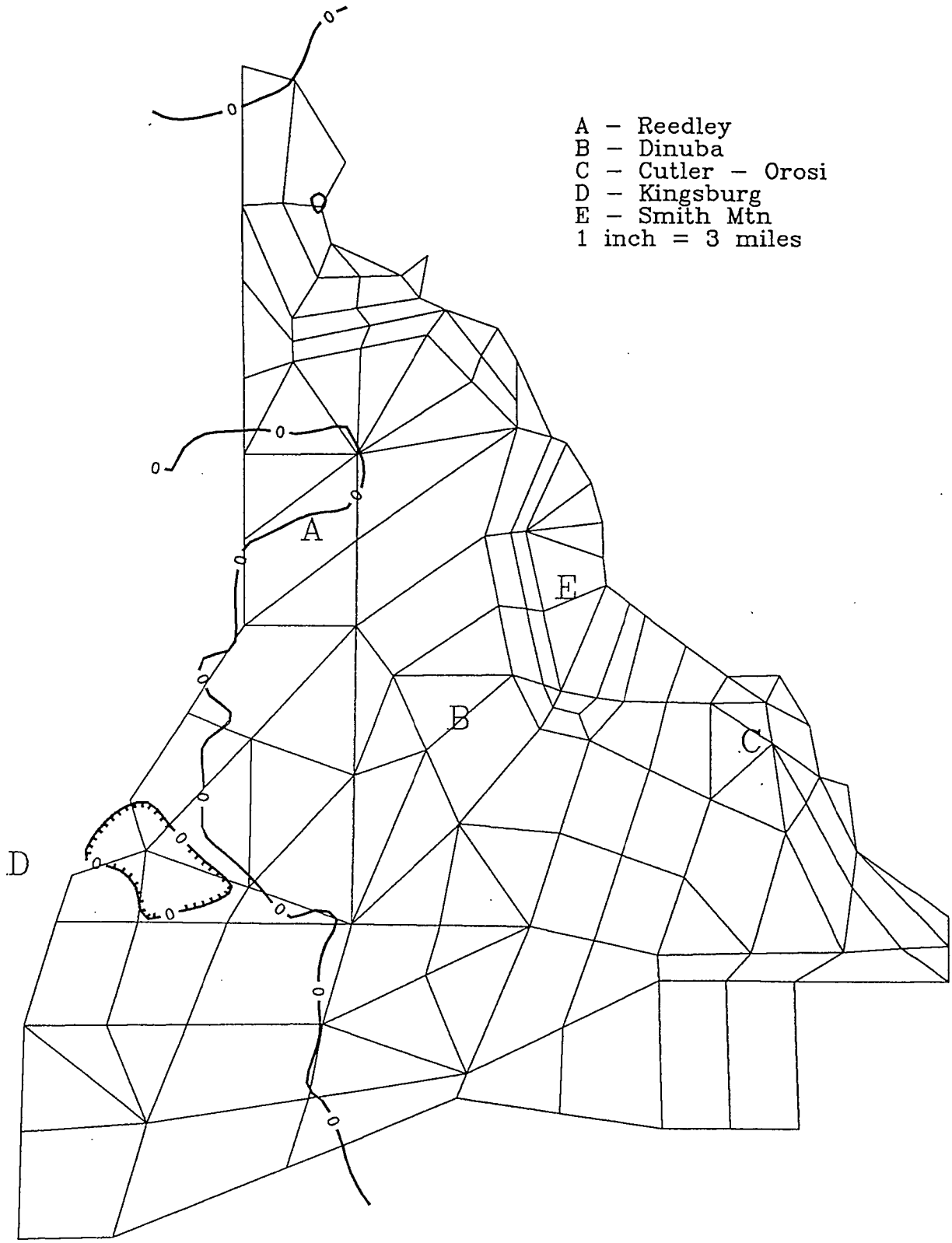


Figure 62
Water Table Height above Bedrock at 250 Feet or Less: Projection 9, Fall 2001

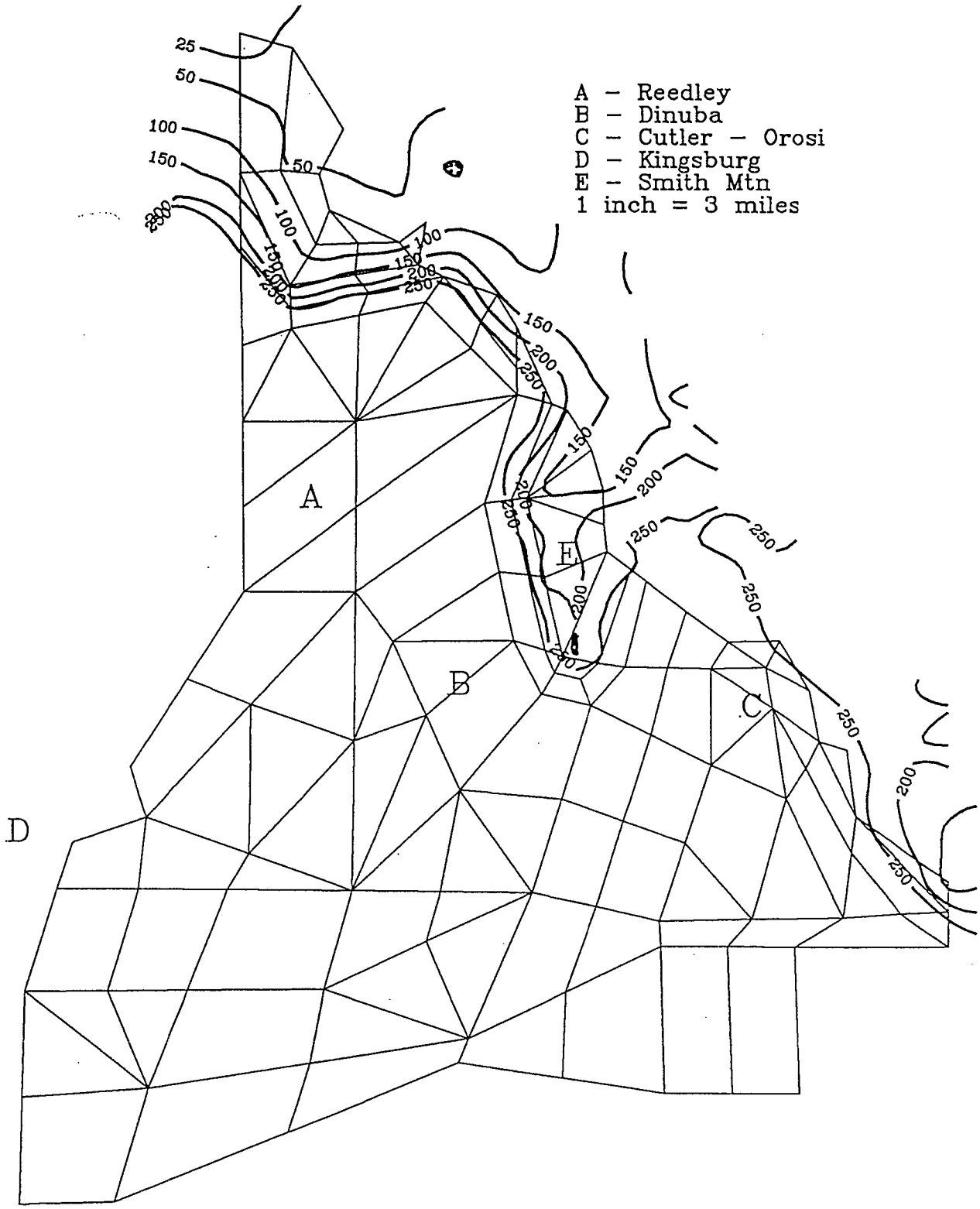
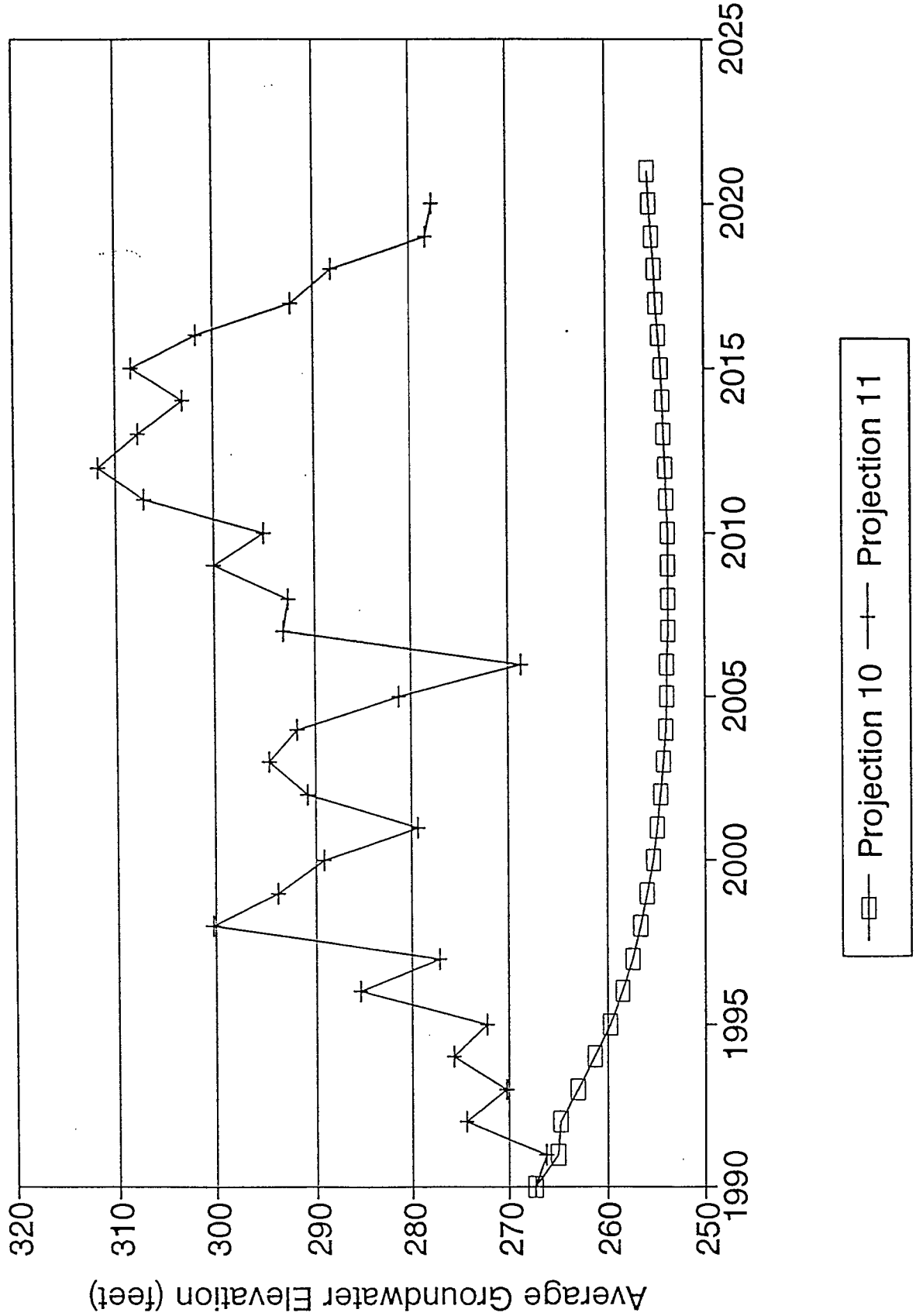


Figure 63
Average Groundwater Elevation: Projection 10 and 11



- The average groundwater level in Alta has dropped to a level that results in increased seepage from the Kings River and subsurface flow from outside the district.

- The total consumption of water within Alta decreases as urban areas expand (Figure 64).

Run 11 (Repeat 30 Historical Years)

Run 11 is also a long-term look at groundwater trends. In this case, the same weather and stream flow pattern was used for 1991 through 2020 as were experienced from 1962 through 1991. The average groundwater elevation for the projection period tends to fluctuate widely due to varying weather conditions just as it has done historically (Figure 63, Page 95).

As with Run 10, this analysis indicates that Alta's overdraft is decreasing with time. Table 7 compares the average groundwater elevation for corresponding years. This shows that the difference between corresponding years is decreasing, with the future years' groundwater levels eventually becoming higher.

Run 12 (Lining/Piping Canals)

Run 12 provides a simulation of the effects of reduced seepage due to lining or piping all of Alta's canals. The results of Run 12 are not significantly different from those of Run 11. Slight changes in localized groundwater elevation occur in the northern tip of Alta (Figure 65), but these differences are considered to represent an anomoly of the narrow portion of the modeling grid.

At the end of the 30-year projection period, the average district groundwater elevation was approximately 1.7 feet lower than in the unlined case. This difference is considered negligible given the precision of the model.

Figure 64
Projected Alta Water Consumption

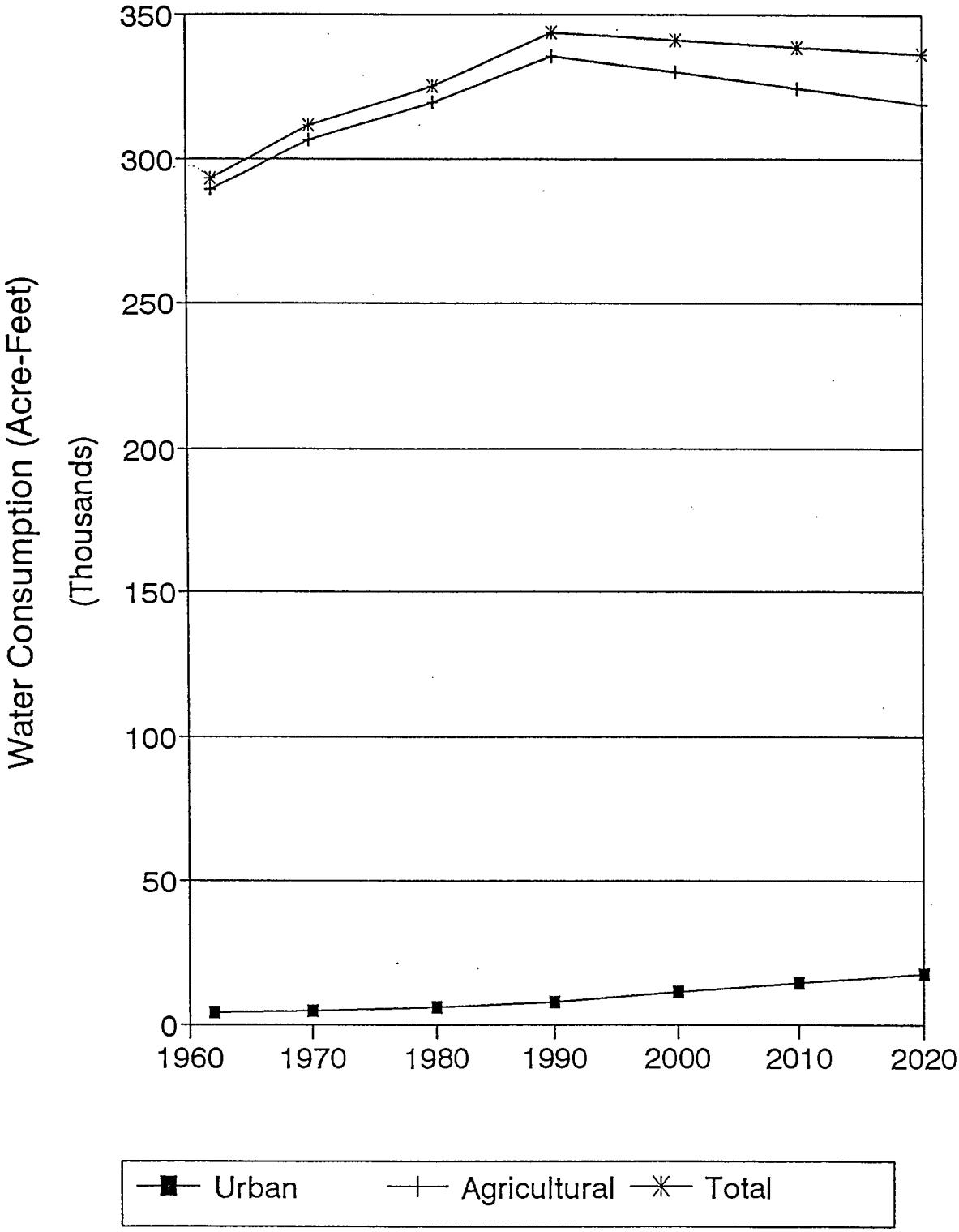
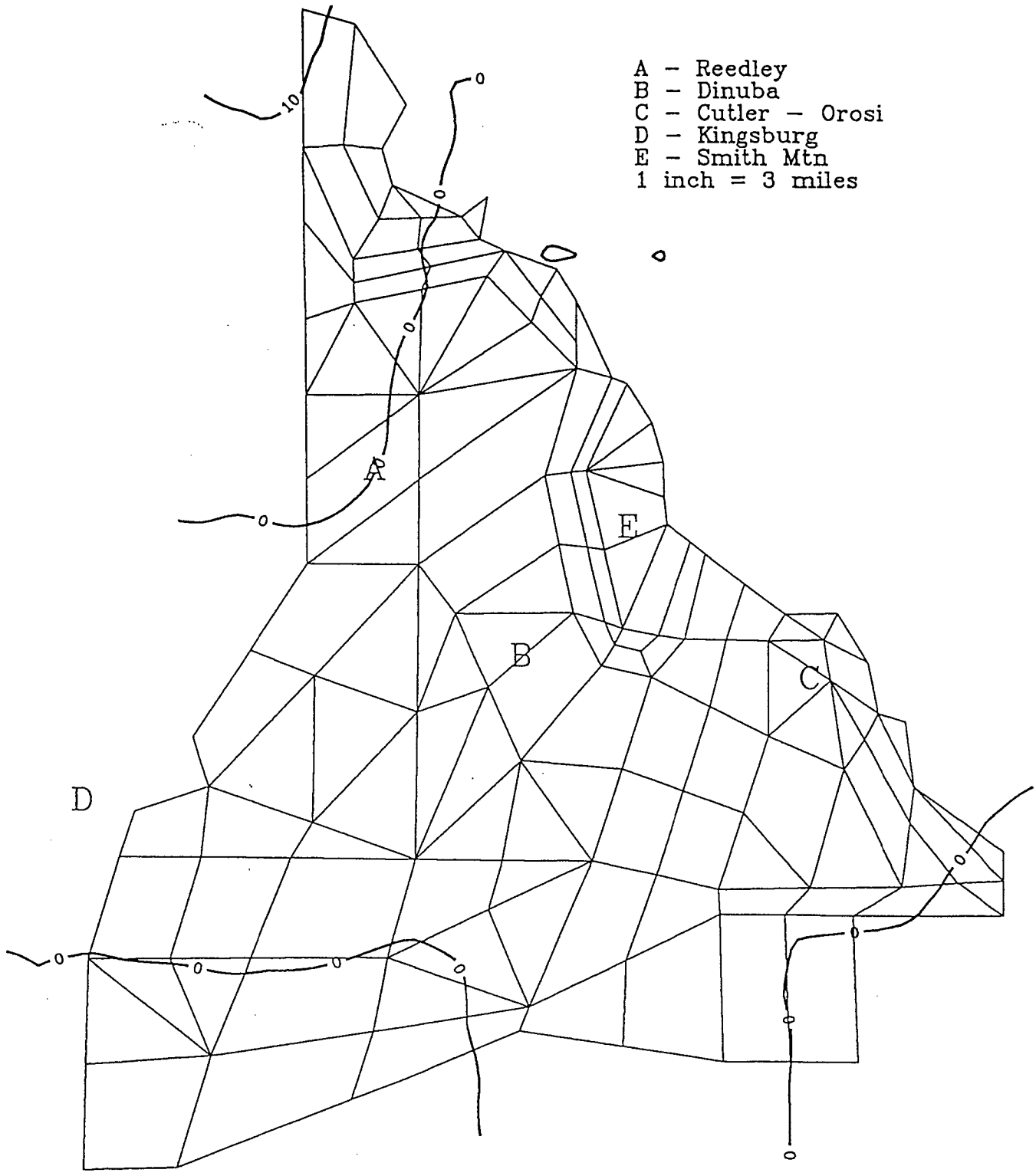


Table 7 Comparison of Historical and Projected Groundwater Elevations: Projection 11				
Historical Year	Ave GW Elev (ft)	Projected Year	Ave GW Elev (ft)	Difference in Ave GW elev
1962	285.2	1991	266.2	18.9
1964	284.9	1993	270.2	14.8
1966	287.2	1995	272.1	15.1
1968	291.2	1997	277.1	14.1
1970	302.3	1999	293.8	8.5
1972	286.6	2001	279.3	7.3
1974	299.1	2003	294.6	4.5
1976	284.1	2005	281.3	2.8
1978	293.7	2007	293.1	0.6
1980	298.3	2009	300.0	-1.7
1982	304.2	2011	307.2	-3.0
1984	304.7	2013	307.7	-3.0
1986	303.7	2015	308.3	-4.6
1988	287.2	2017	292.2	-5.0
1990	267.3	2019	278.3	-11.1

Figure 65
Difference in Groundwater Elevation between Projection 11 and 12 in Feet:
Fall 2020



CONCLUSIONS

FLOW CHARACTERISTICS

Groundwater continually flows into Alta along its eastern boundary. Within Alta, groundwater typically flows from north to south, with a large amount of subsurface flow exiting Alta's southern border.

When groundwater levels are high (average district elevation over 280 feet), groundwater flows from the center of the district to the southwest. During these periods, accretion to the Kings River is significant.

When groundwater levels are low (average district elevation under 260 feet), groundwater flows from the central-western boundary to the center part of the district. During these periods, contribution to Alta's groundwater from the Kings River is large.

Groundwater moves relatively slowly. The maximum computed groundwater velocity in Alta was found to be approximately 5 feet per day north of Smith Mountain. The groundwater along Alta's eastern boundary moves an average about 1.5 feet per day. Groundwater tends to move more slowly elsewhere in the district. The average groundwater velocity around Alta's boundary is approximately one foot per day.

GROUNDWATER BOUNDARY FLOW

Groundwater flow into and out of Alta can vary significantly depending on the elevation of Alta's water table and the water tables to the south and west.

Generally, subsurface inflow (including seepage or accretion from the Kings River) is higher when Alta's water table is low. It is estimated that in 1977, approximately 111,500 acre-feet of groundwater entered Alta's boundary. In 1969, subsurface inflow was approximately 66,100 acre-feet (Table 5, Page 52).

Subsurface outflow is usually less than subsurface inflow, and also varies inversely with water table depth. In 1977, subsurface outflow is estimated at approximately 69,200 acre-feet, while the subsurface outflow in 1969 was about 30,100 acre-feet.

Over the 30-year study/calibration period, there was *net subsurface inflow** of groundwater was approximately 25,000 acre-feet per year.

CRITICAL AREAS

Alta's east-side growers have experienced declining well yields during most extended drought periods. The current drought period is no exception.

If the drought were to continue for another 10 years (as represented by projection Run 1), it is likely that the areas that experience loss in pumping capacity will increase. However, the increase may not be as severe as expected. The number of acres with critical groundwater supply in 1977 were 4920. In 1990, 5806 acres had a critical supply. Model Run 1 indicates that ten years of continued drought would expand that area to 7730 acres.

Ten years of critical water supply (district allotment of 20,000 acre-feet) would severely deplete east side groundwater supplies. Fortunately, the probability of an extended critical period is unlikely. A single critical year affects the east area more severely than 10 dry years.

OVERDRAFT

The district water balance indicates that from 1962 to 1991, Alta's average overdraft was approximately 7,000 acre-feet. The projected conversion of agricultural land to urban uses in the next 30 years has the potential to reduce Alta's water consumption by approximately this amount.

Even though urban growth may reduce Alta's overdraft, it could at the same time create significant localized problems with groundwater levels in the vicinity of urban areas due to concentrated continuous pumping and lack of groundwater recharge.

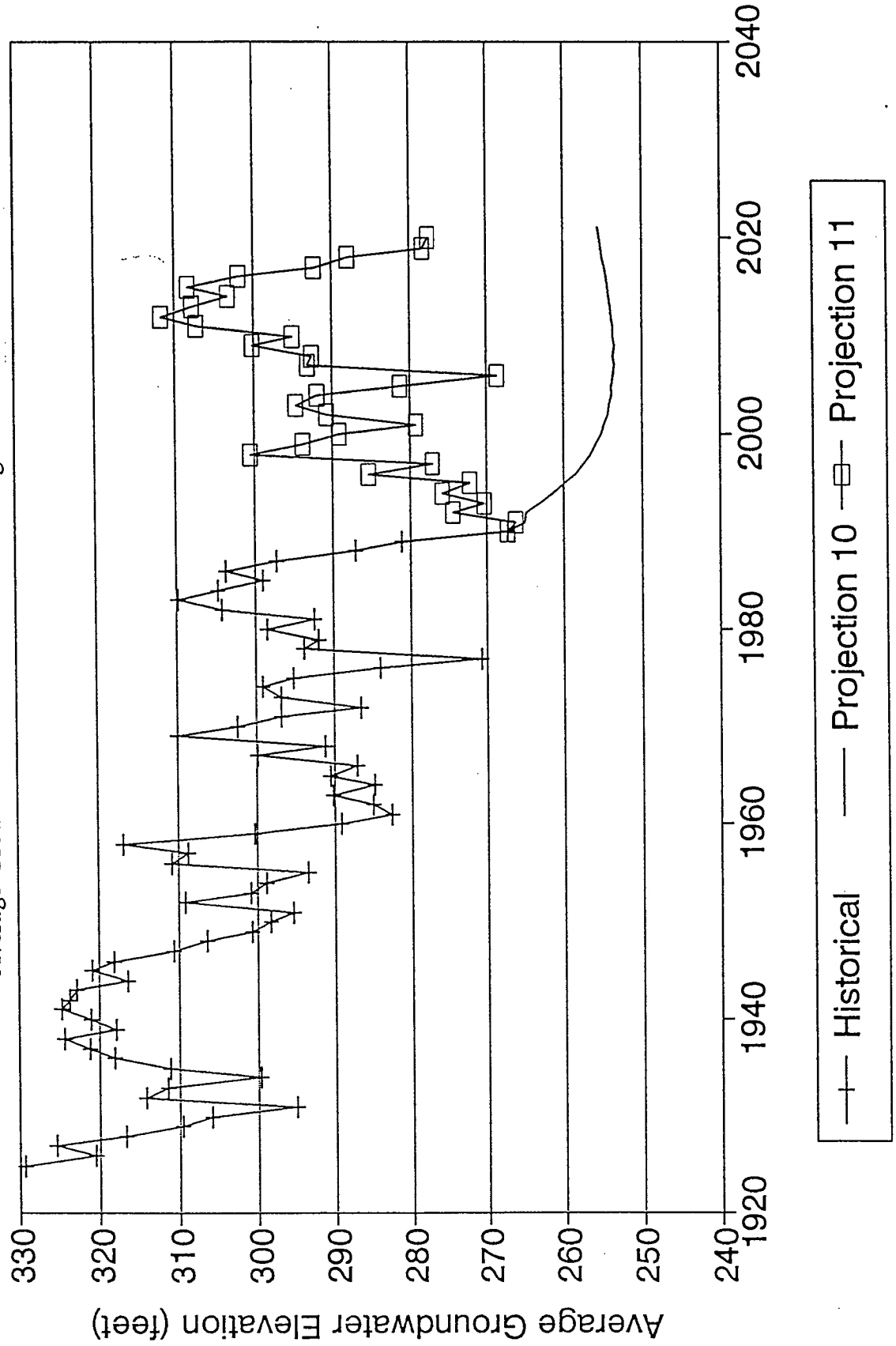
Model runs (Runs 10 and 11) indicate that the overdraft may be reduced in the future (Figure 66). It is likely that this occurrence would be the result of a combination of reduced district consumption and an increase in net subsurface inflow (including Kings River seepage) resulting from overall lower groundwater levels.

It must be emphasized that this conclusion is based on the assumptions of constant cropping patterns, certain expanding urbanization, and a fixed rate of consumption of water by urban users. Accordingly, this model should be updated periodically.

REALLOCATED SURFACE WATER

The proposed plans to reallocate surface water during years of critical allotment would certainly be a benefit to growers with a poor groundwater supply. The model runs indicate that this reallocation would have a negligible effect on the groundwater elevations in the vast majority of the district. This leads to the conclusion that the proposed reallocation of surface water would have no significant adverse impact on the groundwater supply, but could have significant benefits to the areas receiving reallocated surface water.

Figure 66
Average Groundwater Elevation: 1924 through 2021



RECHARGE EFFECTIVENESS

Alta's delivery system is a very effective passive recharge facility. The modeling effort indicates that approximately 25 percent of Alta's surface water is recharged in any given year.

The Kings River channel is an integral part of Alta's recharge ability. During dry years, the water table drops to a level that allows the Kings to infuse large quantities of water into district aquifers. During wet years, the River provides a safety valve that helps to prevent the water table from inundating Alta's growers.

INCREASED IRRIGATION EFFICIENCY

The results of the groundwater model suggest that a wide-spread increase in irrigation efficiency would have little effect on Alta's groundwater quantity. Average groundwater elevations between projection Runs 2 and 3 were very small. Localized differences in the water table are a likely result of the lack of recharge from deep percolation that results from improved irrigation efficiency.

An increase in irrigation efficiency does, however, have a large potential to improve the long-term quality of Alta's groundwater. By reducing deep percolation, the amount of groundwater degradation caused by excessive nutrient and agricultural chemical leaching would be significantly reduced.

An increase in irrigation efficiency would also greatly reduce the energy consumption of the region by reducing groundwater pumping requirements.

CANAL LINING AND PIPING

Given the accuracy of the groundwater model predictions, it appears that if Alta were to line or pipe all of its canals there would be a negligible effect on groundwater levels. The result is not unexpected considering that regardless of canal seepage, the total volume water that enters and exits Alta remains the same.

Subsurface groundwater flow could be affected by an extremely large volume of seepage. However, Atla's average volume of seepage is approximately 38,000 acre-feet per year would result in an average groundwater elevation change of less than three feet. Because this change would not significantly affect groundwater boundary gradients, water that is recharged through Alta's canals for the most part remain available for future pumping.

Widespread canal lining would, however, result in an average reduction of groundwater pumping of about 40,000 acre-feet per year.

The model projection used to predict the effects of wide-spread canal lining was based on the assumption that water conserved through lining could be held in storage and delivered to growers at a later date. This assumption was not confirmed. It is possible that lack of upstream storage could result in a reduction of Alta's water diversion in wet years. If this were the case, then canal lining could result in lower groundwater levels.

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Appendix A

Glossary of Terms

Glossary of Terms

Note: the definitions presented are not all-inclusive but are presented for the benefit of the reader of this report. The terms included may have other broader definitions that do not apply to this report and are not presented here.

Accretion: the movement of groundwater from an aquifer to a stream or water body.

Aquifer: a ground-bearing formation that is sufficiently permeable to transmit and yield water in usable quantities; usually composed of gravel, sand, or other course-textured particles.

CVGSM: acronym for the Central Valley Groundwater/Surface Water Model (JMM, 1990).

Data file: described in this study is a table of numbers that represent parameters used by the groundwater model and stored in digital form that can be used by a computer; the IGSM uses approximately 21 data files that contain a total of approximately 225 printed pages of information.

Effective porosity: the percentage of the volume of a porous media (soil or aquifer) that is available for flow; effective porosity is usually less than porosity.

Field capacity: the water content in a field soil after the drainage rate has become small; it is an estimate of the amount of water that may be temporarily stored in the soil profile for plant use.

Groundwater model: a simplified representation of the flow, extraction, recharge and storage of an aquifer system.

Groundwater/surface water model: a computer model containing groundwater and surface water components that are linked together computationally.

Groundwater overdraft: the long-term decline of the useable quantity of groundwater.

Heterogeneity: consisting of dissimilar or diverse ingredients or constituents; as applied to aquifers, related to differences in horizontal and vertical hydraulic conductivities.

Historical creeks: for this report, refers to creek beds, channels, or strips of light-textured soils that appear to have once been streams; these formations often act as conduits for subsurface flow of groundwater.

Horizontal hydraulic conductivity: the measure of how effectively groundwater moves through a porous media (soil or aquifer) in the horizontal direction; usually expressed as feet per day.

Hydraulic conductivity: the measure of how effectively groundwater moves through a porous media (soil or aquifer); hydraulic conductivity is further defined by its direction, see Vertical Hydraulic Conductivity and Horizontal Hydraulic Conductivity; usually expressed as feet per day.

IGSM: an acronym for the Integrated Groundwater/Surface Water Model (JMM, 1990).

Irrigation efficiency: the ratio of plant water use to applied water; a measure of how much of applied irrigation water is used to sustain plant growth.

Isohyet: a line on a chart or graph connecting areas of equal rainfall.

Leakance: the measure of groundwater flow through a confining layer, such as the Corcoran Clay or bedrock.

Mass balance: a method of accounting for the quantity (mass) of material (water) that enters, exits and is stored within a defined boundary; synonymous with Water Balance.

Net inflow: the difference between inflow and outflow; usually expressed as a positive number indicating that inflow is greater than outflow.

Net outflow: the difference between outflow and inflow; usually expressed as a positive number indicating that outflow is greater than inflow.

Numerical groundwater model: a mathematical representation of an aquifer system, usually existing on a digital computer; See Groundwater Model.

Overdraft: for this report is synonymous with Groundwater Overdraft.

Porosity: the total volume of pores in a porous media (soil or aquifer), usually expressed as percentage.

Root zone: the strata of soil immediately below the ground surface that contains plant roots; the portion of soil that can hold water for use by crops.

Specific storage: the yield of an aquifer per unit of drawdown; this parameter takes into account the volume of water that an aquifer will yield and the compressibility of the aquifer material; this parameter is usually insignificant for unconfined aquifers.

Specific yield: the volume of water that is released from a given volume of aquifer; related to the amount of water that can be pumped from an aquifer; usually expressed as a percentage.

Standard deviation: represents the deviation of a series of numbers from the average of the series; a measure of the typical variation of measured values, such as river flows.

Stratigraphy: geology that deals with the origin, composition, distribution, and succession of strata; a description of the thickness, texture, and other parameters of aquifer layers.

Subsurface inflow: the flow of groundwater through a porous media (aquifer) that enters a defined boundary.

Subsurface outflow: the flow of groundwater through a porous media (aquifer) that exits a defined boundary.

Subsurface flow: the flow of groundwater through a porous media (aquifer).

Unconfined Aquifer: an aquifer that is not confined from above by an impermeable layer or other formation and in which the water contained is under the pressure exerted by the overlying water and atmospheric pressure; the water table in an unconfined aquifer will fluctuate with extraction and recharge; commonly found on the east side of the San Joaquin Valley.

Vadose zone: the unsaturated portion of the soil between the ground surface and the water table.

Vertical hydraulic conductivity: the measure of how effectively groundwater moves through a porous media (soil or aquifer) in the vertical direction; usually expressed as feet per day.

Water balance: a method of accounting for the quantity of water that enters, exits and is stored within a defined boundary; synonymous to Mass Balance.

Wetted perimeter: the perimeter or cross-sectional length of a conduit (pipe, stream, or channel) that is wetted by the fluid (water).

Appendix B

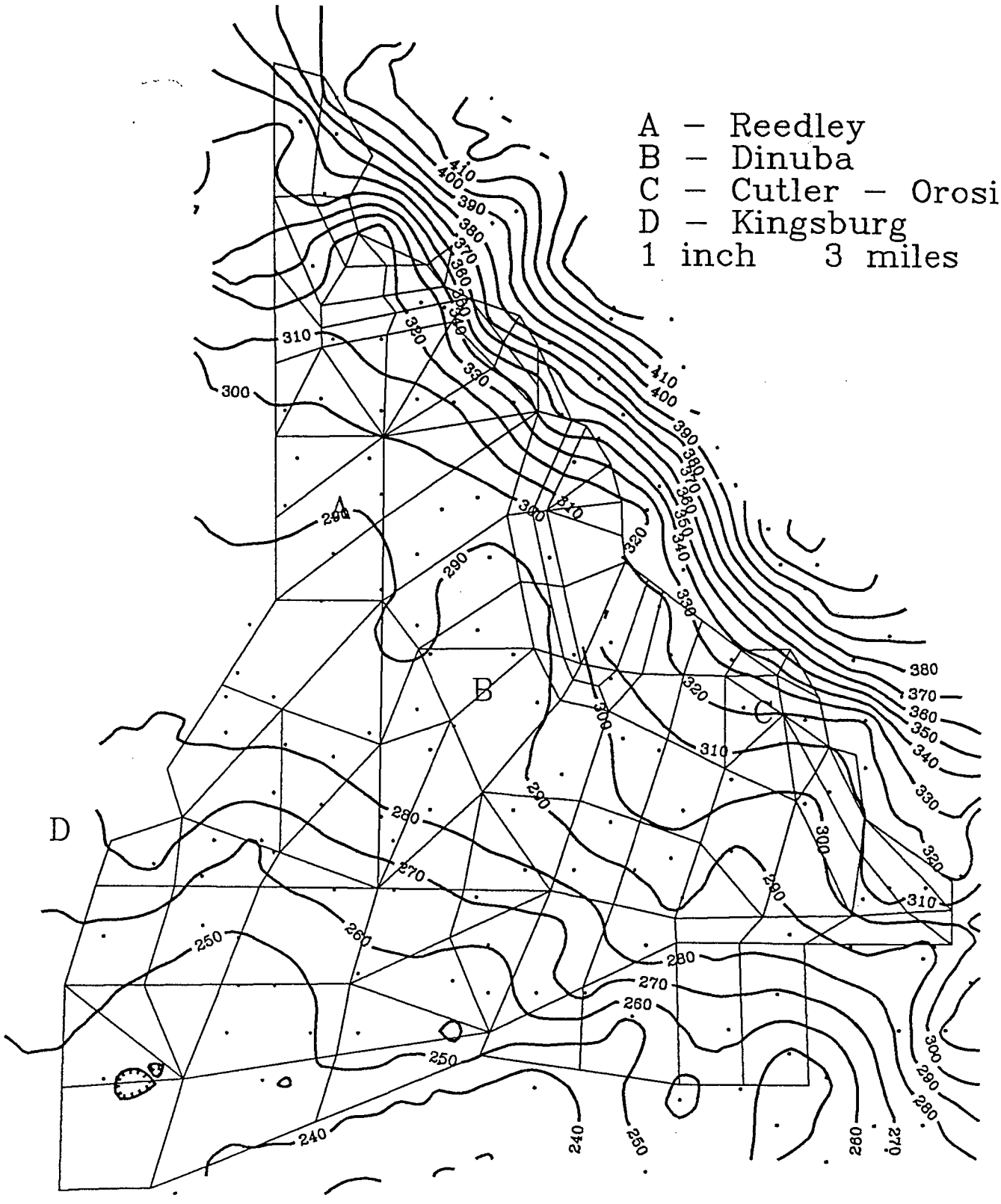
Alta Historical Groundwater Elevation Maps

NOTES

1. Groundwater elevations are from historical well readings (Alta I. D., 1962-1970, KDWCD, 1962-1970; USBR, 1962-1970; USBR 1970-1991).

2. Dots indicate monitoring well locations.

Alta ID Groundwater Elevation, Fall 1960



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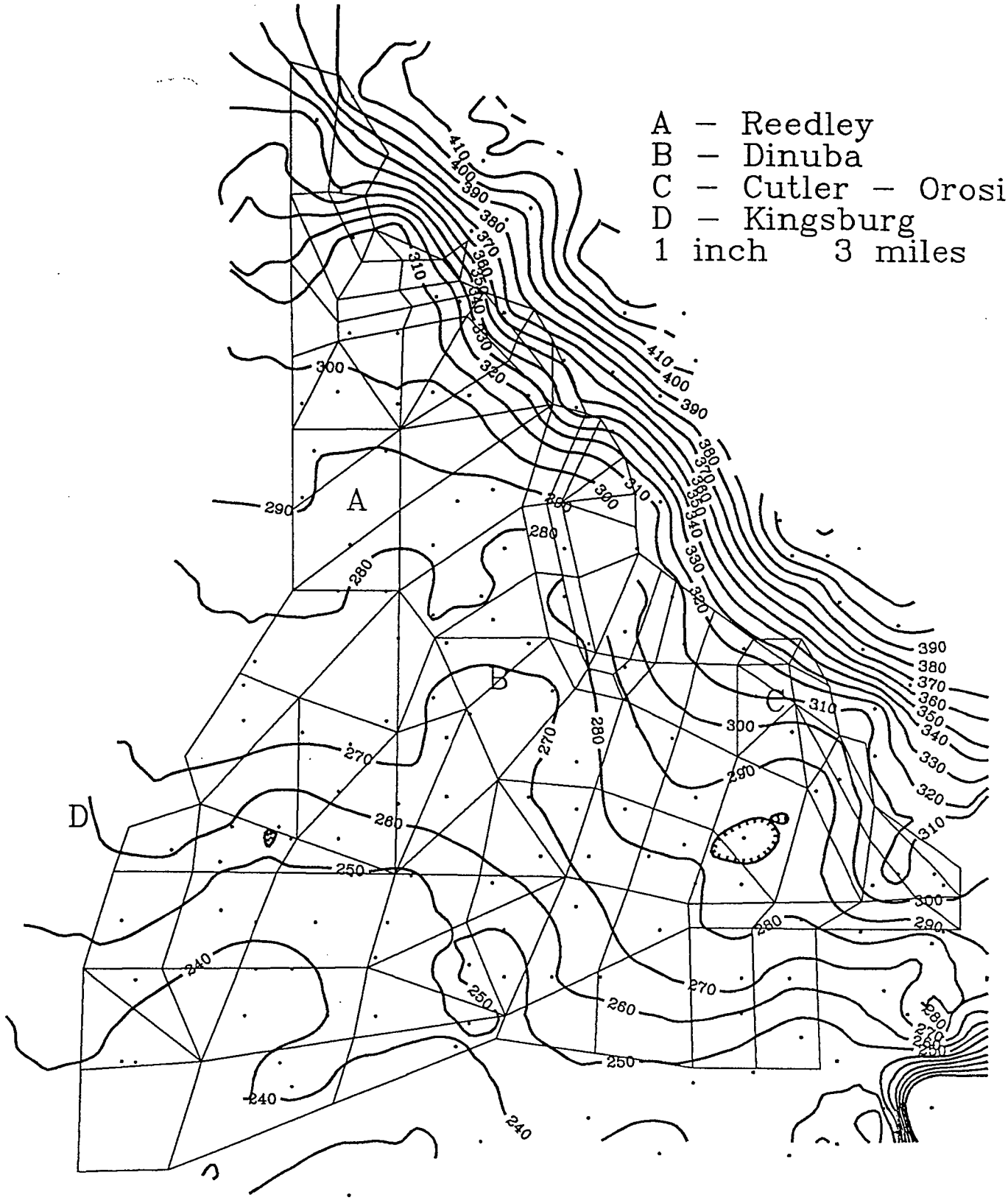

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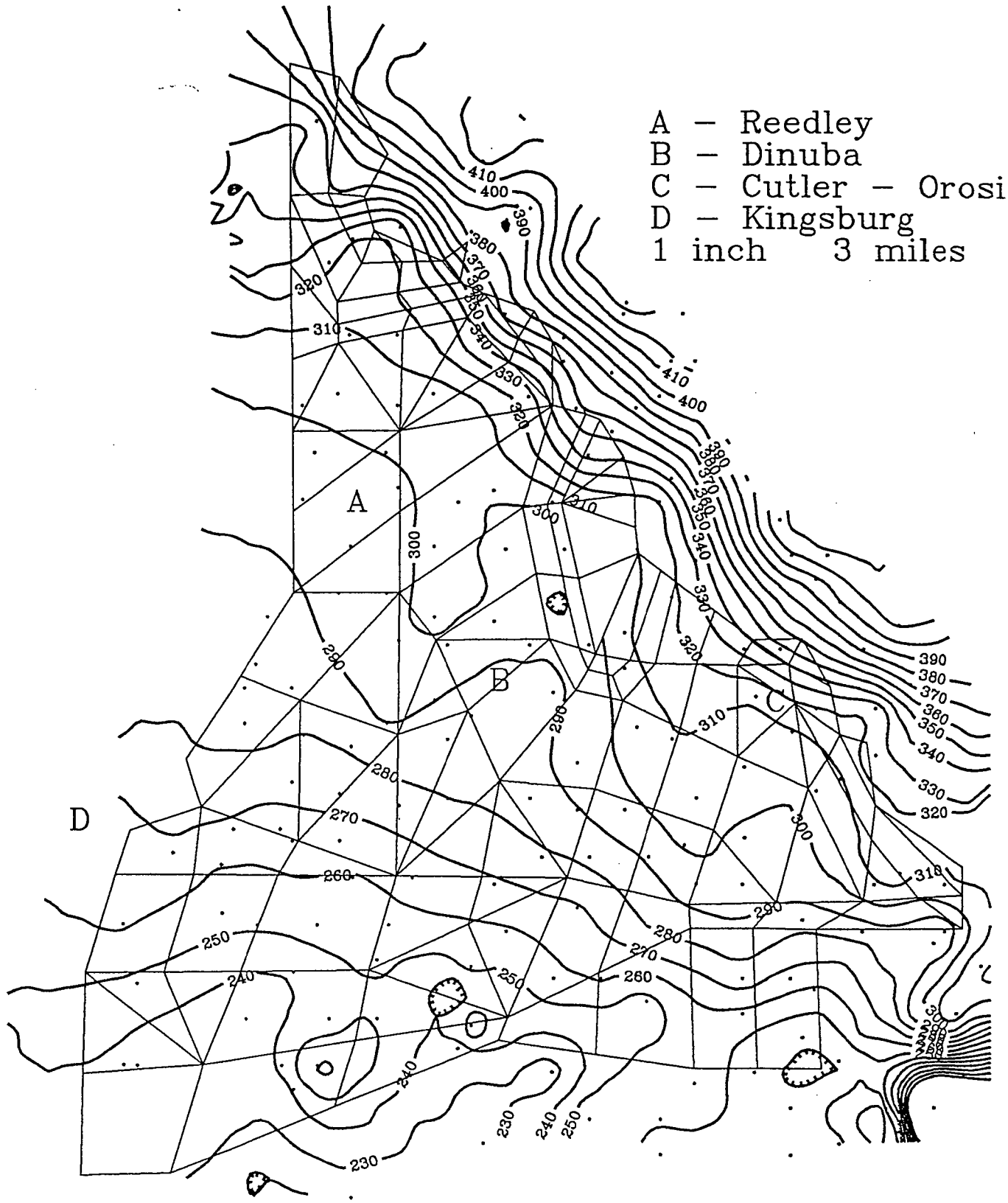
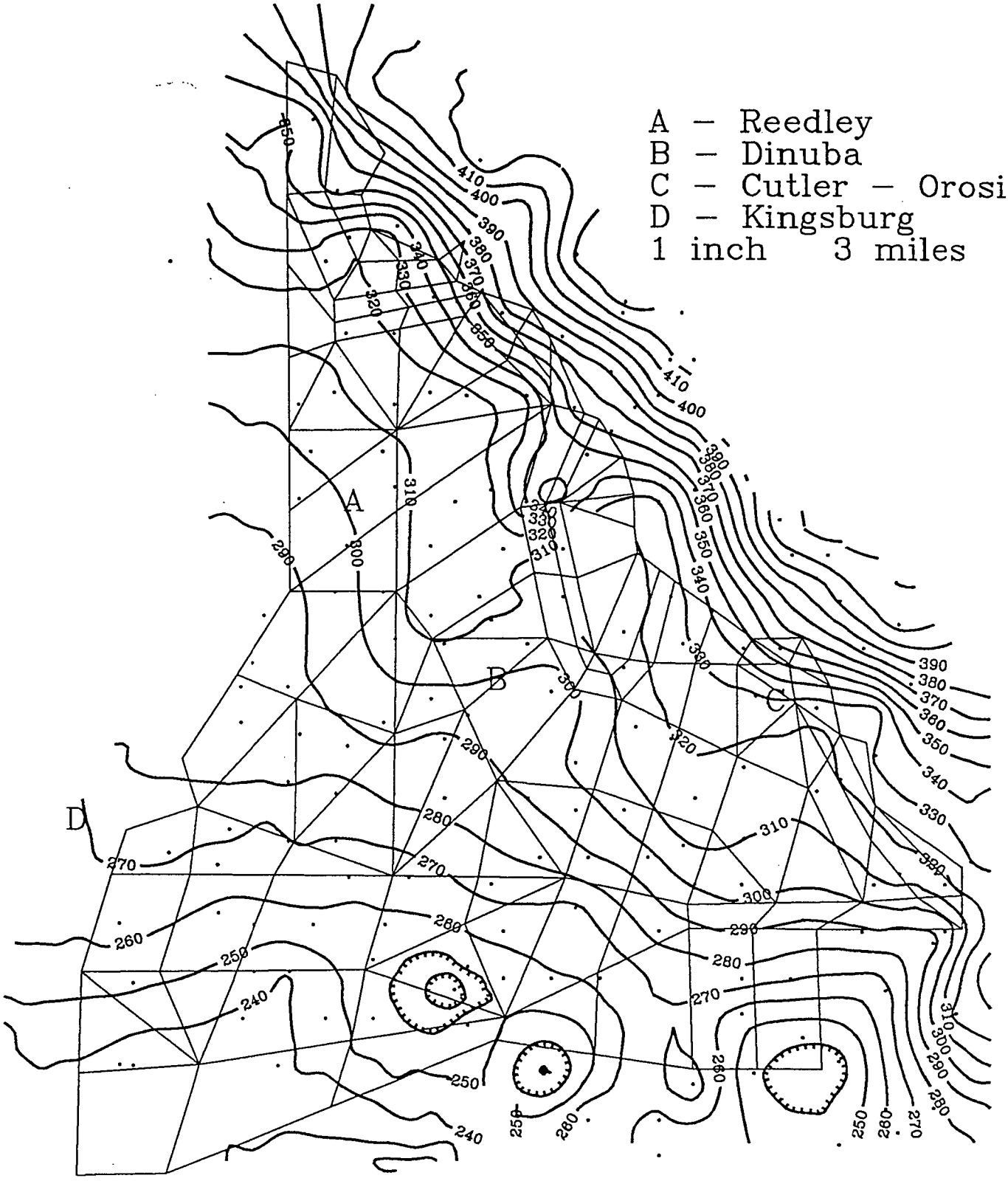


Alta ID Groundwater Elevation, Fall 1963



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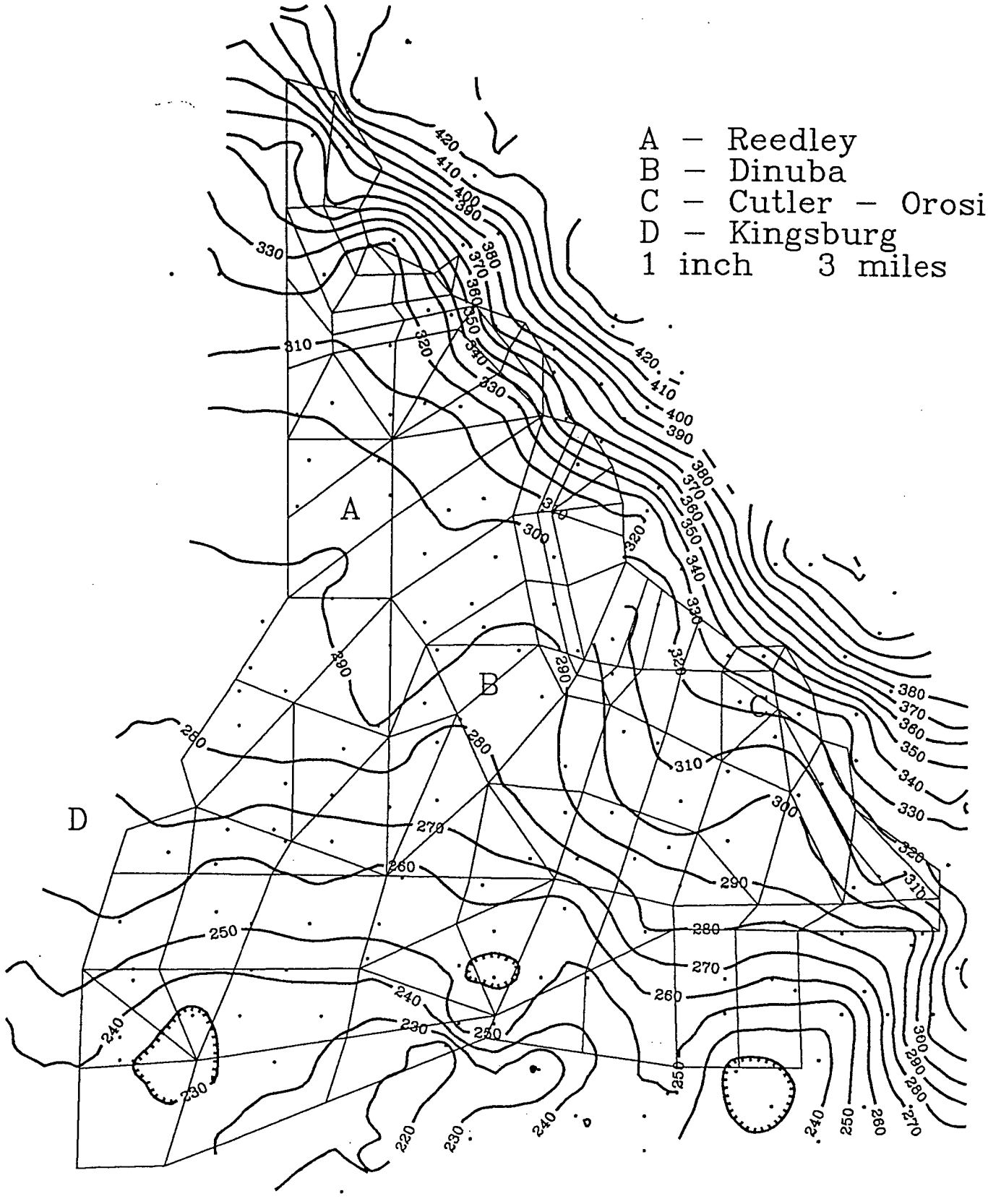
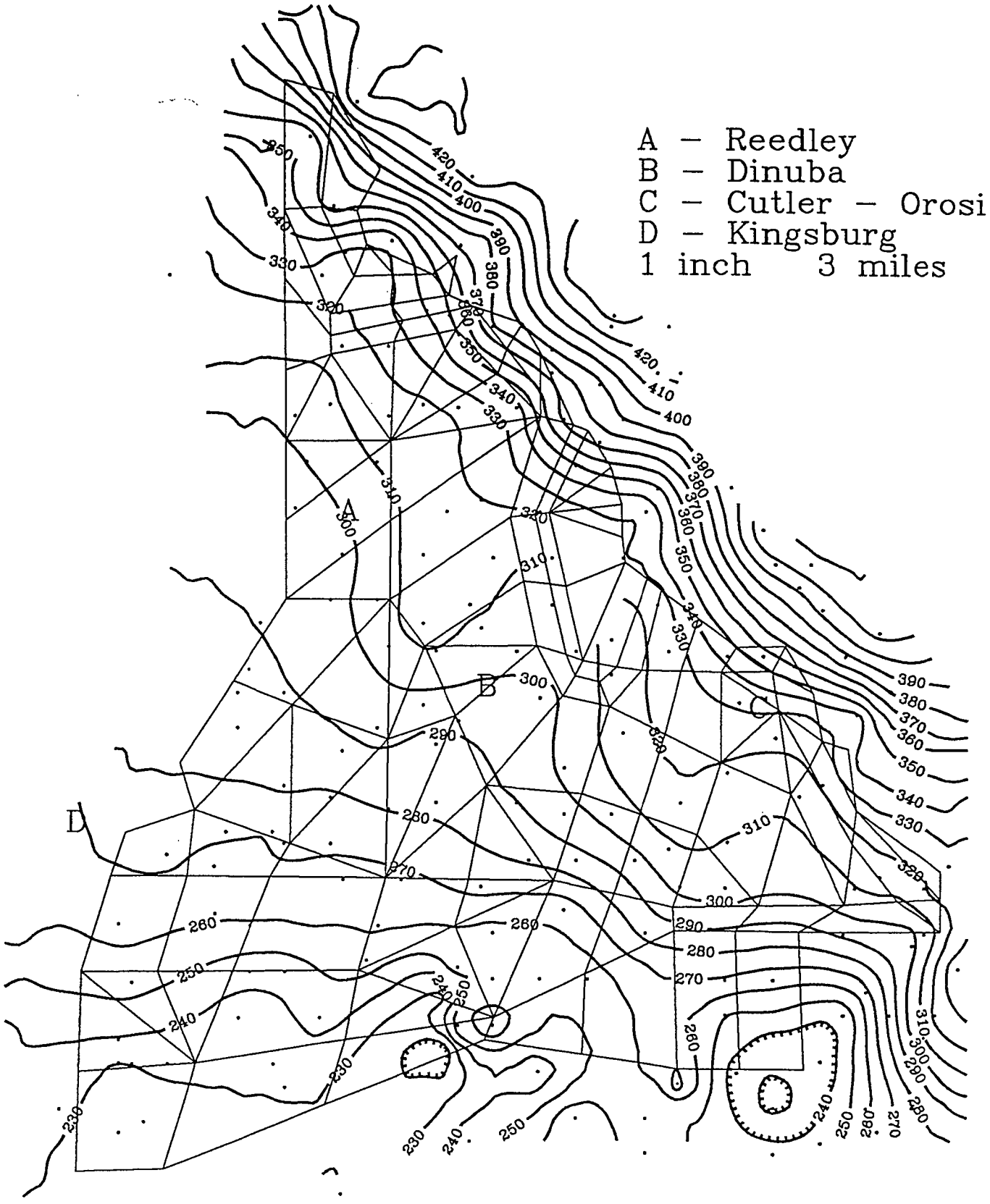
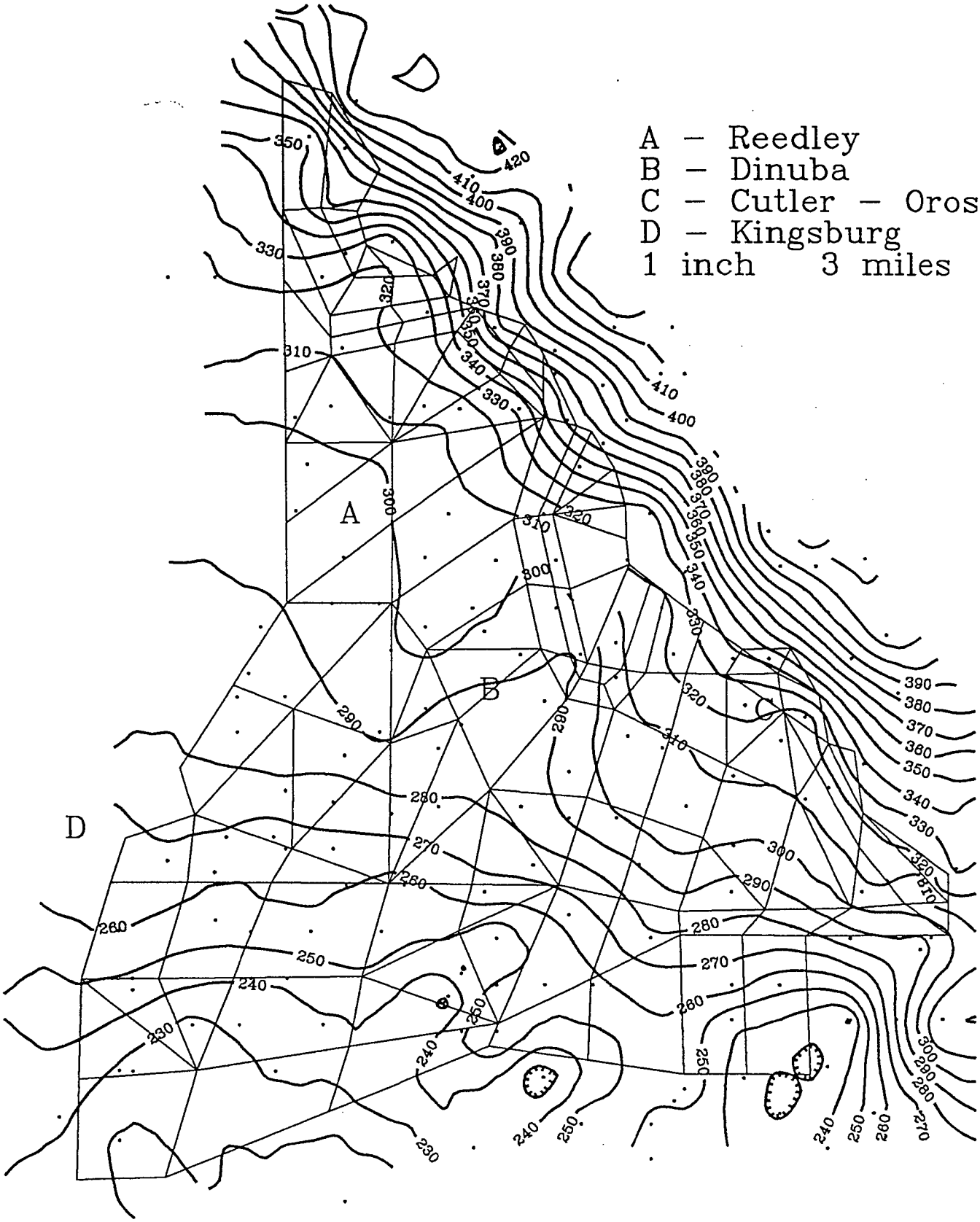


Alta ID Groundwater Elevation, Fall 1965



Alta ID Groundwater Elevation, Fall 1966



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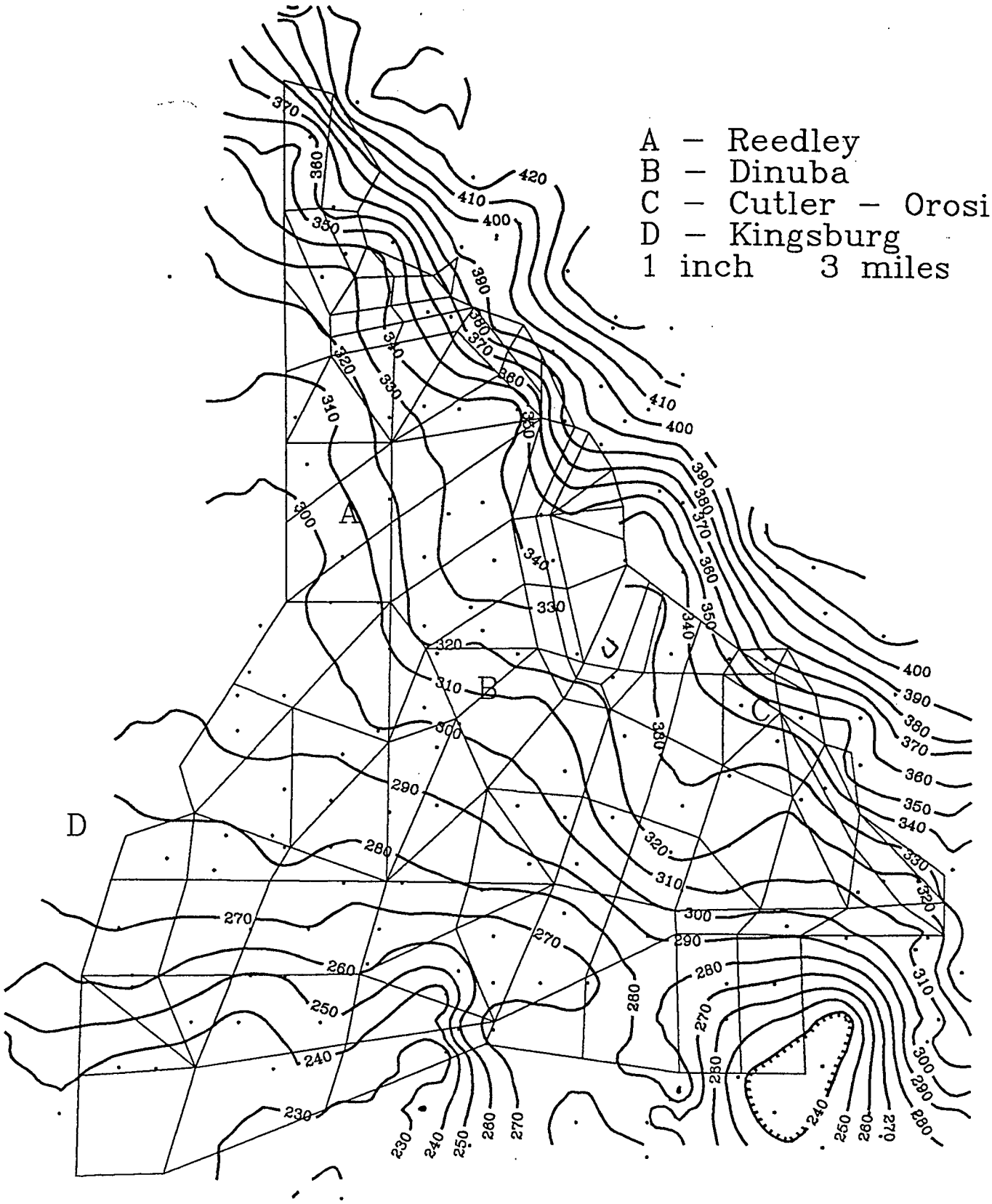

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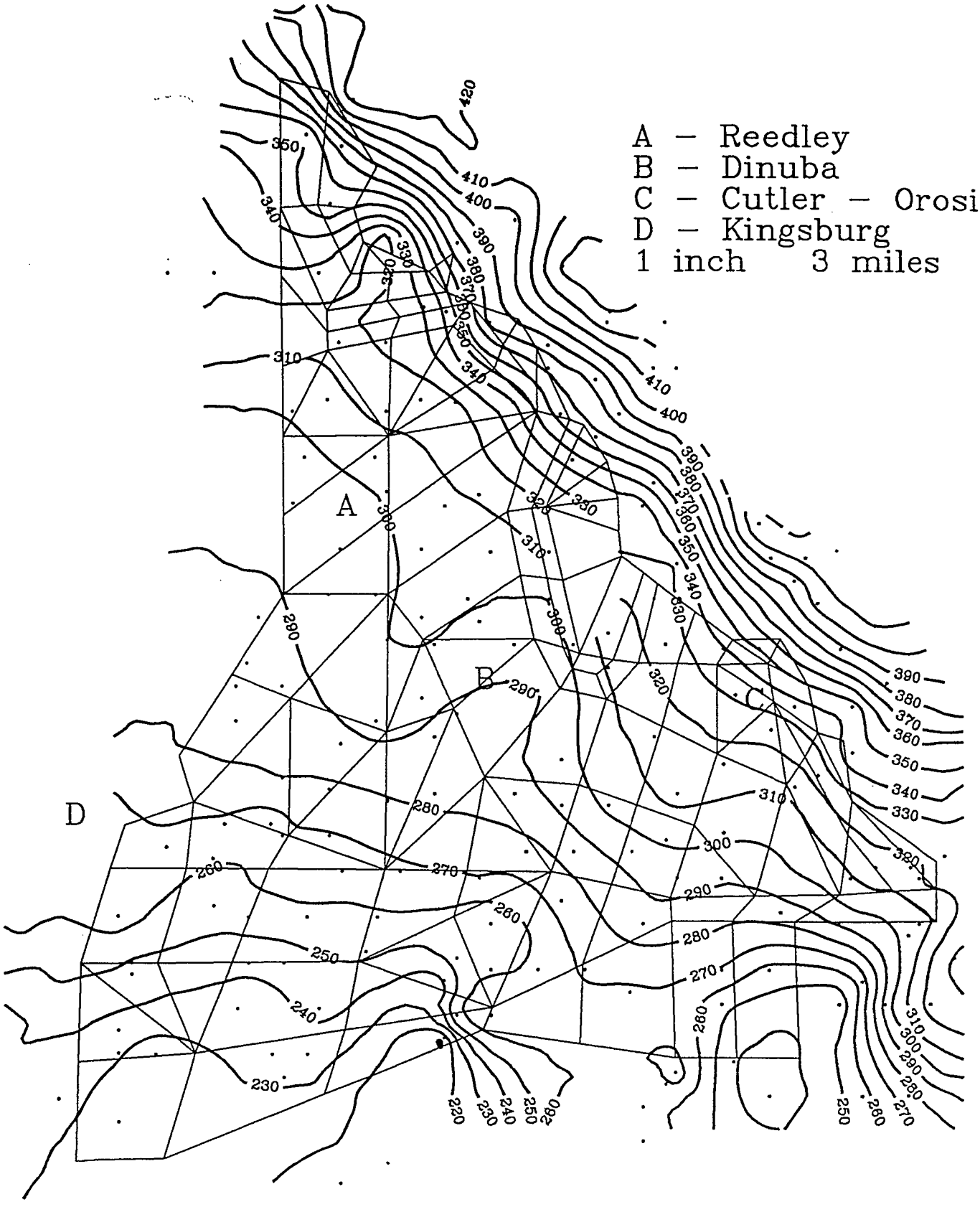

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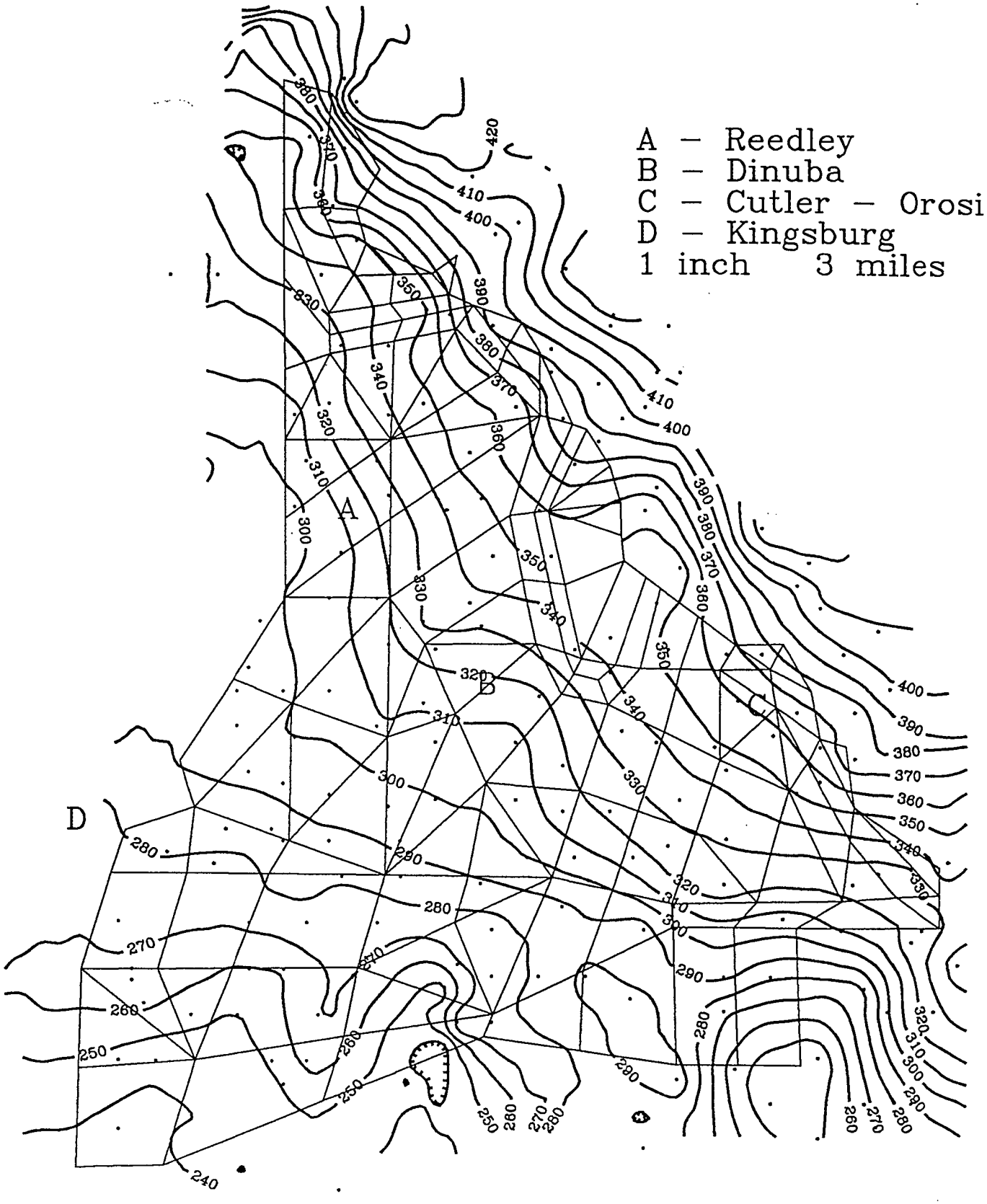

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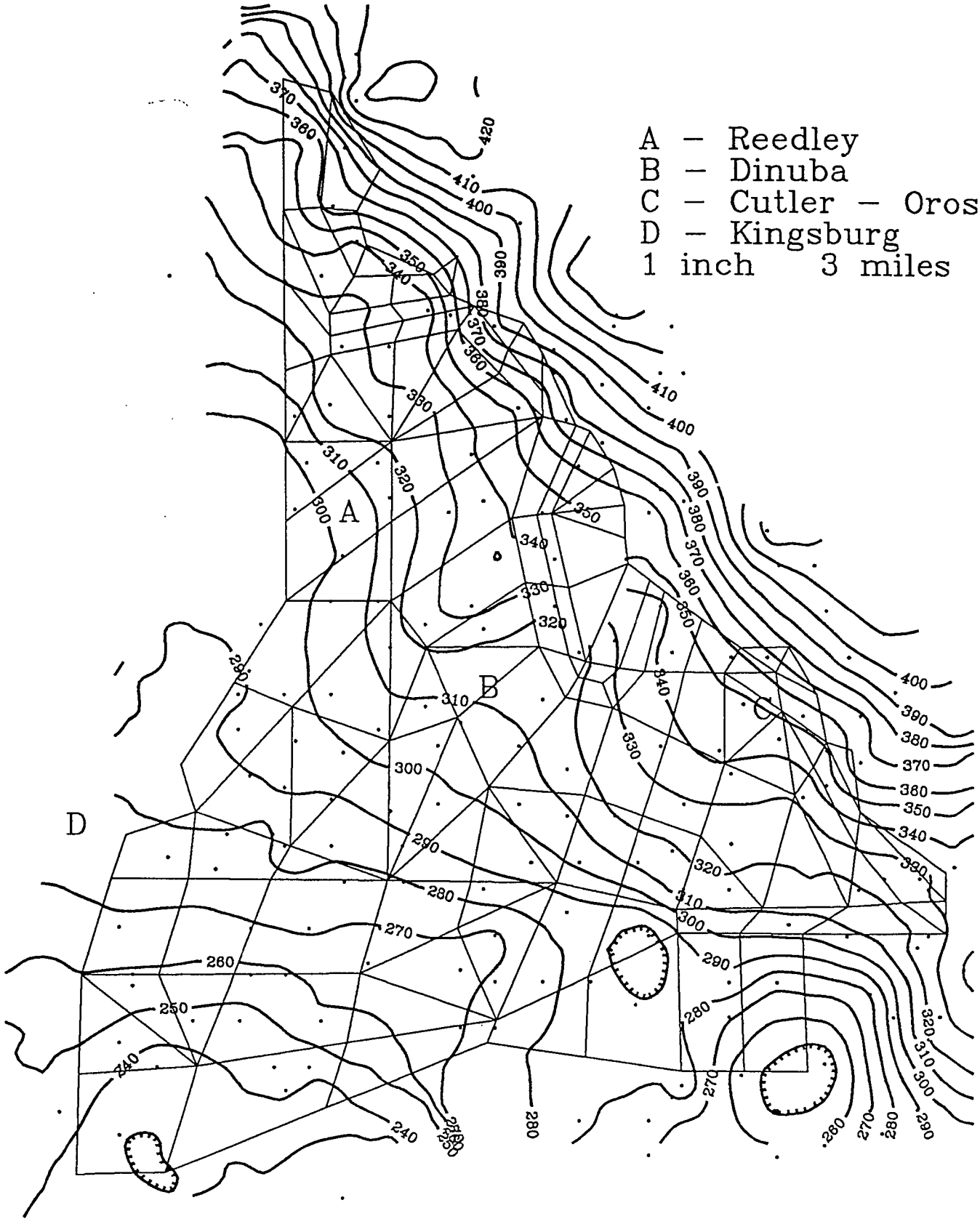
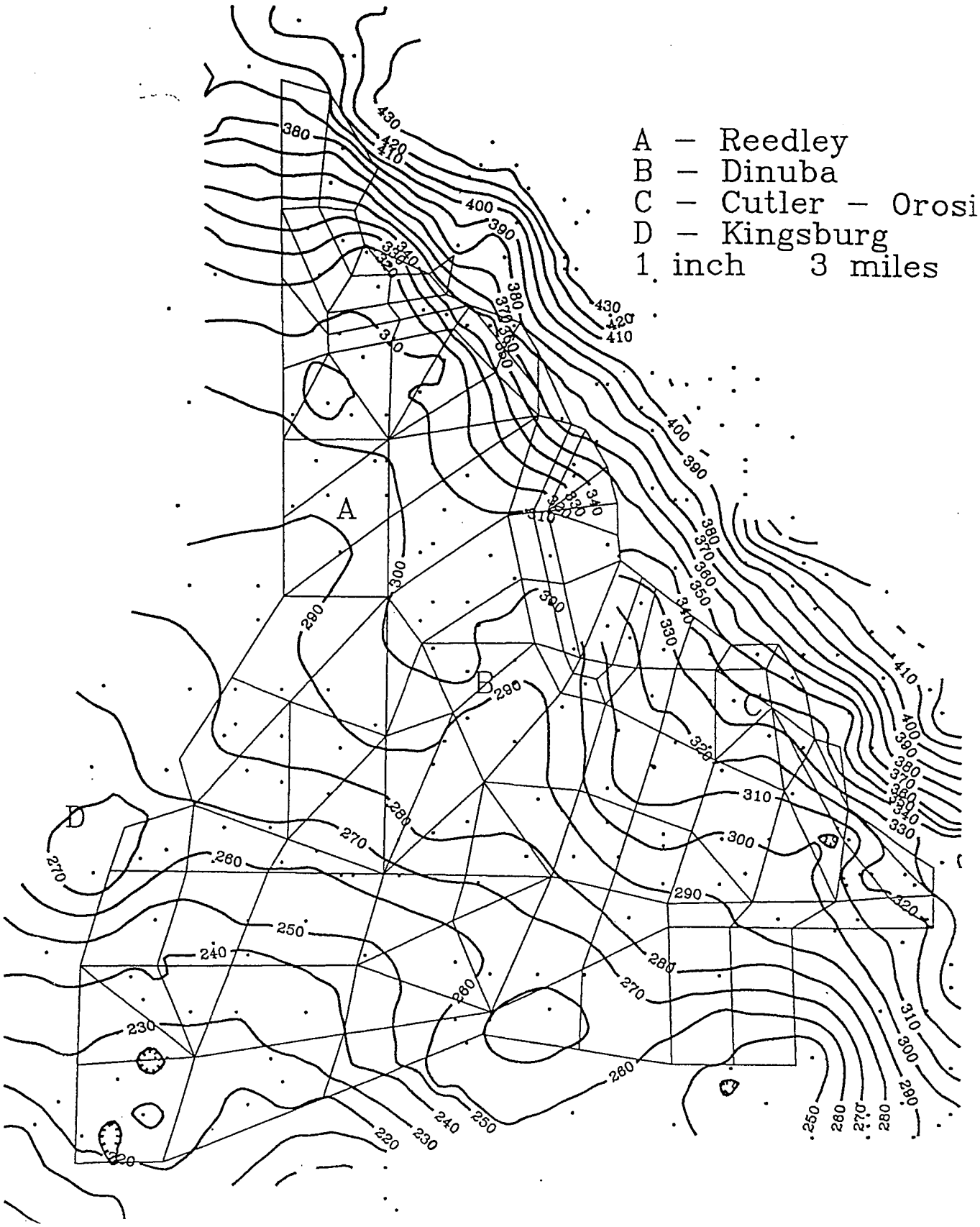


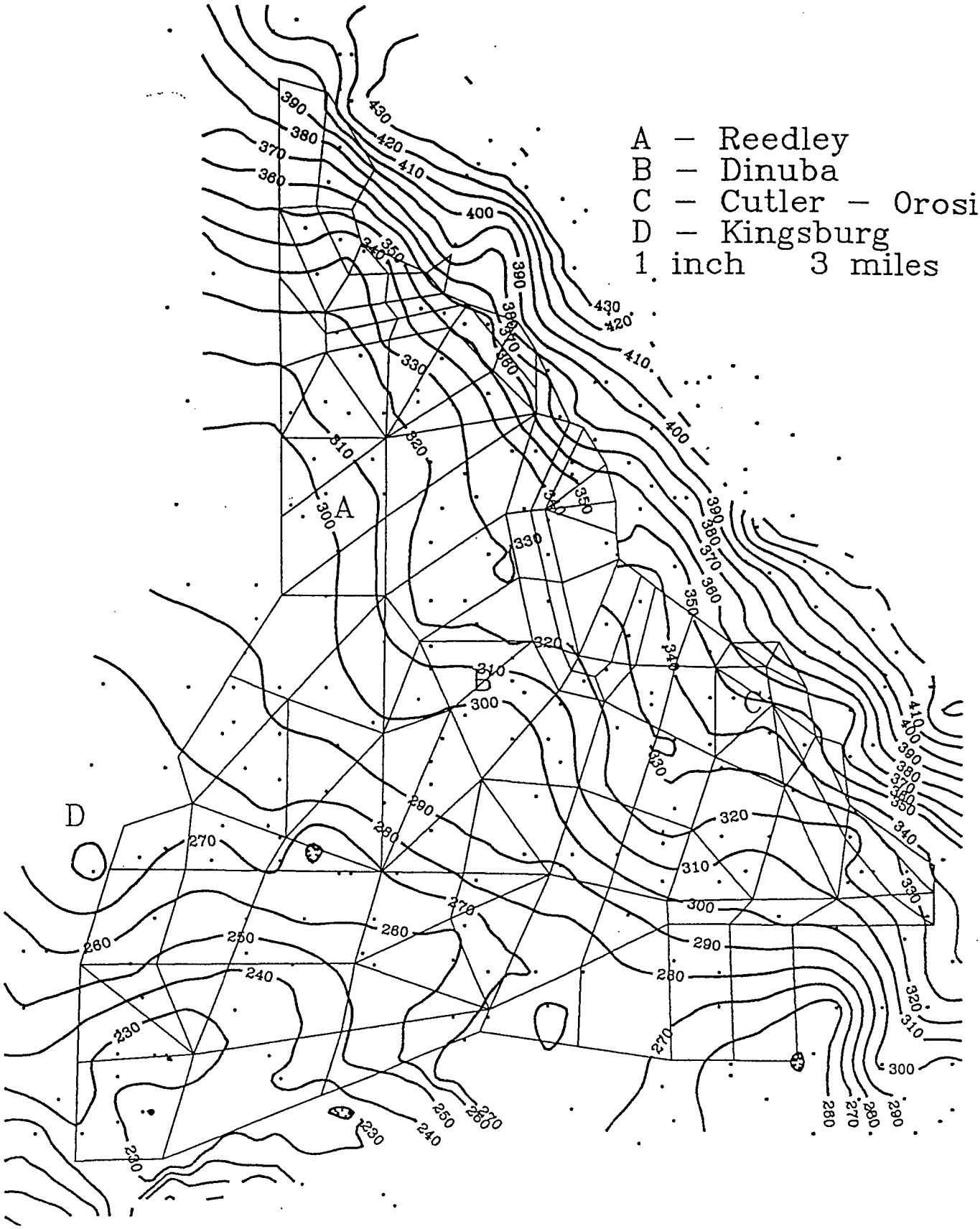
Alta ID Groundwater Elevation, Fall 1971

Insufficient Data Available
for Accurate Representation
of 1971 Groundwater Map

Alta ID Groundwater Elevation, Fall 1972



Alta ID Groundwater Elevation, Fall 1973



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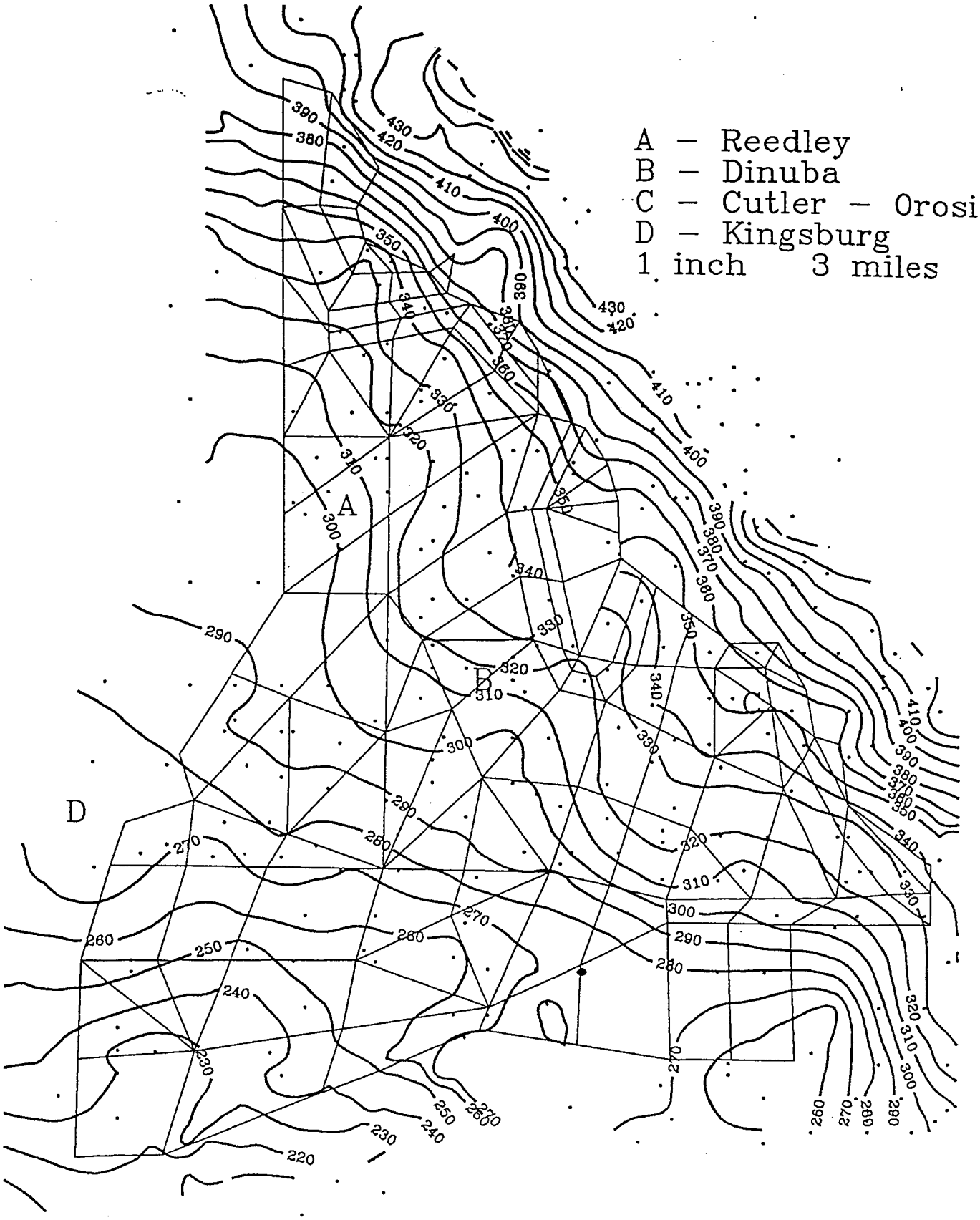

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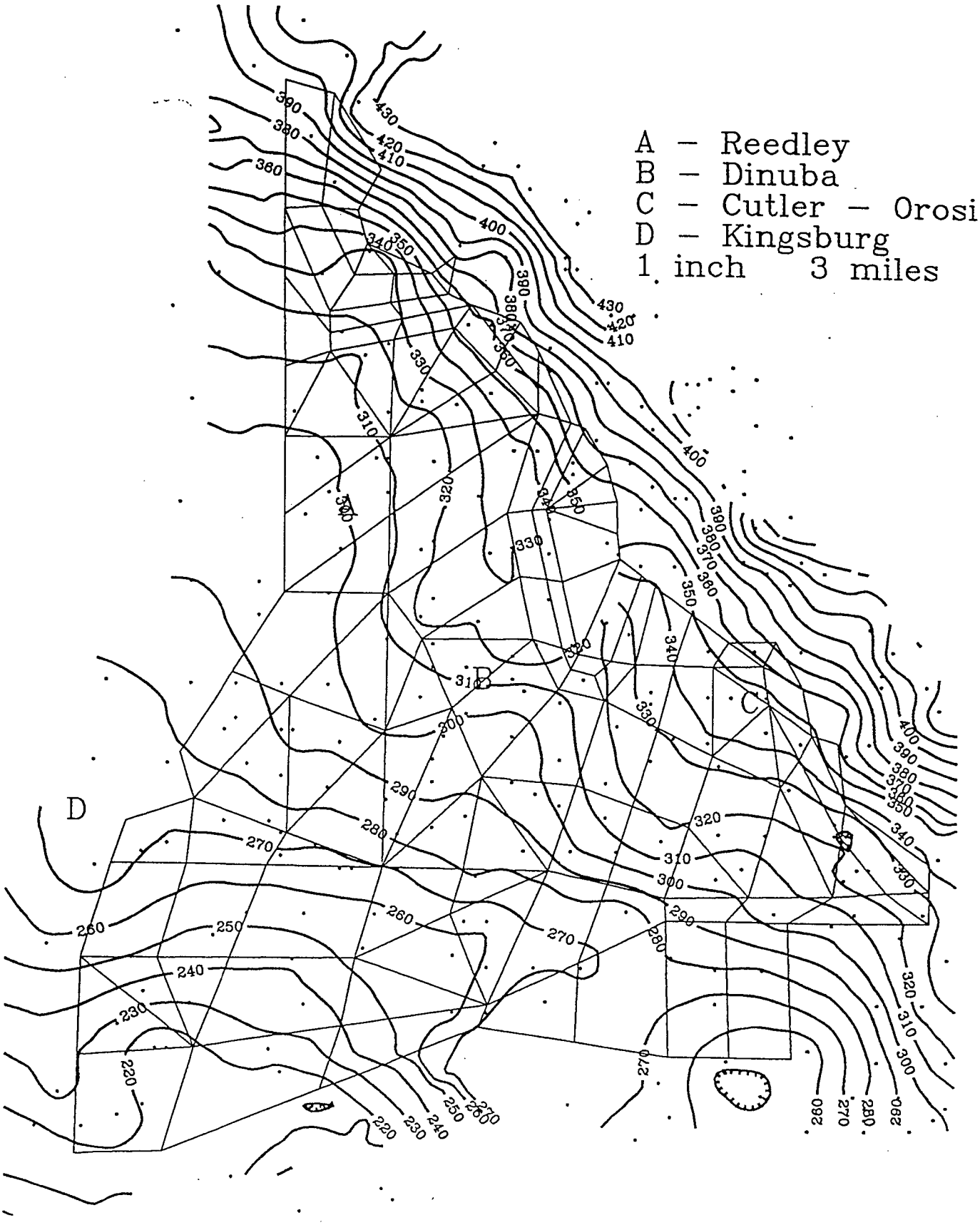

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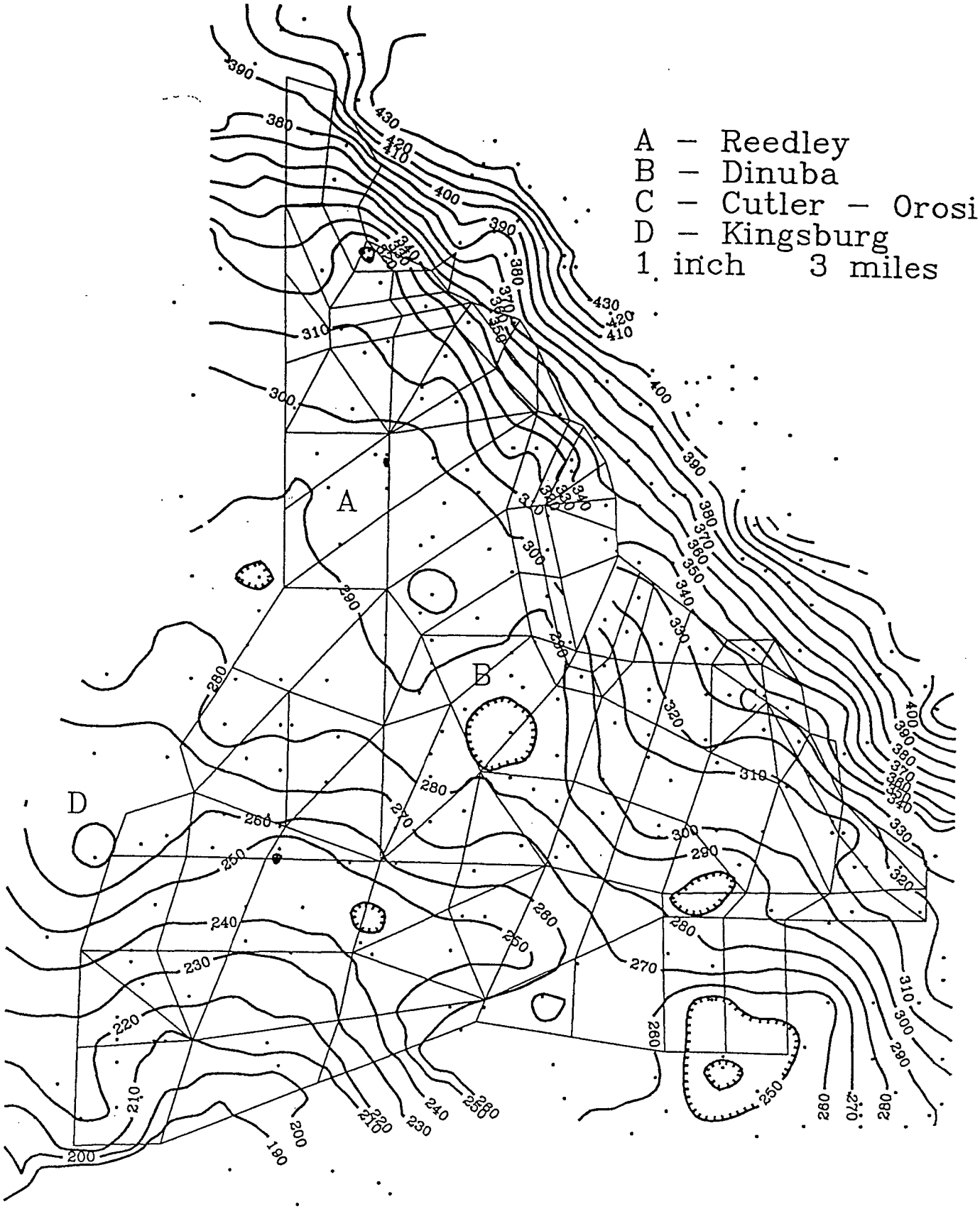
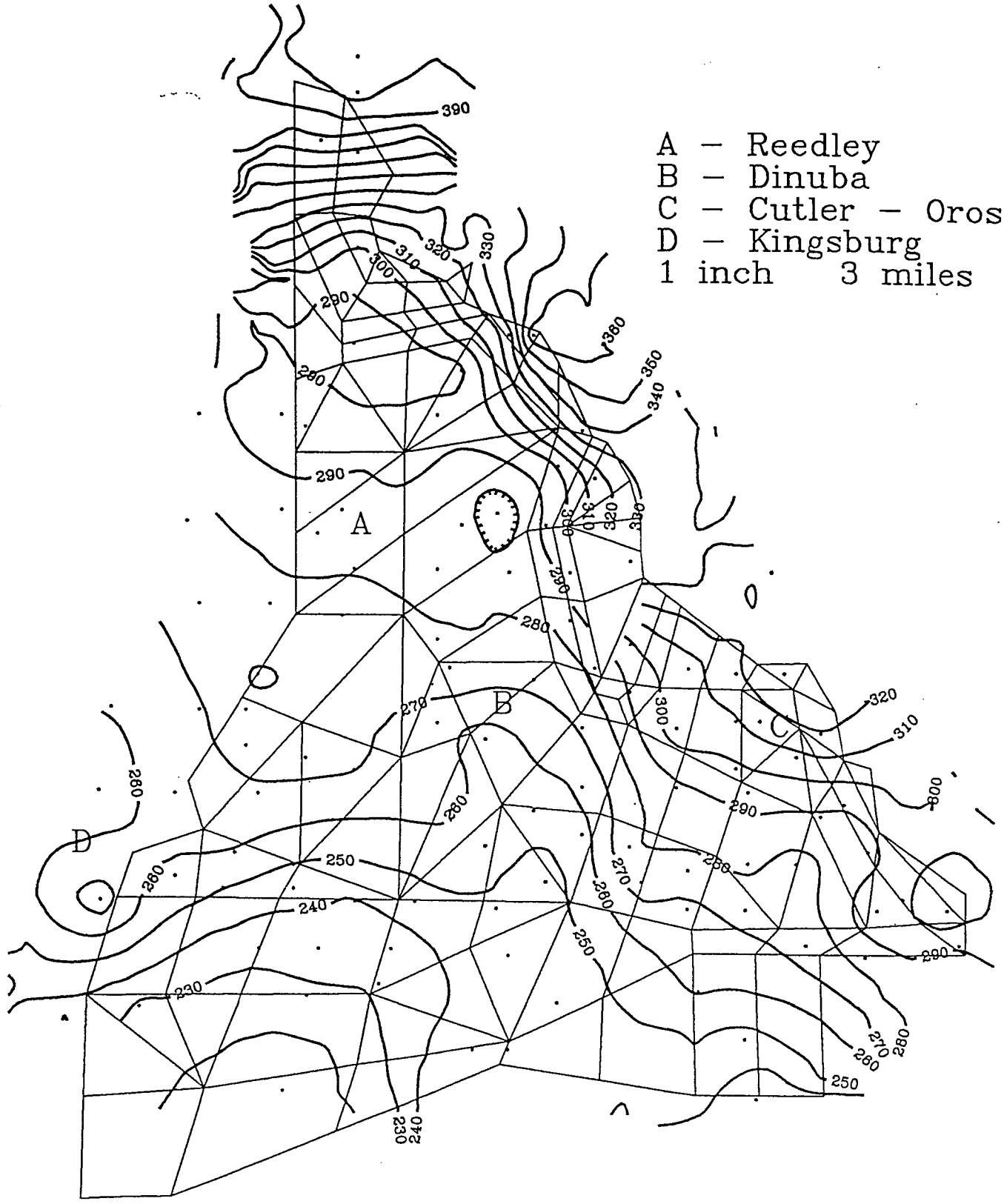


Alta ID Groundwater Elevation, Fall 1977



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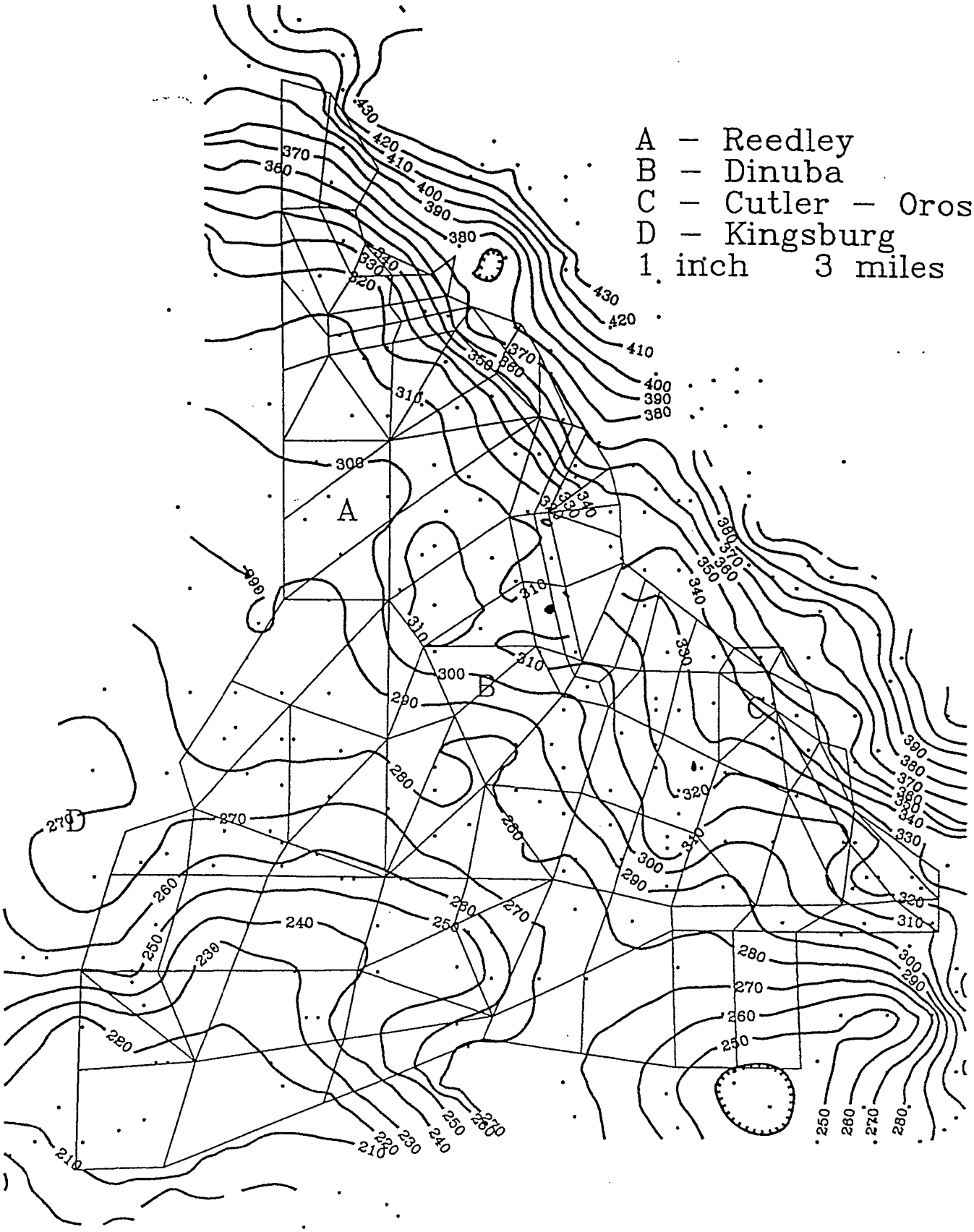

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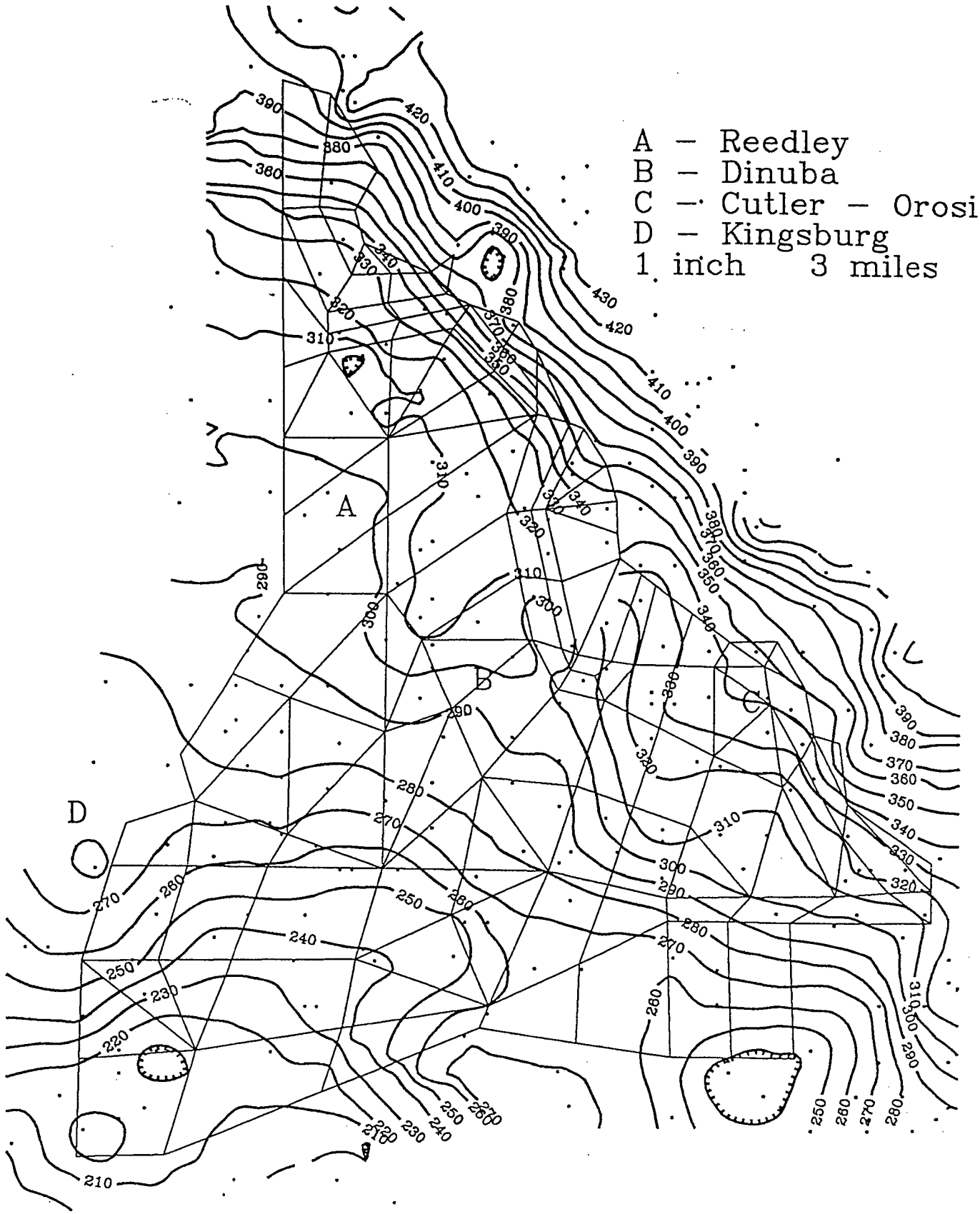

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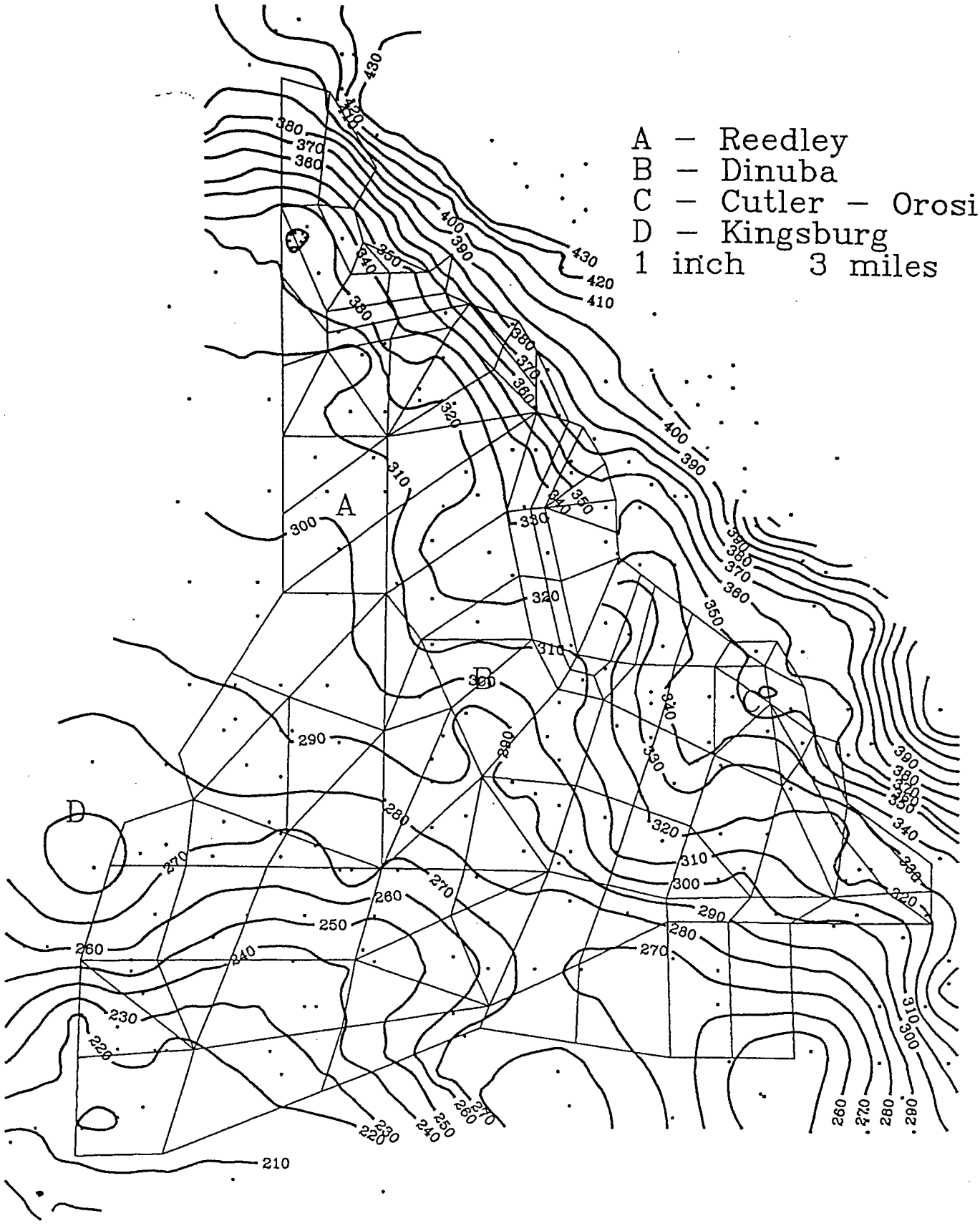

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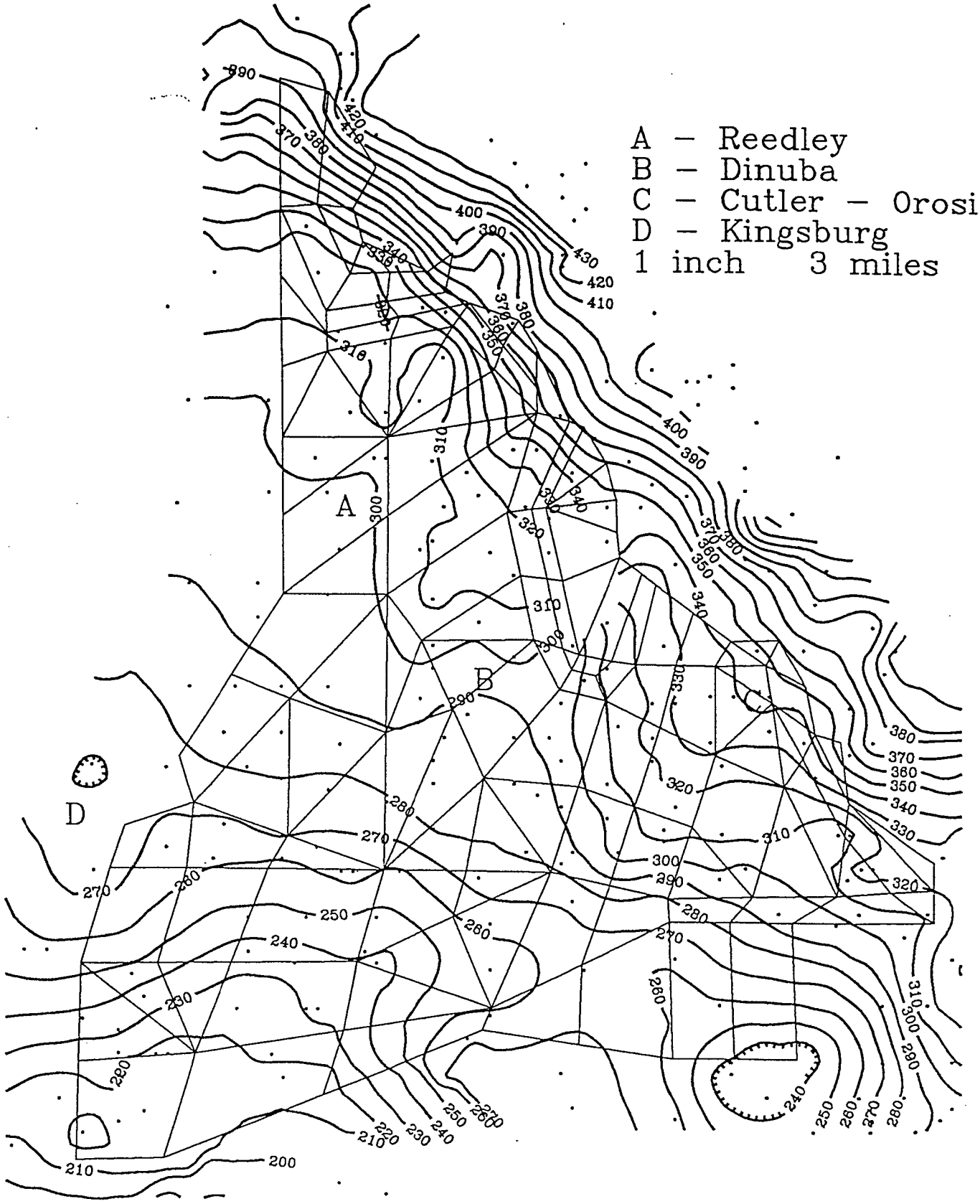

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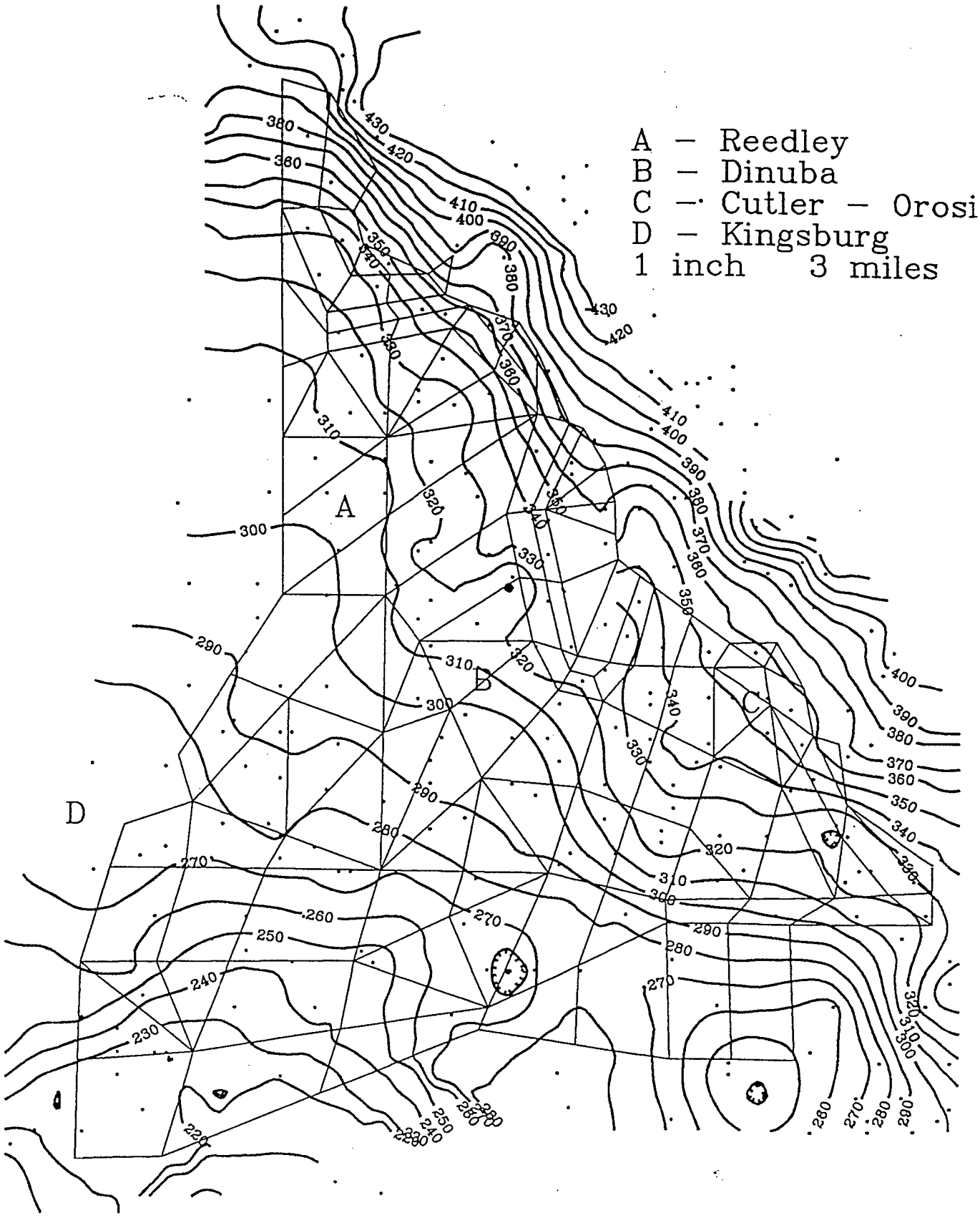

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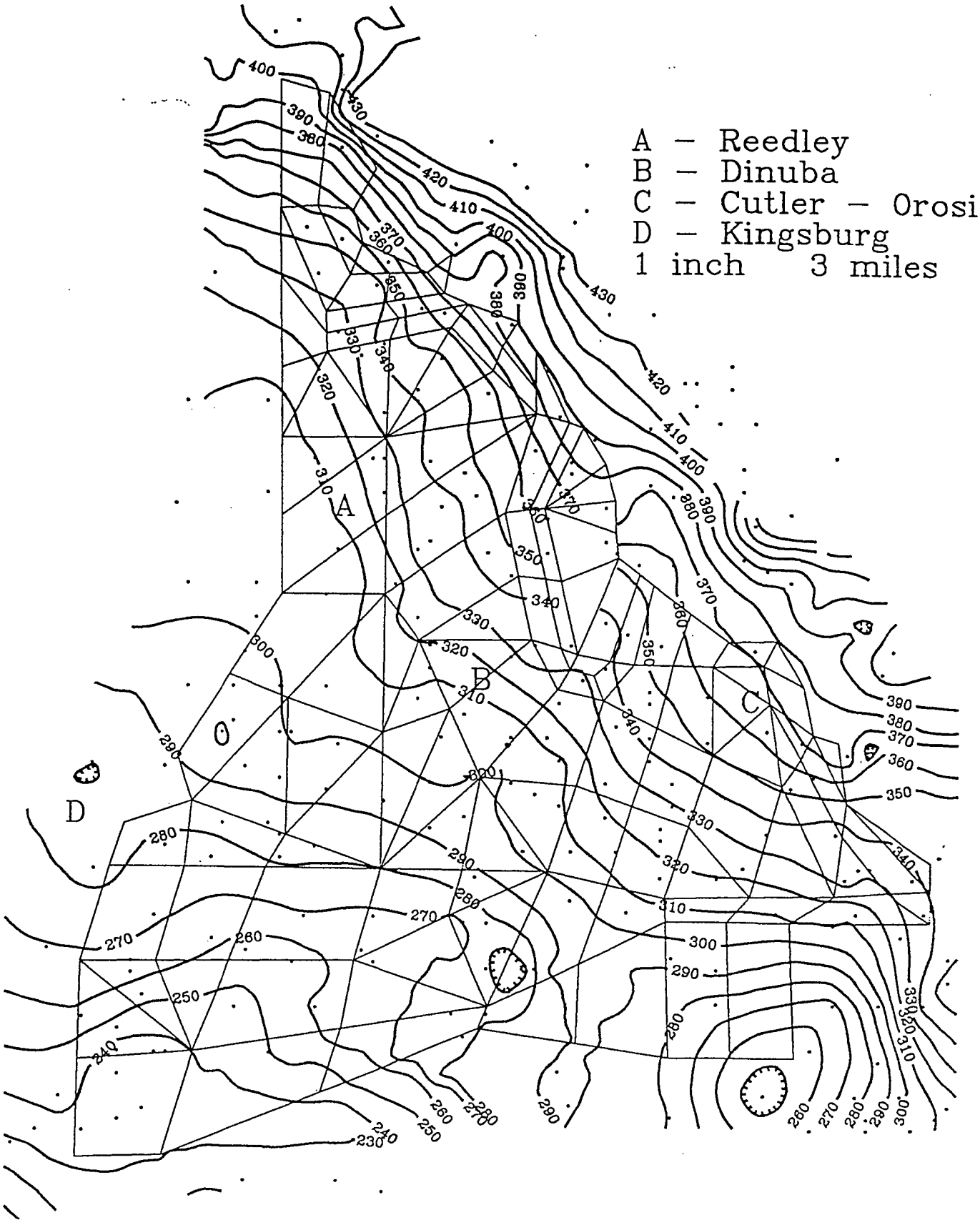

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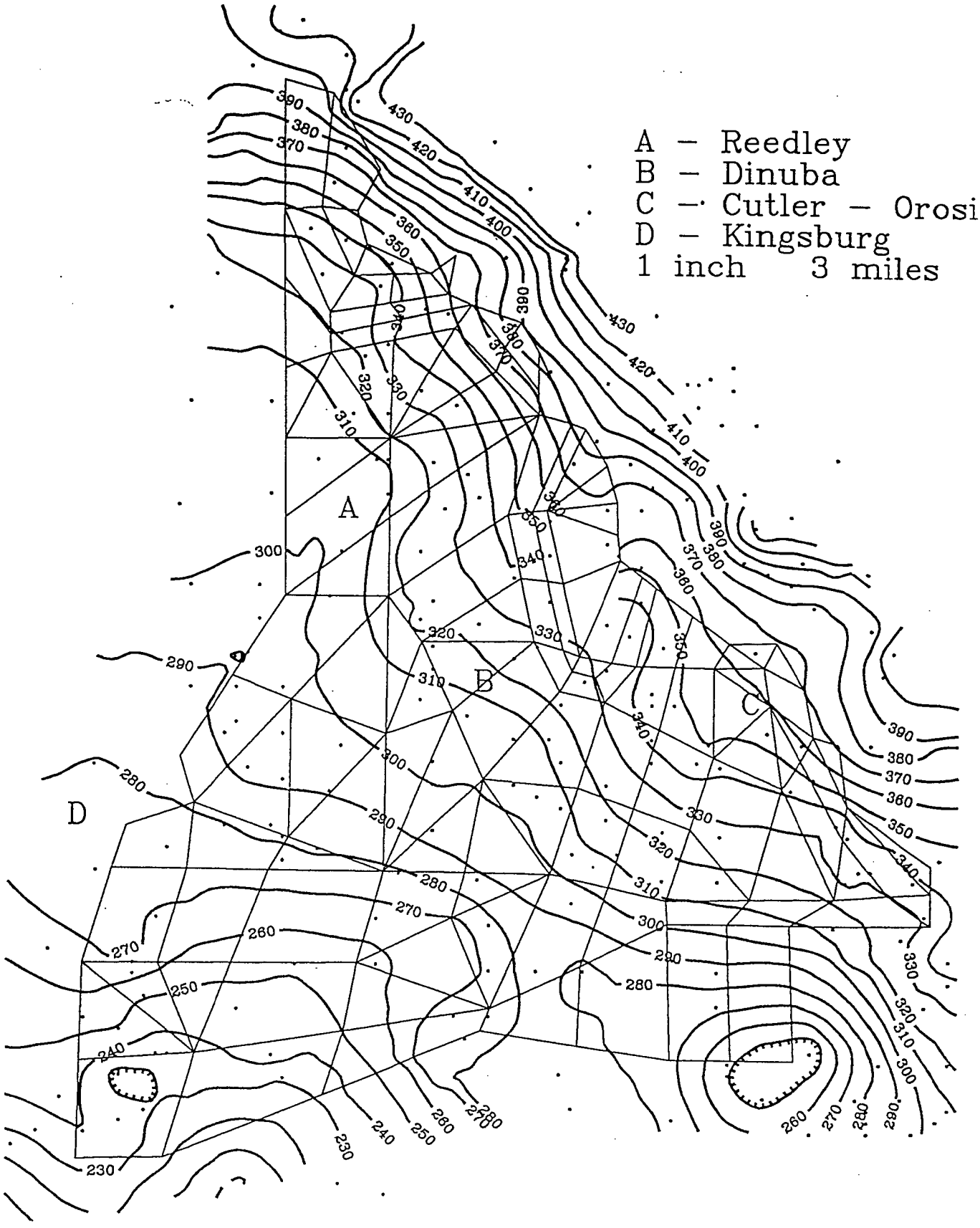

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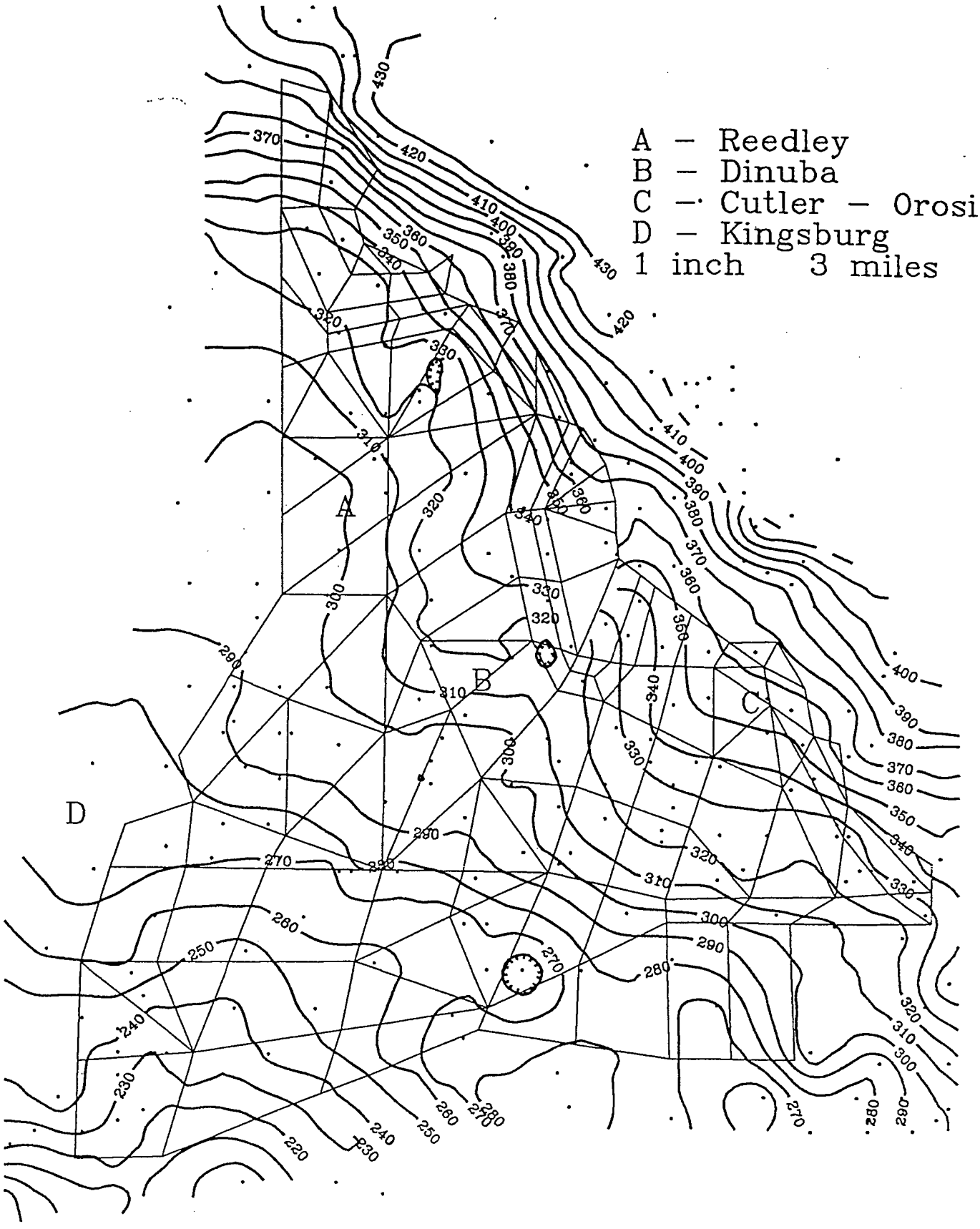

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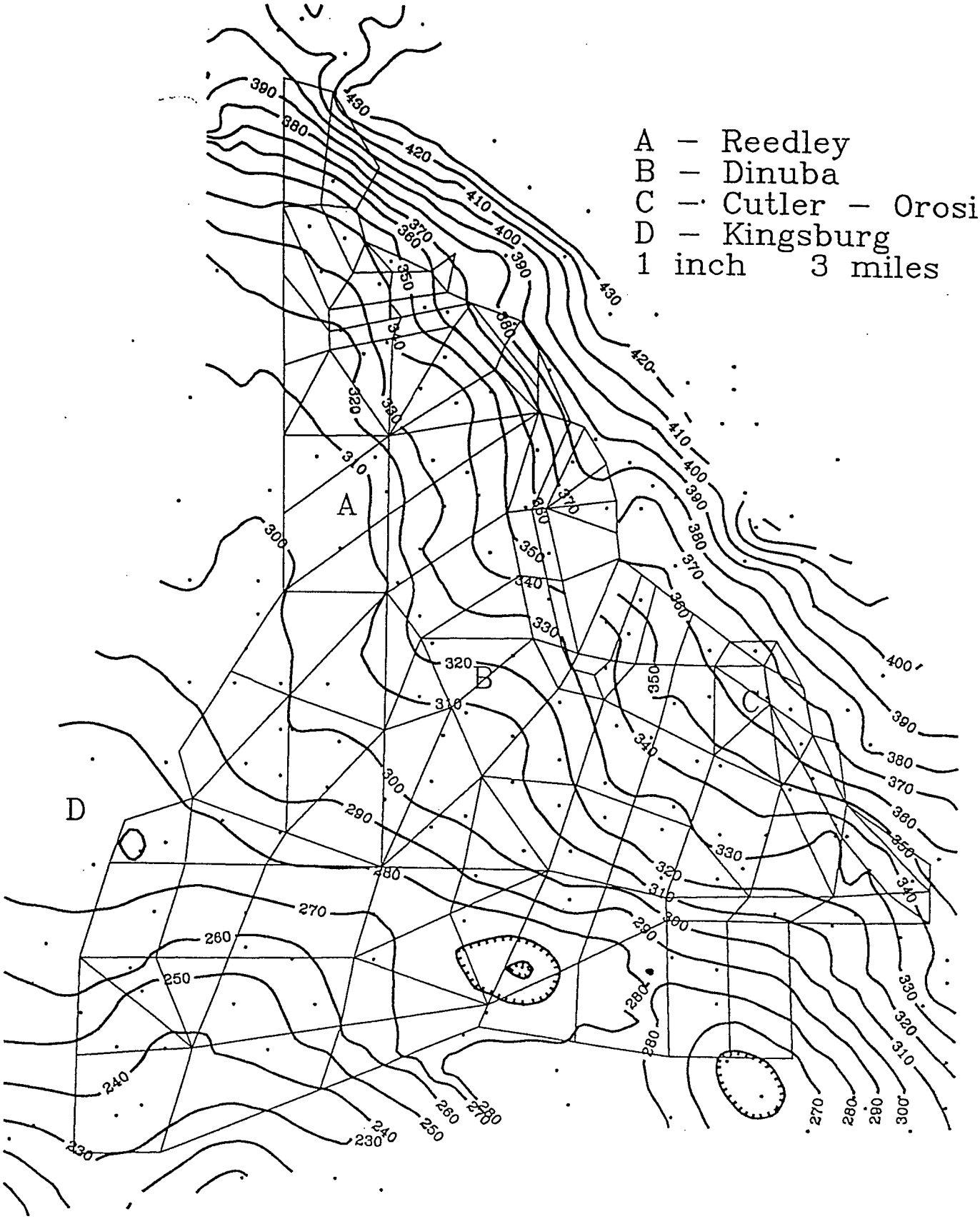

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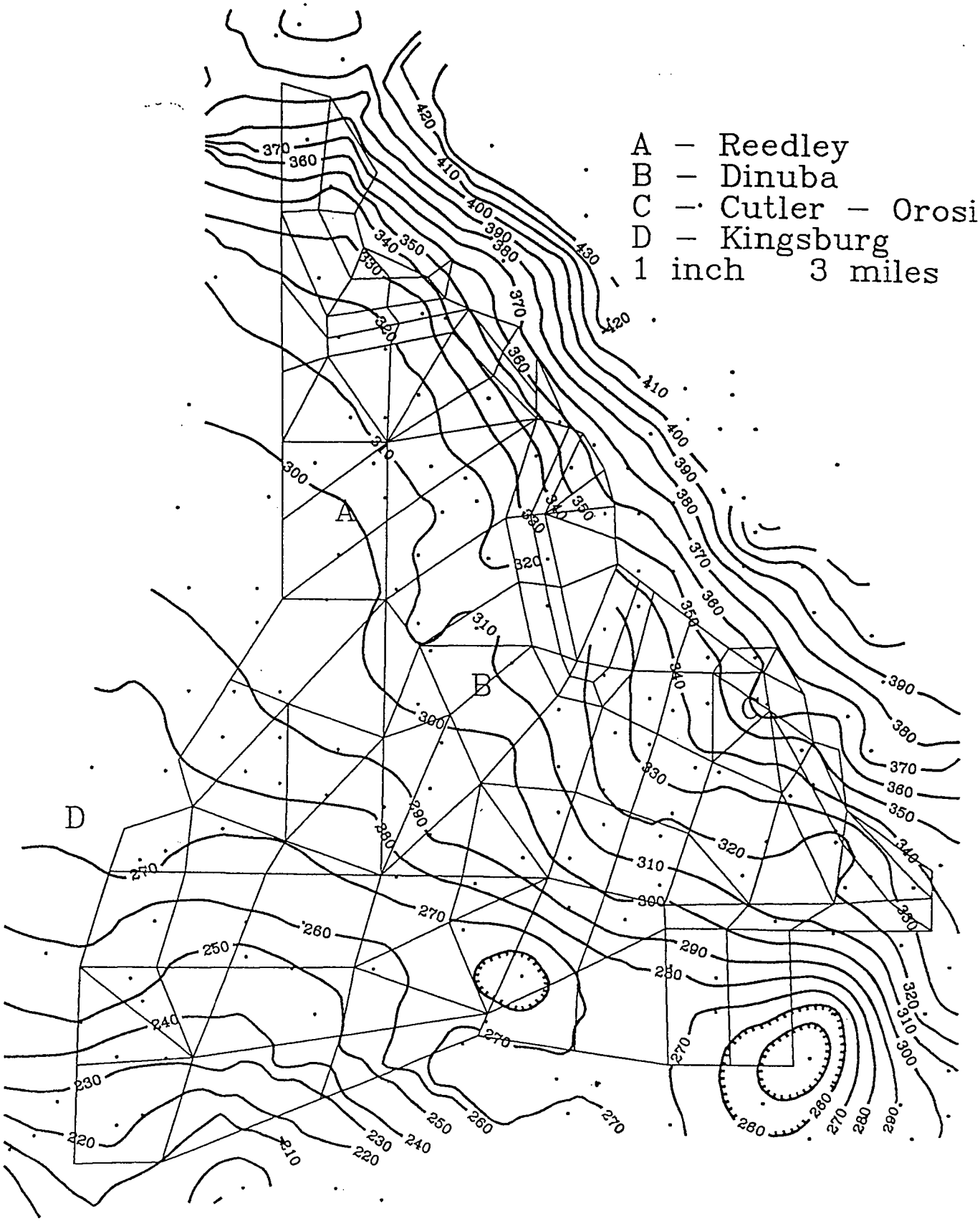

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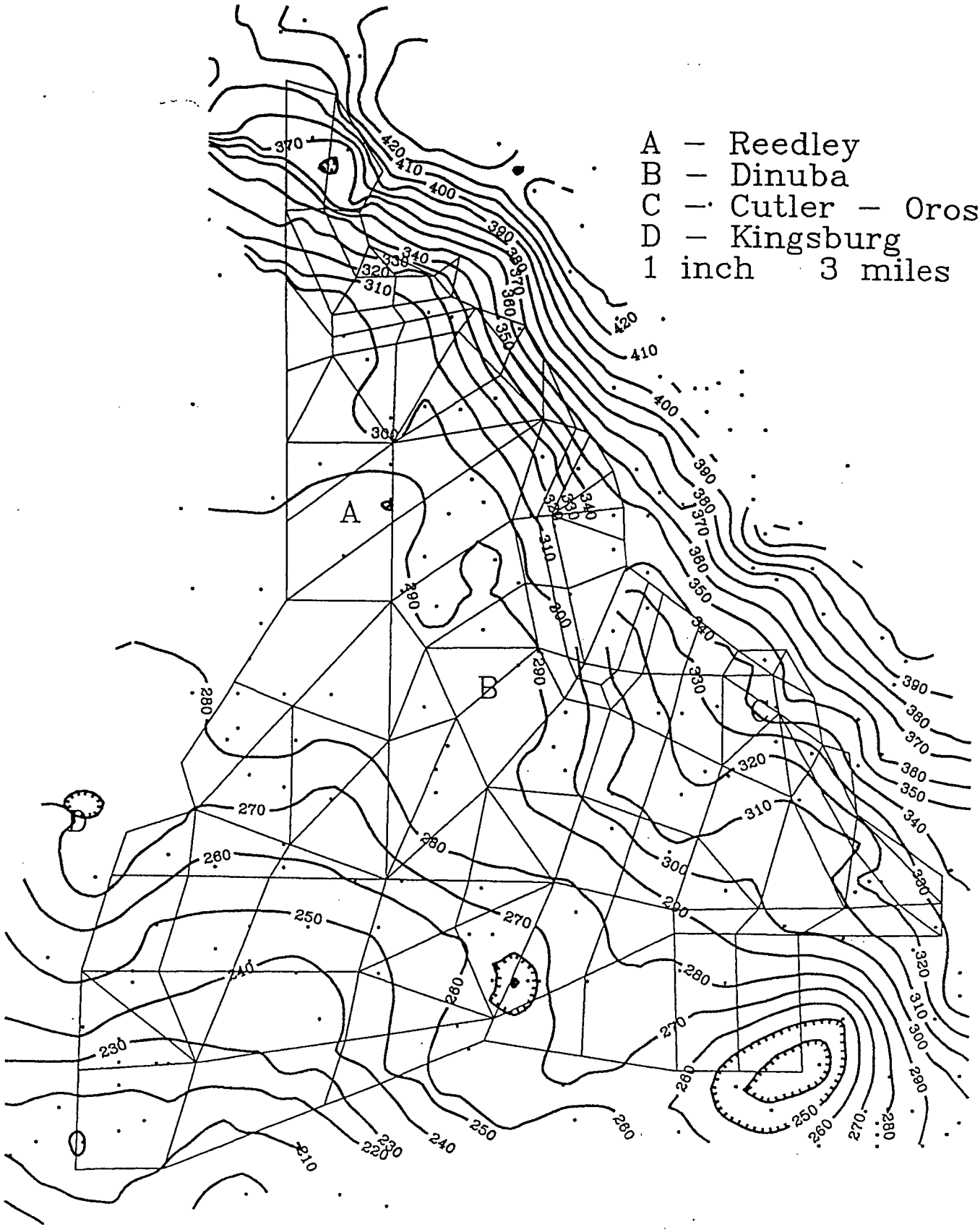
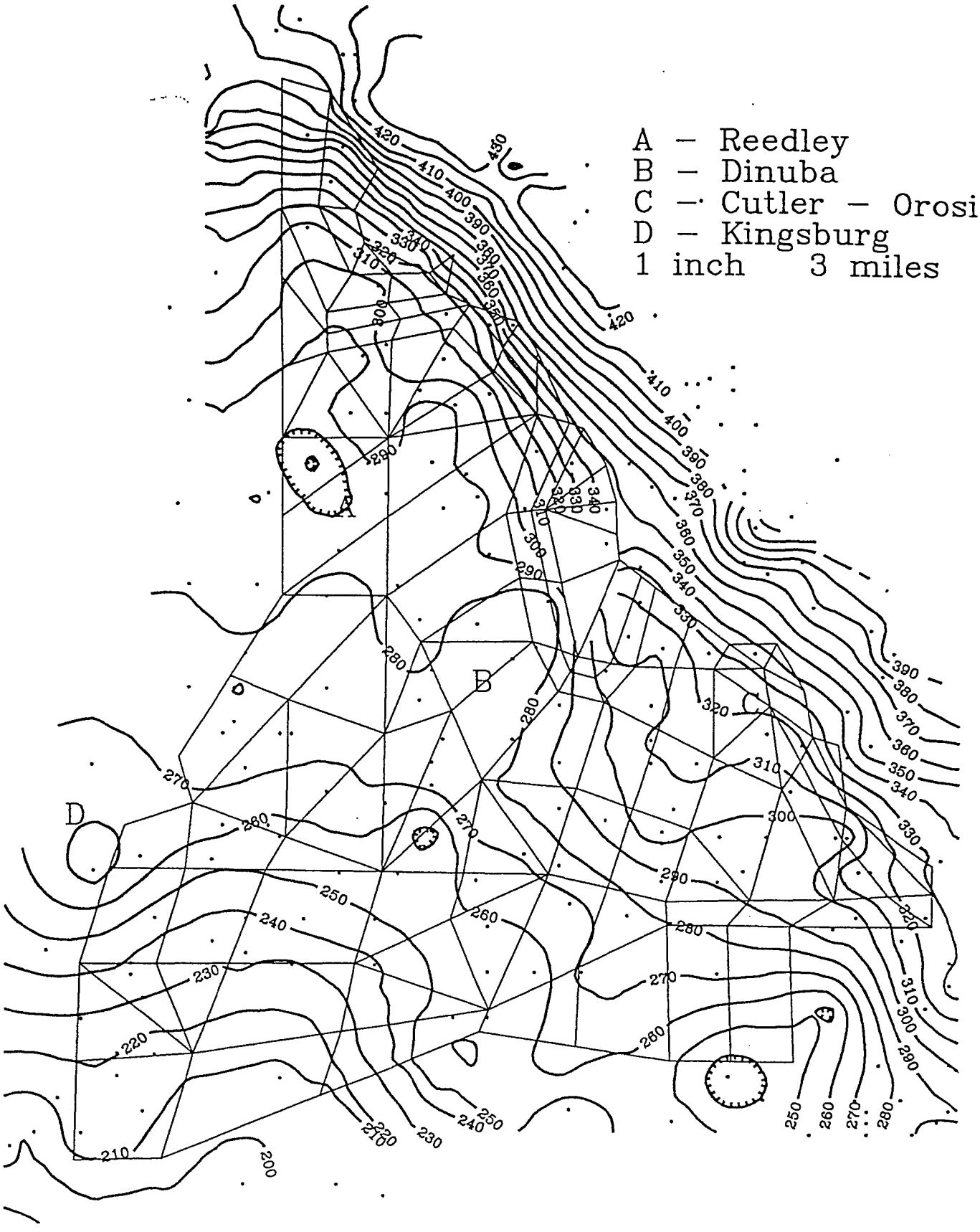


Alta ID Groundwater Elevation, Fall 1989



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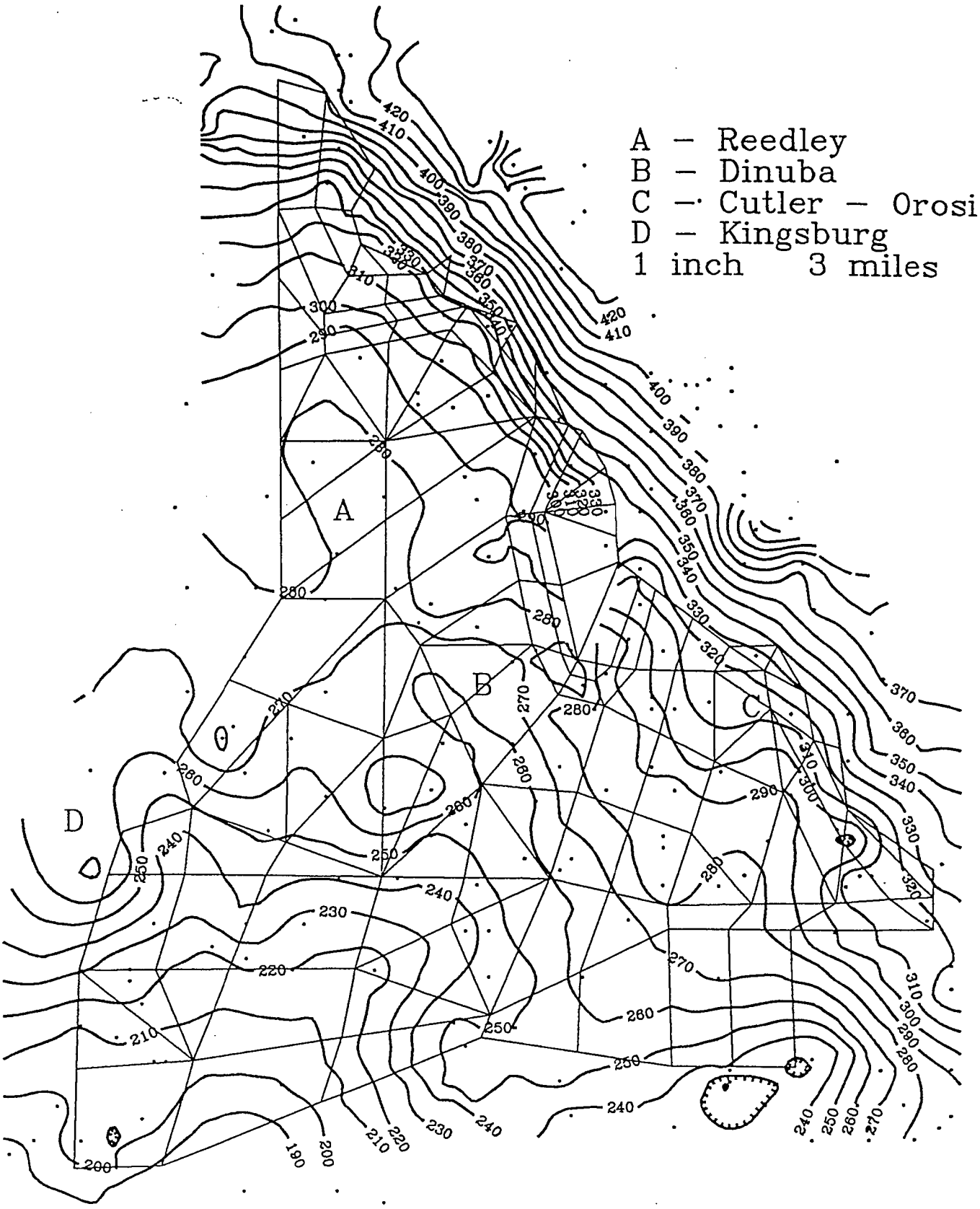

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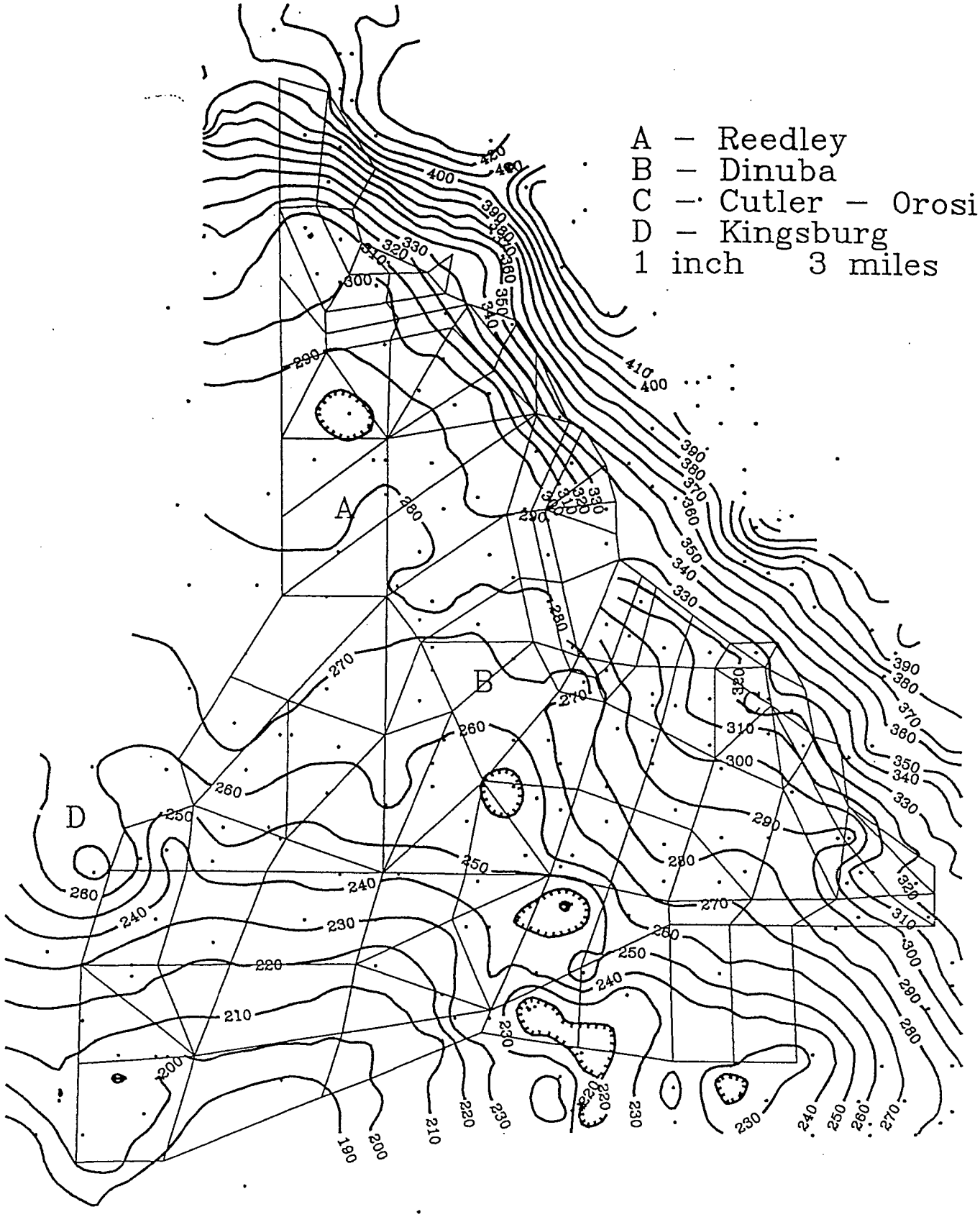

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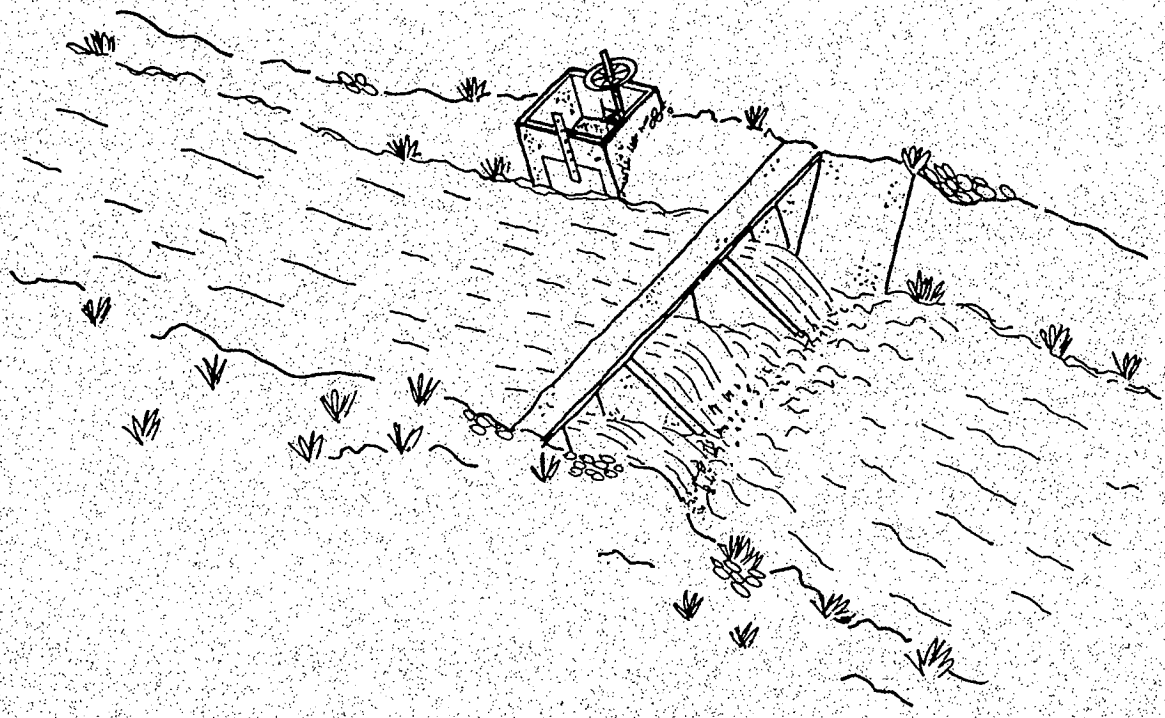
ALTA IRRIGATION DISTRICT

SURFACE WATER STUDY



Kings River Conservation District

KRCD

December 1991

ALTA IRRIGATION DISTRICT

SURFACE WATER STUDY

Prepared by the

KINGS RIVER CONSERVATION DISTRICT

KRCD

December 1991

EXECUTIVE SUMMARY

A study was conducted of the surface water delivery system of Alta Irrigation District (Alta) located on the east side of California's San Joaquin Valley. The study goal was to quantify the losses of the delivery system for use in district planning and to gain information that will be needed for a future groundwater study.

The following losses of Alta's surface water delivery system were estimated:

- Seepage
- Evaporation
- Evapotranspiration (ET) of Bank Vegetation
- Operational Spillage

In addition, a water balance was conducted for wet (1984) and dry (1990) years to estimate the amount of unaccounted water.

Seepage estimates were based on infiltration rates that were developed using blocked canal section tests and U.S.D.A. Soil Conservation Service (SCS) permeability values. SCS soil maps were used to characterize the soil types of individual canal segments.

Evaporation and ET of bank vegetation estimates were based on local crop reference ET. Evaporation estimates were most sensitive to canal section width and length. Bank ET estimates were most sensitive to canal section length and assumptions regarding the amount of weed growth along channels.

Operational spillage estimates were based on interviews with canal operators employed by Alta. The operators estimated from recollection typical flows at system spill points for wet and dry years.

Seepage was determined to be the most significant loss of Alta's distribution system. Seepage was estimated to be approximately 23 percent of the district's total diversion. Wet year operational spillage loss was estimated at about 5 percent of total diversion. Estimates of losses due to evaporation, bank ET, and dry year spillage were insignificant (Table 1).

A system water balance was conducted to inventory the amount of water that enters Alta's delivery system as diversions and exits the system as losses and deliveries. The water balance showed that a significant volume of water is unaccounted for in the dry year of 1990 (Table 2). Analysis of recorded deliveries from additional years showed an apparent correlation between water year and the amount of unaccounted water. The unaccounted water appears to be insignificant during average and above average water years and significant (up to 30 percent of diversion) during dry years (Figure 1).

The reason for variation in unaccounted water is unknown. Some possible explanations could be based on the inexactness of Alta's delivery measurement and the potential for measured water deliveries to be returned to canals as farm runoff.

Table 1

Summary of Alta I.D. Distribution System Losses

Loss	Wet Year (1984)		Dry Year (1990)	
	Percent of Diversion	Percent of Total Losses	Percent of Diversion	Percent of Total Losses
Seepage	23.1%	77.5%	23.6%	94.8%
Evaporation	0.8%	2.7%	0.7%	2.8%
Bank ET	0.4%	1.3%	0.1%	0.4%
Spill	5.5%	18.5%	0.5%	2.0%
Total	29.8%	100.0%	24.9%	100.0%

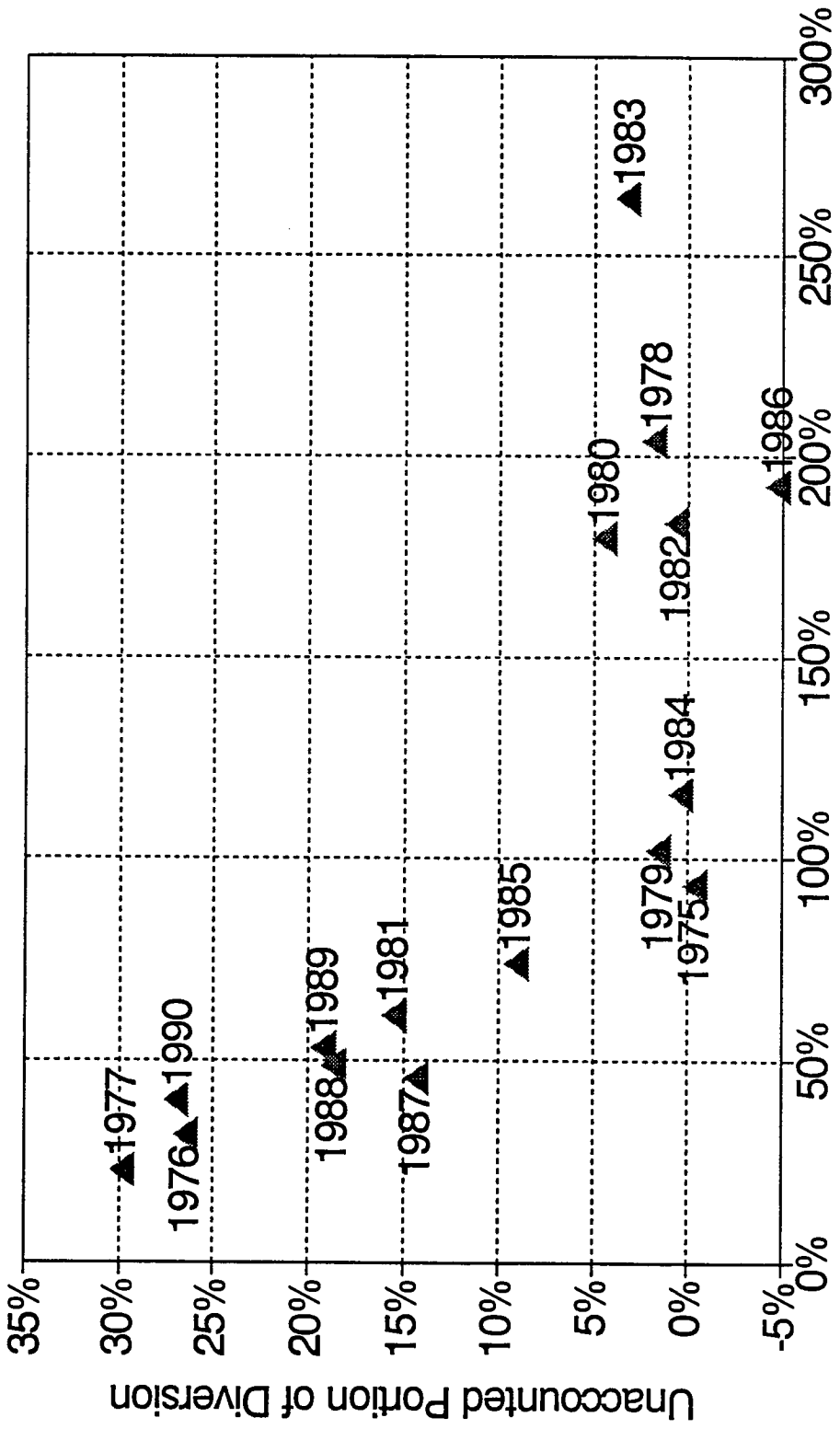
Table 2

Alta I.D. Water Balance

Type of Water Source, Use, or Loss	1984 (Wet)			1990 (Dry)		
	Amount of Source, Use, or Loss (AF)		Percent of Diversion	Amount of Source, Use, or Loss (AF)		Percent of Diversion
Diversion		212,941	100.0%		58,284	100.0%
Losses						
Seepage	49,306		23.1%	13,727		23.6%
Evaporation	1,715		0.8%	430		0.7%
Bank ET	770		0.4%	80		0.1%
Spill	11,656		5.5%	262		0.5%
Sub-Total		63,447	29.8%		14,499	24.9%
Delivered		148,827	69.9%		28,137	48.3%
Unaccounted		643	0.3%		15,658	26.9%

Figure 1

Alta I.D. Unaccounted Water from 1976 to 1990



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I

INTRODUCTION

1. ALTA IRRIGATION DISTRICT

The Alta Irrigation District (Alta) is located on the east side of the San Joaquin Valley southeast of the City of Fresno. The district encompasses a land area of approximately 130,000 acres in parts of Fresno, Tulare, and Kings Counties. The district is bounded roughly by the Kings River on the west and the Sierra Nevada Foothills on the east (Figure I-1).

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.

Kings River water was first diverted to the Alta area in the early-1880's by private land companies. The Alta Irrigation District was created in 1888 by local landowners to help ensure a reliable and equitable source of irrigation water.

Alta's annual entitlement of Kings River water has ranged from 38,700 to 253,300 acre-feet (Alta, 1990), with an average annual diversion of 195,035 acre-feet (KRWA, 1991). Alta typically diverts a relatively steady flow rate of about 700 cubic-feet per second (cfs) starting in May for a period of 28 to 195 days (Alta, 1990). The volume and duration of Alta's diversion is a function of their water rights and the yearly runoff from the Kings River. Kings River runoff can fluctuate greatly from year to year, and the watershed is prone to periods of drought.

2. HISTORY OF SURFACE WATER STUDY

The Alta area receives precipitation of less than 12 inches per year yielding a useable volume of water of less than 100,000 acre-feet on average. Combined with an average annual surface entitlement of 195,035 acre-feet and crop demand of about 325,000 acre-feet, Alta farmers must rely on a secondary source of irrigation water, even in average water years.

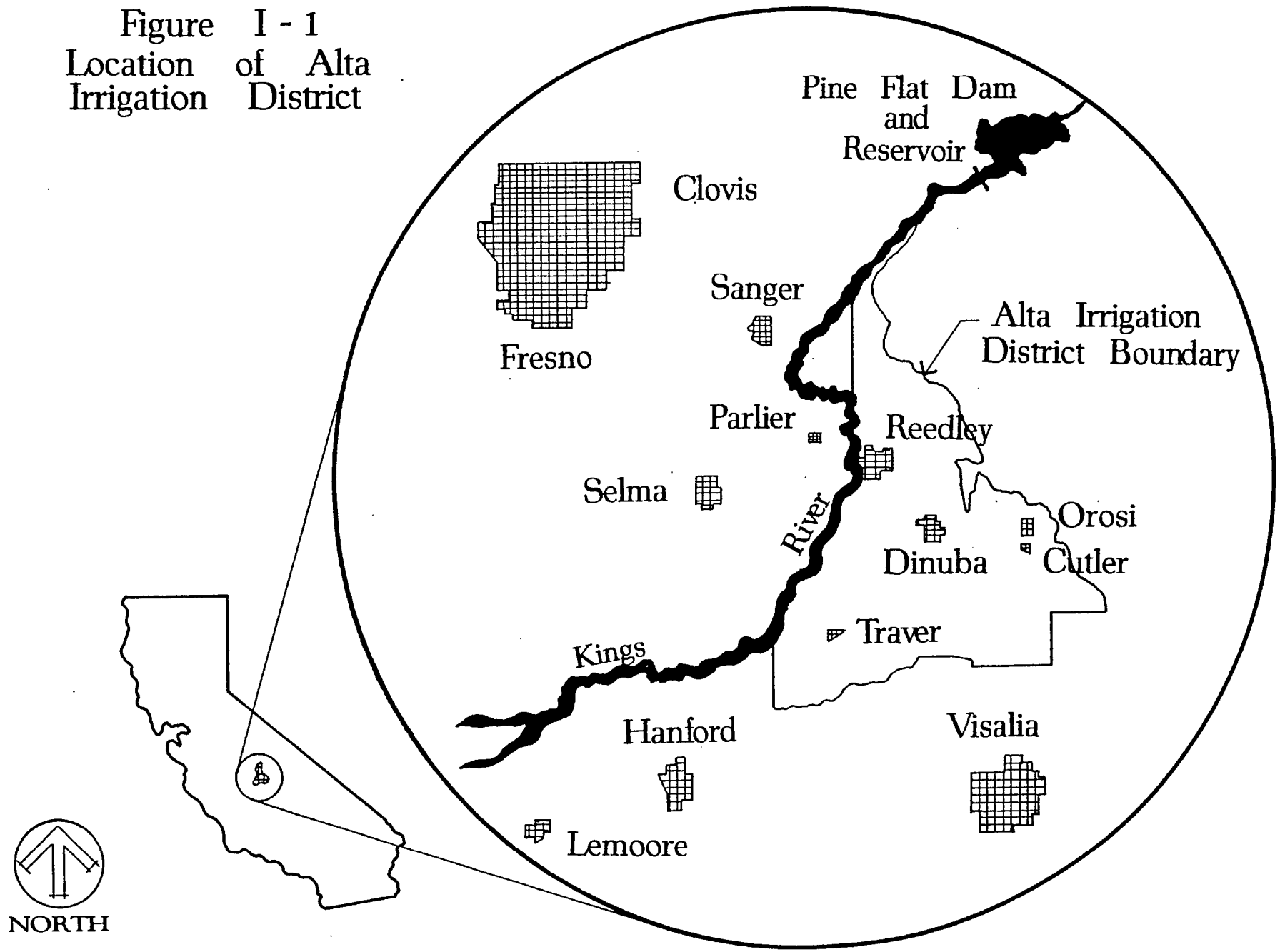
The shortfall in surface supply is routinely made up by groundwater pumping. Steady pumping over a period of several decades has resulted in serious groundwater overdraft. In periods of drought, the rate of water table decline is intensified.

During the recent consecutive dry years of 1987 through 1991, groundwater shortages have occurred in many locations throughout the district. Shortages appear to be most prevalent near the foothills (eastern boundary) where the aquifer tends to be more shallow.

In early 1991, the assistance of the Kings River Conservation District (KRCD) was enlisted to study Alta's surface and subsurface water resources. The purpose of these studies is to quantify losses of Alta's distribution system and model the underlying groundwater flow to predict the severity of future shortfalls.

The KRCD staff intends to address these topics through this Surface Water Study and a subsequent Groundwater Study. The results of the surface water analyses are an integral prerequisite to the groundwater modeling effort.

Figure I - 1
Location of Alta Irrigation District



This study provides an estimate of the losses of Alta's distribution system. Quantified losses include seepage, evaporation, evapotranspiration of canal bank vegetation, and operational spillage (leaving the district). In addition, a water balance was done to quantify the amount of unaccounted water.

3. DISTRIBUTION SYSTEM

Alta diverts water from the Kings River at a structure known as the "Cobbles Weir" below the town of Piedra. Water diverted at this point flows down the 76 Canal to the Alta headgate. The headgate is the point at which Alta's diversion is measured.

Downstream of the headgate, water is delivered to approximately 4,000 farm turnouts through a series of canals and concrete pipelines (Figures I-2A and I-2B). The average canal width varies from 4 to over 70 feet; lengths range from 3,000 feet to nearly 18 miles (Table I-1).

The vast majority of the channels are earth-lined, with most channels having an average width of between 10 and 20 feet (Table I-2). The total length of canals and pipes scaled from district mapping was approximately 315 miles.

Alta strives to maintain a constant diversion from the Kings River and constant flows in the district's canals during the irrigation season. This helps to prevent canal overflows and to reduce the amount of operational spill that leaves the district.

During years of above average entitlement, the canals are at full capacity for the entire irrigation season. During dry years, canals in areas of lower water allotment (primarily in the southern portion of the district) do not flow during certain periods of the irrigation season. Alta is divided into zones of 100 percent, 75 percent, 50 percent, 25 percent, and 5 percent water allotment. Table I-3 gives an estimate of the percent of the season that these intermittent canals flow.

4. WATER MEASUREMENT

The flow of water in Alta's distribution system is measured in most cases by undershot gates and overflow weirs; but Parshall Flumes are used in several locations, and a current meter is used near the headgate. The head loss across the undershot gates is usually determined with permanently installed stilling wells. However, on some of the smaller gates and all of the weirs, heads are measured using hand held measuring tapes. Alta's ditch tenders and water dividers are provided with rating booklets that aid them in converting head measurements to flow rates for most flow structures within the district.

During the irrigation season, farmers order water deliveries directly from their assigned ditch tender. A farm turnout may receive water for a period of one day to several weeks per delivery cycle depending on the acreage that the turnout serves.

The flow of water through farm turnouts is measured by ditch tenders each day during delivery. The flow is estimated by measuring the head loss across a slide gate (rectangular submerged orifice) using a hand-held measuring tape and looking up the corresponding flow in a rating book. The growers arrange in advance with the ditch tenders when to open and close their valves for a delivery.

Figures I-2A and I-2B

Alta I.D. Delivery System

Please Refer to Pocket at Back of Report

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 & Edmiston	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
Cary-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
Horseman	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
Weisse	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 completelypiped.
Width and area values are for open channel segments only.

Table I-2
Summary of Alta I.D. Delivery System

(1) Description	Number of Segments	Total Length (mi)
Unlined Canals:		
wider than 60 feet	22	9.7
between 50 and 60 feet	8	3.3
between 40 and 50 feet	20	10.2
between 30 and 40 feet	26	15.3
between 20 and 30 feet	30	21.0
between 10 and 20 feet	219	134.3
less than 10 feet	104	52.0
Sub-total	429	245.7
Lined Canals:		
wider than 60 feet	0	0.0
between 50 and 60 feet	0	0.0
between 40 and 50 feet	0	0.0
between 30 and 40 feet	0	0.0
between 20 and 30 feet	0	0.0
between 10 and 20 feet	6	3.4
less than 10 feet	6	4.2
Sub-total	12	7.6
Pipe Lines:		
all	121	63.5
Total	562	316.7

Ditch tenders typically unlock the farmer's valves the day before delivery is to start and relock them the day after the delivery ends. Farmers operate the turnout valves themselves.

This relatively low-cost method of water delivery has worked successfully for Alta for many decades. However, some concern has arisen regarding the ability of this method to keep track of fluctuating flow rates and the starting and ending times of farm deliveries for equitable distribution of water within the district.

Table I-3

Alta I.D. Intermittent Canals

Canal	Segment Number	Assumed Percent Operation
Banks	1 - 22	50
Banks	22 - 29	10
Button	10 - 23	50
Cary Hunter Ditch	18	50
Clough	1 - 3	10
Cross Creek Waste Way	1 - 2	10
Kennedy School House	7	50
Kennedy Waste Way	9	50
King	3 - 8	50
McClannahan	9	50
Red Williams	1 - 4	50
Sontag	4 - 7	50
Traver Canal	26 - 32	50
Traver Canal	32 - 34	10
Vanoy	2 - 4	50
Weise	1 - 2	10
Wilson School House	8	50

Notes:

1. Canal segment number: segments defined by canal soil type, cross section, and ground water modeling element boundary (see Figures I-1A and I-1B)

II

METHODS

1. DESCRIPTION OF DELIVERY SYSTEM

A. Field Surveys

The Alta surface delivery system was surveyed to determine its pertinent physical properties. The properties that were surveyed in the field included canal cross section, general soil type, amount of vegetation on the banks, and the presence of a lining.

Because of the large area covered by the district's facilities, it was determined to be infeasible to obtain detailed cross sections using conventional surveying methods. Instead, the cross sections were measured by stretching a fiberglass measuring tape across each section and using a surveying rod to measure the distance from the canal bottom to the tape at several points across the canal. The tape was leveled using a carpenters level held up to the center of the tape's span.

A horizontal measure of each data point was determined from reading the tape, and the vertical component was read from the rod. In this way the general shape of each canal section was determined, but the elevation of each section relative to a known datum was not known.

Most canal cross sections were delineated with six to eight such data points. Larger channels were described with up to ten points. Very small V-shaped ditches were described with three points. Data points were taken at the apparent water line and canal bottom. For most canals, the water line was made obvious from the dead weeds left from the previous year. Wherever possible, points were taken at the top of the bank. Some canals had been recently regraded which obliterated obvious water lines. For these channels, the water line was estimated from the water stain on turnout structures or from freeboard measurements taken during the 1991 irrigation season.

Cross sections were taken at those canal locations which would provide the best representative of the particular canal segment. An attempt was made to obtain cross sections at the beginning of each canal branch or where there was an obvious change in the shape or size of the canal. As a check against measurement or transcription errors, a pair of cross sections, taken approximately 100 feet apart, were obtained at each location selected along the various canals on the distribution system.

When pipes were encountered during the field surveys, the diameter of the pipe was measured. In many cases, a canal indicated on the Alta I.D. map could not be found. In these cases, the canal was assumed to be piped.

Please note that in this report, Traver Creek is considered to lie north of Avenue 416. The portion of this channel that lies south of Avenue 416 is called Traver Canal.

B. Canal Segments

To make estimates of the losses of Alta's surface delivery system, it was necessary to divide the district's distribution system into a series of individual segments. Each segment was delineated to have a single soils group, similar cross section, and to lie within a single groundwater modeling element. Groundwater modeling elements are geographic subdivisions to be used in the Alta Groundwater Study (discussed previously). A total of 559 canal segments were used to compute the Alta's losses (Appendix A).

To compute seepage and evaporation losses, the top width of each cross section was calculated as the distance between the apparent water line points. The cross sectional area at each canal section location was calculated as the area below the apparent water line. Average top width and average cross sectional area of each canal segment was interpolated from the field survey data. The lengths of the canal segments were determined from scaling 7.5 minute U.S. Geologic Survey Quadrangle Maps.

Pipeline diameters were estimated in most cases based on the estimated flow rate for each section and an assumed maximum allowable velocity of 3 feet per second in the pipeline.

2. INFILTRATION RATES

A. Non-Steady Seepage

The seepage rate of an unsaturated soil tends to decrease as the soil approaches saturation. At some time after water is introduced to an unsaturated soil, it reaches a steady-state infiltration rate that is believed to be fairly constant over time. The amount of time that it takes for different soil types to reach steady-state infiltration can vary.

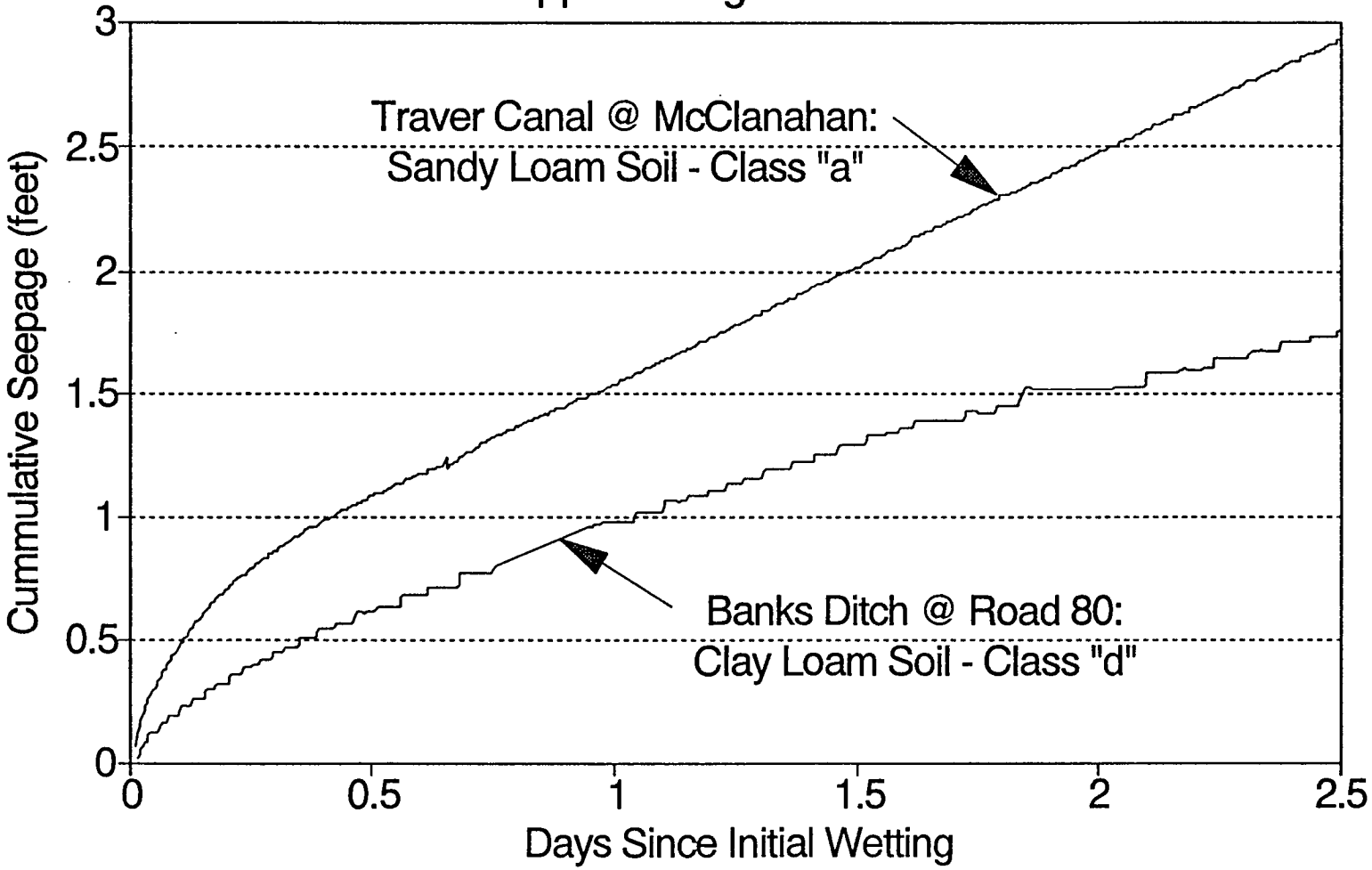
If the initial seepage rate is much higher than the steady-state rate and if the amount of time it takes to reach steady-state is long, then a large volume of water could be infiltrated during the saturation period.

The non-steady seepage rate and the saturation time of Alta's canals were estimated using double-ring infiltrometers. A double-ring infiltrometer is a device that uses an outer buffer ring and an inner measurement ring to estimate the downward rate of seepage (Jensen, 1984). These measurements were taken during the four weeks prior to the start of the 1991 irrigation season to approximate typical canal start-up conditions. Double-ring infiltrometer measurements were taken in a total of 6 canals representing course to fine textured soils.

The double-ring infiltration measurements showed that the initial soil intake rate is not significantly greater than the steady-state rate, and steady-state is achieved relatively quickly on the type of soils tested. Figure II-1 shows that the curve of cumulative seepage versus time is steep initially but flattens out in a matter of a few hours. This pattern holds true for fine and course textured soils in Alta.

It was concluded from this relationship that the amount of additional seepage that occurs during system start-up is not significant. For this reason, the quantity of additional seepage due to the initial infiltration rate was not estimated as part of this study.

Figure II-1
Infiltration of Alta I. D. Canal Soils
Approaching Saturation



B. Steady-State Seepage

Steady-state seepage is the relatively constant rate that water escapes through the sides and bottom of canals. This seepage rate can depend on many factors including soil texture, sedimentation on the canal bottom, water temperature, water velocity, the presence of a hardpan or other restrictive soil strata, and the water content of the subsurface soils.

Given the scope of this study, it was not practical to determine the effects of many of these conditions. Because of the large amount of earth-lined canals in Alta, it was determined that the most appropriate way to estimate seepage losses would be based on soil texture and the presence of confining layers.

The U.S.D.A. Soil Conservation Service (SCS) has mapped the soil in and around Alta and classified them for their use in agriculture and for their effect on storm runoff (SCS, 1940; SCS, 1971). Within the Alta boundary, there are approximately 90 different named soils (Appendix B). The SCS has described the texture and upper profile of these soils down to approximately 10 feet below the ground surface. These soils have also been classified by the SCS into four Hydrologic Soil Groups based on their permeability and tendency to yield storm runoff. The four groups are identified as ***a***, ***b***, ***c***, and ***d*** with ***a*** being most permeable and ***d*** being the least permeable.

These four soil groups have been modified for this study to distinguish between soils that have significant restrictive layers within their profiles. Four additional groups were added and are identified as ***a'***, ***b'***, ***c'***, and ***d'***. A group ***b'*** soil for example, would have the characteristics of a group ***b*** soil with the exception of a restrictive layer within 10 feet of the ground surface (Table II-1). All of these additional soils were originally grouped as ***c*** and ***d*** soils because the restrictive layers produce runoff in a manner similar to the finer-textured soils. Appendix B gives a list of Alta's soils with the original and modified soil groups.

The permeability of these soils has been estimated by the SCS (Table II-1). This permeability value is defined as, "the ability of a soil to transmit air or water (SCS, 1971)." This permeability is proportional to the seepage rate of a full canal, but its magnitude is not a correct measure of that property.

To estimate the seepage rate of Alta's earth-lined canals, blocked seepage tests were conducted on three Alta canal sections varying in length from 1,600 to 3,000 feet. These tests were conducted by blocking a section of the canal and preventing any water from flowing in or out of the test section.

Alta check structures were used as the upstream and downstream dams of the test sections. The dams were sealed by using 2-inch thick check boards and sealing them with a combination of newspaper, sawdust, polyethylene sheeting, and soil. The farm and lateral valves along the test sections were sealed by filling the turnout boxes with soil.

The blocked canal tests were performed during the two weeks following August 10 which was the last day that Alta diverted water from the Kings River during the 1991 irrigation season. It was necessary to conduct these tests after the irrigation season because water was not allowed to flow through the sections during the test period and the canals were at their saturated steady-state condition.

Table II-1

Properties of Modified Soil Groups

(1) Modified Hydrologic Soil Group	(2) Surface Soil Permeability (in/hr) Low	High	(2) Permeability Through Hard Pan (in/hr)	(2) Soil Texture
a	20.00	N/A	N/A	Sand & Sandy Loam
b	2.50	5.00	N/A	Sandy Loam & Loam
c	0.80	2.50	N/A	Loam & Silt Loam, Clay Loam
d	0.05	0.20	N/A	Clay
a'	5.00	10.00	0.05	Sand & Sandy Loam w/ Restrictive Layer
b'	2.50	5.00	0.05	Sandy Loam & Loam w/ Restrictive Layer
c'	0.80	2.50	0.05	Loam & Clay Loam w/ Restrictive Layer
d'	N/A	0.05	0.05	Clay w/ Restrictive Layer

Notes:

1) Modified Hydrologic Soil Group based on Soil Conservation Service (SCS) soil groups with changes to distinguish hardpan soils (*a'*, *b'*, *c'*, *d'*).

2) Properties of soils from SCS (1971).

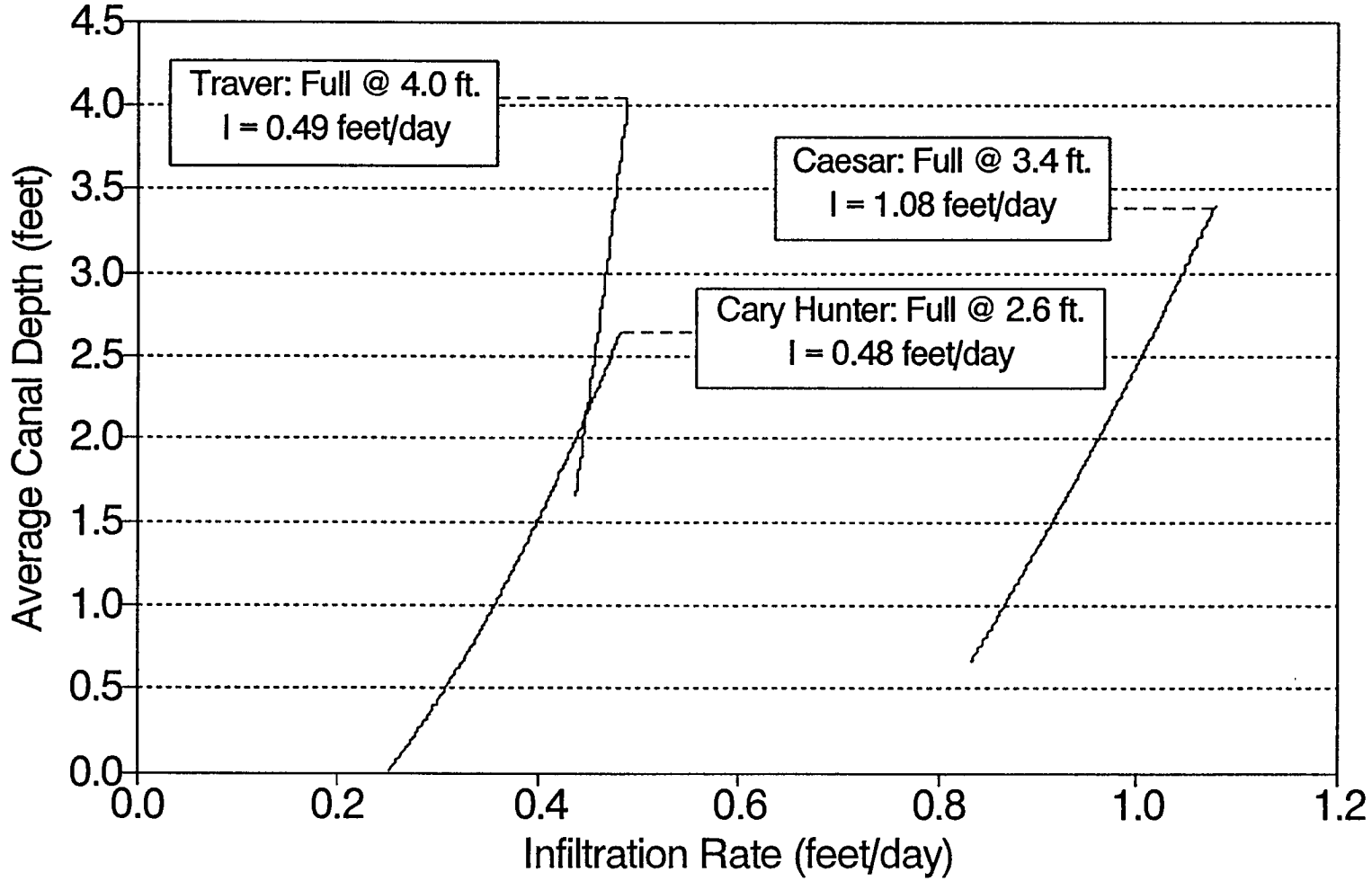
In this manner, the sections were controlled so that any water leaving a section should be the result of either seepage or evaporation. Loss from evaporation was measured using evaporation pans installed in the center of each section. The evaporation rates were calibrated with the hourly reference evapotranspiration recorded at the California Irrigation Management Information System (CIMIS) weather station located in Parlier less than 12 miles away (CIMIS, 1991).

Seepage loss was determined by measuring the depth of water every 10 minutes using a data logger and pressure transducer. The data loggers used for this study are battery operated microprocessors that record and electronically store the signal from the attached pressure transducer. The stored data was uploaded to a desktop computer for analysis. The pressure transducer is a pressure-variable electrical resistance device that is used to measure water depth.

The data loggers were checked by making manual readings of staff gages at least twice a day. Staff gages were installed at five locations along the canal sections to determine if wind effects were causing anomalies in the canal depth at the data logger. Wind was not found to appreciably affect the water depth.

Given the precision of the other inputs to seepage loss computations, it was determined that the seepage rates of the three test sections were relatively insensitive to the depth of water in the canals. Figure II-2 shows that above a depth of 1.5 feet the infiltration rates of all three sections

Figure II-2
Infiltration Rates vs Head for
Alta I.D. Blocked Canal Sections



do not change significantly. For this reason, the seepage rates of Alta's canals were calculated based on the product of the seepage rate (measured in feet per day), length (in feet), and average top width (in feet) of each canal segment.

To determine soil types, test cores were taken and particle size distribution analyses were performed for the test sections. These tests showed that the soils in these sections represented soil groups ***a***, ***b'***, and ***c*** (Table II-2).

Table II-2

Soil Textures of Alta I.D. Blocked Canal Sections

Name	Soil Sample Depth	Percent by Weight Sand	Silt	Clay	Texture	Modified Hydrologic Soil Group
Traver Canal	0-2 inches	57%	43%	0%	sandy loam	*c*
	1-2 feet	57%	43%	0%	silt loam	
Caesar Ditch	0-1.5 inches	58%	42%	0%	sandy loam	*a*
	2-3 feet	42%	58%	0%	silt loam	
Cary Hunter Ditch	0-1 feet	47%	53%	0%	silt loam	*b'*
	5-5.5 feet	61%	39%	0%	sandy loam	

The infiltration rates of the eight Alta soil groups were estimated using the data from the blocked canal tests and the SCS soil permeability values. The infiltration rates from the canal tests were assigned to the three corresponding soil groups. The infiltration rate of 1.0 foot per day from the Caesar Ditch test section was assumed to represent soil group ***a***. The infiltration rate of 0.5 feet per day from the Cary Hunter Ditch and Traver Canal test sections was assumed to represent soil groups ***b'*** and ***c***, respectively.

The infiltration rates for the remaining five soil groups were determined based on the relative proportion of the SCS permeability values (Table II-3). For example, the infiltration rate of soil group ***b*** was interpolated between the known values from groups ***a*** and ***c*** using the permeability values. The rate for group ***d*** was extrapolated in a similar manner. The rates of the remaining restrictive soils (***a'***, ***c'***, and ***d'***) were estimated by assuming that they would be reduced by an amount proportional to the difference between groups ***b*** and ***b'*** (Table II-3).

The infiltration rates of concrete-lined and piped canal sections were assumed to be 0.1 feet per day based on a discussion with Haight (1991).

It is recognized that this method of estimating infiltration rates is based on a small sample size, engineering judgement, and assumption. These estimates are considered to be as accurate as practicable given the scope and schedule of this project.

Table II-3 Estimated Seepage Rates for Alta I.D. Soils	
Soil Group	Assumed Infiltration Rate (feet/day)
a	1.0
a'	0.7
b	0.7
b'	0.5
c	0.5
c'	0.3
d	0.05
l (concrete lining)	0.1
p (pipe)	0.1

3. EVAPORATION

Evaporation is the method by which water is lost to the atmosphere from the canal surface. Evaporation rates are dependent on many factors including temperature, relative humidity, the size of the water body, and wind speed.

The volume of evaporation from Alta's canal surfaces was estimated using ET data obtained from the CIMIS weather station at Parlier, California. Evaporation and ET are closely related since they are both affected by the same factors.

The total evaporation loss for the two seasons analyzed was estimated for each canal segment by:

$$Evap = K \times ETo \times W \times L$$

where

Evap = seasonal canal evaporation for the segment

K = canal coefficient (assumed to be 1.0)

ETo = the sum of daily ETo for all days of the irrigation season

W = the average width of the canal segment

L = the length of the canal segment

Rainfall was not accounted for in the evaporation calculations because its quantity was assumed to be insignificant during the irrigation season. Pipelines within the district were considered to have no evaporation loss for the purpose of this study.

4. EVAPOTRANSPIRATION OF BANK VEGETATION

Evapotranspiration (ET) is the method by which water is lost to the atmosphere from water transpired by a plant and the water evaporated from the soil surface in the vicinity of the plant. The ET rate is dependent on many factors including solar radiation, temperature, relative humidity, the size and type of the plant, and wind speed.

The ET of plants along Alta's banks was estimated from an approximation of the amount of trees, brush, and weeds that extract water from the canals. For each canal segment, the width and length of a band of each vegetative type was estimated.

Only two of Alta's canals were found to have a significant band of trees. The trees along Alta Main Canal are generally larger oaks whereas those along Traver Creek are mostly smaller willows. Traver Creek was the only canal with a significant band of brush along its banks. All earth-lined canals in the system were considered to have a band of weeds along both banks at the water line.

The following equation was used to estimate ET losses for each canal segment:

$$ET = K \times ETo \times w \times l$$

where

ET	=	seasonal ET for trees, brush and weeds along each canal segment for the irrigation season.
K	=	crop coefficient (assumed to be 1.0 for this study)
ETo	=	seasonal reference ET, the sum of daily ETo for the number of days of active growth
w	=	width of the band of trees, brush or weeds
l	=	length of the band of trees, brush or weeds along each canal segment

A crop coefficient of 1.0 was used for all ET losses. This crop coefficient assumes that the trees, brush, and weeds consume about the same amount of water as a healthy stand of grass. A lower crop coefficient might be more accurate, but the relative magnitude of the bank ET value did not warrant additional investigation.

The value of seasonal ETo for trees and brush is the sum of the daily reference ET for each day of the irrigation season. For weeds, the length of the season was reduced by 30 days due to the fact that they take approximately 30 days to start to consume significant amounts of water. The daily ETo estimates were retrieved from the CIMIS weather station at Parlier, California (CIMIS, 1984 and 1990).

The width of the vegetation varied with each vegetative type: 4 feet for weeds, 15 feet for brush, 60 feet for trees along Traver Creek, and 80 feet for trees along Alta Main.

The length of trees and brush down the canal bank was determined from field observations and scaling of aerial photographs of the area. The length of the band of weeds was assumed to be twice the canal segment length because the weeds grow on both sides of the canals.

Pipelines and concrete-lined canal sections within the district were considered to have no vegetative losses for the purpose of this study.

5. OPERATIONAL SPILL

Operational spill is that portion of the district's surface water that flows outside of its boundary and cannot be recovered by the district. These spills can occur at the terminal ends of several of Alta's canals. The spill points are not metered but are monitored periodically by Alta's ditch tenders.

No records are kept of the quantity of the spill. The typical flow rates at spill points were estimated from recollection by Alta's canal operators for wet and dry years. It was assumed that these typical flows represent average flows leaving the district. The volume of spill was estimated as the product of the typical flow rate and the total days of operation of the district for that particular season.

6. UNACCOUNTED WATER

A district-wide water balance was used to quantify the unaccounted water volumes. Unaccounted water was estimated by the following equation:

Unaccounted = Diverted - Losses - Delivered

where

Unaccounted = volume of unaccounted water for the season

Diverted = volume of water diverted at the Alta headgate for the season

Losses = the sum of the seasonal seepage, evaporation, bank evapotranspiration, and operational spillage (discussed previously)

Delivered = the total volume of water deliveries from Alta's records

The volume of delivered water for 1984 (wet) and 1990 (dry) was determined from Alta's delivery records. Additional years of record were later examined after discovery of a significant difference between wet and dry years in the volume of unaccounted water.

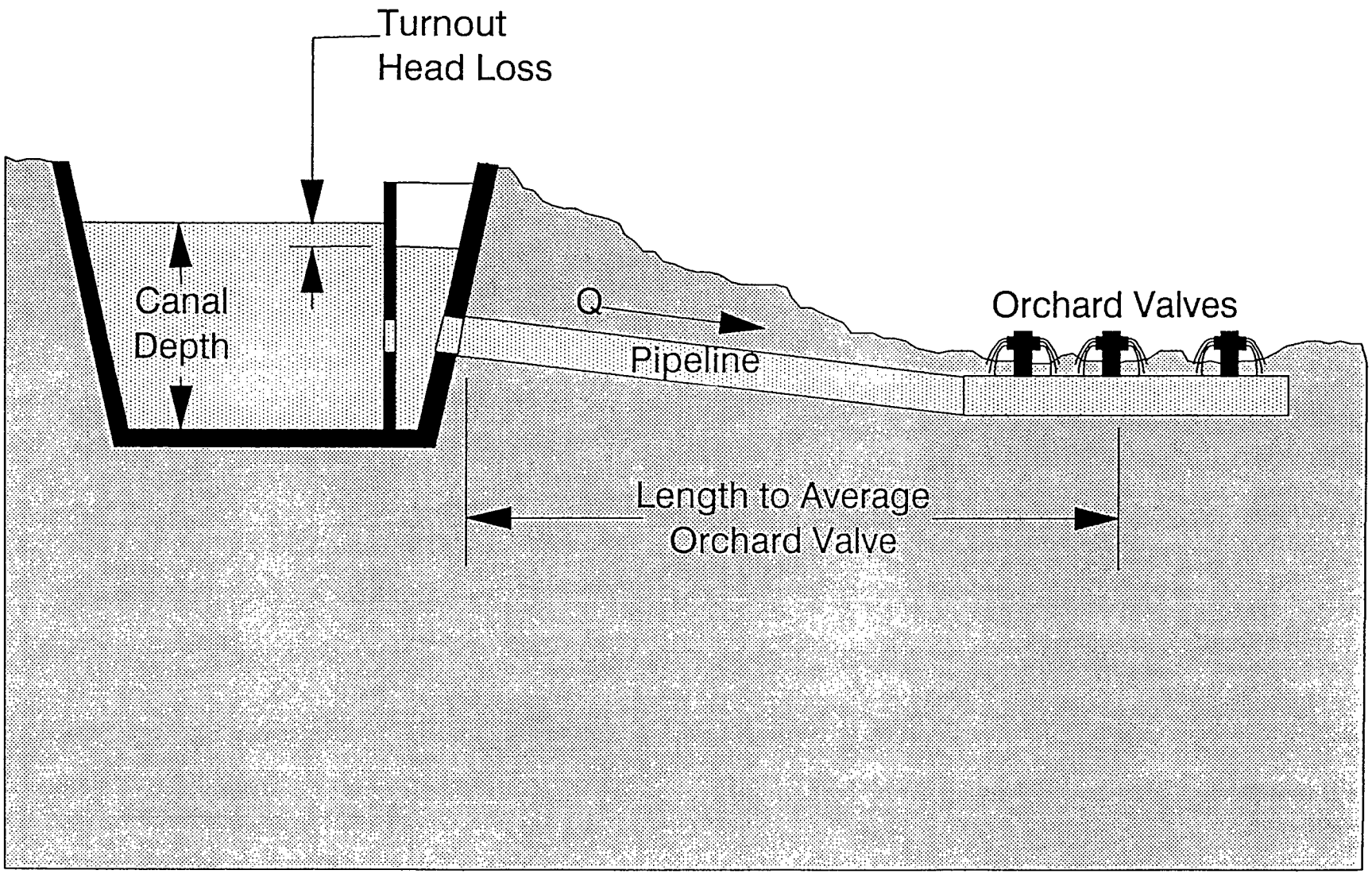
To better determine how water is delivered and accounted for in the Alta system, the operation of the district's distribution system was studied. KRCD staff accompanied three of Alta's ditch tenders and one water divider during the course of their daily duties.

Farm turnouts were monitored during the water run in order to determine typical fluctuations of flow rates during an irrigation delivery. This monitoring was done by placing data loggers on selected turnouts to measure the water surface elevations in the canal and inside the turnout box.

Measurements were taken on ten minute intervals for at least 24 hours. The elevation difference was used to calculate the instantaneous flow rate every 10 minutes and the total volume delivered during a 24-hour period.

A simplified computer model was developed to better determine the extent that district operations (primarily canal depth fluctuations) and on-farm operations affected flow through the turnouts. The model is a mathematical description of a typical Alta turnout with slide gate; screw valve, a half-mile of 12-inch diameter concrete pipe, and up to 9 orchard valves (Figure II-3). The model was developed to calculate the flow rate of this system for a base condition of 5-foot canal depth and 5 orchard valves operating at 80 percent open. The canal depth, number of operating turnouts, and opening of the turnouts was varied to determine the effects of these changes on the system flow rate.

Figure II-3
Schematic of Farm Turnout Model



III

RESULTS

1. SEEPAGE

Computations show that seepage is a significant loss of the Alta delivery system. Of the 77 canals analyzed, seepage rates varied from a negligible amount for many of the small, lined ditches to approximately 21.6 cfs for Traver Canal (Table III-1). The volume of seepage in individual canals varied from a negligible amount to volumes in excess of 6,900 acre-feet in the wet year (1984). The seepage volumes varied from negligible amounts to volumes in excess of 1,700 acre-feet in the dry year (1990).

Seepage loss in the largest canals amounted to several percent of the total head gate diversion. The total seepage for the wet and dry years is estimated at 49,230 and 13,700 acre-feet respectively. This amounts to approximately 23 percent of Alta's total diversion (Table III-1).

Both Alta's diversion and canal seepage remain relatively constant throughout the irrigation season. Therefore, the seepage can be thought of as a constant delivery of 23 percent of the district's diversion. If the district diverts 650 cfs at the head gate, approximately 150 cfs can be envisioned as flowing out through the bottom of its canals.

The canals with the greatest seepage loss are those that tend to be wider such as Traver Canal, East Branch Canal, Traver Creek, and Alta Main (Tables III-2A and III-2B). An overwhelming majority of the seepage occurs on the sandy-textured soils. The group ***a*** soils account for about 6 percent of the district diversion, and the group ***b*** soils account for almost 13 percent of the diversion (Table III-3). By contrast, all of the finer textured soils combined account for less than 5 percent of the total diversion. Appendix C gives values of seepage for each canal segment.

2. EVAPORATION

Computations show that evaporation is not a significant loss of the Alta delivery system. The total volume of evaporation lost from Alta's delivery system varied from 1,700 acre-feet in the wet year of 1984 to 430 acre-feet in the dry year of 1990 (Table III-4). These losses correspond to 0.8 and 0.7 percent of Alta's total annual diversion respectively.

Over 80 percent of the total evaporation loss occurring in Alta's delivery system is attributed to its 20 widest and longest canals (Tables III-5A and III-5B). The greater the canal's water surface area, the greater will be its evaporation; so the widest and longest canals will have the most evaporation loss.

The variance in evaporation on a daily basis was also considered insignificant. Figures III-1A and III-1B show that, even on the hottest days of 1984 and 1991, the total canal evaporation never exceeded 2 percent of the daily diversion. Appendix C gives values of evaporation for each canal segment.

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.

Table III-2A

Alta's 20 Canals with the Greatest Seepage in Wet (1984) Year.

Canal Name	1984 (AF)	1984 Percent of Diversion
Traver Canal	6,910	3.2%
East Branch	5,753	2.7%
Traver Creek	3,878	1.8%
Alta Main	3,592	1.7%
Buttonwillow	2,830	1.3%
Wilson	2,220	1.0%
California Vineyard	1,938	0.9%
McClanahan	1,527	0.7%
Dinuba Town	1,507	0.7%
Banks	1,409	0.7%
Caesar	1,397	0.7%
Button	1,345	0.6%
Kennedy Waste Way	1,166	0.5%
Monson	1,128	0.5%
King	979	0.5%
Smith Mountain	977	0.5%
Reedley Main	917	0.4%
Cary-Hunter	885	0.4%
A.B. Clark	810	0.4%
Clements	667	0.3%
All Other Canals	7,471	3.5%
Total	49,306	23.1%

Table III-2B

Alta's 20 Canals with the Greatest Seepage in Dry (1990) Year.

Canal Name	1990 (AF)	1990 Percent of Diversion
Traver Canal	1,788	3.1%
East Branch	1,715	2.9%
Traver Creek	1,156	2.0%
Alta Main	1,071	1.8%
Buttonwillow	844	1.4%
Wilson	662	1.1%
California Vineyard	578	1.0%
Dinuba Town	449	0.8%
McClanahan	446	0.8%
Caesar	417	0.7%
Kennedy Waste Way	347	0.6%
Monson	336	0.6%
Smith Mountain	291	0.5%
Button	281	0.5%
Reedley Main	273	0.5%
Cary-Hunter	263	0.5%
A.B. Clark	242	0.4%
King	206	0.4%
Clements	199	0.3%
East Reedley	168	0.3%
All Other Canals	1,995	3.4%
Total	13,727	23.6%

3. EVAPOTRANSPIRATION OF BANK VEGETATION

Computations show that ET losses along Alta's canal banks are also insignificant. The total volume of water lost to bank ET from Alta's delivery system varied from 770 acre-feet in the wet year of 1984 to 80 acre-feet in the dry year of 1990 (Table III-6). These losses correspond to 0.4 percent and 0.1 percent of Alta's total annual diversion respectively.

Weeds play a much larger role in ET losses during wet years than in dry years because of the time they take to reach maturity. For shorter irrigation seasons, the mature life of grass is a

Table III-3

Alta I.D. Seepage by Soil Type

(1) Canal Segment Characteristic	Length (miles)	Seepage (cfs)	Seepage 1984 (AF)	Seepage 1984 % of Diversion	Seepage 1990 (AF)	Seepage 1990 % of Diversion
a	33.81	38.3	12,242	5.7%	3,452	5.9%
b	108.16	83.2	26,592	12.5%	7,504	12.9%
c	6.16	4.9	1,569	0.7%	448	0.8%
d	38.20	2.7	846	0.4%	219	0.4%
a'	0	0	0	0.0%	0	0.0%
b'	29.58	12.2	3,910	1.8%	1,116	1.9%
c'	29.77	11.7	3,727	1.8%	864	1.5%
d'	0	0	0	0.0%	0	0.0%
p	63.41	0.9	273	0.1%	80	0.1%
l	7.61	0.5	147	0.1%	44	0.1%
Totals	316.7	154.4	49,306	23%	13,727	24%

Notes:

1. Canal Segment Characteristic delineates canal type: Concrete Lined (l) or Piped (p); or canal bottom soil type for unlined (See Table II-1).

smaller fraction of the season. For the longer, wet seasons, the grasses have more time to mature and consume water. Appendix D gives values of bank ET for each canal segment.

4. OPERATIONAL SPILL

Computations show that operational spill losses can vary from insignificant to significant amounts depending on the water year. During the wet year (1984) a total of 11,600 acre-feet of water was spilled; during the dry year (1990) only 260 acre-feet of water was spilled (Table III-7). These volumes represent 5.5 and 0.4 percent of the Alta's total diversion, respectively.

5. UNACCOUNTED WATER

The district-wide water balance computations show that unaccounted water varied from 750 acre-feet in the wet year of 1984 to 15,672 acre feet in the dry year of 1990 (Table III-8). This represents 0.4 and 26.9 percent of the diverted water respectively.

The results shown in Table III-8 made it necessary to look at records from other wet and dry years. It was found that the amount of unaccounted water varies from negligible amounts to

Table III-4
Alta I.D. Canal Surface Evaporation

Canal Name	Length (mi)	Average Width (ft)	1984 Evaporation (AF)	1990 Evaporation (AF)	Canal Name	Length (mi)	Average Width (ft)	1984 Evaporation (AF)	1990 Evaporation (AF)
Alta Main	8.9	72.4	235.2	64.7	King	4.4	13.8	22.2	4.3
A.B. Clark	4.4	12.4	15.0	4.1	Kirk	1.7	4.6	2.2	0.6
A.N. Smith	1.8	5.7	1.6	0.4	Knestric	5.6	6.2	5.9	1.6
A.W. Clark	2.9	8.3	7.0	1.9	Loper	3.2	6.3	7.4	2.0
Andrews	2.5	4.0	3.6	1.0	Lovell	2.0	5.7	3.6	1.0
Ballard	2.8	9.3	3.3	0.9	McBriar	2.0	N/A	N/A	N/A
Banks	17.7	13.2	85.3	9.1	McClanahan	5.9	15.1	30.9	8.3
Bowhay	3.1	12.6	14.4	4.0	Mc Gee	1.9	4.6	1.3	0.3
Bump & Edmiston	1.8	7.3	1.6	0.4	Monson	7.0	13.9	35.4	9.7
Button	15.0	17.7	96.2	18.4	Montague	1.3	4.4	1.4	0.4
Buttonwillow	11.0	19.9	73.6	20.2	Mt. Campbell	3.7	12.8	12.0	3.3
Caesar	5.3	15.7	27.2	7.5	Nichols-Cann	1.9	N/A	N/A	N/A
California Vineyard	6.9	19.2	44.7	12.3	Nuss	1.2	N/A	N/A	N/A
Cary-Hunter	7.7	12.9	31.7	8.4	Orosi School House	3.2	7.5	8.8	2.4
Carpenter	1.2	10.9	0.9	0.2	Parenti	1.3	N/A	N/A	N/A
Clapp	1.5	6.1	0.5	0.1	Parks	1.5	7.7	2.5	0.7
Clements	4.0	13.5	19.5	5.4	Peck	0.6	N/A	N/A	N/A
Clough	3.9	10.7	15.3	0.4	Red Williams	1.5	16.1	8.8	1.2
Cross Creek W.W.	1.9	11.6	8.0	0.2	Reedley Main	3.0	21.5	23.7	6.5
Curtis Cutoff	1.5	15.0	4.1	1.1	Reo	1.5	4.5	2.2	0.6
Lower Curtis Cutoff	0.9	10.2	1.7	0.5	Rice-Brubaker	2.2	5.4	2.6	0.7
Upper Curtis Cutoff	1.0	11.0	0.4	0.1	Sandridge	2.9	15.4	7.6	2.1
Dinuba Town	8.8	13.9	40.4	11.1	Segrue	0.3	N/A	N/A	N/A
East Branch	15.5	42.8	242.0	66.5	Smith Mountain	9.3	12.8	38.7	10.7
East Gould	1.5	4.5	1.2	0.3	Sontag	6.7	9.5	21.3	4.8
East Reedley	5.5	17.5	13.7	3.8	Tout	6.0	10.2	16.5	4.5
East Section 20	1.2	8.3	3.7	1.0	Traver Creek	10.1	28.0	102.8	28.3
Elter	2.5	6.5	1.8	0.5	Traver Canal	12.3	39.4	176.0	40.6
Floyd	1.5	4.8	2.6	0.7	Uphill	0.6	N/A	N/A	N/A
Frane	1.4	N/A	N/A	N/A	Van Noy	2.2	8.9	7.0	1.6
Gordon	1.0	5.7	1.1	0.3	Wahtoke	5.1	12.8	12.8	3.5
Grove	1.7	7.5	2.6	0.7	Weisse	1.0	9.1	3.3	0.1
Haden & Boone	2.7	6.0	3.7	1.0	West Gould	4.9	7.6	8.6	2.4
Hogan	2.1	5.4	0.9	0.2	West Reedley	5.6	10.6	11.0	3.0
Horseman	5.0	9.2	16.7	4.6	West Section 20	1.8	7.5	4.8	1.3
J. T. Williams	2.4	N/A	N/A	N/A	Wilson	10.7	16.4	62.4	17.2
Jack	1.2	8.0	3.6	1.0	Wilson Hunter	1.5	10.4	5.8	1.6
Kennedy School House	5.0	13.4	1.4	0.4	Wilson School House	3.4	11.1	13.2	3.5
Kennedy Waste Way	7.3	13.4	25.6	7.0	Windsor	1.3	N/A	N/A	N/A
					Total	316.7		1,714.5	429.6

Note: Evaporation shown as N/A denote canals that are completely piped.

Table III-5A

Alta's 20 Canals with the Greatest Evaporation in Wet (1984) Year

Canal Name	1984 Evaporation (AF)
East Branch	242.0
Alta Main	235.2
Traver Canal	176.0
Traver Creek	102.8
Button	96.2
Banks	85.3
Buttonwillow	73.6
Wilson	62.4
California Vineyard	44.7
Dinuba Town	40.4
Smith Mountain	38.7
Monson	35.4
Cary-Hunter	31.7
McClanahan	30.9
Caesar	27.2
Kennedy Waste Way	25.6
Reedley Main	23.7
King	22.2
Sontag	21.3
Clements	19.5
All Other Canals	279.6
Total	1,714.6

Table III-5B

Alta's 20 Canals with the Greatest Evaporation in Dry (1990) Year

Canal Name	1990 Evaporation (AF)
East Branch	66.5
Alta Main	64.7
Traver Canal	40.6
Traver Creek	28.3
Buttonwillow	20.2
Button	18.4
Wilson	17.2
California Vineyard	12.3
Dinuba Town	11.1
Smith Mountain	10.7
Monson	9.7
Banks	9.1
Cary-Hunter	8.4
McClanahan	8.3
Caesar	7.5
Kennedy Waste Way	7.0
Reedley Main	6.5
Clements	5.4
Sontag	4.8
Horseman	4.6
All Other Canals	68.3
Total	429.6

values up to 30 percent of total district diversion (Table III-9). This variation appears to correspond to the type of water year. Unaccounted water is significant in dry years and negligible in average and above average water years (Figure III-2).

Fluctuations in turnout flow rate seem to be dependent on more than just canal head (Figure III-3). During a typical 24-hour period, the head in the canal varied by less than 0.3 feet while flow rate varied from 1.6 cfs to 2.0 cfs. The turnout head had many more small fluctuations than the canal head. This suggests that turnout flow fluctuations are affected more by activities occurring on the farm than by canal depth.

Figure III-1A
Alta I.D. Temperature and Canal Evaporation, 1984

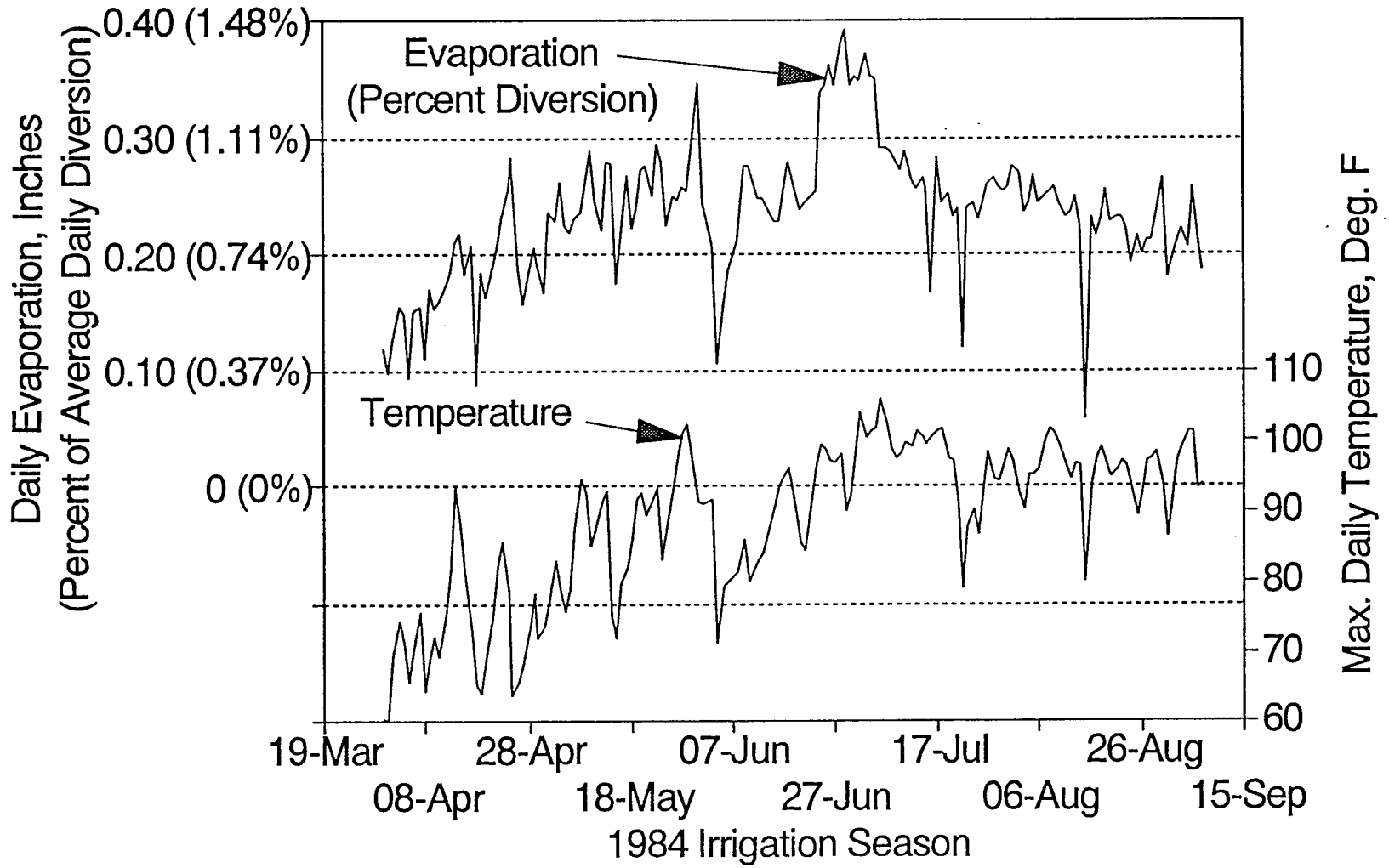


Figure III-1B
Alta I.D. Temperature and Canal Evaporation, 1990

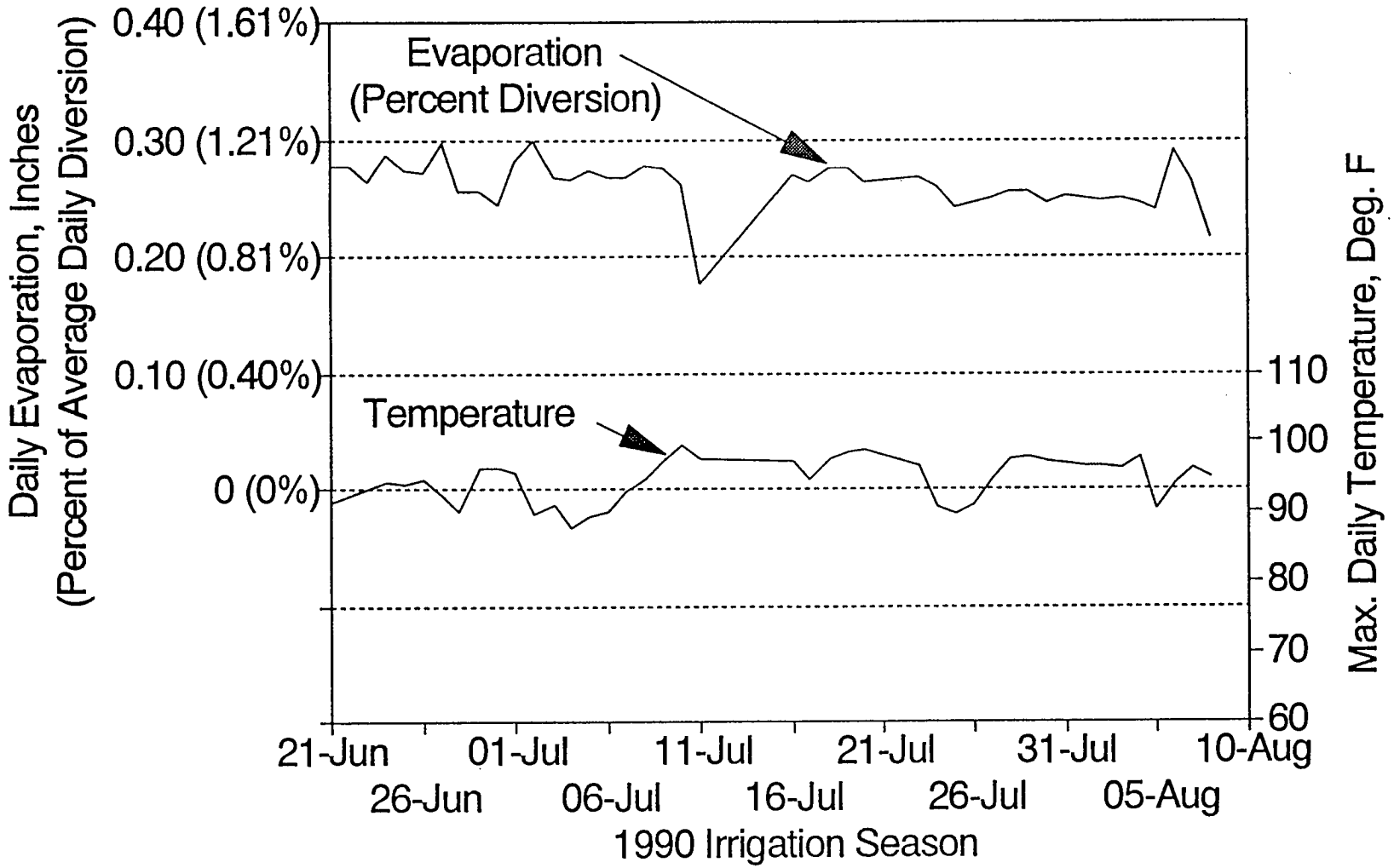


Table III-6
Alta I.D. Evapotranspiration (ET) of Canal Bank Vegitation for Wet (1984) and Dry (1990) Years

Canal Name	Length of Canal (mi)	Length of Tree (mi)	Length of Brush (mi)	Length of Grass (mi)	1984 ET (AF)	1990 ET (AF)
Alta Main	8.9	1.3	0.0	17.9	61.1	12.2
A.B. Clark	4.4	0.0	0.0	8.9	8.3	0.6
A.N. Smith	1.8	0.0	0.0	3.5	1.9	0.1
A.W. Clark	2.9	0.0	0.0	5.8	5.9	0.4
Andrews	2.5	0.0	0.0	4.9	6.2	0.4
Ballard	2.8	0.0	0.0	5.5	2.5	0.2
Banks	17.7	0.0	0.0	35.5	44.7	1.3
Bowhay	3.1	0.0	0.0	6.3	7.9	0.6
Bump & Edmiston	1.8	0.0	0.0	3.7	1.5	0.1
Button	15.0	0.0	0.0	29.9	37.7	1.9
Buttonwillow	11.0	0.0	0.0	22.0	25.7	1.8
Caesar	5.3	0.0	0.0	10.5	12.0	0.8
California Vineyard	6.9	0.0	0.0	13.9	16.2	1.1
Cary-Hunter	7.7	0.0	0.0	15.4	17.0	1.1
Carpenter	1.2	N/A	N/A	N/A	N/A	N/A
Clapp	1.5	N/A	N/A	N/A	N/A	N/A
Clements	4.0	0.0	0.0	7.9	10.0	0.7
Clough	3.9	0.0	0.0	7.9	9.9	0.1
Cross Creek W.W.	1.9	0.0	0.0	3.8	4.8	0.0
Curtis Cutoff	1.5	0.0	0.0	3.1	1.9	0.1
Lower Curtis Cutoff	0.9	0.0	0.0	1.9	1.1	0.1
Upper Curtis Cutoff	1.0	0.0	0.0	2.0	0.3	0.0
Dinuba Town	8.8	0.0	0.0	17.7	20.2	1.4
East Branch	15.5	0.0	0.0	31.1	39.2	2.8
East Gould	1.5	0.0	0.0	3.0	1.8	0.1
East Reedley	5.5	0.0	0.0	10.9	5.4	0.4
East Section 20	1.2	N/A	N/A	N/A	N/A	N/A
Elter	2.5	0.0	0.0	5.1	1.9	0.1
Floyd	1.5	0.0	0.0	3.0	3.8	0.3
Frane	1.4	N/A	N/A	N/A	N/A	N/A
Gordon	1.0	0.0	0.0	2.0	1.3	0.1
Grove	1.7	N/A	N/A	N/A	N/A	N/A
Haden & Boone	2.7	0.0	0.0	5.5	4.3	0.3
Hogan	2.1	0.0	0.0	4.2	1.1	0.1
Horseman	5.0	0.0	0.0	10.0	12.6	0.9
J. T. Williams	2.4	N/A	N/A	N/A	N/A	N/A
Jack	1.2	0.0	0.0	2.5	3.1	0.2
Kennedy School Hous	5.0	0.0	0.0	10.0	0.7	0.1
Kennedy Waste Way	7.3	0.0	0.0	14.6	13.2	0.9
King	4.4	0.0	0.0	8.8	11.1	0.6
Kirk	1.7	0.0	0.0	3.5	3.3	0.2
Knestric	5.6	0.0	0.0	11.1	6.6	0.5
Loper	3.2	0.0	0.0	6.5	8.2	0.6
Lovell	2.0	0.0	0.0	4.0	4.4	0.3
McBriar	2.0	N/A	N/A	N/A	N/A	N/A
McClanahan	5.9	0.0	0.0	11.8	14.2	1.0
Mc Gee	1.9	0.0	0.0	3.9	1.9	0.1
Monson	7.0	0.0	0.0	14.0	17.7	1.2
Montague	1.3	0.0	0.0	2.6	2.1	0.2
Mt. Campbell	3.7	0.0	0.0	7.4	6.6	0.5
Nichols-Cann	1.9	N/A	N/A	N/A	N/A	N/A
Nuss	1.2	N/A	N/A	N/A	N/A	N/A
Orosi School House	3.2	0.0	0.0	6.5	8.2	0.6
Parenti	1.3	N/A	N/A	N/A	N/A	N/A
Parks	1.5	0.0	0.0	3.1	2.2	0.2
Peck	0.6	N/A	N/A	N/A	N/A	N/A
Red Williams	1.5	0.0	0.0	3.0	3.8	0.1
Reedley Main	3.0	0.0	0.0	6.1	7.6	0.5
Reo	1.5	0.0	0.0	3.0	3.3	0.2
Rice-Brubaker	2.2	0.0	0.0	4.5	3.3	0.2
Sandridge	2.9	0.0	0.0	5.8	1.2	0.1
Segrue	0.3	N/A	N/A	N/A	N/A	N/A
Smith Mountain	9.3	0.0	0.0	18.6	21.0	1.5
Sontag	6.7	0.0	0.0	13.3	15.5	0.9
Tout	6.0	0.0	0.0	12.1	9.4	0.7
Traver Creek	10.1	1.2	16.0	20.2	137.8	32.7
Traver Canal	12.3	0.0	0.0	24.6	31.0	1.8
Uphill	0.6	N/A	N/A	N/A	N/A	N/A
Van Noy	2.2	0.0	0.0	4.4	2.8	0.1
Wahtoke	5.1	0.0	0.0	10.2	6.9	0.5
Weisse	1.0	0.0	0.0	2.0	2.5	0.0
West Gould	4.9	0.0	0.0	9.9	6.6	0.5
West Reedley	5.6	0.0	0.0	11.2	7.2	0.5
West Section 20	1.8	N/A	N/A	N/A	N/A	N/A
Wilson	10.7	0.0	0.0	21.3	26.4	1.9
Wilson Hunter	1.5	0.0	0.0	3.1	3.9	0.3
Wilson School House	3.4	0.0	0.0	6.8	8.3	0.6
Windsor	1.3	N/A	N/A	N/A	N/A	N/A
Total	316.7	2.5	16.0	592.7	770.3	80.3

Note: Length and ET shown as N/A denote canals that are completely piped or lined.

Table III-7

Operational Spill that Leaves Alta Irrigation District for Wet (1984) and Dry (1990) Years

Canal Name	1984		1990	
	Spill Flow (cfs)	Seasonal Spill Volume (AF)	Spill Flow (cfs)	Seasonal Spill Volume (AF)
Cross Creek Waste Way	6.00	1,916		
Traver Canal	5.50	1,756		
West Section 20	0.50	160	0.50	1.0
Clough	5.00	1,597		
Lyndecker	5.00	1,597		
Wahtoke Ditch	0.50	160	0.50	1.0
Mt. Campbell	1.00	319	1.00	2.0
Banks	1.75	559		
Orosi School House	0.75	240	0.75	
Button	7.50	2,395		
E. Branch	3.00	958		
Watoke Creek Waste Way*				
West Reedley*				
Total	36.5	11,656	2.75	262
Percent of Diversion		5.5%		0.4%

Note:

*Spill is possible from these points but does not happen on a day to day basis.

Results of the turnout model analysis show that opening or closing 1 out of 5 orchard valves will change the turnout flow rate as much as 18 percent (Table III-10). Similarly, a 10 percent change in orchard valve opening results in at least a 10 percent change in turnout flow rate. By contrast, it takes a 2-foot change in canal depth to cause a 10 percent change in turnout flow rate.

Table III-8

Alta I.D. Water Balance

Type of Water Source, Use, or Loss	1984 (Wet)			1990 (Dry)		
	Amount of Source, Use, or Loss (AF)		Percent of Diversion	Amount of Source, Use, or Loss (AF)		Percent of Diversion
Diversion		212,941	100.0%		58,284	100.0%
Losses						
Seepage	49,306		23.1%	13,727		23.6%
Evaporation	1,715		0.8%	430		0.7%
Bank ET	770		0.4%	80		0.1%
Spill	11,656		5.5%	262		0.5%
Sub-Total		63,447	29.8%		14,499	24.9%
Delivered		148,827	69.9%		28,137	48.3%
Unaccounted		643	0.3%		15,658	26.9%

Table III - 9

Alta I.D. Unaccounted Water from 1976 through 1990

(1) Year	Percent Of Average Kings River Runoff	Alta Head Gate Diversion (AF)	Recorded Farm Delivery (AF)	Percent Delivered	(2) Estimated Losses	Percent Unaccounted For
1975	93.6%	184,034	129,407	70.3%	30%	-0.3%
1976	31.9%	43,381	21,064	48.6%	25%	26.4%
1977	23.4%	38,721	17,441	45.0%	25%	30.0%
1978	204.1%	246,204	167,980	68.2%	30%	1.8%
1979	102.2%	181,996	124,662	68.5%	30%	1.5%
1980	180.0%	242,611	159,017	65.5%	30%	4.5%
1981	61.5%	145,581	86,654	59.5%	25%	15.5%
1982	183.8%	241,759	167,651	69.3%	30%	0.7%
1983	264.5%	203,099	135,592	66.8%	30%	3.2%
1984	116.5%	214,165	149,077	69.6%	30%	0.4%
1985	74.0%	170,826	112,489	65.9%	25%	9.1%
1986	192.8%	227,709	170,047	74.7%	30%	-4.7%
1987	46.0%	121,270	73,546	60.6%	25%	14.4%
1988	48.9%	59,118	33,305	56.3%	25%	18.7%
1989	53.5%	89,983	50,238	55.8%	25%	19.2%
1990	40.5%	58,468	28,137	48.1%	25%	26.9%

Notes:

(1) Water year (i.e. 1975 means October 1974 through September 1975).

(2) Estimated Losses Assumed: 25 percent of diverted water for dry year (Kings River runoff less than 80% of average).

30 percent of diverted water for wet year (Kings River runoff greater than 80% of average).

Figure III-2

Alta I.D. Unaccounted Water from 1976 to 1990

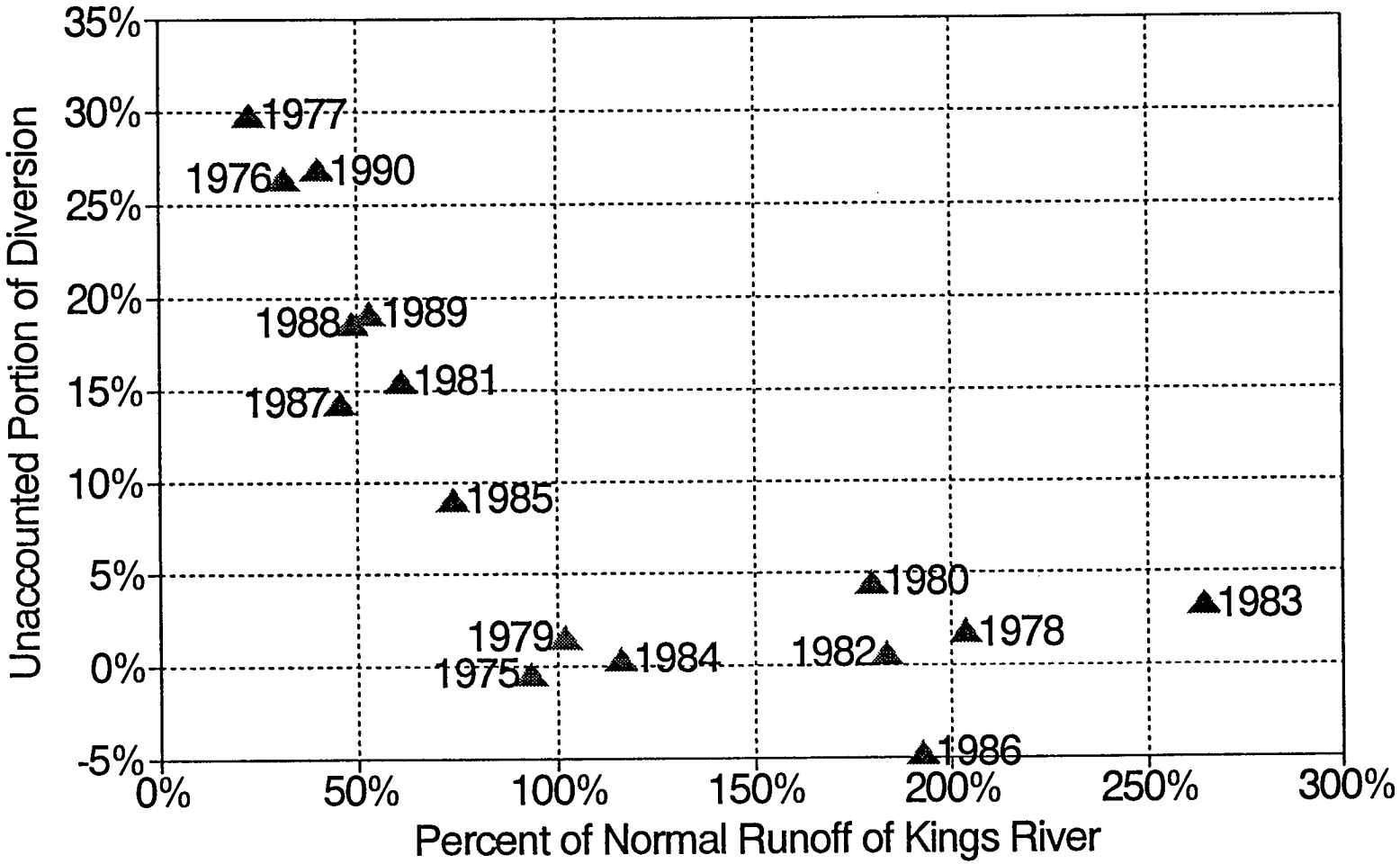


Figure III - 3
Turnout Heads and Flow Rates
(Ceasar Canal @ Rd. 40)

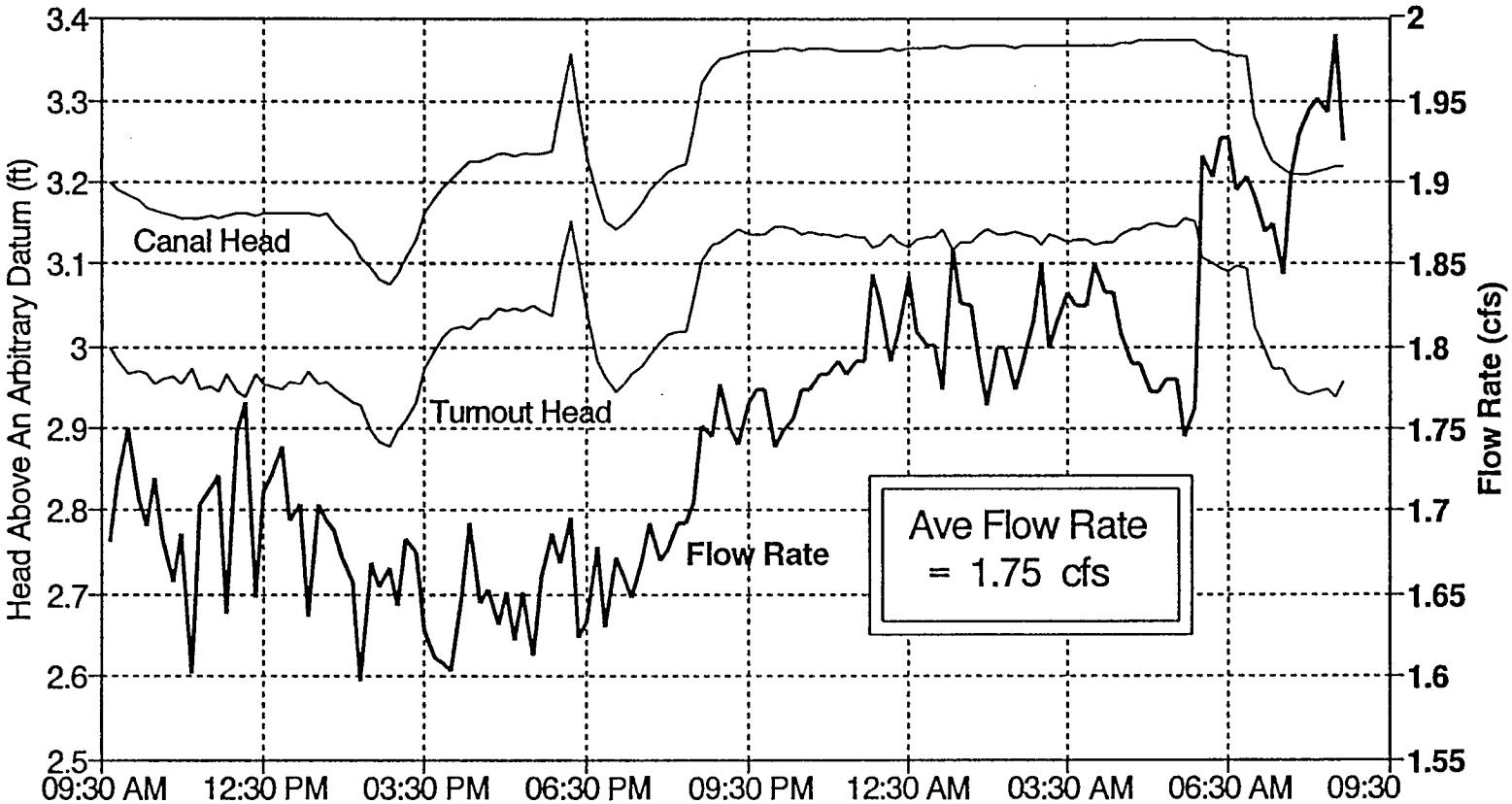


Table III-10
Effects of Farmer and District Operations on Turnout Flow

Canal Depth (ft)	Number of Orchard Valves	Percent Orchard Valves Open	Turnout Head Loss (ft)	Turnout Flow (cfs)	Percent of Base Flow
Base Flow:					
5.0	5	80%	0.05	0.87	100%
Changing Canal Depth:					
3.0	5	80%	0.038	0.78	89%
3.5	5	80%	0.040	0.80	92%
4.0	5	80%	0.042	0.82	95%
4.5	5	80%	0.045	0.85	97%
5.0	5	80%	0.047	0.87	100%
5.5	5	80%	0.049	0.89	102%
6.0	5	80%	0.052	0.91	105%
6.5	5	80%	0.054	0.93	107%
7.0	5	80%	0.056	0.95	110%
Changing Number of Orchard Valves:					
5.0	1	80%	0.002	0.19	22%
5.0	2	80%	0.009	0.37	43%
5.0	3	80%	0.019	0.55	63%
5.0	4	80%	0.032	0.72	82%
5.0	5	80%	0.047	0.87	100%
5.0	6	80%	0.063	1.01	116%
5.0	7	80%	0.080	1.13	130%
5.0	8	80%	0.096	1.24	143%
5.0	9	80%	0.112	1.34	154%
Changing Amount Valves are Open:					
5.0	5	100%	0.067	1.04	120%
5.0	5	90%	0.057	0.96	110%
5.0	5	80%	0.047	0.87	100%
5.0	5	70%	0.037	0.77	89%
5.0	5	60%	0.028	0.68	78%
5.0	5	50%	0.020	0.57	66%
5.0	5	40%	0.013	0.46	53%
5.0	5	30%	0.008	0.35	40%
5.0	5	20%	0.003	0.24	27%
5.0	5	10%	0.001	0.12	14%

IV

SUMMARY

Seepage is by far the most significant loss to the Alta Delivery system. Seepage accounted for approximately 77 percent and 95 percent of the total losses estimated for wet (1984) and dry years (1990), respectively (Table IV-1).

Table IV-1
Summary of Alta I.D. Distribution System Losses

Loss	Wet Year (1984)		Dry Year (1990)	
	Percent of Diversion	Percent of Total Losses	Percent of Diversion	Percent of Total Losses
Seepage	23.1%	77.5%	23.6%	94.8%
Evaporation	0.8%	2.7%	0.7%	2.8%
Bank ET	0.4%	1.3%	0.1%	0.4%
Spill	5.5%	18.5%	0.5%	2.0%
Total	29.8%	100.0%	24.9%	100.0%

Operational spillage accounted for about 18 percent of the total loss in the wet year. The spillage is greater in wet years because more of the "tail end" canals are operated in these periods. During dry years most of the canals at the end of the system (near south and southwest boundaries) do not receive very much water because they are in low water allotment zones. For this reason, the total amount of spill from the delivery system is significantly reduced in dry years.

Evaporation and ET of bank vegetation combined accounted for less than 5 percent of the total losses. Therefore, evaporation and ET losses are not considered significant.

V

DISCUSSION

1. ACCURACY OF ESTIMATES

There are many factors affecting the losses that were estimated in this study such as soil infiltration rates, soil texture distribution, canal size, evaporation rate, et cetera. This study has made reasonable estimates of the most significant of these many factors. It is recognized that there is always some inherent error in an analysis of this type.

Given the precision of the data at hand, it is believed that these loss estimates are accurate to approximately 25 percent of their magnitude. For example, this means that the seepage estimate of 23 percent of total diversion may be as low as 17 percent or as high as 29 percent. Likewise, the evaporation estimate of 0.8 percent of total diversion may be as low as .6 percent or as high as 1.0 percent.

The magnitude of the most significant loss, seepage, will be tested and refined as part of the groundwater modeling effort discussed in Section I. The groundwater model requires calibration of inputs such as seepage and physical properties. The seepage values will be adjusted as required to calibrate the model to historical data.

2. WHY IS UNACCOUNTED WATER HIGH IN DRY YEARS?

Unaccounted water is that portion of Alta's total diversion remaining after losses and deliveries are accounted for. There is no practical way of determining exactly where this unaccounted water goes, but it can be assumed that the unaccounted water is delivered to farms without being recorded.

There is also no practical way of determining exactly why the amount of unaccounted water appears to be so high in dry years. One possible explanation is that unaccounted water is less in wet years because water measured and delivered to farms is returned to canals unmetered in the form of surface runoff.

Another possibility could be related to the inherent inexactness of the measurement methods used by Alta. There is error in any measurement. The cost of making a measurement usually increases with the accuracy of the desired result. Alta's measurements are relatively inexpensive but leave room for potentially large errors. It is possible that growers have learned to take advantage of the potential errors and perhaps do so during drought years. If this is the case, it should **not** be assumed that growers are doing anything improper or illegal, but are simply using the system to their greatest advantage.

Either or both of these explanations may explain this phenomenon, or there may be other reasons that were not apparent in this study. Regardless, this analysis implies that there may be significant error in the measurement of Alta's water deliveries. Of particular concern is whether the error is distributed evenly among Alta's water users, or if some growers are more adept at squeezing extra water from the system than others.

3. DEAD STORAGE

There is a portion of water that is diverted into Alta's system that can never be delivered to farms. This is the water that is trapped below the turnout and check structures at the end of the irrigation season. This loss was not included in other discussions because it is assumed that this water is included in the seepage estimates.

However, for the sake of discussion, the volume of dead storage is estimated to be approximately 15 percent (186 acre-feet) of the total storage in Alta's canal system (1,238 acre-feet). This dead storage volume represents about 0.1 percent of the average annual diversion. Therefore, it is not considered practical to attempt to reduce this insignificant loss.

4. IDEAS FOR REDUCING LOSSES

A. Canal Lining and Piping

Seepage losses could be reduced if canals were concrete-lined or piped. This alternative would be very expensive and could result in destroying an important source of groundwater recharge for the Alta area.

It may be possible to replace this recharge potential with artificial recharge basins. The cost of such basins was not estimated in this study, but a total basin area of between 500 and 1,000 acres would be required to replace the existing seepage of the Alta system.

A combined system of concrete-lined or piped ditches and basins would allow Alta to deliver all of its surface entitlement in dry years and recharge a portion of the entitlement in wet years.

Piping of canals would also reduce the amount of evaporation and bank ET losses. However, since these losses are less than 2 percent of the total diversion, reduction of evaporation or ET losses should not be considered a sufficient motive for piping canals.

B. Water Meters

Totalizing water meters could be installed at farmer turnouts to keep a constant count of the volume of water delivered to growers. These devices would not reduce the losses of the system, but would help ensure that water is delivered in an equitable manner.

Retrofitting turnouts can cost from $500 to $2,000 per turnout. The cost of meters can vary from $1,000 to $2,500. Other San Joaquin Valley irrigation districts have successfully rotated a few meters to several different turnouts, thereby significantly reducing costs (Rayner, 1991). The cost of purchasing 1,000 meters and retrofitting all 4,000 of Alta's turnouts could cost from $3-million to $10.5-million. Assuming that the meters would have a useful life of 15 years, and can be financed at an interest rate of 6 percent, the additional cost of the meters would be an average of $1.58 to $5.54 per acre-foot of water (based on an average entitlement of 195,035 acre-feet).

The additional annual grower assessment required to pay for meters would be an average of $3.09 to $10.81 per acre (based on an average assessment area of 100,000 acres).

District flow meters can also be a very valuable water management tool for Alta's growers. Many on-farm water management techniques (such as irrigation scheduling) depend on accurate and timely measurement of irrigation water applications.

C. Regulating Basins

If regulating basins were constructed at strategic locations within Alta's canal system, the amount of operational spillage that leaves the district could be reduced even in wet years.

The cost and optimum locations of such basins was not determined for this study. If the otherwise spilled water is to be used directly by farmers, it might have to be pumped from the basins, thereby increasing costs. If the water is allowed to recharge into the ground, it might be available to Alta growers in the future. The groundwater modeling effort will help to resolve this question.

Other benefits could be derived from these regulating basins. Basins could help to alleviate "tail ender" problems such as canal depth fluctuation; and they might also double as groundwater recharge facilities.

D. Reduce Bank Vegetation

The amount of trees, brush, and weed growth could be reduced along Alta's banks through off-season clearing and a more aggressive spray program. However, since the loss due to bank vegetation is estimated at less than one half of a percent, this should probably not be considered a sufficient motive for devegetation of canal banks.

5. SEEPAGE ISSUES AND UNANSWERED QUESTIONS

It is not known at this time whether water lost to seepage is a benefit to Alta constituents. It is possible that this percolated water replenishes the underlying aquifer and is available to Alta farmers for future pumping. It may be, however, that seeped water flows out from beneath Alta's growers and is not available for future use within Alta.

The groundwater modeling effort currently underway will attempt to resolve these and similar questions.

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Appendix A

Characteristics of Alta Delivery System by Segment

NOTES

1. Canal Segment Number: sections defined by canal soil type, cross section, and ground water modeling element boundary (see Figures II-1A and II-IB)

2. Canal Segment Characteristic delineates canal type: Concrete Lined (l) or Piped (p); or canal bottom soil type for unlined: See Table II-4.

3. Average Top Width: determined from averaging surveyed widths for each canal section; pipe diameters estimated from field notes and channel flow rates.

4. Average seepage rate of full channel or pipe.

5. Length of trees determined from field notes and aerial photographs. Width of trees assumed to be 80 feet on Alta Main and 60 feet on Traver Canal.

6. Length of brush determined from field notes and aerial photographs. Width of brush assumed to be 15 ft.

7. Evapotranspiration of weeds assumes 4-feet wide strip of weeds on each side of canal; crop efficient is 0.0 for first 30 days of irrigation season and 1.0 for remaining season.

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
Alta Main	2	2400	b	88.9	285.9	213269	15.8	100%	100%
	3	1200	d	85.0	265.5	101999	7.3	100%	100%
	4	16200	d	74.7	231.3	1210492	86.0	100%	100%
	5	3800	d	63.6	197.4	241766	17.2	100%	100%
	6	8400	d	55.8	161.4	468890	31.1	100%	100%
	7	1200	c'	49.3	127.6	59176	3.5	100%	100%
	8	3200	b	71.1	313.2	227441	23.0	100%	100%
	9	3200	b	99.5	469.0	318244	34.5	100%	100%
	10	1000	c'	96.3	384.6	96322	8.8	100%	100%
	11	800	d	80.2	293.9	64198	5.4	100%	100%
	12	5800	b	71.3	245.3	413760	32.7	100%	100%
East Branch	13	200	c'	69.5	236.6	13902	1.1	100%	100%
	14	400	b	69.3	235.8	27731	2.2	100%	100%
	15	3600	c'	68.1	230.0	245197	19.0	100%	100%
	16	400	b	66.9	224.3	26757	2.1	100%	100%
	17	2800	c'	65.9	219.7	184570	14.1	100%	100%
	18	600	b	64.9	214.8	38930	3.0	100%	100%
	19	400	c'	64.6	212.5	25836	2.0	100%	100%
	20	800	d	64.3	208.0	51411	3.8	100%	100%
	21	800	c'	63.8	202.1	51061	3.7	100%	100%
	22	2000	d	63.1	191.7	126123	8.8	100%	100%
	23	800	c'	62.3	181.4	49838	3.3	100%	100%
	24	200	b	62.0	177.7	12405	0.8	100%	100%
	25	400	c'	61.9	175.5	24744	1.6	100%	100%
	26	400	c'	59.4	166.5	23770	1.5	100%	100%
	27	2400	b	56.1	156.0	134566	8.6	100%	100%
	28	1600	b	54.4	151.2	86961	5.6	100%	100%
	29	1800	c'	52.9	147.1	95203	6.1	100%	100%
	30	600	a	51.9	144.2	31116	2.0	100%	100%
	31	1200	c'	51.1	142.1	61303	3.9	100%	100%
	32	1200	c'	50.1	139.2	60066	3.8	100%	100%
	33	1000	b	49.1	136.5	49110	3.1	100%	100%
	34	2400	c'	47.6	132.4	114359	7.3	100%	100%
	35	1000	c'	46.2	128.3	46189	2.9	100%	100%
	36	3400	c'	44.3	123.0	150617	9.6	100%	100%
	37	3000	c'	41.5	115.3	124650	7.9	100%	100%
	38	3200	c'	38.9	107.8	124437	7.9	100%	100%
	39	1000	c'	37.1	102.8	37082	2.4	100%	100%
	40	1800	b	35.9	99.4	64583	4.1	100%	100%
	41	12800	b	33.2	92.9	425574	27.3	100%	100%
	42	1800	b	31.1	88.0	56031	3.6	100%	100%
	43	800	a	37.2	108.1	29787	2.0	100%	100%
	44	2200	b	42.5	128.5	93501	6.5	100%	100%
	45	7800	b'	39.1	117.2	304804	21.0	100%	100%
	46	5200	b'	35.2	99.0	183069	11.8	100%	100%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	47	1600	b	33.2	89.5	53089	3.3	100%	100%
	48	3800	b'	29.5	69.0	111926	6.0	100%	100%
	49	6600	d	26.2	50.7	172951	7.7	100%	100%
A.B. Clark	1	6680	a	13.1	22.3	87332	3.4	100%	100%
	2	1600	p	3.0	7.1	0	0.3	100%	100%
	3	10800	a	12.1	17.7	130145	4.4	100%	100%
	4	2200	p	3.0	7.1	0	0.4	100%	100%
	5	2200	p	3.0	7.1	0	0.4	100%	100%
A.N. Smith	1	1600	p	2.4	4.5	0	0.2	100%	100%
	2	4000	b	5.7	5.2	22804	0.5	100%	100%
	3	2400	p	1.0	0.8	0	0.0	100%	100%
	4	1240	p	1.0	0.8	0	0.0	100%	100%
A.W. Clark	1	2800	c'	8.3	8.8	23255	0.6	100%	100%
	2	200	d	8.3	8.8	1661	0.0	100%	100%
	3	1600	c'	8.3	8.8	13289	0.3	100%	100%
	4	1800	c'	8.3	8.8	14950	0.4	100%	100%
	5	800	p	1.5	1.8	0	0.0	100%	100%
	6	1600	p	1.5	1.8	0	0.1	100%	100%
	7	2280	b	8.3	8.8	18936	0.5	100%	100%
	8	600	p	1.0	0.8	0	0.0	100%	100%
	9	3640	b	8.3	8.8	30232	0.7	100%	100%
Andrews	1	1240	b'	4.0	3.2	4962	0.1	100%	100%
	2	1640	b'	4.0	3.2	6562	0.1	100%	100%
	3	2280	b	4.0	3.2	9123	0.2	100%	100%
	4	2960	b'	4.0	3.2	11844	0.2	100%	100%
	5	3640	a	4.0	3.2	14565	0.3	100%	100%
	6	1240	b'	4.0	3.2	4962	0.1	100%	100%
Ballard	1	920	b'	9.3	11.2	8518	0.2	100%	100%
	2	400	b	9.3	11.2	3704	0.1	100%	100%
	3	720	b	9.3	11.2	6666	0.2	100%	100%
	4	1880	c'	9.3	11.2	17407	0.5	100%	100%
	5	800	p	1.5	1.8	0	0.0	100%	100%
	6	1280	c'	9.3	11.2	11851	0.3	100%	100%
	7	4640	p	1.0	0.8	0	0.1	100%	100%
	8	3960	p	1.0	0.8	0	0.1	100%	100%
Banks	1	2280	d	11.6	11.5	26449	0.6	100%	50%
	2	2880	d	11.6	12.0	33411	0.8	100%	50%
	3	2560	d	11.6	12.5	29700	0.7	100%	50%
	4	1200	c	11.6	12.8	13922	0.4	100%	50%
	5	3600	d	11.6	13.2	41769	1.1	100%	50%
	6	3400	c'	11.6	13.8	39451	1.1	100%	50%
	7	1040	b'	11.6	14.2	12068	0.3	100%	50%
	8	5040	c'	11.6	14.8	58485	1.7	100%	50%
	9	6280	d	11.6	15.8	72881	2.3	100%	50%
	10	1440	d	11.6	16.4	16713	0.5	100%	50%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	11	6400	b'	11.6	17.1	74283	2.5	100%	50%
	12	2200	d	11.6	17.9	25537	0.9	100%	50%
	13	5160	b'	11.6	18.6	59899	2.2	100%	50%
	14	8240	d	12.4	20.4	102049	3.9	100%	50%
	15	2200	d	13.4	22.1	29408	1.1	100%	50%
	16	3240	d	13.9	23.1	44970	1.7	100%	50%
	17	1240	b	14.3	23.8	17734	0.7	100%	50%
	18	5880	c'	15.0	25.0	88034	3.4	100%	50%
	19	3880	b	16.0	24.9	62162	2.2	100%	50%
	20	720	a	16.6	23.5	11958	0.4	100%	50%
	21	2000	b	16.5	25.7	32901	1.2	100%	50%
	22	3400	c'	15.4	25.8	52282	2.0	100%	10%
	23	800	a	14.4	23.1	11488	0.4	100%	10%
	24	2200	c'	13.6	21.1	29995	1.1	100%	10%
	25	2596	b	13.5	21.7	35096	1.3	100%	10%
	26	2160	c'	14.3	25.5	30856	1.3	100%	10%
	27	1280	b	14.8	28.2	18994	0.8	100%	10%
	28	4520	c'	15.8	32.8	71291	3.4	100%	10%
	29	5760	c'	16.5	36.4	95040	4.8	100%	10%
Bowhay	1	3200	d	11.1	12.6	35417	0.9	100%	100%
	2	4040	b'	11.9	16.5	48070	1.5	100%	100%
	3	3280	b'	12.7	20.5	41783	1.5	100%	100%
	4	1640	d	13.3	23.1	21817	0.9	100%	100%
	5	3960	b	13.9	26.1	55226	2.4	100%	100%
	6	440	b	14.4	28.3	6336	0.3	100%	100%
Bump & Edmiston	1	3240	b	7.3	7.2	23654	0.5	100%	100%
	2	2200	p	1.0	0.8	0	0.0	100%	100%
	3	4200	p	1.0	0.8	0	0.1	100%	100%
Button	1	520	d	21.8	49.8	11339	0.6	100%	100%
	2	3320	d	21.1	46.1	70048	3.5	100%	100%
	3	1560	b'	20.2	41.4	31512	1.5	100%	100%
	4	2920	b'	19.4	37.0	56574	2.5	100%	100%
	5	1200	d	18.6	33.0	22339	0.9	100%	100%
	6	1560	d	18.1	30.4	28247	1.1	100%	100%
	7	1000	d	17.6	27.9	17636	0.6	100%	100%
	8	9160	d	14.7	20.1	134661	4.2	100%	100%
	9	11640	b'	15.1	18.0	175479	4.8	100%	100%
	10	1760	b'	18.1	23.6	31818	1.0	100%	50%
	11	3880	c'	17.7	26.9	68626	2.4	100%	50%
	12	800	a	17.4	29.6	13890	0.5	100%	50%
	13	1480	c'	17.2	30.9	25462	1.0	100%	50%
	14	8480	d	18.0	29.5	152738	5.7	100%	50%
	15	840	c'	19.0	27.1	15970	0.5	100%	50%
	16	4920	d	16.7	20.2	82177	2.3	100%	50%
	17	11600	d	20.4	34.3	236968	9.1	100%	50%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	18	3040	a	24.4	48.7	74093	3.4	100%	50%
	19	2800	c'	20.2	36.7	56512	2.4	100%	50%
	20	1840	b	16.9	27.1	31012	1.1	100%	50%
	21	1000	b	14.8	21.3	14817	0.5	100%	50%
	22	1600	d	13.0	15.9	20723	0.6	100%	50%
	23	2080	c'	11.8	12.6	24552	0.6	100%	50%
Buttonwillow	1	400	c'	41.1	155.9	16454	1.4	100%	100%
	2	800	c'	40.3	151.9	32268	2.8	100%	100%
	3	800	c'	39.3	146.6	31414	2.7	100%	100%
	4	1800	b	37.5	138.0	67557	5.7	100%	100%
	5	2200	b	34.9	124.7	76697	6.3	100%	100%
	6	2400	a	31.8	109.5	76301	6.0	100%	100%
	7	1800	b	29.0	95.6	52180	4.0	100%	100%
	8	1800	a	26.6	83.7	47855	3.5	100%	100%
	9	4800	b	22.2	61.8	106468	6.8	100%	100%
	10	400	c'	18.7	44.6	7484	0.4	100%	100%
	11	2800	b	16.6	34.0	46408	2.2	100%	100%
	12	400	b'	14.5	25.5	5801	0.2	100%	100%
	13	2480	b	13.5	23.4	33369	1.3	100%	100%
	14	7800	b	13.2	18.9	103271	3.4	100%	100%
	15	3920	b	14.2	16.3	55611	1.5	100%	100%
	16	1640	b	14.6	16.4	24023	0.6	100%	100%
	17	1280	b'	14.9	18.1	19080	0.5	100%	100%
	18	4720	b	15.4	21.6	72860	2.3	100%	100%
	19	1120	b	16.0	25.0	17867	0.6	100%	100%
	20	6800	b	16.7	29.6	113237	4.6	100%	100%
	21	3640	a	17.3	33.6	62803	2.8	100%	100%
	22	4200	p	3.0	7.1	0	0.7	100%	100%
Caesar	1	840	p	8.0	25.1	0	0.5	100%	100%
	2	1760	p	8.0	25.1	0	1.0	100%	100%
	3	1920	a	20.2	46.0	38788	2.0	100%	100%
	4	5480	a	18.2	37.5	99728	4.7	100%	100%
	5	2520	c	15.3	25.2	38489	1.5	100%	100%
	6	9000	a	14.4	21.3	129167	4.4	100%	100%
	7	6200	a	14.4	21.3	88982	3.0	100%	100%
California Vineyar	1	600	c'	21.3	60.6	12781	0.8	100%	100%
	2	6400	b	20.0	53.2	128191	7.8	100%	100%
	3	920	b	19.0	45.3	17510	1.0	100%	100%
	4	6200	b	18.9	44.3	117222	6.3	100%	100%
	5	2040	b	18.9	44.3	38570	2.1	100%	100%
	6	4440	b	18.9	44.3	83946	4.5	100%	100%
	7	2800	p	8.0	25.1	0	1.6	100%	100%
	8	480	b	18.9	44.3	9075	0.5	100%	100%
	9	11200	a	18.9	44.3	211756	11.4	100%	100%
	10	1600	a	18.9	44.3	30251	1.6	100%	100%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
Cary-Hunter	1	400	p	4.0	12.6	0	0.1	100%	100%
	2	1000	p	4.0	12.6	0	0.3	100%	100%
	3	1200	b'	14.0	23.2	16818	0.6	100%	100%
	4	1880	c'	13.7	21.9	25750	0.9	100%	100%
	5	1040	b'	13.5	21.0	14029	0.5	100%	100%
	6	4760	b	13.1	19.3	62245	2.1	100%	100%
	7	760	p	3.0	7.1	0	0.1	100%	100%
	8	2320	b	12.5	17.1	29045	0.9	100%	100%
	9	1960	b	12.3	16.1	24151	0.7	100%	100%
	10	1520	p	2.5	4.9	0	0.2	100%	100%
	11	2840	b	12.4	15.8	35195	1.0	100%	100%
	12	480	p	2.5	4.9	0	0.1	100%	100%
	13	5360	b	12.6	16.3	67428	2.0	100%	100%
	14	1040	p	2.5	4.9	0	0.1	100%	100%
	15	3080	b	12.8	17.6	39444	1.2	100%	100%
	16	1880	c'	12.9	18.5	24345	0.8	100%	100%
	17	6400	c'	13.1	19.6	84144	2.9	100%	100%
	18	2840	d	13.3	20.5	37773	1.3	100%	50%
Carpenter	1	3000	p	2.5	4.9	0	0.3	100%	100%
	2	2320	p	2.5	4.9	0	0.3	100%	100%
	3	1160	l	10.9	15.3	12645	0.4	100%	100%
Clapp	1	1280	l	6.1	5.8	7809	0.2	100%	100%
	2	6680	p	1.0	0.8	0	0.1	100%	100%
Clements	1	440	b'	16.9	21.5	7415	0.2	100%	100%
	2	560	b'	17.7	29.2	9886	0.4	100%	100%
	3	2160	b	17.1	31.1	37033	1.5	100%	100%
	4	5880	b	13.6	21.8	79886	2.9	100%	100%
	5	7760	b	12.2	16.4	94998	2.9	100%	100%
	6	3520	b'	13.1	18.1	46138	1.5	100%	100%
	7	600	d	12.7	18.5	7628	0.3	100%	100%
Clough	1	11120	b	10.7	14.4	118433	3.7	100%	10%
	2	5160	b	10.7	14.2	55214	1.7	100%	10%
	3	4480	c'	10.7	14.2	47938	1.5	100%	10%
Cross Creek W.W.	1	2880	c'	11.6	16.8	33428	1.1	100%	10%
	2	7120	c'	11.6	16.8	82641	2.7	100%	10%
Curtis Cutoff	1	3960	b	15.0	24.0	59406	2.2	100%	100%
	2	4200	p	1.0	0.8	0	0.1	100%	100%
Lower Curtis Cutof	1	1120	b	9.3	8.9	10424	0.2	100%	100%
	2	2560	p	2.5	4.9	0	0.3	100%	100%
	3	360	b'	10.4	13.5	3746	0.1	100%	100%
	4	880	a	11.2	16.8	9856	0.3	100%	100%
Upper Curtis Cutof	1	4640	p	2.0	3.1	0	0.3	100%	100%
	2	560	b	11.0	13.6	6160	0.2	100%	100%
Dinuba Town	1	520	b'	11.1	18.4	5769	0.2	100%	100%
	2	1400	b	11.1	18.1	15505	0.6	100%	100%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	3	280	p	3.0	7.1	0	0.0	100%	100%
	4	1080	p	3.0	7.1	0	0.2	100%	100%
	5	1320	b	11.0	17.5	14564	0.5	100%	100%
	6	800	b	11.0	17.0	8799	0.3	100%	100%
	7	1240	b	11.0	16.6	13612	0.5	100%	100%
	8	840	c'	11.0	16.3	9203	0.3	100%	100%
	9	1280	b	10.9	16.0	13996	0.5	100%	100%
	10	560	b'	10.9	15.7	6113	0.2	100%	100%
	11	840	b	10.9	15.5	9157	0.3	100%	100%
	12	2160	b	10.9	15.0	23481	0.7	100%	100%
	13	2200	a	10.8	14.3	23818	0.7	100%	100%
	14	11480	b	12.4	17.3	142046	4.6	100%	100%
	15	4040	b	14.5	21.9	58558	2.0	100%	100%
	16	1960	p	3.0	7.1	0	0.3	100%	100%
	17	3360	b	15.8	24.6	53001	1.9	100%	100%
	18	960	p	3.0	7.1	0	0.2	100%	100%
	19	1680	b'	16.7	36.9	27978	1.4	100%	100%
	20	760	b	17.2	39.0	13045	0.7	100%	100%
	21	6400	b	18.7	45.1	119456	6.6	100%	100%
	22	1440	b	20.0	50.5	28809	1.7	100%	100%
East Gould	1	2400	p	1.0	0.8	0	0.0	100%	100%
	2	1000	p	1.0	0.8	0	0.0	100%	100%
	3	600	b	4.5	2.0	2697	0.0	100%	100%
	4	2200	c'	4.5	2.0	9888	0.1	100%	100%
	5	200	p	1.0	0.8	0	0.0	100%	100%
	6	600	p	1.0	0.8	0	0.0	100%	100%
	7	1000	b	4.5	2.0	4494	0.0	100%	100%
East Reedley	1	600	p	8.0	25.1	0	0.3	100%	100%
	2	1200	p	8.0	25.1	0	0.7	100%	100%
	3	1000	a	17.8	46.7	17800	1.1	100%	100%
	4	3200	b	17.8	46.7	56961	3.4	100%	100%
	5	200	p	8.0	25.1	0	0.1	100%	100%
	6	600	p	8.0	25.1	0	0.3	100%	100%
	7	400	c'	8.0	25.1	3200	0.2	100%	100%
	8	1200	p	8.0	25.1	0	0.7	100%	100%
	9	5000	b	17.8	46.7	89001	5.4	100%	100%
	10	13600	p	4.0	12.6	0	3.9	100%	100%
	11	680	a	17.8	46.7	12104	0.7	100%	100%
	12	440	c'	17.8	46.7	7832	0.5	100%	100%
	13	680	b	17.8	46.7	12104	0.7	100%	100%
East Section 20	1	6520	l	8.3	9.5	53798	1.4	100%	100%
Elter	1	600	p	2.5	4.9	0	0.1	100%	100%
	2	2200	c'	6.5	5.3	14383	0.3	100%	100%
	3	1800	c'	6.5	5.3	11768	0.2	100%	100%
	4	1600	p	2.5	4.9	0	0.2	100%	100%

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	5	1600	p	2.5	4.9	0	0.2	100%	100%
	6	2600	p	2.5	4.9	0	0.3	100%	100%
	7	3000	p	2.5	4.9	0	0.3	100%	100%
Floyd	1	2280	b	5.0	3.7	11402	0.2	100%	100%
	2	800	b'	5.0	3.7	4001	0.1	100%	100%
	3	4400	d	5.0	3.7	22004	0.4	100%	100%
	4	440	b	1.0	0.8	440	0.0	100%	100%
Frane	1	7320	p	1.0	0.8	0	0.1	100%	100%
Gordon	1	2680	b	5.7	6.5	15278	0.4	100%	100%
	2	2680	p	1.5	1.8	0	0.1	100%	100%
Grove	1	1800	l	7.5	10.0	13500	0.4	100%	100%
	2	2040	l	7.5	10.0	15300	0.5	100%	100%
	3	3800	p	1.0	0.8	0	0.1	100%	100%
	4	1280	l	7.5	10.0	9600	0.3	100%	100%
Haden & Boone	1	5320	b	6.0	5.7	31938	0.7	100%	100%
	2	3600	b	6.0	5.7	21612	0.5	100%	100%
	3	5480	p	1.0	0.8	0	0.1	100%	100%
Hogan	1	2400	b	5.4	4.7	12962	0.3	100%	100%
	2	8800	p	1.0	0.8	0	0.2	100%	100%
Horseman	1	2960	a	9.2	9.4	27238	0.6	100%	100%
	2	8240	b	9.2	9.4	75826	1.8	100%	100%
	3	920	b'	9.2	9.4	8466	0.2	100%	100%
	4	1840	b	9.2	9.4	16932	0.4	100%	100%
	5	2440	c'	9.2	9.4	22453	0.5	100%	100%
	6	5680	b'	9.2	9.4	52268	1.2	100%	100%
	7	4240	b'	9.2	9.4	39017	0.9	100%	100%
J. T. Williams	1	11320	p	2.0	3.1	0	0.8	100%	100%
	2	1600	p	0.5	0.2	0	0.0	100%	100%
Jack	1	1120	b	7.9	10.4	8868	0.3	100%	100%
	2	1400	b'	8.0	9.8	11141	0.3	100%	100%
	3	720	b'	8.0	9.3	5754	0.2	100%	100%
	4	3320	b'	8.0	9.2	26568	0.7	100%	100%
Kennedy School Hou	1	720	p	2.2	3.7	0	0.1	100%	100%
	2	520	c	13.4	23.1	6968	0.3	100%	100%
	3	1000	a	13.4	23.1	13400	0.5	100%	100%
	4	4400	p	2.2	3.7	0	0.4	100%	100%
	5	2800	p	2.2	3.7	0	0.2	100%	100%
	6	10840	p	2.2	3.7	0	0.9	100%	100%
	7	6040	p	2.2	3.7	0	0.5	100%	50%
Kennedy Waste Way	1	15000	a	14.5	25.5	217646	8.8	100%	100%
	2	1800	b	15.8	27.5	28454	1.1	100%	100%
	3	1000	a	16.0	27.9	16024	0.6	100%	100%
	4	1600	b	14.6	24.2	23322	0.9	100%	100%
	5	1600	b'	11.5	16.6	18441	0.6	100%	100%
	6	4000	b'	10.0	12.8	40002	1.2	100%	100%

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	7	2720	b'	10.0	12.8	27201	0.8	100%	100%
	8	5840	p	2.5	4.9	0	0.7	100%	100%
	9	4960	p	2.5	4.9	0	0.6	100%	50%
King	1	2920	b'	16.5	27.7	48285	1.9	100%	100%
	2	6480	a	13.2	17.5	85235	2.6	100%	100%
	3	2960	b	13.3	17.5	39515	1.2	100%	50%
	4	1040	b	13.4	17.5	13970	0.4	100%	50%
	5	1840	a	13.5	17.6	24827	0.7	100%	50%
	6	2640	b	13.6	17.6	35867	1.1	100%	50%
	7	3840	a	13.7	17.6	52687	1.6	100%	50%
	8	1600	b	13.8	17.7	22081	0.6	100%	50%
Kirk	1	2400	b	4.6	3.5	11058	0.2	100%	100%
	2	2240	p	1.5	1.8	0	0.1	100%	100%
	3	4560	b	4.6	3.8	20981	0.4	100%	100%
Knestric	1	4400	p	3.0	7.1	0	0.7	100%	100%
	2	1760	c	6.2	3.6	10981	0.1	100%	100%
	3	1000	p	3.0	7.1	0	0.2	100%	100%
	4	2680	c	6.2	3.6	16722	0.2	100%	100%
	5	2240	a	6.2	3.6	13976	0.2	100%	100%
	6	320	b	6.2	3.6	1997	0.0	100%	100%
	7	2080	c	6.2	3.6	12978	0.2	100%	100%
	8	2600	a	6.2	3.6	16222	0.2	100%	100%
	9	3560	p	2.0	3.1	0	0.3	100%	100%
	10	1200	p	2.0	3.1	0	0.1	100%	100%
	11	720	p	1.5	1.8	0	0.0	100%	100%
	12	2160	a	6.2	3.6	13477	0.2	100%	100%
	13	4680	p	1.5	1.8	0	0.2	100%	100%
Loper	1	1040	b	5.4	3.8	5575	0.1	100%	100%
	2	2160	b'	5.5	3.9	11985	0.2	100%	100%
	3	6120	b'	6.0	4.1	36932	0.6	100%	100%
	4	4320	b'	6.6	4.4	28716	0.4	100%	100%
	5	3480	d	6.9	4.5	24015	0.4	100%	100%
Lovell	1	9200	b	5.7	5.2	52448	1.1	100%	100%
	2	1360	p	1.0	0.8	0	0.0	100%	100%
McBriar	1	9640	p	2.2	3.6	0	0.8	100%	100%
	2	920	p	0.5	0.2	0	0.0	100%	100%
McClanahan	1	1760	a	15.4	30.2	27125	1.2	100%	100%
	2	4560	c	15.8	32.1	72101	3.4	100%	100%
	3	7480	a	15.8	31.0	117817	5.3	100%	100%
	4	720	p	3.0	7.1	0	0.1	100%	100%
	5	1560	a	15.3	27.5	23808	1.0	100%	100%
	6	3000	a	15.0	25.9	45146	1.8	100%	100%
	7	600	p	3.0	7.1	0	0.1	100%	100%
	8	10200	a	14.4	21.1	146641	4.9	100%	100%
	9	1160	a	13.9	17.7	16124	0.5	100%	50%

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Mc Gee	1	1320	b	4.6	3.6	6078	0.1	100%	100%
	2	6280	p	3.0	7.1	0	1.0	100%	100%
	3	2640	b	4.6	3.6	12155	0.2	100%	100%
Monson	1	2240	d	23.2	102.4	51968	5.3	100%	100%
	2	7040	b	12.8	19.2	90117	3.1	100%	100%
	3	9000	b	14.8	25.1	133515	5.2	100%	100%
	4	1840	b'	17.3	32.2	31805	1.4	100%	100%
	5	11040	b	14.1	25.1	155708	6.4	100%	100%
	6	1960	b'	9.9	15.2	19342	0.7	100%	100%
	7	2240	b'	8.5	12.1	19039	0.6	100%	100%
	8	720	c'	7.5	9.8	5425	0.2	100%	100%
	9	920	d	7.3	9.3	6717	0.2	100%	100%
Montague	1	3440	b	4.4	3.5	15152	0.3	100%	100%
	2	480	p	1.5	1.8	0	0.0	100%	100%
	3	1040	b	4.4	3.5	4581	0.1	100%	100%
	4	1960	p	1.5	1.8	0	0.1	100%	100%
Mt. Campbell	1	1080	p	2.0	3.1	0	0.1	100%	100%
	2	2280	b	12.8	19.5	29070	1.0	100%	100%
	3	1320	p	2.0	3.1	0	0.1	100%	100%
	4	5280	b	12.8	19.5	67320	2.4	100%	100%
	5	720	a	12.8	19.5	9180	0.3	100%	100%
	6	1200	b	12.8	19.5	15300	0.5	100%	100%
	7	1000	b	12.8	19.5	12750	0.4	100%	100%
	8	3240	b	12.8	19.5	41310	1.5	100%	100%
	9	2560	p	1.0	0.8	0	0.0	100%	100%
	10	800	p	1.0	0.8	0	0.0	100%	100%
Nichols-Cann	1	1880	p	2.0	3.1	0	0.1	100%	100%
	2	8280	p	1.5	1.8	0	0.3	100%	100%
Nuss	1	2280	p	1.3	1.3	0	0.1	100%	100%
	2	3840	p	1.0	0.8	0	0.1	100%	100%
Orosi School House	1	1040	a	7.5	7.0	7801	0.2	100%	100%
	2	1480	b	7.5	7.0	11101	0.2	100%	100%
	3	2400	b	7.5	7.0	18002	0.4	100%	100%
	4	1200	b	7.5	7.0	9001	0.2	100%	100%
	5	10960	b'	7.5	7.0	82207	1.8	100%	100%
Parenti	1	6800	p	1.6	2.0	0	0.3	100%	100%
Parks	1	3440	p	1.0	0.8	0	0.0	100%	100%
	2	1980	b	7.7	8.7	15246	0.4	100%	100%
	3	2640	b'	7.7	8.7	20328	0.5	100%	100%
Peck	1	3000	p	1.5	1.8	0	0.1	100%	100%
Red Williams	1	1960	d	20.6	29.8	40454	1.3	100%	50%
	2	680	a	18.1	23.4	12330	0.4	100%	50%
	3	2200	d	15.4	16.3	33876	0.8	100%	50%
	4	3120	d	13.3	11.0	41525	0.8	100%	50%
Reedley Main	1	2000	b	26.3	58.4	52634	2.7	100%	100%

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	2	3800	b	24.3	53.0	92374	4.6	100%	100%
	3	6400	b	20.8	43.5	132980	6.4	100%	100%
	4	2400	b	17.7	35.2	42557	1.9	100%	100%
	5	1400	a	16.9	33.0	23662	1.1	100%	100%
Reo	1	2400	b	4.5	2.0	10787	0.1	100%	100%
	2	1000	p	1.5	1.8	0	0.0	100%	100%
	3	2800	c'	4.5	2.0	12584	0.1	100%	100%
	4	1800	b	4.5	2.0	8090	0.1	100%	100%
Rice-Brubaker	1	4920	b	5.4	4.7	26573	0.5	100%	100%
	2	360	b	5.4	4.7	1944	0.0	100%	100%
	3	2960	p	1.0	0.8	0	0.1	100%	100%
	4	1680	b	5.4	4.7	9074	0.2	100%	100%
	5	1920	p	1.0	0.8	0	0.0	100%	100%
Sandridge	1	3200	l	14.3	29.6	45739	2.2	100%	100%
	2	2040	p	3.0	7.1	0	0.3	100%	100%
	3	1360	l	16.3	31.1	22168	1.0	100%	100%
	4	2840	p	3.0	7.1	0	0.5	100%	100%
	5	2560	b	16.3	31.1	41729	1.8	100%	100%
	6	3400	p	1.0	0.8	0	0.1	100%	100%
Segrue	1	1760	p	1.5	1.8	0	0.1	100%	100%
Smith Mountain	1	2760	b	12.6	23.8	34669	1.5	100%	100%
	2	280	d	12.7	23.4	3565	0.2	100%	100%
	3	3800	b	13.0	22.9	49250	2.0	100%	100%
	4	3200	a	13.4	21.9	42730	1.6	100%	100%
	5	600	a	13.6	21.4	8140	0.3	100%	100%
	6	800	b	14.8	23.1	11841	0.4	100%	100%
	7	16000	d	13.7	19.3	219992	7.1	100%	100%
	8	1720	b	11.3	13.2	19357	0.5	100%	100%
	9	280	b	11.0	12.5	3072	0.1	100%	100%
	10	2600	b	10.6	11.5	27473	0.7	100%	100%
	11	4480	b	10.8	11.1	48290	1.1	100%	100%
	12	4960	p	1.5	1.8	0	0.2	100%	100%
	13	7520	b	12.5	12.5	94108	2.2	100%	100%
Sontag	1	1600	d	9.5	12.3	15200	0.5	100%	100%
	2	15200	d	9.5	12.3	144400	4.3	100%	100%
	3	3680	d	9.5	12.3	34960	1.0	100%	100%
	4	4800	d	9.5	12.3	45600	1.4	100%	50%
	5	3360	d	9.5	12.3	31920	1.0	100%	50%
	6	3880	d	9.5	12.3	36860	1.1	100%	50%
	7	2640	p	1.5	1.8	0	0.1	100%	50%
Tout	1	3400	p	3.0	7.1	0	0.6	100%	100%
	2	3880	l	14.7	29.0	57044	2.6	100%	100%
	3	1120	b	12.8	21.7	14358	0.6	100%	100%
	4	2320	p	3.0	7.1	0	0.4	100%	100%
	5	6560	b	10.8	14.9	70810	2.2	100%	100%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	6	1440	b	9.5	10.5	13650	0.3	100%	100%
	7	2640	p	2.0	3.1	0	0.2	100%	100%
	8	1440	b'	8.1	6.1	11718	0.2	100%	100%
	9	9080	b'	7.9	5.3	71738	1.1	100%	100%
Traver Creek	1	2200	b	33.3	64.2	73257	3.2	100%	100%
	2	600	c'	32.4	75.1	19442	1.0	100%	100%
	3	1400	b	31.8	82.8	44468	2.7	100%	100%
	4	3600	b	30.2	102.2	108586	8.4	100%	100%
	5	8000	b	27.5	95.0	220155	17.4	100%	100%
	6	12000	b	25.7	80.9	307879	22.3	100%	100%
	7	1000	a	25.3	88.6	25255	2.0	100%	100%
	8	1400	b	25.2	90.0	35253	2.9	100%	100%
	9	600	a	25.1	91.2	15071	1.3	100%	100%
	10	11400	b	26.8	78.7	305524	20.6	100%	100%
	11	2400	b	28.9	63.2	69261	3.5	100%	100%
	12	8800	b	30.5	50.6	268656	10.2	100%	100%
Traver Canal	13	2000	b	33.0	45.4	65934	2.1	100%	100%
	14	2400	c	35.4	55.6	85063	3.1	100%	100%
	15	720	a	37.2	62.9	26783	1.0	100%	100%
	16	1600	c	38.5	68.3	61607	2.5	100%	100%
	17	6400	a	39.6	70.2	253651	10.3	100%	100%
	18	9600	c	40.2	65.5	385958	14.4	100%	100%
	19	3760	b	40.7	61.5	152960	5.3	100%	100%
	20	2160	c	40.9	59.8	88327	3.0	100%	100%
	21	440	a	41.0	59.0	18033	0.6	100%	100%
	22	3880	a	42.7	58.8	165672	5.2	100%	100%
	23	6400	a	47.2	58.6	302075	8.6	100%	100%
	24	1200	b	49.5	58.2	59368	1.6	100%	100%
	25	3400	a	47.5	56.9	161336	4.4	100%	100%
	26	3520	b	44.4	54.9	156325	4.4	100%	50%
	27	1240	a	42.3	53.5	52475	1.5	100%	50%
	28	2800	b	40.5	52.4	113520	3.4	100%	50%
	29	1440	c	38.7	51.2	55698	1.7	100%	50%
	30	4440	c'	36.1	49.5	160263	5.0	100%	50%
	31	2080	b	33.2	47.6	69118	2.3	100%	50%
	32	1280	a	26.7	47.8	34122	1.4	100%	10%
	33	2880	c'	21.0	48.5	60480	3.2	100%	10%
	34	1280	b	21.0	48.5	26880	1.4	100%	10%
Uphill	1	3000	p	1.5	1.8	0	0.1	100%	100%
Van Noy	1	5760	l	11.1	16.9	64159	2.2	100%	100%
	2	960	d	8.0	10.9	7712	0.2	100%	50%
	3	1720	d	6.8	8.5	11688	0.3	100%	50%
	4	3080	a	6.0	6.9	18483	0.5	100%	50%
Wahtoke	1	680	p	3.0	7.1	0	0.1	100%	100%
	2	1720	d	15.6	21.9	26771	0.9	100%	100%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	3	1200	c'	14.6	19.5	17493	0.5	100%	100%
	4	800	c'	13.9	17.9	11122	0.3	100%	100%
	5	400	c'	13.5	17.0	5399	0.2	100%	100%
	6	2000	p	3.0	7.1	0	0.3	100%	100%
	7	2800	c'	12.0	13.4	33629	0.9	100%	100%
	8	3000	c'	12.0	13.4	36031	0.9	100%	100%
	9	400	c'	12.0	13.4	4804	0.1	100%	100%
	10	200	b	12.0	13.4	2402	0.1	100%	100%
	11	1400	d	12.0	13.4	16815	0.4	100%	100%
	12	400	b	12.0	13.4	4804	0.1	100%	100%
	13	600	b'	12.0	13.4	7206	0.2	100%	100%
	14	1600	b	12.0	13.4	19217	0.5	100%	100%
	15	2200	p	3.0	7.1	0	0.4	100%	100%
	16	7400	p	3.0	7.1	0	1.2	100%	100%
Weisse	1	2040	b	9.1	11.1	18565	0.5	100%	10%
	2	3160	c'	9.1	11.1	28758	0.8	100%	10%
West Gould	1	4080	p	3.0	7.1	0	0.7	100%	100%
	2	240	p	3.0	7.1	0	0.0	100%	100%
	3	2560	l	10.4	15.0	26724	0.9	100%	100%
	4	2200	p	3.0	7.1	0	0.4	100%	100%
	5	4360	b	8.7	11.7	38004	1.2	100%	100%
	6	1480	b	8.0	10.3	11866	0.4	100%	100%
	7	280	p	3.0	7.1	0	0.0	100%	100%
	8	800	b	7.6	9.6	6093	0.2	100%	100%
	9	1600	p	1.5	1.8	0	0.1	100%	100%
	10	1560	b	6.8	8.1	10658	0.3	100%	100%
	11	1280	p	1.5	1.8	0	0.1	100%	100%
	12	3000	b	5.8	6.1	17481	0.4	100%	100%
	13	1200	b	5.4	5.3	6484	0.1	100%	100%
	14	1400	a	5.4	5.3	7565	0.2	100%	100%
West Reedley	1	600	p	4.0	12.6	0	0.2	100%	100%
	2	2400	p	4.0	12.6	0	0.7	100%	100%
	3	400	d	10.0	10.7	4001	0.1	100%	100%
	4	2600	b	10.0	10.7	26005	0.6	100%	100%
	5	2200	p	4.0	12.6	0	0.6	100%	100%
	6	1000	b	10.0	10.7	10002	0.2	100%	100%
	7	800	p	3.0	7.1	0	0.1	100%	100%
	8	7000	b	10.0	10.7	70014	1.7	100%	100%
	9	1400	b	10.0	10.7	14003	0.3	100%	100%
	10	800	p	3.0	7.1	0	0.1	100%	100%
	11	1800	b	10.9	14.2	19549	0.6	100%	100%
	12	7640	p	3.0	7.1	0	1.2	100%	100%
	13	880	a	19.0	47.4	16728	1.0	100%	100%
West Section 20	1	9320	l	7.5	7.2	69900	1.5	100%	100%
Wilson	1	6800	b	19.3	44.7	131484	7.0	100%	100%

Canal Name	(1) No.	Length (ft)	(2) Soil	(3) Average Top Width (ft)	Average Cross Sectional Area (sq. ft.)	Exposed Water Surface Area (sq. ft.)	Canal Volume (AF)	Percent Season Operated 1984	1990
	2	3160	b	19.3	44.3	61053	3.2	100%	100%
	3	2000	b	19.3	44.0	38626	2.0	100%	100%
	4	3200	b'	19.3	43.8	61776	3.2	100%	100%
	5	960	p	3.0	7.1	0	0.2	100%	100%
	6	560	b	17.7	37.4	9937	0.5	100%	100%
	7	2280	b	16.0	30.1	36398	1.6	100%	100%
	8	21400	b	14.4	21.9	307474	10.7	100%	100%
	9	10880	b	15.7	28.2	170555	7.0	100%	100%
	10	1760	c'	17.4	38.5	30605	1.6	100%	100%
	11	640	b	17.7	40.4	11337	0.6	100%	100%
	12	2640	b'	17.8	40.9	46995	2.5	100%	100%
Wilson Hunter	1	4160	b	9.4	13.9	38902	1.3	100%	100%
	2	3960	c'	11.5	21.3	45540	1.9	100%	100%
Wilson School Hous	1	3240	b	10.4	13.1	33856	1.0	100%	100%
	2	1760	b'	11.4	15.9	20149	0.6	100%	100%
	3	2720	b'	12.3	18.4	33574	1.1	100%	100%
	4	680	p	2.0	3.1	0	0.0	100%	100%
	5	1200	c'	12.9	20.0	15440	0.6	100%	100%
	6	1960	c'	12.1	18.3	23710	0.8	100%	100%
	7	4560	c'	10.5	14.7	47927	1.5	100%	100%
	8	1840	d	9.4	12.3	17297	0.5	100%	50%
Windsor	1	6720	p	1.3	1.3	0	0.2	100%	100%

Appendix B

Soils in Alta Irrigation District with Hydrologic Soil Groups

County	(1) Map Symbol	Hydrologic Soil Group		Permeability (in/hr)			Soil Name	Soil Texture	Occurances in Alta I.D.
		Original	Modified	Low	High	Hardpan			
Fresno	AaB	C	C	0.8	2.5	N/A	Academy	Loam	1
Fresno	An	D	D'	N/A	0.05	N/A	Alamo	Clay	20
Fresno	AoA	B	B	5	10	N/A	Atwater	Loamy Sand	14
Fresno	AoB	B	B	5	10	N/A	Atwater	Loamy Sand	3
Fresno	ArA	B	B	2.5	5	N/A	Atwater	Sandy Loam	22
Fresno	ArB	B	B	2.5	5	N/A	Atwater	Sandy Loam	2
Fresno	AtA	B	B	2.5	5	N/A	Atwater	Sandy Loam Moderately D	3
Tulare	Ca	A	A	5	10	N/A	Cajon	Sandy Loam	4
Tulare	Cc	C	C	0.5	2.5	N/A	Chino	Clay Loam	1
Fresno	CzaB	D	B'	2.5	5	0.05	Cometa	Sandy Loam	3
Fresno	CzaC	D	B'	2.5	5	0.05	Cometa	Sandy Loam	3
Fresno	CzaD	D	B'	2.5	5	0.05	Cometa	Sandy Loam	10
Fresno	DeA	A	A	20	N/A	N/A	Delhi	Sand	3
Fresno	DeB	A	A	20	N/A	N/A	Delhi	Sand	2
Fresno	DhA	A	A	5	10	N/A	Delhi	Loamy Sand	6
Fresno	DhB	A	A	5	10	N/A	Delhi	Loamy Sand	1
Tulare	Dl	A	A	5	10	N/A	Delhi	Loam Sand	6
Fresno	Dm	A	A	20	N/A	N/A	Dello	Loamy Sand	7
Tulare	Ds	C	C	N/A	N/A	N/A	Dinuba	Sandy Loam	5
Tulare	Ec	C	B'	2.5	5	0.05	Exeter	Clay Loam	1
Tulare	El	C	B'	2.5	5	0.05	Exeter	Loam	12
Fresno	Es	C	B'	2.5	10	0.05	Exeter	Sandy Loam	1
Fresno	Ex	C	B'	2.5	10	0.05	Exeter	Loam	5
Tulare	Fl	B	B	0.8	5	N/A	Foster	Loam	3
Tulare	Fr	D	B'	2.5	5	0.05	Fresno	Fine Sandy Loam	7
Fresno	Gl	B	B	2.5	5	N/A	Grangeville	Fine Sandy Loam	1
Fresno	GP	B	B	2.5	5	N/A	Grangeville	Chanled	9
Fresno	Ga	B	B	2.5	5	N/A	Grangeville	Sandy Loam	4
Fresno	Gf	B	B	2.5	5	N/A	Grangeville	Fine Sandy Loam	33
Fresno	Gg	B	B	2.5	5	N/A	Grangeville	Fine Sandy Loam, Saline A	2
Fresno	Gh	B	B	2.5	5	N/A	Grangeville	Fine Sandy Loam, Water T	1
Tulare	Gs	B	B	2.5	5	N/A	Greenfield	Sandy Loam	32
Fresno	GsA	B	B	2.5	5	N/A	Greenfield	Coarse Sandy Loam	12
Fresno	GtA	B	B	2.5	5	N/A	Greenfield	Sandy Loam	16
Fresno	GtB	B	B	2.5	5	N/A	Greenfield	Sandy Loam	1
Fresno	GuA	B	B	2.5	5	N/A	Greenfield	Sandy Loam, Moderately D	34
Fresno	Ha	B	B	2.5	5	N/A	Hanford	Coarse Sandy Loam	23
Fresno	Hb	B	B	2.5	5	N/A	Hanford	Coarse Sandy Loam, Hard	1
Fresno	Hc	B	B	2.5	5	N/A	Hanford	Sandy Loam	23
Fresno	Hd	B	B	2.5	5	N/A	Hanford	Sandy Loam, Benches	4
Fresno	He	B	B	2.5	5	N/A	Hanford	Sandy Loam, Gravel Sub S	6
Fresno	Hk	B	B	2.5	5	N/A	Hanford	Sandy Loam, Hard Substra	8
Tulare	Hl	B	B	2.5	5	N/A	Hanford	Sandy Loam	2
Fresno	Hm	B	B	2.5	5	N/A	Hanford	Fine Sandy Loam	18
Fresno	Hn	B	B	2.5	5	N/A	Hanford	Fine Sandy Loam, Garvelly	5
Fresno	Ho	B	B	2.5	5	N/A	Hanford	Fine Sandy Loam, Silty Su	6
Fresno	Hr	B	B	2.5	5	N/A	Hanford	Fine Sandy Loam, Hard Su	7
Fresno	Hsr	B	B	2.5	5	N/A	Hesperia	Fine Sandy Loam	3
Fresno	Hst	B	B	2.5	5	N/A	Hesperia	Fine Sandy Loam, Moderat	2
Fresno	Hsy	B	B	2.5	5	N/A	Hesperia	Fine Sandy Loam, Moderat	1
Fresno	Hu	D	D	0.05	0.2	N/A	Hildreth	Clay	2
Tulare	Hy	C	C	N/A	N/A	N/A	Hovey	Adobe Clay	1

County	(1) Map Symbol	Hydrologic Soil Group		Permeability (in/hr)			Soil Name	Soil Texture	Occurances in Alta I.D.
		Original	Modified	Low	High	Hardpan			
Fresno	LbB	B	B	2.5	5	N/A	Los Robles	Sandy Laom	2
Tulare	Lc	D	D	N/A	N/A	N/A	Lewis	Clay Loam	10
Fresno	LmA	B	B	N/A	N/A	N/A	Los Robles	Loam	3
Fresno	LoA	B	B	0.2	2.5	N/A	Los Robles	Clay Loam	1
Tulare	Ls	C	C	N/A	N/A	N/A	Las Posas	Stony Clay Loam	1
Fresno	Ma	D	B'	2.5	5	0.05	Madera	Sandy Loam	11
Fresno	Mc	D	C'	2.5	5	0.05	Madera	Loam	7
Tulare	Mc	D	C'	2.5	5	0.05	Madera	Clay Laom	4
Fresno	Md	D	C'	2.5	5	0.05	Madera	Loam, Saline Alkali	1
Tulare	Ml	D	C'	2.5	5	0.05	Madera	Loam	16
Tulare	Ms	D	B'	2.5	5	0.05	Madera	Sandy Laom	10
Tulare	Pc	D	D	0.05	5	N/A	Porterville	Adobe Clay	3
Fresno	Pk	D	D	N/A	N/A	N/A	Pits	ERR	2
Fresno	PmB	B	B	2.5	5	N/A	Pollasky	Sandy Loam	1
Fresno	PmC	B	B	2.5	5	N/A	Pollasky	Sandy Loam	1
Fresno	PnB	B	B	2.5	5	N/A	Pollasky	Fine Sandy Loam	3
Fresno	PnC	B	B	2.5	5	N/A	Pollasky	Fine Sandy Loam	3
Fresno	PxA	D	D	0.05	5	N/A	Porterville	Clay	12
Fresno	PxC	D	D	0.05	5	N/A	Porterville	Clay	5
Fresno	Ra	B	B	2.5	5	N/A	Ramona	Sandy Loam	21
Fresno	Rb	B	B	2.5	5	N/A	Ramona	Sandy Loam,Hard Substrat	11
Fresno	Rc	B	B	2.5	5	N/A	Ramona	Loam	7
Fresno	Re	B	B	2.5	5	N/A	Ramona	Loam, Hard Substratum	3
Tulare	Rl	B	B	2.5	5	N/A	Ramona	Loam	1
Tulare	Sc	D	C'	0.8	2.5	0.05	San Joaquin	Clay Loam	5
Fresno	ScA	D	B'	0.8	2.5	0.05	San Joaquin	Sandy Loam	15
Tulare	Se	D	D	N/A	N/A	N/A	Seville	Adobe Clay	1
Fresno	SeA	D	C'	0.8	2.5	0.05	San Joaquin	Loam	40
Fresno	SgA	D	C'	0.8	2.5	0.05	San Joaquin	Loam, Shallow	2
Tulare	Sl	D	C'	0.8	2.5	0.05	San Joaquin	Loam	4
Tulare	Ss	D	B'	0.8	2.5	0.05	San Joaquin	Sandy Loam	2
Tulare	Tf	B	B	2.5	5	N/A	Traver	Fine Sandy Loam	15
Fresno	ThF	B	B	N/A	N/A	N/A	Terrace	Escarpments	4
Tulare	Tl	A	A	5	10	N/A	Tujunga	Sandy Loam	6
Tulare	Ts	A	A	5	10	N/A	Tujunga	Sand	10
Fresno	TzaA	A	A	20	N/A	N/A	Tujunga	Sand	3
Fresno	TzbA	A	A	5	10	N/A	Tujunga	Loamy Sand	35
Fresno	TzcA	A	A	5	10	N/A	Tujunga	Loamy Sand,Gravelly Subs	4
Fresno	TzdA	A	A	5	10	N/A	Tujunga	Cobbly Loamy Sand	32
Fresno	TzeB	A	A	5	10	N/A	Tujunga	Soils Channeled	6
Fresno	VaA	B	B	2.5	5	N/A	Visalia	Sandy Loam	1
Fresno	VeA	B	B	2.5	5	N/A	Visalia	Loam	2

Notes:

(1) Map symbols related to soils maps from SCS (1971) and SCS (1978).

Appendix C

Seepage and Evaporation of the Alta Delivery System by Segment

NOTES

1. Canal Segment Number: sections defined by canal soil type, cross section, and ground water modeling element boundary (see Figures II-1A and II-IB)

2. Canal Segment Characteristic delineates canal type: Concrete Lined (l) or Piped (p); or canal bottom soil type for unlined: See Table II-4.

3. Average Top Width: determined from averaging surveyed widths for each canal section; pipe diameters estimated from field notes and channel flow rates.

4. Average seepage rate of full channel or pipe.

5. Length of trees determined from field notes and aerial photographs. Width of trees assumed to be 80 feet on Alta Main and 60 feet on Traver Canal.

6. Length of brush determined from field notes and aerial photographs. Width of brush assumed to be 15 ft.

7. Evapotranspiration of weeds assumes 4-feet wide strip of weeds on each side of canal; crop efficient is 0.0 for first 30 days of irrigation season and 1.0 for remaining season.

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
Alta Main	2	1.73	551.8	164.5	14.69	4.04
	3	0.06	18.8	5.6	7.02	1.93
	4	0.70	223.7	66.7	83.37	22.93
	5	0.14	44.7	13.3	16.65	4.58
	6	0.27	86.7	25.8	32.29	8.88
	7	0.21	65.6	19.6	4.08	1.12
	8	1.84	588.4	175.4	15.66	4.31
	9	2.58	823.4	245.5	21.92	6.03
	10	0.33	106.8	31.8	6.63	1.82
	11	0.04	11.9	3.5	4.42	1.22
	12	3.35	1070.5	319.2	28.50	7.84
East Branch	13	0.05	15.4	4.6	0.96	0.26
	14	0.22	71.7	21.4	1.91	0.53
	15	0.85	271.9	81.1	16.89	4.64
	16	0.22	69.2	20.6	1.84	0.51
	17	0.64	204.7	61.0	12.71	3.50
	18	0.32	100.7	30.0	2.68	0.74
	19	0.09	28.6	8.5	1.78	0.49
	20	0.03	9.5	2.8	3.54	0.97
	21	0.18	56.6	16.9	3.52	0.97
	22	0.07	23.3	6.9	8.69	2.39
	23	0.17	55.3	16.5	3.43	0.94
	24	0.10	32.1	9.6	0.85	0.23
	25	0.09	27.4	8.2	1.70	0.47
	26	0.08	26.4	7.9	1.64	0.45
	27	1.09	348.2	103.8	9.27	2.55
	28	0.70	225.0	67.1	5.99	1.65
	29	0.33	105.6	31.5	6.56	1.80
	30	0.36	115.0	34.3	2.14	0.59
	31	0.21	68.0	20.3	4.22	1.16
	32	0.21	66.6	19.9	4.14	1.14
	33	0.40	127.1	37.9	3.38	0.93
	34	0.40	126.8	37.8	7.88	2.17
	35	0.16	51.2	15.3	3.18	0.87
	36	0.52	167.0	49.8	10.37	2.85
	37	0.43	138.2	41.2	8.58	2.36
	38	0.43	138.0	41.1	8.57	2.36
	39	0.13	41.1	12.3	2.55	0.70
	40	0.52	167.1	49.8	4.45	1.22
	41	3.45	1101.1	328.3	29.31	8.06
	42	0.45	145.0	43.2	3.86	1.06
	43	0.34	110.1	32.8	2.05	0.56
	44	0.76	241.9	72.1	6.44	1.77
	45	1.76	563.3	167.9	20.99	5.77

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	46	1.06	338.3	100.9	12.61	3.47
	47	0.43	137.4	40.9	3.66	1.01
	48	0.65	206.8	61.7	7.71	2.12
	49	0.10	32.0	9.5	11.91	3.28
A.B. Clark	1	1.01	322.8	96.2	6.01	1.65
	2	0.01	1.8	0.5	0.00	0.00
	3	1.51	481.0	143.4	8.96	2.46
	4	0.01	2.4	0.7	0.00	0.00
	5	0.01	2.4	0.7	0.00	0.00
A.N. Smith	1	0.00	1.4	0.4	0.00	0.00
	2	0.18	59.0	17.6	1.57	0.43
	3	0.00	0.9	0.3	0.00	0.00
	4	0.00	0.5	0.1	0.00	0.00
A.W. Clark	1	0.08	25.8	7.7	1.60	0.44
	2	0.00	0.3	0.1	0.11	0.03
	3	0.05	14.7	4.4	0.92	0.25
	4	0.05	16.6	4.9	1.03	0.28
	5	0.00	0.4	0.1	0.00	0.00
	6	0.00	0.9	0.3	0.00	0.00
	7	0.15	49.0	14.6	1.30	0.36
	8	0.00	0.2	0.1	0.00	0.00
	9	0.24	78.2	23.3	2.08	0.57
Andrews	1	0.03	9.2	2.7	0.34	0.09
	2	0.04	12.1	3.6	0.45	0.12
	3	0.07	23.6	7.0	0.63	0.17
	4	0.07	21.9	6.5	0.82	0.22
	5	0.17	53.8	16.0	1.00	0.28
	6	0.03	9.2	2.7	0.34	0.09
Ballard	1	0.05	15.7	4.7	0.59	0.16
	2	0.03	9.6	2.9	0.26	0.07
	3	0.05	17.2	5.1	0.46	0.13
	4	0.06	19.3	5.8	1.20	0.33
	5	0.00	0.4	0.1	0.00	0.00
	6	0.04	13.1	3.9	0.82	0.22
	7	0.01	1.7	0.5	0.00	0.00
	8	0.00	1.5	0.4	0.00	0.00
Banks	1	0.02	4.9	0.7	1.82	0.25
	2	0.02	6.2	0.9	2.30	0.32
	3	0.02	5.5	0.8	2.05	0.28
	4	0.08	25.7	3.8	0.96	0.13
	5	0.02	7.7	1.2	2.88	0.40
	6	0.14	43.7	6.5	2.72	0.37
	7	0.07	22.3	3.3	0.83	0.11
	8	0.20	64.8	9.7	4.03	0.55

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	9	0.04	13.5	2.0	5.02	0.69
	10	0.01	3.1	0.5	1.15	0.16
	11	0.43	137.3	20.5	5.12	0.70
	12	0.01	4.7	0.7	1.76	0.24
	13	0.35	110.7	16.5	4.13	0.57
	14	0.06	18.9	2.8	7.03	0.97
	15	0.02	5.4	0.8	2.03	0.28
	16	0.03	8.3	1.2	3.10	0.43
	17	0.14	45.9	6.8	1.22	0.17
	18	0.31	97.6	14.6	6.06	0.83
	19	0.50	160.8	24.0	4.28	0.59
	20	0.14	44.2	6.6	0.82	0.11
	21	0.27	85.1	12.7	2.27	0.31
	22	0.18	58.0	1.7	3.60	0.10
	23	0.13	42.5	1.3	0.79	0.02
	24	0.10	33.3	1.0	2.07	0.06
	25	0.28	90.8	2.7	2.42	0.07
	26	0.11	34.2	1.0	2.13	0.06
	27	0.15	49.1	1.5	1.31	0.04
	28	0.25	79.0	2.4	4.91	0.14
	29	0.33	105.4	3.1	6.55	0.18
Bowhay	1	0.02	6.5	2.0	2.44	0.67
	2	0.28	88.8	26.5	3.31	0.91
	3	0.24	77.2	23.0	2.88	0.79
	4	0.01	4.0	1.2	1.50	0.41
	5	0.45	142.9	42.6	3.80	1.05
	6	0.05	16.4	4.9	0.44	0.12
Bump & Edmiston	1	0.19	61.2	18.2	1.63	0.45
	2	0.00	0.8	0.2	0.00	0.00
	3	0.00	1.6	0.5	0.00	0.00
Button	1	0.01	2.1	0.6	0.78	0.21
	2	0.04	12.9	3.9	4.82	1.33
	3	0.18	58.2	17.4	2.17	0.60
	4	0.33	104.6	31.2	3.90	1.07
	5	0.01	4.1	1.2	1.54	0.42
	6	0.02	5.2	1.6	1.95	0.53
	7	0.01	3.3	1.0	1.21	0.33
	8	0.08	24.9	7.4	9.27	2.55
	9	1.02	324.3	96.7	12.09	3.32
	10	0.18	58.8	8.8	2.19	0.30
	11	0.24	76.1	11.3	4.73	0.65
	12	0.16	51.3	7.7	0.96	0.13
	13	0.09	28.2	4.2	1.75	0.24
	14	0.09	28.2	4.2	10.52	1.45

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	15	0.06	17.7	2.6	1.10	0.15
	16	0.05	15.2	2.3	5.66	0.78
	17	0.14	43.8	6.5	16.32	2.24
	18	0.86	273.9	40.8	5.10	0.70
	19	0.20	62.7	9.3	3.89	0.54
	20	0.25	80.2	12.0	2.14	0.29
	21	0.12	38.3	5.7	1.02	0.14
	22	0.01	3.8	0.6	1.43	0.20
	23	0.09	27.2	4.1	1.69	0.23
Buttonwillow	1	0.06	18.2	5.4	1.13	0.31
	2	0.11	35.8	10.7	2.22	0.61
	3	0.11	34.8	10.4	2.16	0.59
	4	0.55	174.8	52.1	4.65	1.28
	5	0.62	198.4	59.2	5.28	1.45
	6	0.88	282.0	84.1	5.25	1.45
	7	0.42	135.0	40.2	3.59	0.99
	8	0.55	176.9	52.7	3.30	0.91
	9	0.86	275.5	82.1	7.33	2.02
	10	0.03	8.3	2.5	0.52	0.14
	11	0.38	120.1	35.8	3.20	0.88
	12	0.03	10.7	3.2	0.40	0.11
	13	0.27	86.3	25.7	2.30	0.63
	14	0.84	267.2	79.7	7.11	1.96
	15	0.45	143.9	42.9	3.83	1.05
	16	0.19	62.2	18.5	1.65	0.45
	17	0.11	35.3	10.5	1.31	0.36
	18	0.59	188.5	56.2	5.02	1.38
	19	0.14	46.2	13.8	1.23	0.34
	20	0.92	293.0	87.3	7.80	2.14
	21	0.73	232.1	69.2	4.33	1.19
	22	0.01	4.7	1.4	0.00	0.00
Caesar	1	0.01	2.5	0.7	0.00	0.00
	2	0.02	5.2	1.6	0.00	0.00
	3	0.45	143.4	42.7	2.67	0.73
	4	1.15	368.6	109.9	6.87	1.89
	5	0.22	71.1	21.2	2.65	0.73
	6	1.49	477.4	142.3	8.90	2.45
	7	1.03	328.9	98.1	6.13	1.69
California Vineyar	1	0.04	14.2	4.2	0.88	0.24
	2	1.04	331.7	98.9	8.83	2.43
	3	0.14	45.3	13.5	1.21	0.33
	4	0.95	303.3	90.4	8.07	2.22
	5	0.31	99.8	29.8	2.66	0.73
	6	0.68	217.2	64.8	5.78	1.59

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	7	0.03	8.3	2.5	0.00	0.00
	8	0.07	23.5	7.0	0.63	0.17
	9	2.45	782.7	233.3	14.58	4.01
	10	0.35	111.8	33.3	2.08	0.57
Cary-Hunter	1	0.00	0.6	0.2	0.00	0.00
	2	0.00	1.5	0.4	0.00	0.00
	3	0.10	31.1	9.3	1.16	0.32
	4	0.09	28.6	8.5	1.77	0.49
	5	0.08	25.9	7.7	0.97	0.27
	6	0.50	161.0	48.0	4.29	1.18
	7	0.00	0.8	0.3	0.00	0.00
	8	0.24	75.1	22.4	2.00	0.55
	9	0.20	62.5	18.6	1.66	0.46
	10	0.00	1.4	0.4	0.00	0.00
	11	0.29	91.1	27.1	2.42	0.67
	12	0.00	0.4	0.1	0.00	0.00
	13	0.55	174.5	52.0	4.64	1.28
	14	0.00	1.0	0.3	0.00	0.00
	15	0.32	102.1	30.4	2.72	0.75
	16	0.08	27.0	8.0	1.68	0.46
	17	0.29	93.3	27.8	5.80	1.59
	18	0.02	7.0	1.0	2.60	0.36
Carpenter	1	0.01	2.8	0.8	0.00	0.00
	2	0.01	2.1	0.6	0.00	0.00
	3	0.01	4.7	1.4	0.87	0.24
Clapp	1	0.01	2.9	0.9	0.54	0.15
	2	0.01	2.5	0.7	0.00	0.00
Clements	1	0.04	13.7	4.1	0.51	0.14
	2	0.06	18.3	5.4	0.68	0.19
	3	0.30	95.8	28.6	2.55	0.70
	4	0.65	206.7	61.6	5.50	1.51
	5	0.77	245.8	73.3	6.54	1.80
	6	0.27	85.3	25.4	3.18	0.87
	7	0.00	1.4	0.4	0.53	0.14
Clough	1	0.96	306.4	9.1	8.16	0.22
	2	0.45	142.9	4.3	3.80	0.10
	3	0.17	53.2	1.6	3.30	0.09
Cross Creek W.W.	1	0.12	37.1	1.1	2.30	0.06
	2	0.29	91.6	2.7	5.69	0.16
Curtis Cutoff	1	0.48	153.7	45.8	4.09	1.13
	2	0.00	1.6	0.5	0.00	0.00
Lower Curtis Cutof	1	0.08	27.0	8.0	0.72	0.20
	2	0.01	2.4	0.7	0.00	0.00
	3	0.02	6.9	2.1	0.26	0.07

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	4	0.11	36.4	10.9	0.68	0.19
Upper Curtis Cutof	1	0.01	3.4	1.0	0.00	0.00
	2	0.05	15.9	4.8	0.42	0.12
Dinuba Town	1	0.03	10.7	3.2	0.40	0.11
	2	0.13	40.1	12.0	1.07	0.29
	3	0.00	0.3	0.1	0.00	0.00
	4	0.00	1.2	0.4	0.00	0.00
	5	0.12	37.7	11.2	1.00	0.28
	6	0.07	22.8	6.8	0.61	0.17
	7	0.11	35.2	10.5	0.94	0.26
	8	0.03	10.2	3.0	0.63	0.17
	9	0.11	36.2	10.8	0.96	0.27
	10	0.04	11.3	3.4	0.42	0.12
	11	0.07	23.7	7.1	0.63	0.17
	12	0.19	60.8	18.1	1.62	0.44
	13	0.28	88.0	26.2	1.64	0.45
	14	1.15	367.5	109.6	9.78	2.69
	15	0.47	151.5	45.2	4.03	1.11
	16	0.01	2.2	0.6	0.00	0.00
	17	0.43	137.1	40.9	3.65	1.00
	18	0.00	1.1	0.3	0.00	0.00
	19	0.16	51.7	15.4	1.93	0.53
	20	0.11	33.8	10.1	0.90	0.25
	21	0.97	309.1	92.1	8.23	2.26
	22	0.23	74.5	22.2	1.98	0.55
East Gould	1	0.00	0.9	0.3	0.00	0.00
	2	0.00	0.4	0.1	0.00	0.00
	3	0.02	7.0	2.1	0.19	0.05
	4	0.03	11.0	3.3	0.68	0.19
	5	0.00	0.1	0.0	0.00	0.00
	6	0.00	0.2	0.1	0.00	0.00
	7	0.04	11.6	3.5	0.31	0.09
East Reedley	1	0.01	1.8	0.5	0.00	0.00
	2	0.01	3.5	1.1	0.00	0.00
	3	0.21	65.8	19.6	1.23	0.34
	4	0.46	147.4	43.9	3.92	1.08
	5	0.00	0.6	0.2	0.00	0.00
	6	0.01	1.8	0.5	0.00	0.00
	7	0.01	3.5	1.1	0.22	0.06
	8	0.01	3.5	1.1	0.00	0.00
	9	0.72	230.3	68.7	6.13	1.69
	10	0.06	20.1	6.0	0.00	0.00
	11	0.14	44.7	13.3	0.83	0.23
	12	0.03	8.7	2.6	0.54	0.15

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	13	0.10	31.3	9.3	0.83	0.23
East Section 20	1	0.06	19.9	5.9	3.71	1.02
Elter	1	0.00	0.6	0.2	0.00	0.00
	2	0.05	15.9	4.8	0.99	0.27
	3	0.04	13.0	3.9	0.81	0.22
	4	0.00	1.5	0.4	0.00	0.00
	5	0.00	1.5	0.4	0.00	0.00
	6	0.01	2.4	0.7	0.00	0.00
	7	0.01	2.8	0.8	0.00	0.00
Floyd	1	0.09	29.5	8.8	0.79	0.22
	2	0.02	7.4	2.2	0.28	0.08
	3	0.01	4.1	1.2	1.52	0.42
	4	0.00	1.1	0.3	0.03	0.01
Frane	1	0.01	2.7	0.8	0.00	0.00
Gordon	1	0.12	39.5	11.8	1.05	0.29
	2	0.00	1.5	0.4	0.00	0.00
Grove	1	0.02	5.0	1.5	0.93	0.26
	2	0.02	5.7	1.7	1.05	0.29
	3	0.00	1.4	0.4	0.00	0.00
	4	0.01	3.5	1.1	0.66	0.18
Haden & Boone	1	0.26	82.6	24.6	2.20	0.60
	2	0.18	55.9	16.7	1.49	0.41
	3	0.01	2.0	0.6	0.00	0.00
Hogan	1	0.11	33.5	10.0	0.89	0.25
	2	0.01	3.3	1.0	0.00	0.00
Horseman	1	0.32	100.7	30.0	1.88	0.52
	2	0.61	196.2	58.5	5.22	1.44
	3	0.05	15.6	4.7	0.58	0.16
	4	0.14	43.8	13.1	1.17	0.32
	5	0.08	24.9	7.4	1.55	0.43
	6	0.30	96.6	28.8	3.60	0.99
	7	0.23	72.1	21.5	2.69	0.74
J. T. Williams	1	0.03	8.4	2.5	0.00	0.00
	2	0.00	0.3	0.1	0.00	0.00
Jack	1	0.07	22.9	6.8	0.61	0.17
	2	0.06	20.6	6.1	0.77	0.21
	3	0.03	10.6	3.2	0.40	0.11
	4	0.15	49.1	14.6	1.83	0.50
Kennedy School Hou	1	0.00	0.6	0.2	0.00	0.00
	2	0.04	12.9	3.8	0.48	0.13
	3	0.16	49.5	14.8	0.92	0.25
	4	0.01	3.5	1.1	0.00	0.00
	5	0.01	2.2	0.7	0.00	0.00
	6	0.03	8.7	2.6	0.00	0.00

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	7	0.02	4.8	0.7	0.00	0.00
Kennedy Waste Way	1	2.52	804.4	239.8	14.99	4.12
	2	0.23	73.6	21.9	1.96	0.54
	3	0.19	59.2	17.7	1.10	0.30
	4	0.19	60.3	18.0	1.61	0.44
	5	0.11	34.1	10.2	1.27	0.35
	6	0.23	73.9	22.0	2.75	0.76
	7	0.16	50.3	15.0	1.87	0.52
	8	0.02	5.4	1.6	0.00	0.00
	9	0.01	4.6	0.7	0.00	0.00
King	1	0.28	89.2	26.6	3.33	0.91
	2	0.99	315.0	93.9	5.87	1.61
	3	0.32	102.2	15.2	2.72	0.37
	4	0.11	36.1	5.4	0.96	0.13
	5	0.29	91.8	13.7	1.71	0.24
	6	0.29	92.8	13.8	2.47	0.34
	7	0.61	194.7	29.0	3.63	0.50
	8	0.18	57.1	8.5	1.52	0.21
Kirk	1	0.09	28.6	8.5	0.76	0.21
	2	0.00	1.2	0.4	0.00	0.00
	3	0.17	54.3	16.2	1.44	0.40
Knestric	1	0.02	4.9	1.5	0.00	0.00
	2	0.06	20.3	6.1	0.76	0.21
	3	0.00	1.1	0.3	0.00	0.00
	4	0.10	30.9	9.2	1.15	0.32
	5	0.16	51.7	15.4	0.96	0.26
	6	0.02	5.2	1.5	0.14	0.04
	7	0.08	24.0	7.2	0.89	0.25
	8	0.19	60.0	17.9	1.12	0.31
	9	0.01	2.6	0.8	0.00	0.00
	10	0.00	0.9	0.3	0.00	0.00
	11	0.00	0.4	0.1	0.00	0.00
	12	0.16	49.8	14.9	0.93	0.26
	13	0.01	2.6	0.8	0.00	0.00
Loper	1	0.05	14.4	4.3	0.38	0.11
	2	0.07	22.1	6.6	0.83	0.23
	3	0.21	68.3	20.3	2.54	0.70
	4	0.17	53.1	15.8	1.98	0.54
	5	0.01	4.4	1.3	1.65	0.45
Lovell	1	0.42	135.7	40.5	3.61	0.99
	2	0.00	0.5	0.1	0.00	0.00
McBriar	1	0.02	7.7	2.3	0.00	0.00
	2	0.00	0.2	0.1	0.00	0.00
McClanahan	1	0.31	100.3	29.9	1.87	0.51

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	2	0.42	133.2	39.7	4.97	1.37
	3	1.36	435.5	129.8	8.11	2.23
	4	0.00	0.8	0.2	0.00	0.00
	5	0.28	88.0	26.2	1.64	0.45
	6	0.52	166.9	49.7	3.11	0.86
	7	0.00	0.7	0.2	0.00	0.00
	8	1.70	542.0	161.6	10.10	2.78
	9	0.19	59.6	8.9	1.11	0.15
Mc Gee	1	0.05	15.7	4.7	0.42	0.12
	2	0.02	7.0	2.1	0.00	0.00
	3	0.10	31.4	9.4	0.84	0.23
Monson	1	0.03	9.6	2.9	3.58	0.98
	2	0.73	233.2	69.5	6.21	1.71
	3	1.08	345.4	103.0	9.20	2.53
	4	0.18	58.8	17.5	2.19	0.60
	5	1.26	402.9	120.1	10.72	2.95
	6	0.11	35.7	10.7	1.33	0.37
	7	0.11	35.2	10.5	1.31	0.36
	8	0.02	6.0	1.8	0.37	0.10
	9	0.00	1.2	0.4	0.46	0.13
Montague	1	0.12	39.2	11.7	1.04	0.29
	2	0.00	0.3	0.1	0.00	0.00
	3	0.04	11.9	3.5	0.32	0.09
	4	0.00	1.1	0.3	0.00	0.00
Mt. Campbell	1	0.00	0.8	0.2	0.00	0.00
	2	0.24	75.2	22.4	2.00	0.55
	3	0.00	1.0	0.3	0.00	0.00
	4	0.55	174.2	51.9	4.64	1.28
	5	0.11	33.9	10.1	0.63	0.17
	6	0.12	39.6	11.8	1.05	0.29
	7	0.10	33.0	9.8	0.88	0.24
	8	0.33	106.9	31.9	2.85	0.78
	9	0.00	0.9	0.3	0.00	0.00
	10	0.00	0.3	0.1	0.00	0.00
Nichols-Cann	1	0.00	1.4	0.4	0.00	0.00
	2	0.01	4.6	1.4	0.00	0.00
Nuss	1	0.00	1.1	0.3	0.00	0.00
	2	0.00	1.4	0.4	0.00	0.00
Orosi School House	1	0.09	28.8	8.6	0.54	0.15
	2	0.09	28.7	8.6	0.76	0.21
	3	0.15	46.6	13.9	1.24	0.34
	4	0.07	23.3	6.9	0.62	0.17
	5	0.48	151.9	45.3	5.66	1.56
Parenti	1	0.01	4.0	1.2	0.00	0.00

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
Parks	1	0.00	1.3	0.4	0.00	0.00
	2	0.12	39.4	11.8	1.05	0.29
	3	0.12	37.6	11.2	1.40	0.39
Peck	1	0.01	1.7	0.5	0.00	0.00
Red Williams	1	0.02	7.5	1.1	2.79	0.38
	2	0.14	45.6	6.8	0.85	0.12
	3	0.02	6.3	0.9	2.33	0.32
	4	0.02	7.7	1.1	2.86	0.39
Reedley Main	1	0.43	136.2	40.6	3.62	1.00
	2	0.75	239.0	71.3	6.36	1.75
	3	1.08	344.1	102.6	9.16	2.52
	4	0.34	110.1	32.8	2.93	0.81
	5	0.27	87.5	26.1	1.63	0.45
Reo	1	0.09	27.9	8.3	0.74	0.20
	2	0.00	0.6	0.2	0.00	0.00
	3	0.04	14.0	4.2	0.87	0.24
	4	0.07	20.9	6.2	0.56	0.15
Rice-Brubaker	1	0.22	68.7	20.5	1.83	0.50
	2	0.02	5.0	1.5	0.13	0.04
	3	0.00	1.1	0.3	0.00	0.00
	4	0.07	23.5	7.0	0.62	0.17
	5	0.00	0.7	0.2	0.00	0.00
Sandridge	1	0.05	16.9	5.0	3.15	0.87
	2	0.01	2.3	0.7	0.00	0.00
	3	0.03	8.2	2.4	1.53	0.42
	4	0.01	3.1	0.9	0.00	0.00
	5	0.34	108.0	32.2	2.87	0.79
	6	0.00	1.3	0.4	0.00	0.00
Segrue	1	0.00	1.0	0.3	0.00	0.00
Smith Mountain	1	0.28	89.7	26.7	2.39	0.66
	2	0.00	0.7	0.2	0.25	0.07
	3	0.40	127.4	38.0	3.39	0.93
	4	0.49	157.9	47.1	2.94	0.81
	5	0.09	30.1	9.0	0.56	0.15
	6	0.10	30.6	9.1	0.82	0.22
	7	0.13	40.7	12.1	15.15	4.17
	8	0.16	50.1	14.9	1.33	0.37
	9	0.02	7.9	2.4	0.21	0.06
	10	0.22	71.1	21.2	1.89	0.52
	11	0.39	124.9	37.2	3.33	0.91
	12	0.01	2.7	0.8	0.00	0.00
	13	0.76	243.5	72.6	6.48	1.78
Sontag	1	0.01	2.8	0.8	1.05	0.29
	2	0.08	26.7	8.0	9.94	2.73
	3	0.02	6.5	1.9	2.41	0.66
	4	0.03	8.4	1.3	3.14	0.43

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	5	0.02	5.9	0.9	2.20	0.30
	6	0.02	6.8	1.0	2.54	0.35
	7	0.00	1.5	0.2	0.00	0.00
Tout	1	0.01	3.8	1.1	0.00	0.00
	2	0.07	21.1	6.3	3.93	1.08
	3	0.12	37.1	11.1	0.99	0.27
	4	0.01	2.6	0.8	0.00	0.00
	5	0.57	183.2	54.6	4.88	1.34
	6	0.11	35.3	10.5	0.94	0.26
	7	0.01	2.0	0.6	0.00	0.00
	8	0.07	21.7	6.5	0.81	0.22
	9	0.42	132.6	39.5	4.94	1.36
Traver Creek	1	0.59	189.5	56.5	5.05	1.39
	2	0.07	21.6	6.4	1.34	0.37
	3	0.36	115.0	34.3	3.06	0.84
	4	0.88	280.9	83.8	7.48	2.06
	5	1.78	569.6	169.8	15.16	4.17
	6	2.49	796.6	237.5	21.20	5.83
	7	0.29	93.3	27.8	1.74	0.48
	8	0.29	91.2	27.2	2.43	0.67
	9	0.17	55.7	16.6	1.04	0.29
	10	2.48	790.5	235.7	21.04	5.79
	11	0.56	179.2	53.4	4.77	1.31
	12	2.18	695.1	207.2	18.50	5.09
Traver Canal	13	0.53	170.6	50.9	4.54	1.25
	14	0.49	157.2	46.9	5.86	1.61
	15	0.31	99.0	29.5	1.84	0.51
	16	0.36	113.9	33.9	4.24	1.17
	17	2.94	937.5	279.5	17.47	4.80
	18	2.23	713.3	212.6	26.58	7.31
	19	1.24	395.7	118.0	10.53	2.90
	20	0.51	163.2	48.7	6.08	1.67
	21	0.21	66.7	19.9	1.24	0.34
	22	1.92	612.3	182.6	11.41	3.14
	23	3.50	1116.5	332.9	20.80	5.72
	24	0.48	153.6	45.8	4.09	1.12
	25	1.87	596.3	177.8	11.11	3.06
	26	1.27	404.4	60.3	10.77	1.48
	27	0.61	193.9	28.9	3.61	0.50
	28	0.92	293.7	43.8	7.82	1.08
	29	0.32	102.9	15.3	3.84	0.53
	30	0.56	177.7	26.5	11.04	1.52
	31	0.56	178.8	26.7	4.76	0.65
	32	0.39	126.1	3.8	2.35	0.06
	33	0.21	67.1	2.0	4.17	0.11

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	34	0.22	69.5	2.1	1.85	0.05
Uphill	1	0.01	1.7	0.5	0.00	0.00
Van Noy	1	0.07	23.7	7.1	4.42	1.22
	2	0.00	1.4	0.2	0.53	0.07
	3	0.01	2.2	0.3	0.80	0.11
	4	0.21	68.3	10.2	1.27	0.18
Wahtoke	1	0.00	0.8	0.2	0.00	0.00
	2	0.02	4.9	1.5	1.84	0.51
	3	0.06	19.4	5.8	1.20	0.33
	4	0.04	12.3	3.7	0.77	0.21
	5	0.02	6.0	1.8	0.37	0.10
	6	0.01	2.2	0.7	0.00	0.00
	7	0.12	37.3	11.1	2.32	0.64
	8	0.13	40.0	11.9	2.48	0.68
	9	0.02	5.3	1.6	0.33	0.09
	10	0.02	6.2	1.9	0.17	0.05
	11	0.01	3.1	0.9	1.16	0.32
	12	0.04	12.4	3.7	0.33	0.09
	13	0.04	13.3	4.0	0.50	0.14
	14	0.16	49.7	14.8	1.32	0.36
	15	0.01	2.4	0.7	0.00	0.00
	16	0.03	8.2	2.4	0.00	0.00
Weisse	1	0.15	48.0	1.4	1.28	0.04
	2	0.10	31.9	1.0	1.98	0.05
West Gould	1	0.01	4.5	1.3	0.00	0.00
	2	0.00	0.3	0.1	0.00	0.00
	3	0.03	9.9	2.9	1.84	0.51
	4	0.01	2.4	0.7	0.00	0.00
	5	0.31	98.3	29.3	2.62	0.72
	6	0.10	30.7	9.2	0.82	0.22
	7	0.00	0.3	0.1	0.00	0.00
	8	0.05	15.8	4.7	0.42	0.12
	9	0.00	0.9	0.3	0.00	0.00
	10	0.09	27.6	8.2	0.73	0.20
	11	0.00	0.7	0.2	0.00	0.00
	12	0.14	45.2	13.5	1.20	0.33
	13	0.05	16.8	5.0	0.45	0.12
	14	0.09	28.0	8.3	0.52	0.14
West Reedley	1	0.00	0.9	0.3	0.00	0.00
	2	0.01	3.5	1.1	0.00	0.00
	3	0.00	0.7	0.2	0.28	0.08
	4	0.21	67.3	20.1	1.79	0.49
	5	0.01	3.3	1.0	0.00	0.00
	6	0.08	25.9	7.7	0.69	0.19

Canal Name	(1) No.	(4) Seepage Rate (cfs)	Seepage Volume (AF) 1984	Seepage Volume (AF) 1990	Evaporation Volume (AF) 1984	Evaporation Volume (AF) 1990
	7	0.00	0.9	0.3	0.00	0.00
	8	0.57	181.1	54.0	4.82	1.33
	9	0.11	36.2	10.8	0.96	0.27
	10	0.00	0.9	0.3	0.00	0.00
	11	0.16	50.6	15.1	1.35	0.37
	12	0.03	8.5	2.5	0.00	0.00
	13	0.19	61.8	18.4	1.15	0.32
West Section 20	1	0.08	25.8	7.7	4.81	1.32
Wilson	1	1.07	340.2	101.4	9.06	2.49
	2	0.49	158.0	47.1	4.20	1.16
	3	0.31	99.9	29.8	2.66	0.73
	4	0.36	114.2	34.0	4.25	1.17
	5	0.00	1.1	0.3	0.00	0.00
	6	0.08	25.7	7.7	0.68	0.19
	7	0.29	94.2	28.1	2.51	0.69
	8	2.49	795.5	237.2	21.18	5.82
	9	1.38	441.3	131.6	11.75	3.23
	10	0.11	33.9	10.1	2.11	0.58
	11	0.09	29.3	8.7	0.78	0.21
	12	0.27	86.8	25.9	3.24	0.89
Wilson Hunter	1	0.32	100.6	30.0	2.68	0.74
	2	0.16	50.5	15.1	3.14	0.86
Wilson School Hous	1	0.27	87.6	26.1	2.33	0.64
	2	0.12	37.2	11.1	1.39	0.38
	3	0.19	62.0	18.5	2.31	0.64
	4	0.00	0.5	0.1	0.00	0.00
	5	0.05	17.1	5.1	1.06	0.29
	6	0.08	26.3	7.8	1.63	0.45
	7	0.17	53.1	15.8	3.30	0.91
	8	0.01	3.2	0.5	1.19	0.16
Windsor	1	0.01	3.2	0.9	0.00	0.00

Appendix D

Evapotranspiration of Bank Vegetation of the Alta Delivery System by Segment

NOTES

1. Canal Segment Number: sections defined by canal soil type, cross section, and ground water modeling element boundary (see Figures II-1A and II-IB)

2. Canal Segment Characteristic delineates canal type: Concrete Lined (l) or Piped (p); or canal bottom soil type for unlined: See Table II-4.

3. Average Top Width: determined from averaging surveyed widths for each canal section; pipe diameters estimated from field notes and channel flow rates.

4. Average seepage rate of full channel or pipe.

5. Length of trees determined from field notes and aerial photographs. Width of trees assumed to be 80 feet on Alta Main and 60 feet on Traver Canal.

6. Length of brush determined from field notes and aerial photographs. Width of brush assumed to be 15 ft.

7. Evapotranspiration of weeds assumes 4-feet wide strip of weeds on each side of canal; crop efficient is 0.0 for first 30 days of irrigation season and 1.0 for remaining season.

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	1990 Tree	1990 Brush	1990 Grass
Alta Main	2	3760		20.72	1.15		5.70	0.08	
	3				0.57			0.04	
	4	1080		5.95	7.74		1.64	0.55	
	5	1280		7.05	1.81		1.94	0.13	
	6	880		4.85	4.01		1.33	0.28	
	7				0.57			0.04	
	8				1.53			0.11	
	9				1.53			0.11	
	10				0.48			0.03	
	11				0.38			0.03	
	12				2.77			0.20	
East Branch	13				0.10			0.01	
	14				0.19			0.01	
	15				1.72			0.12	
	16				0.19			0.01	
	17				1.34			0.09	
	18				0.29			0.02	
	19				0.19			0.01	
	20				0.38			0.03	
	21				0.38			0.03	
	22				0.96			0.07	
	23				0.38			0.03	
	24				0.10			0.01	
	25				0.19			0.01	
	26				0.19			0.01	
	27				1.15			0.08	
	28				0.76			0.05	
	29				0.86			0.06	
	30				0.29			0.02	
	31				0.57			0.04	
	32				0.57			0.04	
	33				0.48			0.03	
	34				1.15			0.08	
	35				0.48			0.03	
	36				1.62			0.11	
	37				1.43			0.10	
	38				1.53			0.11	
	39				0.48			0.03	
	40				0.86			0.06	
	41				6.11			0.43	
	42				0.86			0.06	
	43				0.38			0.03	
	44				1.05			0.07	

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	45			3.72			0.26		
	46			2.48			0.18		
	47			0.76			0.05		
	48			1.81			0.13		
	49			3.15			0.22		
A.B. Clark	1			3.19			0.22		
	2			0.00			0.00		
	3			5.16			0.36		
	4			0.00			0.00		
	5			0.00			0.00		
A.N. Smith	1			0.00			0.00		
	2			1.91			0.13		
	3			0.00			0.00		
	4			0.00			0.00		
A.W. Clark	1			1.34			0.09		
	2			0.10			0.01		
	3			0.76			0.05		
	4			0.86			0.06		
	5			0.00			0.00		
	6			0.00			0.00		
	7			1.09			0.08		
	8			0.00			0.00		
	9			1.74			0.12		
Andrews	1			0.59			0.04		
	2			0.78			0.06		
	3			1.09			0.08		
	4			1.41			0.10		
	5			1.74			0.12		
	6			0.59			0.04		
Ballard	1			0.44			0.03		
	2			0.19			0.01		
	3			0.34			0.02		
	4			0.90			0.06		
	5			0.00			0.00		
	6			0.61			0.04		
	7			0.00			0.00		
	8			0.00			0.00		
Banks	1			1.09			0.04		
	2			1.38			0.05		
	3			1.22			0.04		
	4			0.57			0.02		
	5			1.72			0.06		
	6			1.62			0.06		

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	7				0.50			0.02	
	8				2.41			0.08	
	9				3.00			0.11	
	10				0.69			0.02	
	11				3.06			0.11	
	12				1.05			0.04	
	13				2.46			0.09	
	14				3.93			0.14	
	15				1.05			0.04	
	16				1.55			0.05	
	17				0.59			0.02	
	18				2.81			0.10	
	19				1.85			0.07	
	20				0.34			0.01	
	21				0.96			0.03	
	22				1.62			0.01	
	23				0.38			0.00	
	24				1.05			0.01	
	25				1.24			0.01	
	26				1.03			0.01	
	27				0.61			0.00	
	28				2.16			0.02	
	29				2.75			0.02	
Bowhay	1				1.53			0.11	
	2				1.93			0.14	
	3				1.57			0.11	
	4				0.78			0.06	
	5				1.89			0.13	
	6				0.21			0.01	
Bump & Edmiston	1				1.55			0.11	
	2				0.00			0.00	
	3				0.00			0.00	
Button	1				0.25			0.02	
	2				1.59			0.11	
	3				0.74			0.05	
	4				1.39			0.10	
	5				0.57			0.04	
	6				0.74			0.05	
	7				0.48			0.03	
	8				4.37			0.31	
	9				5.56			0.39	
	10				0.84			0.03	
	11				1.85			0.07	

		(5) (6) Vegetative Length		(7) Evapotranspiration (AF)					
	(1)	(ft)		1984			1990		
Canal Name	No.	Tree	Brush	Tree	Brush	Grass	Tree	Brush	Grass
	12			0.38			0.01		
	13			0.71			0.02		
	14			4.05			0.14		
	15			0.40			0.01		
	16			2.35			0.08		
	17			5.54			0.20		
	18			1.45			0.05		
	19			1.34			0.05		
	20			0.88			0.03		
	21			0.48			0.02		
	22			0.76			0.03		
	23			0.99			0.04		
Buttonwillow	1			0.19			0.01		
	2			0.38			0.03		
	3			0.38			0.03		
	4			0.86			0.06		
	5			1.05			0.07		
	6			1.15			0.08		
	7			0.86			0.06		
	8			0.86			0.06		
	9			2.29			0.16		
	10			0.19			0.01		
	11			1.34			0.09		
	12			0.19			0.01		
	13			1.18			0.08		
	14			3.72			0.26		
	15			1.87			0.13		
	16			0.78			0.06		
	17			0.61			0.04		
	18			2.25			0.16		
	19			0.53			0.04		
	20			3.25			0.23		
	21			1.74			0.12		
	22			0.00			0.00		
Caesar	1			0.00			0.00		
	2			0.00			0.00		
	3			0.92			0.06		
	4			2.62			0.18		
	5			1.20			0.08		
	6			4.30			0.30		
	7			2.96			0.21		
California Vineyar	1			0.29			0.02		
	2			3.06			0.22		

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	3				0.44			0.03	
	4				2.96			0.21	
	5				0.97			0.07	
	6				2.12			0.15	
	7				0.00			0.00	
	8				0.23			0.02	
	9				5.35			0.38	
	10				0.76			0.05	
Cary-Hunter	1				0.00			0.00	
	2				0.00			0.00	
	3				0.57			0.04	
	4				0.90			0.06	
	5				0.50			0.04	
	6				2.27			0.16	
	7				0.00			0.00	
	8				1.11			0.08	
	9				0.94			0.07	
	10				0.00			0.00	
	11				1.36			0.10	
	12				0.00			0.00	
	13				2.56			0.18	
	14				0.00			0.00	
	15				1.47			0.10	
	16				0.90			0.06	
	17				3.06			0.22	
	18				1.36			0.05	
Carpenter	1				0.00			0.00	
	2				0.00			0.00	
	3				0.00			0.00	
Clapp	1				0.00			0.00	
	2				0.00			0.00	
Clements	1				0.21			0.01	
	2				0.27			0.02	
	3				1.03			0.07	
	4				2.81			0.20	
	5				3.71			0.26	
	6				1.68			0.12	
	7				0.29			0.02	
Clough	1				5.31			0.04	
	2				2.46			0.02	
	3				2.14			0.02	
Cross Creek W.W.	1				1.38			0.01	
	2				3.40			0.02	

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
Curtis Cutoff	1			1.89			0.13		
	2			0.00			0.00		
Lower Curtis Cutof	1			0.53			0.04		
	2			0.00			0.00		
	3			0.17			0.01		
	4			0.42			0.03		
Upper Curtis Cutof	1			0.00			0.00		
	2			0.27			0.02		
Dinuba Town	1			0.25			0.02		
	2			0.67			0.05		
	3			0.00			0.00		
	4			0.00			0.00		
	5			0.63			0.04		
	6			0.38			0.03		
	7			0.59			0.04		
	8			0.40			0.03		
	9			0.61			0.04		
	10			0.27			0.02		
	11			0.40			0.03		
	12			1.03			0.07		
	13			1.05			0.07		
	14			5.48			0.39		
	15			1.93			0.14		
	16			0.00			0.00		
	17			1.60			0.11		
	18			0.00			0.00		
	19			0.80			0.06		
	20			0.36			0.03		
	21			3.06			0.22		
	22			0.69			0.05		
East Gould	1			0.00			0.00		
	2			0.00			0.00		
	3			0.29			0.02		
	4			1.05			0.07		
	5			0.00			0.00		
	6			0.00			0.00		
	7			0.48			0.03		
East Reedley	1			0.00			0.00		
	2			0.00			0.00		
	3			0.48			0.03		
	4			1.53			0.11		
	5			0.00			0.00		
	6			0.00			0.00		

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	7				0.19			0.01	
	8				0.00			0.00	
	9				2.39			0.17	
	10				0.00			0.00	
	11				0.32			0.02	
	12				0.21			0.01	
	13				0.32			0.02	
East Section 20	1				0.00			0.00	
Elter	1				0.00			0.00	
	2				1.05			0.07	
	3				0.86			0.06	
	4				0.00			0.00	
	5				0.00			0.00	
	6				0.00			0.00	
	7				0.00			0.00	
Floyd	1				1.09			0.08	
	2				0.38			0.03	
	3				2.10			0.15	
	4				0.21			0.01	
Frane	1				0.00			0.00	
Gordon	1				1.28			0.09	
	2				0.00			0.00	
Grove	1				0.00			0.00	
	2				0.00			0.00	
	3				0.00			0.00	
	4				0.00			0.00	
Haden & Boone	1				2.54			0.18	
	2				1.72			0.12	
	3				0.00			0.00	
Hogan	1				1.15			0.08	
	2				0.00			0.00	
Horseman	1				1.41			0.10	
	2				3.93			0.28	
	3				0.44			0.03	
	4				0.88			0.06	
	5				1.17			0.08	
	6				2.71			0.19	
	7				2.02			0.14	
J. T. Williams	1				0.00			0.00	
	2				0.00			0.00	
Jack	1				0.53			0.04	
	2				0.67			0.05	
	3				0.34			0.02	

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	1990 Tree	1990 Brush	1990 Grass
	4			1.59			0.11		
Kennedy School Hou	1			0.00			0.00		
	2			0.25			0.02		
	3			0.48			0.03		
	4			0.00			0.00		
	5			0.00			0.00		
	6			0.00			0.00		
	7			0.00			0.00		
Kennedy Waste Way	1			7.16			0.51		
	2			0.86			0.06		
	3			0.48			0.03		
	4			0.76			0.05		
	5			0.76			0.05		
	6			1.91			0.13		
	7			1.30			0.09		
	8			0.00			0.00		
	9			0.00			0.00		
King	1			1.39			0.10		
	2			3.09			0.22		
	3			1.41			0.05		
	4			0.50			0.02		
	5			0.88			0.03		
	6			1.26			0.04		
	7			1.83			0.06		
	8			0.76			0.03		
Kirk	1			1.15			0.08		
	2			0.00			0.00		
	3			2.18			0.15		
Knestric	1			0.00			0.00		
	2			0.84			0.06		
	3			0.00			0.00		
	4			1.28			0.09		
	5			1.07			0.08		
	6			0.15			0.01		
	7			0.99			0.07		
	8			1.24			0.09		
	9			0.00			0.00		
	10			0.00			0.00		
	11			0.00			0.00		
	12			1.03			0.07		
	13			0.00			0.00		
Loper	1			0.50			0.04		
	2			1.03			0.07		

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	3			2.92			0.21		
	4			2.06			0.15		
	5			1.66			0.12		
Lovell	1			4.39			0.31		
	2			0.00			0.00		
McBriar	1			0.00			0.00		
	2			0.00			0.00		
McClanahan	1			0.84			0.06		
	2			2.18			0.15		
	3			3.57			0.25		
	4			0.00			0.00		
	5			0.74			0.05		
	6			1.43			0.10		
	7			0.00			0.00		
	8			4.87			0.34		
	9			0.55			0.02		
Mc Gee	1			0.63			0.04		
	2			0.00			0.00		
	3			1.26			0.09		
Monson	1			1.07			0.08		
	2			3.36			0.24		
	3			4.30			0.30		
	4			0.88			0.06		
	5			5.27			0.37		
	6			0.94			0.07		
	7			1.07			0.08		
	8			0.34			0.02		
	9			0.44			0.03		
Montague	1			1.64			0.12		
	2			0.00			0.00		
	3			0.50			0.04		
	4			0.00			0.00		
Mt. Campbell	1			0.00			0.00		
	2			1.09			0.08		
	3			0.00			0.00		
	4			2.52			0.18		
	5			0.34			0.02		
	6			0.57			0.04		
	7			0.48			0.03		
	8			1.55			0.11		
	9			0.00			0.00		
	10			0.00			0.00		
Nichols-Cann	1			0.00			0.00		

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	2			0.00			0.00		
Nuss	1			0.00			0.00		
	2			0.00			0.00		
Orosi School House	1			0.50			0.04		
	2			0.71			0.05		
	3			1.15			0.08		
	4			0.57			0.04		
	5			5.23			0.37		
Parenti	1			0.00			0.00		
Parks	1			0.00			0.00		
	2			0.95			0.07		
	3			1.26			0.09		
Peck	1			0.00			0.00		
Red Williams	1			0.94			0.03		
	2			0.32			0.01		
	3			1.05			0.04		
	4			1.49			0.05		
Reedley Main	1			0.96			0.07		
	2			1.81			0.13		
	3			3.06			0.22		
	4			1.15			0.08		
	5			0.67			0.05		
Reo	1			1.15			0.08		
	2			0.00			0.00		
	3			1.34			0.09		
	4			0.86			0.06		
Rice-Brubaker	1			2.35			0.17		
	2			0.17			0.01		
	3			0.00			0.00		
	4			0.80			0.06		
	5			0.00			0.00		
Sandridge	1			0.00			0.00		
	2			0.00			0.00		
	3			0.00			0.00		
	4			0.00			0.00		
	5			1.22			0.09		
	6			0.00			0.00		
Segrue	1			0.00			0.00		
Smith Mountain	1			1.32			0.09		
	2			0.13			0.01		
	3			1.81			0.13		
	4			1.53			0.11		
	5			0.29			0.02		
	6			0.38			0.03		

Canal Name	(1) No.	(5) Vegetative Length (ft) Tree	(6) Vegetative Length (ft) Brush	(7) Evapotranspiration (AF) 1984 Tree	1984 Brush	1984 Grass	(7) Evapotranspiration (AF) 1990 Tree	1990 Brush	1990 Grass
	7					7.64			0.54
	8					0.82			0.06
	9					0.13			0.01
	10					1.24			0.09
	11					2.14			0.15
	12					0.00			0.00
	13					3.59			0.25
Sontag	1					0.76			0.05
	2					7.26			0.51
	3					1.76			0.12
	4					2.29			0.08
	5					1.60			0.06
	6					1.85			0.07
	7					0.00			0.00
Tout	1					0.00			0.00
	2					0.00			0.00
	3					0.53			0.04
	4					0.00			0.00
	5					3.13			0.22
	6					0.69			0.05
	7					0.00			0.00
	8					0.69			0.05
	9					4.34			0.31
Traver Creek	1		4400		4.55	1.05		1.25	0.07
	2		1200		1.24	0.29		0.34	0.02
	3	320	2800	1.32	2.89	0.67	0.36	0.80	0.05
	4	520	7200	2.15	7.44	1.72	0.59	2.05	0.12
	5	2240	16000	9.26	16.53	3.82	2.55	4.55	0.27
	6	2200	24000	9.09	24.79	5.73	2.50	6.82	0.40
	7		2000		2.07	0.48		0.57	0.03
	8		2800		2.89	0.67		0.80	0.05
	9		1200		1.24	0.29		0.34	0.02
	10	800	22800	3.31	23.55	5.44	0.91	6.48	0.38
	11					1.15			0.08
	12					4.20			0.30
Traver Canal	13					0.96			0.07
	14					1.15			0.08
	15					0.34			0.02
	16					0.76			0.05
	17					3.06			0.22
	18					4.58			0.32
	19					1.80			0.13
	20					1.03			0.07
	21					0.21			0.01

		(5) (6) Vegetative Length		(7) Evapotranspiration (AF)					
	(1)	(ft)		1984			1990		
Canal Name	No.	Tree	Brush	Tree	Brush	Grass	Tree	Brush	Grass
	22			1.85			0.13		
	23			3.06			0.22		
	24			0.57			0.04		
	25			1.62			0.11		
	26			1.68			0.06		
	27			0.59			0.02		
	28			1.34			0.05		
	29			0.69			0.02		
	30			2.12			0.07		
	31			0.99			0.04		
	32			0.61			0.00		
	33			1.38			0.01		
	34			0.61			0.00		
Uphill	1			0.00			0.00		
Van Noy	1			0.00			0.00		
	2			0.46			0.02		
	3			0.82			0.03		
	4			1.47			0.05		
Wahtoke	1			0.00			0.00		
	2			0.82			0.06		
	3			0.57			0.04		
	4			0.38			0.03		
	5			0.19			0.01		
	6			0.00			0.00		
	7			1.34			0.09		
	8			1.43			0.10		
	9			0.19			0.01		
	10			0.10			0.01		
	11			0.67			0.05		
	12			0.19			0.01		
	13			0.29			0.02		
	14			0.76			0.05		
	15			0.00			0.00		
	16			0.00			0.00		
Weisse	1			0.97			0.01		
	2			1.51			0.01		
West Gould	1			0.00			0.00		
	2			0.00			0.00		
	3			0.00			0.00		
	4			0.00			0.00		
	5			2.08			0.15		
	6			0.71			0.05		
	7			0.00			0.00		
	8			0.38			0.03		

		(5) (6) Vegetative Length		(7) Evapotranspiration (AF)					
	(1)	(ft)		1984			1990		
Canal Name	No.	Tree	Brush	Tree	Brush	Grass	Tree	Brush	Grass
	9			0.00			0.00		
	10			0.74			0.05		
	11			0.00			0.00		
	12			1.43			0.10		
	13			0.57			0.04		
	14			0.67			0.05		
West Reedley	1			0.00			0.00		
	2			0.00			0.00		
	3			0.19			0.01		
	4			1.24			0.09		
	5			0.00			0.00		
	6			0.48			0.03		
	7			0.00			0.00		
	8			3.34			0.24		
	9			0.67			0.05		
	10			0.00			0.00		
	11			0.86			0.06		
	12			0.00			0.00		
	13			0.42			0.03		
West Section 20	1			0.00			0.00		
Wilson	1			3.25			0.23		
	2			1.51			0.11		
	3			0.96			0.07		
	4			1.53			0.11		
	5			0.00			0.00		
	6			0.27			0.02		
	7			1.09			0.08		
	8			10.22			0.72		
	9			5.20			0.37		
	10			0.84			0.06		
	11			0.31			0.02		
	12			1.26			0.09		
Wilson Hunter	1			1.99			0.14		
	2			1.89			0.13		
Wilson School Hous	1			1.55			0.11		
	2			0.84			0.06		
	3			1.30			0.09		
	4			0.00			0.00		
	5			0.57			0.04		
	6			0.94			0.07		
	7			2.18			0.15		
	8			0.88			0.03		
Windsor	1								

ALTA

IRRIGATION DISTRICT

SCALE

1" = 2000'

NORTH

Reedley

Orange Cove

DATE	REVISED BY	REDRAWN BY

ALTA IRRIGATION DISTRICT

DRAWN BY: [illegible] CHECKED BY: [illegible] DRAWING NO.

DATE: 12/3/81 SCALE: 1" = 2000' 1 OF 2

FIGURE I-2A

Reedley

Dinuba

Orosi

Cutler

Traver

NORTH

FRESNO CO.
TULARE CO.

KINGS CO.
TULARE CO.

TULARE CO.
KINGS CO.

DATE	REVISED BY	REDRAWN BY

ALTA IRRIGATION DISTRICT

DRAWN BY:	CHECKED BY:	DRAWING NO.
DATE: 12/8/71	SCALE: 1" = 2000'	2 OF 2

FIGURE I-2B