THE Cross SECTION

Published monthly by High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405—Ph. 762-0181

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IRS cost-in-water tax deduction available to irrigators

Landowners in the Southern High Plains of Texas who utilize ground water produced from the Ogallala Formation in the business of irrigation farming may claim a cost-in-water income tax depletion allowance on their federal income tax return. This allowance is permitted under strict guidelines of the Internal Revenue Service.

Cost-In-Water

The cost-in-water as a part of the total cost of the tract of land must be determined for the year of purchase. The tax law requires that the taxpayer must have paid more for the property because it had ground water in storage than he would have paid for a similar tract of land in the same area which had little or no ground water in storage. The landowner may provide the IRS with documentation of land sales in the area of his farm to support the fact that he paid more for his tract of land which has ground water reserves in storage than was paid for a similar tract of land which had little or no water or he may use the cost-in-water guidelines provided by the High Plains Underground Water Conservation District No. 1.

The Water District contracts with a professional land appraiser, who documents land sales which occur in a part of its service area each year. Each tract of land sold during the year is visited and the value of the improvements are subtracted from the total purchase price. Tracts which sold for an abnormally high or low price are eliminated from the sales records. The remaining sales records of all tracts are divided into two categories: "dryland" and "irrigated". An average per-acre sales value for each category of land sales is determined.

Engineers representing the IRS review this data with Water District officials and "cost-in-water" guidelines are developed for each county each year for those counties or parts of counties served by the Water District. The guidelines require that the taxpayer subtract from his purchase price the average price paid for dryland in his county for the year he made his purchase. Also, the value he attributes to the price he paid for the ground water on his claim cannot exceed the average price paid for ground water as listed on the guidelines.

As an example, if the average price paid for land with little or no water (dryland) during the year the tract was purchased was $200 per acre and the average price paid for irrigated land was $500 per acre, the taxpayer may not claim more than $300 per acre for the ground water in storage ($500 − $200 = $300). The taxpayer first must deduct the value of the improvements from the total purchase price, then deduct $200 per acre as the value for dryland. The remaining sum up to a maximum of $300 per acre may be claimed as his cost in the ground water.

Saturated Thickness Calculations

The saturated thickness of the formation is calculated by first determining the depth to water below the land surface and subtracting this value from the depth of the base of the Ogallala Formation encountered in wells drilled on the property. If the landowner has records of valid water level measurements made in his wells at the date of purchase and copies of driller's logs of wells drilled on the property which record in feet the depth below land surface the base of the Ogallala Formation was encountered, he may use these records to support his claim as to the quantity of water in storage under his property at the date of purchase.

If he does not have these records, he may request the Water District to provide this data from maps constructed by the Water District and approved for this use by the IRS to establish the quantity of water he had in storage at the date of purchase.

The cost-in-water per foot of saturated thickness is then determined according to the formula illustrated by the following example. If the depth to water below the land surface was 200 feet at the date of purchase and the base of the Ogallala Formation was 500 feet below land surface, the saturated thickness of the formation would be 300 feet. If the price paid for the water in storage was determined to be $300 per acre, the landowner would have a cost in the water of $1.00 per foot of saturated thickness.

Decline Data

The landowner may claim a water depletion allowance for the amount of the decline in the water table which occurred on his farm during the tax year of the claim. Again, he can provide his own change-in-water level data to support his claim or he can obtain the data which has been approved for this use by the IRS from the Water District. If he chooses to provide his own data to support his claim, he would be required to provide copies of valid depth-to-water level measurements made in one or more of the wells located on the tract of land for which he is filing the claim. Two sets of measurements would be required. One set of measurements would document the water level in the aquifer at the beginning of the year and the second set would document the water level in the aquifer at the end of the year. The difference in the measurements, provided it is a negative value which must be rounded to the nearest foot, would be the amount of depletion which occurred.

For example, using the example above in which the landowner determined that he had a cost of $1.00 per foot of saturated formation with a difference in the water level measurements of two feet (assuming that 200 feet was the measured depth to

See IRRIGATION Page Two

Former manager Rayner dies in San Antonio

Frank A. Rayner

Former High Plains Underground Water Conservation District Manager Frank A. Rayner died Nov. 23 in San Antonio after a lengthy illness. He was 58.

Private funeral services were held Nov. 27 in San Antonio.

A Registered Professional Engineer and Geologist, Rayner received his Bachelor of Science degree in Geological Engineering from Texas A & M University in May 1958. He began his water career as assistant director of water quality programs for the Texas Water Development Board Ground Water Division.

He joined the High Plains Water District staff as chief engineer in August 1966. In October 1969, the District's Board of Directors appointed Rayner to succeed Tom McFarland as manager. Rayner served as manager as well as the District's chief engineer until his resignation in August 1977. He was then a water resources consultant to the Ministry of Planning in Riyadh, Saudi Arabia, until his retirement in 1985.

Rayner was a former board member of the Texas Water Conservation Association, a founding member and past president of the Ground Water Management Districts Association, a member of Former Texas Governor Dolph Briscoe's Task Force on Water Conservation and Development, and a past board member of the West Texas Water Institute. He was also a member of several national water associations.

Estimated net depletion shown

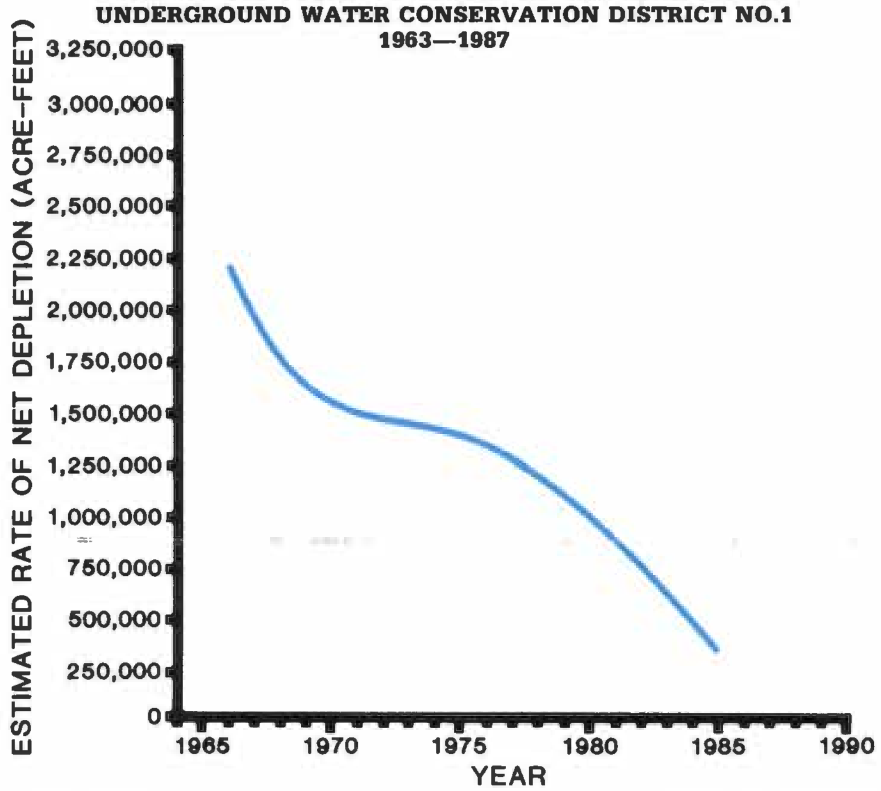
MANAGER'S NOTE: In the early days of irrigation in the Texas High Plains, a well was drilled on the high point of a field. The water was transported from the well to the field in unlined, open earthen ditches. Water losses ranged from 10 to 30 percent per 1,000 feet of ditch. It was a common practice to irrigate rows one-half mile long in 12-hour sets. Over-irrigation occurred at the ditch end of the field with water percolating below the plant soil root zone. Also, tailwater losses equalling about 20 percent of the water pumped would occur at the field end.

The installation of approximately 10,000 miles of underground pipeline and more than 3,000 tailwater return systems, plus reducing the length and time of irrigation sets, resulted in a reduction of almost one-third in pumpage. A serious effort to maximize precipitation use through furrow dike installation and other land management practices helped to further reduce pumpage. More recently, the use of time-controlled surge valves has further reduced water pumpage from 10 to 40 percent on many farms.

The water use efficiency on farms irrigated with sprinkler systems has improved at an equal or greater rate. The early-day systems had water losses of as much as 40 percent. Today's modern efficient systems have losses of less than five percent.

The progress of the irrigators in the High Plains Water District service area in implementing the best water conservation effort possible has contributed greatly to the decrease in the net depletion rate of the aquifer as shown below — **A. Wayne Wyatt**

ESTIMATED NET DEPLETION OF THE OGALLALA AQUIFER IN ACRE-FEET BY CALENDAR YEAR FOR THE 5,215,600 ACRES IN THE FIFTEEN COUNTIES SERVED BY THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO.1
1963—1987



1963—1964	– 1,934,714 acre-feet
1964—1965	– 3,010,494 acre-feet
1965—1966	– 1,824,332 acre-feet
1966—1967	– 2,215,678 acre-feet
4 Year Average	*– 2,246,304 acre-feet*
1967—1968	– 2,288,778 acre-feet
1968—1969	– 824,960 acre-feet
1969—1970	– 875,758 acre-feet
1970—1971	– 2,106,809 acre-feet
1971—1972	– 1,430,993 acre-feet
5 Year Average	*– 1,505,460 acre-feet*
1972—1973	– 499,922 acre-feet
1973—1974	– 953,868 acre-feet
1974—1975	– 2,078,848 acre-feet
1975—1976	– 1,037,805 acre-feet
1976—1977	– 1,971,406 acre-feet
5 Year Average	*– 1,308,370 acre-feet*
1977—1978	– 1,540,461 acre-feet
1978—1979	– 1,179,705 acre-feet
1979—1980	– 517,206 acre-feet
1980—1981	– 1,903,331 acre-feet
1981—1982	– 534,918 acre-feet
5 Year Average	*– 1,135,124 acre-feet*
1982—1983	– 625,090 acre-feet
1983—1984	– 546,096 acre-feet
1984—1985	– 639,363 acre-feet
1985—1986	– 51,151 acre-feet
1986—1987	+ 375,054 acre-feet
5 Year Average	*– 297,329 acre-feet*

The Ogallala Formation in the High Plains of Texas covers an area of 36,080 square miles which is about 23,091,200 acres. The aquifer had about 420 million acre-feet of water in storage in 1980. This is enough water to cover the 23,091,200 acre surface area with a layer of water 18.19 feet deep. Prior to the development of large scale irrigation in the High Plains of Texas, the aquifer contained about 500 million acre-feet of water. Net depletion of the Ogallala Aquifer in the High Plains of Texas was about 23 percent from 1936 to 1980.

Irrigation tax deduction noted

Continued From Page One

water below the land surface in January 1986 and the measured depth to water was 202 feet in January 1987), he would have a change or decline in the water level of 2 feet during the calendar year. If he had purchased a 320 acre tract of land, his water depletion allowance would be 2 feet times the $1.00 per foot cost in the water times the 320 acres in the tract, resulting in a cost-in-water income tax depletion allowance of $640 for that tax year. (2 × $1.00 × 320 = $640)

A landowner may file an amended tax return to claim cost-in-water income tax depletion allowances for three prior years, provided he has owned the land during those three prior years, that he has used ground water in the business of agricultural farming and that water depletion has actually occurred.

Information necessary to support a claim for a cost-in-water income depletion allowance may be obtained from the Water District. Requests for data must be in writing. They may be mailed to the District office at 2930 Avenue Q, Lubbock, Texas 79405 or you may come to the Water District office and fill out a request form.

Cost of water values for land acquired in 1987

County	Percent of Cost Attributed To Irrigation Water	Cost Per Acre For Irrigation Water Not To Exceed	Cost Per Acre Attributed To Dryland Cannot Be Less Than
Armstrong	27	75.00	200.00
Bailey	63	280.00	155.00
Castro	50	290.00	165.00
Cochran	42	125.00	145.00
Crosby	63	395.00	190.00
Deaf Smith	44	255.00	185.00
Floyd	52	270.00	165.00
Hale	50	375.00	225.00
Hockley	33	155.00	135.00
Lamb	52	340.00	145.00
Lubbock	42	355.00	320.00
Lynn	53	370.00	135.00
Parmer	51	435.00	160.00
Potter	45	195.00	200.00
Randall (NW)	45	195.00	200.00
Randall (SE)	27	75.00	200.00

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

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2930 Avenue Q, Lubbock, Texas 79405
Telephone (806) 762-0181

CARMON McCAIN, Editor
DIRECTOR, INFORMATION/EDUCATION

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Northern precincts to choose directors, county committeemen

A board member and two committeemen from each county in Director's Precincts Three and Four will be elected when voters go to the polls during the High Plains Underground Water Conservation District No. 1 election Saturday, January 16th.

A.W. "Webb" Gober of Farwell is the incumbent Director's Precinct Three Director and will seek re-election to a four-year term. Precinct Three consists of the portions of Bailey, Castro and Parmer counties which lie within the Water District's service area.

James C. Conkwright of Hereford is seeking re-election to a four-year term in his Precinct Four office. Directors' Precinct Four consists of the portions of Armstrong, Deaf Smith, Potter and Randall counties which lie within the Water District's service area.

Two Water District committeemen from each of these counties will also be elected to four-year terms.

Polls will be open from 7 a.m. to 7 p.m. The voting places and election judges are as follows:

DISTRICT DIRECTORS' PRECINCT THREE:

Bailey County — Bailey County Courthouse, Muleshoe, Texas 79347; Margrethe Taylor, Presiding Judge.

Castro County — City Hall Alderman's room, Dimmitt, Texas 79027; Oleta Gollehon, Presiding Judge.

Parmer County — Parmer County Courthouse, Farwell, Texas 79325; Carolla Smith, Presiding Judge.

DISTRICT DIRECTORS' PRECINCT FOUR:

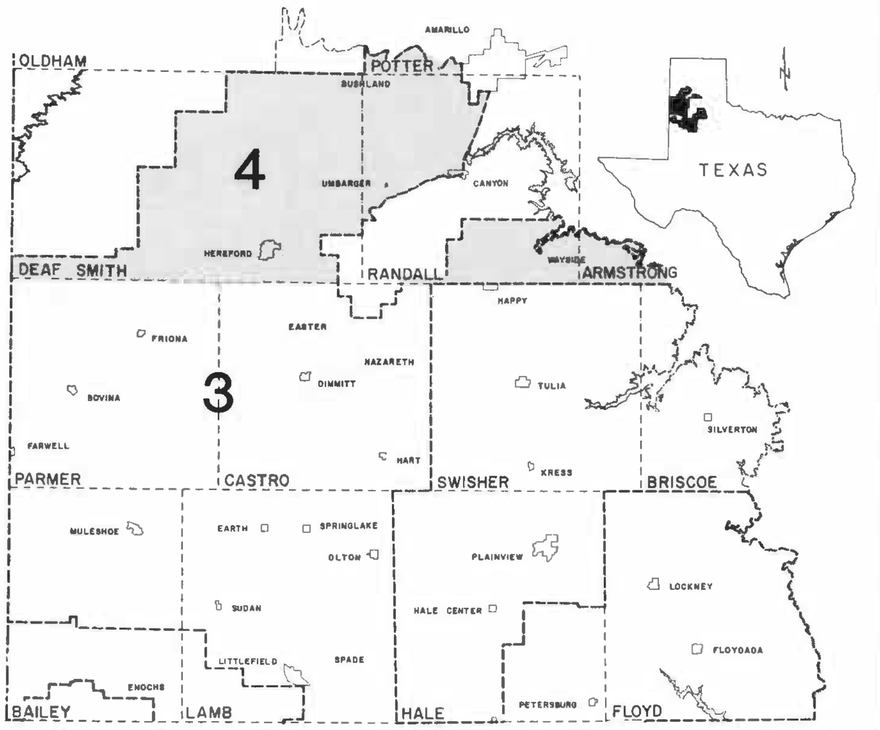
Armstrong County — Wayside Community Center, Wayside, Texas 79094; Estelle Rogers, Presiding Judge.

Deaf Smith County — Deaf Smith County Courthouse, Hereford, Texas 79045; Virginia Holmes, Presiding Judge.

Potter County — School House, Bushland, Texas 79012; Billie Walton, Presiding Judge.

Randall County — Consumers Fuel Association, West First Avenue, Canyon, Texas 79015.

Water District Precincts Three and Four



INCUMBENT DISTRICT DIRECTORS

A.W. "Webb" Gober
Farwell, Texas
Precinct Three

James C. Conkwright
Hereford, Texas
Precinct Four

Water quality, open hole programs show increased activity

Increased activity in the High Plains Underground Water Conservation District No. 1 bacteriological testing and open hole investigation programs suggests that recent media attention has increased public awareness of both programs. The high number of requests illustrates the need for both programs.

High Number Of Wells Tested Show Contamination

Since the October *Cross Section* article appeared, 17 requests have been received for rural domestic water well quality sampling. According to Dan Seale, Engineer Technician in the Water District's Field Support Section, 19 well sites, located in Castro, Deaf Smith, Floyd, Lamb, and Lubbock Counties, were sampled. The majority of the sites were located in Lubbock County, he notes. From this group, five wells, or 29.4 percent, tested positive for fecal coliform bacteria contamination.

Seale says two of the contaminated wells have been chlorinated and retested and are now safe for domestic use. The remaining three wells have been treated and will be re-tested in the future.

"In most of these cases, the problem was caused by an improperly sealed well which allowed rodents and other contaminants to enter from above," Seale says.

Water samples collected by Seale are incubated on a media pad at 104° F for 24 hours. If the results are positive, the residents are urged to find an alternate domestic water supply until the source of contamination is eliminated and the well water is safe.

Once the contamination source is located and corrected, chlorine is added to the water well and pumped through the distribution system. The system is then closed for 24 hours.

A contaminated water supply may be suspected if rural residents have repeated flu-like virus symptoms or if house guests complain of cramping or diarrhea.

Bacteriological water testing may be scheduled by contacting Dan Seale at the High Plains Underground Water Conservation District office, 2930 Avenue Q, Lubbock, Texas 79405 or by calling (806) 762-0181.

District Learns Of 59 Open Hole Sites

Attention surrounding Midland toddler Jessica McClure's rescue from an open, abandoned water well has caused approximately 59 open holes to be reported to the High Plains Water District office.

"For about a month after the little girl's accident, we spent our full time investigating open hole reports," says Obbie Goolsby, Engineer Technician in charge of the District's open hole program. "We have investigated all the reports, contacted the owners and advised them that the wells had to be covered. We are in the process of rechecking to make sure all the holes have been properly closed. Landowners have really cooperated with us to get these holes closed," he says.

Several of the reports investigated by district staff turned out to be cesspools and other types of holes which require a different treatment. Goolsby advised the landowners in these cases on the appropriate procedures.

Goolsby says the Midland accident increased awareness of the dangers smaller open holes can pose. Although Water District rules do not include the smaller holes, he says they cannot be ignored.

"If a six-inch open hole extends into the Ogallala Aquifer, there is a direct path for contaminants to enter the ground water. The Water District is responsible for protecting the quality of the ground water and can require the hole to be closed," he says.

Goolsby reminds landowners that open, unused wells are in violation of State law. "Violation of this law is a misdemeanor and carries a $100 to $500 dollar fine on conviction. The Water District is not interested in taking people to court for an open hole. We just want the hole covered and made safe," he says.

A solid cap capable of supporting a minimum of 400 pounds is required to cover unused wells. The cap should extend at least three feet into the well casing. Also, the cover should extend out far enough from the hole on all sides to assure that the hole will remain covered if the cap is shifted to the side.

"The possible consequences of having open holes on your property outweighs the small amount of time it takes to fill them up. You can't justify having them out there," he says.

Open hole sites may be reported to Obbie Goolsby, High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405 or by calling (806) 762-0181.

Open Holes Outside the District

The Texas Water Commission's Ground Water Conservation Section inventories unused wells around the state and is responsible for pursuing the necessary action for proper well capping. Reports of open holes outside a water district boundary should be directed to Geologist Brad Cross, Ground Water Conservation Section, Texas Water Commission, P.0. Box 13087, Capitol Station, Austin, Texas 78711-3087. The telephone number is (512) 463-8280.

Tech research targets problem areas

Fertility, water management key to consistent cotton yields

MANAGER'S NOTE: The following article was written from comments made by Dr. Dan Krieg, Texas Tech University crop physiology professor, during the Brownfield research plot site tour — **A. Wayne Wyatt.**

A cotton yield goal of 50 pounds of lint per one inch of water is the objective of current research conducted by Dr. Dan Krieg, Crop Physiology Professor in Texas Tech University's Department of Plant and Soil Sciences. Krieg's research is partially funded by the High Plains Underground Water Conservation District No. 1.

James P. Mitchell and Mack Hicks, President and Vice President of the Water District Board of Directors, along with several District staff members, visited the research plots at the Brownfield site in late July to observe Krieg's progress.

Fertilization

Krieg explained that improved fertility and water management will be necessary to produce consistent yields of 50 pounds of lint per inch of available water. Research thus far indicates that cotton needs about five pounds of nitrogen per acre for each one inch of water received as precipitation or through irrigation.

In sandier soils where nitrogen leaching occurs very rapidly, he recommends a small pre-plant application of nitrogen to help start plant growth and to keep the plant healthy. Then, from the beginning of the growing season until the end of July, an application of five pounds of nitrogen per acre for each one inch of water added through precipitation or irrigation is recommended.

Krieg applies the nitrogen through the sprinkler system when he irrigates and by side-dressing after rainfall as a part of the cultivator operation. He side-dresses the nitrogen in the center of the furrow between the rows of cotton to a depth of four to six inches. Krieg adds that nitrogen should not be applied in the soil after August 1, because of root pruning and the resultant delay before the plant can use the nitrogen. If nitrogen is needed late in the growing season, it needs to be foliar applied and should be sprayed into the lower part of the foliage.

Heat Units Affect Irrigation Timing

Krieg has observed that the cotton plant will begin to produce squares when it has received 500 heat units. The plant will continue producing squares for four to five weeks. The plant produces squares until it is stressed either through lack of available moisture and nutrients or it receives insect or weather related damage. Flowering begins when 950 to 1000 more heat units are accumulated. An additional 800 heat units are needed to mature the boll to the opening stage. A cotton crop requires a total of 2200 to 2300 heat units for full maturity.

Daily heat units are calculated by adding the daily high and low temperatures together, dividing the total by two and then subtracting 60. A larger number of heat units is accumulated each day during July and August than can be accumulated in September and October here in the High Plains. During July and August, when the maximum daily temperature averages about 95°F and the low temperatures during the nights average about 65°F, approximately 20 heat units are accumulated each day.

In contrast, during late September when the daily high temperatures average about 85°F and night temperatures average about 50°F, only about seven and a half heat units are accumulated each day. Assuming these averages, it would take eight days in late September to accumulate the same number of heat units that could be accumulated in three days in July or August.

If the plant becomes water stressed, growth and squaring stops. If water is then applied, the plant aborts the previously set squares and begins growing and setting new fruit. The fruiting locations at the bottom of the plant are lost. This is of critical importance with our short growing season because of the time needed for the newly formed squares to obtain the required number of heat units to grow to full sized bolls with full length staple, Krieg says.

Soil Moisture

Assuming that your soil root profile is wet to field capacity at planting, the cotton plant will use only a small amount of the stored water during the first 45 days of the growing season. Most of the soil water losses will be from plowing and evaporation from the soil surface. During May and June, the probability is that adequate precipitation will be received to replace the water used by the plants and lost through evaporation. However, if no precipitation occurs, a light irrigation may be needed to bring the soil moisture back up to field capacity prior to square stage, which begins 40 to 45 days after planting.

When the cotton begins to square, it will use about one-tenth of one inch of water per day, all coming from the top 18 inches of soil. Also, some water losses occur from plowing and surface soil evaporation. The sandy soil types hold only one to one and one-half inches of available water per foot of depth. At square stage, the effective root depth of the plant is 12 to 18 inches. Thus, only one and one-half to two and a quarter inches of moisture is available in the soil in the root zone area for the plant's use.

Plant Stress and Fruit Set

When the plant is using one-tenth of one inch of water per day, it takes about 22 days to use up the "available" water in the top two feet of sandy soil. The plant tries to adjust by extending its root system deeper. After the top two feet of soil are dried out, it cannot extract enough water to grow, develop the fruit previously set and put on more fruit. Wilting or rolling of the leaves begins to occur during the heat of the day. Each day the length of time wilt occurs will get longer, indicating greater stress.

The practice of withholding irrigation water to force the plant to root downward appears to be a very costly practice. This practice must be changed if yields are to be brought up to a profitable level. It appears that a good general irrigation guide is to provide a small irrigation of two or three inches just prior to first square if precipitation has not been adequate to wet the top 18 inches of soil to field capacity at this point in the growing season. Thereafter, an application of one to two inches of irrigation water every 10 to 12 days during the fruiting period is desirable. A cotton boll set after August 20th during a normal year will not receive enough heat units to grow to a fully mature boll. Therefore, there is little or no value in attempting to set more fruit after this time.

By late August, the plant should be fully loaded with fruit, and the root system should extend down four feet or more. A full irrigation should be made to fill the total root zone area to field capacity before the end of August. No additional water should be applied after that time, since the days are cooler, the fruit is maturing, and the plant requires less water. There should be ample water available in the soil to supply the plant's needs until the September rains come or at least to mature most of the bolls.

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Incumbents Gober, Conkwright, re-elected to Board

PRECINCT THREE DIRECTOR TAKES OATH — A.W. "Webb" Gober of Farwell receives the Director's oath of office from U.S. Magistrate J.Q. Warnick during swearing-in ceremonies held January 19th at the High Plains Underground Water Conservation District office. Accompanying Gober is his wife, Irene.

PRECINCT FOUR DIRECTOR REAFFIRMS DUTIES — James C. Conkwright of Hereford reaffirms his responsibilities as Precinct Four Director by taking the oath of office administered by U.S. Magistrate J.Q. Warnick. Accompanying Conkwright during the January 19th ceremony is his wife, Janice.

Voters in District Director's Precincts Three and Four filled County Committeemen positions and re-elected their incumbent Directors during the High Plains Underground Water Conservation District No. 1 election, Saturday, January 16, 1988.

Director's Precinct Three

A.W. "Webb" Gober of Farwell was re-elected to a four-year term as Precinct Three Director. He will represent those portions of Bailey, Castro and Parmer Counties within the Water District service area. Gober was first elected to the Board in 1973. He served as Secretary-Treasurer in 1974-75, Vice-President in 1976-77 and President in 1977-78. He was again elected Secretary-Treasurer of the Board in 1982 and has served in that capacity ever since.

Also, four new County Committeemen were elected and two incumbent Committeemen were re-elected to serve Precinct Three residents.

Nick Bamert of Muleshoe and Jarrol A. Layton of southern Bailey County are the newly-elected Bailey County Committeemen. They join W. Lewis Scoggin, Jay Herington, and Sam Harlan, all of Muleshoe, on the County Committee.

Robert Benton and Katy Wright, both of Dimmitt, were each elected to a four-year term as members of the Castro County Committee. Other Castro County Committeemen are Mack Steffey of Hart and Garnett Holland and Gerald Summers, both of Dimmitt.

Incumbents Jerry London of Friona and Billy Lynn Marshall of Bovina will each serve another four-year term on the Parmer County Committee. Wendol Christian of Farwell and John R. Cook and Robert Gallman, both of Friona, are the other Parmer County Committeemen.

Director's Precinct Four

James C. Conkwright of Hereford was re-elected to serve a four-year term as Precinct Four Director. He will represent those portions of Armstrong, Deaf Smith, Potter, and Randall Counties within the Water District boundaries. Conkwright was elected to the Board in 1979 and served the following year as Secretary-Treasurer.

Precinct Four voters also chose five new County Committeemen and three incumbents to represent them in their respective counties.

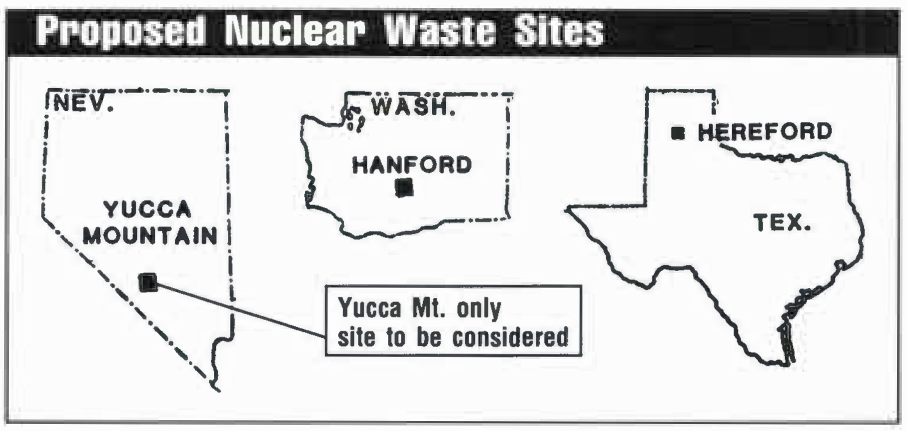
James Bible of Wayside is the newest Armstrong County Committeeman. Other members are Larry Stevens of Happy and Tom Ferris, Kent Scroggins and Joe Edd Burnett, all of Wayside. Burnett was re-elected to his Armstrong County position.

R.D. (Don) Hicks of Hereford was re-elected as Deaf Smith County Committeeman, and Rex Lee was elected to a four-year term. Hereford residents J.F. Martin, Troy Sublett, and Virgil P. Walker are also on the County Committee.

Marshall Cutright, Jr. and Charles Henderson, both of Bushland, were elected to four-year terms as Potter County Committeemen. Others include Frank Bezner of Bushland, Bob Lolley of Amarillo and L.C. Moore of Bushland.

Tim Payne of Happy is the new Randall County Committeeman. He joins Gary Wagner of Bushland, Charles Kuhnert of Umbarger, Lyndon Wagner of Amarillo and Tom Payne of Canyon on the committee. Tom Payne was re-elected to his Randall County position.

Congress halts DOE Deaf Smith nuclear waste site activity



The Department of Energy (DOE) has been ordered by Congress to stop characterization studies within 90 days at the proposed high level nuclear waste disposal sites in Deaf Smith County, Texas, and Hanford, Washington.

The DOE was authorized to conduct a characterization study at the Yucca Mountain, Nevada, site. If the study reveals the site to be unfavorable for high level nuclear waste storage, the DOE must then return to Congress for further project instructions.

During the past several years, the High Plains Underground Water Conservation District No. 1 has closely monitored DOE work plans and studies for the Deaf Smith County site. High Plains Water District staff advised the DOE and Congress of various technical problems associated with the possible use of the site which could endanger the Ogallala Aquifer.

Congress resolved the issue in its year-end action. Thank God.

— A. Wayne Wyatt.

COMPREHENSIVE IRRIGATION REPORT RELEASED — Dr. Wayne R. Jordan, left, and Dr. John M. Sweeten of the Texas Water Resources Institute, review their findings on High Plains irrigation and precipitation management. The report summarizes water management practices for the four major crops and examines the efficiency of various precipitation harvesting techniques. Copies of the report are available from the Texas Water Resources Institute at Texas A & M University.

Irrigation report released

A very comprehensive report on irrigation water management for the Texas High Plains has recently been published by the Texas Water Resources Institute at Texas A & M University.

The report is co-authored by Dr. John M. Sweeten and Dr. Wayne R. Jordan. Sweeten is an agricultural engineer who currently serves as coordinator for water quality and conservation programs for the Texas Agricultural Extension Service (TAEX). Jordan, the Water Resources Institute Director, also serves as coordinator of water research Programs for the Texas Agricultural Experimental Stations (TAES) and Texas A & M University.

The report reviews and summarizes major research findings on irrigation and precipitation water management on the Texas High Plains. The authors explain irrigation water use efficiency concepts and how moisture deficits and crop stress are dealt with in irrigation scheduling.

Research results on precipitation harvesting, principally using tillage practices, are given. Also, furrow and sprinkler irrigation systems are extensively reviewed. A summary of research results from water management concepts and practices for the four major crops (cotton, wheat, grain sorghum and corn) is also presented.

Copies of the report may be obtained by contacting the Texas Water Resources Institute, Texas A & M University, College Station, Texas 77843-2118. When ordering copies, please refer to Technical Report No. 139 — *Irrigation Water Management for the Texas High Plains: A Research Summary.*

A TAX BREAK — Dallas Internal Revenue Service Engineers visit with High Plains Underground Water Conservation District representatives after their annual review of District cost-in-water depletion data. The guidelines and decline data will be used by landowners to claim a water depletion allowance on their federal income tax returns. Pictured from left to right are Farm and Ranch Appraiser B.L. Jones, III, District Geologist Don McReynolds, District Assistant Manager Ken Carver, Engineer Stonewall Brinkman, Appraiser B.L. Jones, Jr. and Engineers Jack Page and Lorinda Busby.

Landowners assist District by closing abandoned wells

More than 1,200 abandoned, unused water wells have been closed or properly capped by High Plains Underground Water Conservation District landowners and operators since the open hole program was initiated in 1951. We would like to thank all the landowners and operators within the Water District for their cooperation in closing their dangerous, open well holes. Open hole sites located within the Water District's 15-county service area should be reported to the District office, 2930 Avenue Q, Lubbock, Texas 79405, or by calling (806) 762-0181.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
2930 Avenue Q, Lubbock, Texas 79405
Telephone (806) 762-0181

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DIRECTOR, INFORMATION/EDUCATION

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NOTICE: Information regarding times and places of the monthly County Committee meetings can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name.

Revised hydrologic atlases update ground water availability

When the time comes to drill a new irrigation well, many landowners wonder where the best site is and how far they must drill to reach the thickest portion of the water-bearing formation. Others may wonder which direction the water table slopes under their land.

Newly-revised county hydrologic atlases constructed and published by the High Plains Underground Water Conservation District No. 1 give landowners answers to these questions.

Each atlas packet contains a descriptive text and four county maps. Contour lines on the maps depict the altitude of the base of the Ogallala Formation, the water table altitude, the land surface altitude and the approximate saturated thickness of the Ogallala Formation.

Subtracting the altitude of the base of the formation from the altitude of the land surface gives a landowner the approximate depth to which a well must be drilled.

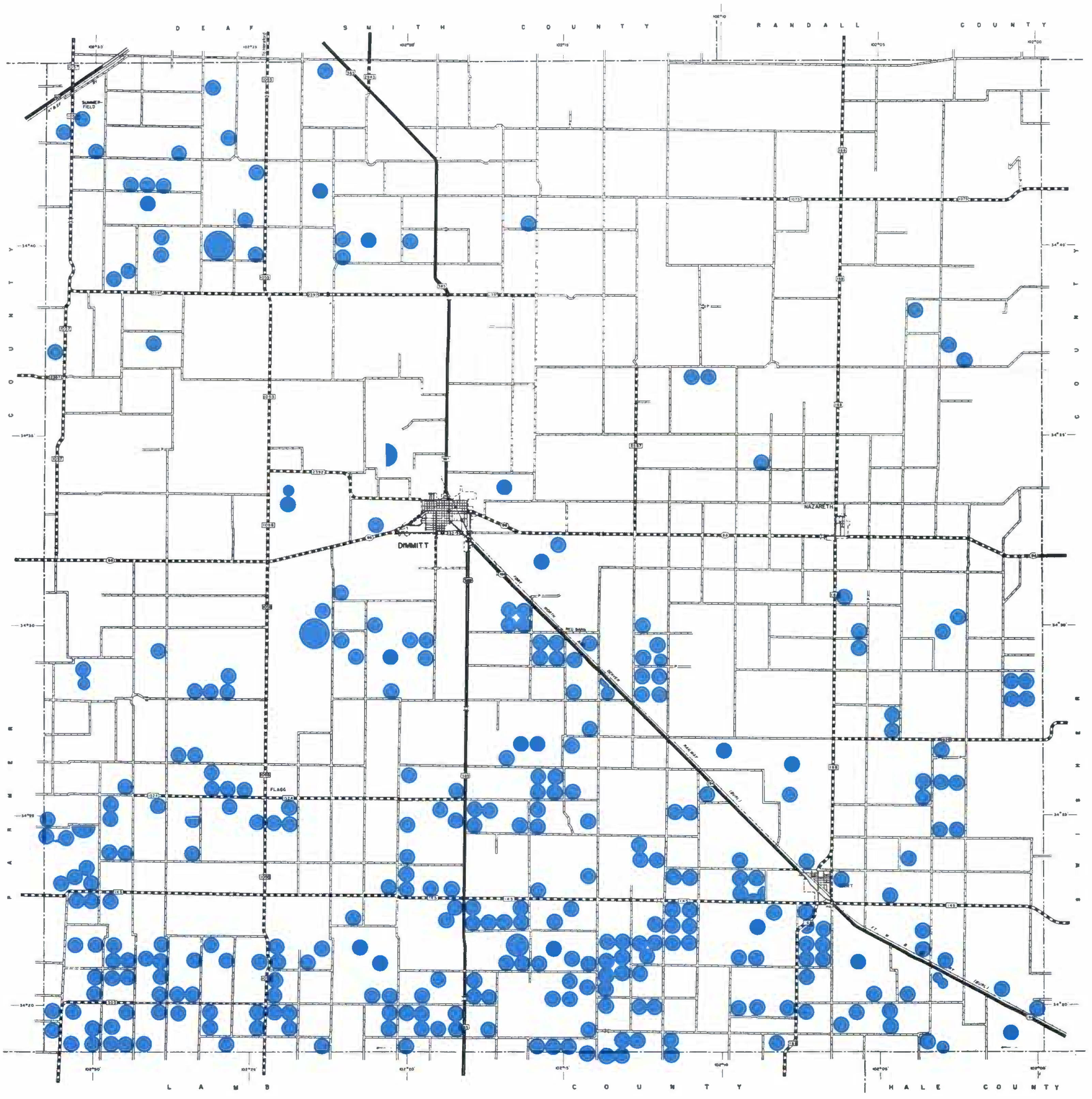
The land surface altitude minus the altitude of the water table gives the approximate depth at which water will be encountered. The difference in the elevation of the water table and the elevation of the base of the formation is the saturated thickness. Knowing the saturated thickness helps landowners estimate the expected yield from a well.

Revised hydrologic atlases now available to the public include the portions of Bailey, Castro, Cochran, Crosby, Floyd, Hale, Hockley, Lamb, Lubbock and Lynn counties located within the Water District service area.

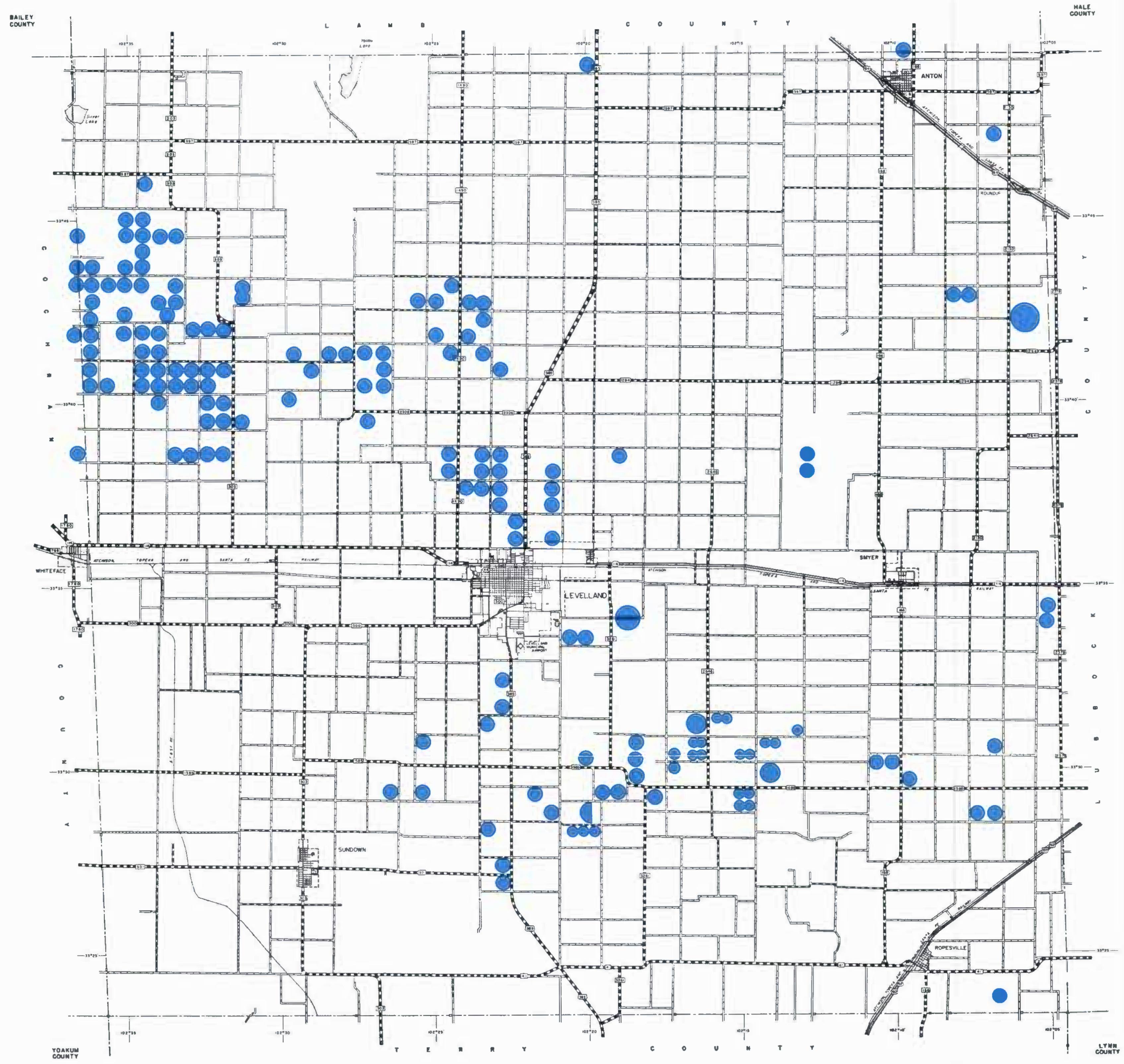
Atlases for Armstrong, Deaf Smith, Parmer, Potter and Randall counties are in the final production stages and will be ready in early 1988, according to Don McReynolds, Geohydrologic Division Director.

"The original hydrologic atlases were printed in 1981. We have now revised these atlases to include updated water table elevation and saturated thickness maps reflecting 1985 groundwater conditions. We feel this has enhanced the estimation of groundwater availability in these counties," McReynolds says.

Atlases may be obtained by visiting the High Plains Underground Water Conservation District No. 1 office, 2930 Avenue Q, Lubbock, Texas 79405 or calling (806) 762-0181.



CASTRO COUNTY CENTER PIVOTS MAPPED — Engineer Technicians Obbie Goolsby and Arnold Husky have continued to plot the locations of center pivot sprinklers in the High Plains Underground Water Conservation District No. 1 service area. In Castro County, 336 center pivot systems are in operation. These sprinklers, assuming an average cost of $30,000 each, represent a $10 million dollar investment by county farmers. More than 90 percent of the center pivot systems are equipped with drop lines, which have an average water application efficiency of 80 to 90 percent. Most of these systems were installed on previously furrow-irrigated land, where efficiency ratings were about 60 percent. Our congratulations to Castro County landowners for their involvement with this tremendous water conservation and energy saving management tool.



HOCKLEY COUNTY CENTER PIVOT INVENTORY MADE — 163 center pivot sprinkler systems are currently in operation in the portions of Hockley County served by the High Plains Underground Water Conservation District No. 1. These sprinkler systems, at an average $30,000 cost, represent a $4 million dollar investment by Hockley County farmers. Water District Engineer Technicians Obbie Goolsby and Arnold Husky plotted the location of the center pivots with the help of county aerial photographs. Center pivot maps for the remaining counties in the High Plains Underground Water Conservation District service area are being plotted by Goolsby and Husky and will be published in future issues of *The Cross Section.* We congratulate Hockley County landowners for their use of this water conservation tool.

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CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

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Published monthly by High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405—Ph. 762-0181

Volume 34—No. 3 Publication Number USPS 564-920, Second Class Postage paid at Lubbock, Texas *March 1988*

Annual soil moisture survey reveals dry field conditions

Low soil moisture conditions across the southern High Plains may have a major effect on the outcome of the 1988 crop yields. Soil moisture data collected by the High Plains Underground Water Conservation District No. 1 and the Soil Conservation Service (SCS) indicates the plant root zone is drier than it has been in the past several years.

"Over the majority of the District, soils will need four to six inches of water to bring the top five feet of soil up to field capacity for the upcoming growing season," says Mike Risinger, SCS Soil Scientist. "Much of the southeastern and northwestern parts of the District are even drier and will require six to eight inches of water to refill the soil. A few areas will only need two to four inches of water to bring the soil to field capacity," he says.

Moisture levels in the top foot are generally fair to good and should provide excellent conditions for land preparation. While there may be sufficient moisture for plowing, Risinger is concerned that producers will be misled by these moist plow layer conditions. He encourages producers to check subsoil moisture with an auger or sharpshooter to determine for themselves the moisture conditions below the 12 to 18 inch levels.

Checking soil moisture conditions by digging holes and examining the soil from the hole is called the "feel and appearance" method. The Water District has published a Water Management Note outlining this technique, and the free booklet is available upon request by interested producers.

He adds that research and past producer experience have proven that pre-plant irrigations to ensure a full soil profile greatly improve a producer's chances for high-yielding crops.

High pre-plant soil moisture levels help prevent early plant moisture stress and reduces reliance upon irrigation between rains. Also, good pre-plant soil moisture allows irrigators to make more uniform and more efficient water applications.

"With poor subsoil moisture conditions. irrigators are forced to apply smaller amounts of water rapidly across the field to keep plants from burning up. Unfortunately, smaller applications are less efficient since the percentage of moisture lost to evaporation is much greater. With good subsoil moisture, the producer can make larger, more uniform applications at a slower rate and get more water into the soil with a lower percentage lost to evaporation," Risinger says.

Moisture Levels Mapped

Soil moisture conditions were measured at approximately 220 neutron tube sites over the District's 15-county service area. Soil moisture monitoring sites are selected based on the soil type and the variations in the saturated thickness of the Ogallala Aquifer.

The map on page two reveals the moisture deficit which currently exists. The deficit is an indication of the amount of moisture that needs to be added to the five-foot crop root zone to bring the soil profile to field capacity prior to planting. The map on page three illustrates the amount of plant-available water currently stored in the top five feet of the soil profile throughout the District.

Hard Pans

Soil compaction, or hard pan, increases runoff and erosion while greatly reducing the soil's water infiltration rate.

See FIELD Page Two

Atlas Revision Completed

How deep is it to water? How thick is the water-bearing formation? How deep should a new well be drilled to totally penetrate the water-bearing formation on your land tract? Where on your farm is the formation the thickest? Which way does the water table slope under your land tract? How does the depth to the base of the formation and saturation vary in your county?

All of the above questions can be answered from individual county hydrologic atlases constructed and published by the High Plains Underground Water Conservation District No. 1.

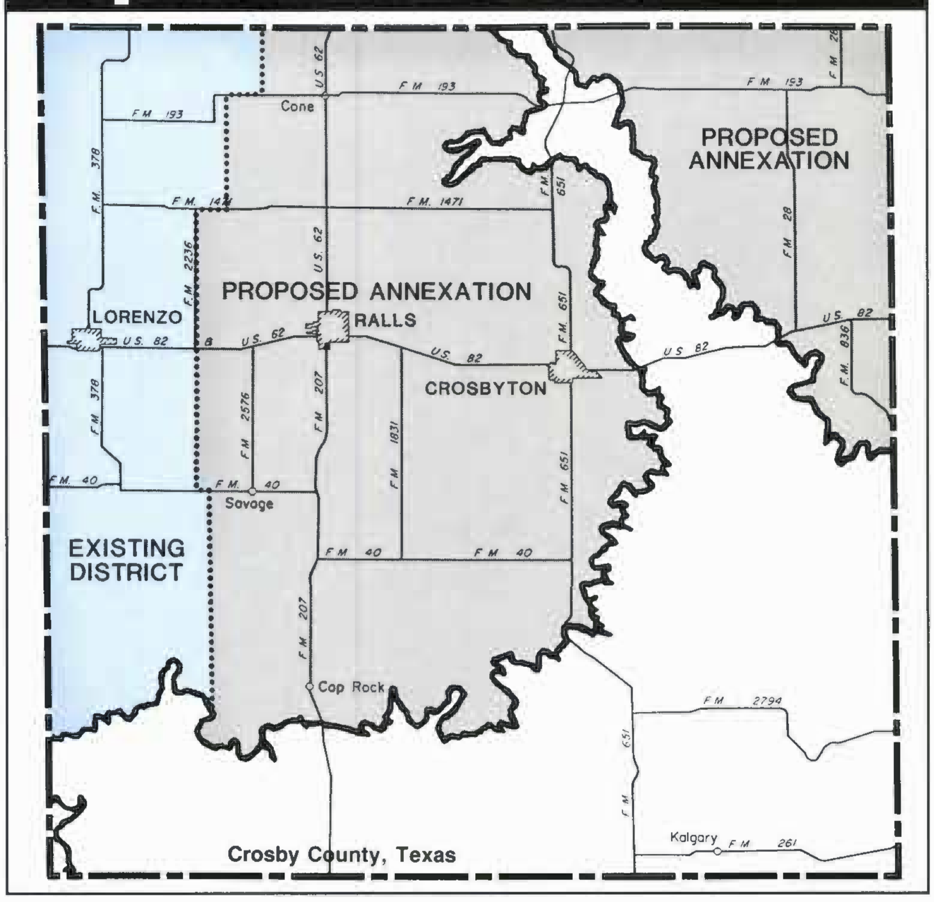
Revised hydrologic atlases are now available for the portions of Armstrong, Deaf Smith, Parmer, Potter and Randall counties located within the Water District service area. This addition provides full hydrologic atlas coverage for each of the 15 counties in the Water District service area.

Each atlas packet contains a

See REVISED Page Three

April Crosby County annexation election set

Proposed annexation area



Registered voters living within the High Plains Underground Water Conservation District No. 1 boundaries and the eastern part of Crosby County will have an opportunity to go to the polls, Saturday, April 2, 1988, to ratify the annexation into the Water District of the portion of Crosby County Commissioners Precincts One, Two and Four located above the Caprock.

Separate elections for the proposed new area and for the 15-county area presently served by the Water District are required by the Texas Water Code. A majority vote in favor of the annexation in both elections is required before the proposed area can become a permanent part of the Water District.

In addition, Crosby County residents in the proposed annexation area must approve the levying of an ad valorem tax to pay for their pro rata share of the operation and maintenance of the Water District.

They will be asked to approve a maximum tax rate of $0.05 per $100 assessed valuation, even though the current Water District tax rate is $0.007 per $100 valuation, or $7 per

See WATER Page Four

Field conditions vary across Water District service area

Continued From Page One

Hard pans were found at more than half of the 220 soil moisture monitoring sites throughout the District. "Before the December rains, producers who began chiseling or deep breaking their soil were turning up large clods. These large clods indicate that hard pans are present." Risinger says.

The compaction may also be detected by digging or probing the soil. The force needed to push a steel rod slowly into the soil will be constant unless a compacted layer is found. When the rod comes in contact with a compacted layer, it will become difficult to push the rod deeper into the soil.

Risinger suggests producers consider using deep tillage operations, such as chiseling or deep breaking, to remove the compaction layer. This will help ensure that irrigation water and/or rainfall will be able to enter the ground.

Rainfall Conditions

"In the 1987 season, most of the District received above average rainfall, and it fell generally at the right time for good crop development. A warm fall and late freeze also assisted producers in achieving a record crop. However, during the fall, these crops also extracted most of the water in the soil root zone profile to produce these yields," Risinger says.

After the freeze, only .1 to .6 inches of moisture was received until December snow and drizzle blanketed the area. Risinger notes that this precipitation varied across the District from a half inch to over three inches rainfall equivalent.

Tillage Influences Moisture Conditions

"Approximately half of the soil moisture sites had been monitored before the December snows. We went out, rechecked 39 of them, and found from a half inch to one and a half inch increase in stored soil moisture. The producer's tillage practice influenced the amount of snow stored as soil moisture. For example, no-till fields with stubble kept the snow from blowing off and allowed it to melt into the soil. Stored soil water amounts were increased from one-half to one inch through the no-till practices," Risinger says.

He added that land which has been deep broken or deep chiseled since the December snows lost much of the moisture gained from the precipitation.

Rainfall Probabilities

Monthly precipitation averages for March and April over the 1975-1985 period are .95 and 1.29 at Amarillo and .73 and 1.24 at Lubbock. Long-term rainfall probability charts indicate less than a 50 percent chance for rainfall of over an inch in either month. Based on these 10-year averages and rainfall probabilities, most producers will need to pre-irrigate wherever possible to refill the soil profile.

Soil Fertility Sampling

The top five feet of soil provides water, food and support for a growing crop. The plant obtains its water and food supply through an extensive root system which can extend down as much as five feet. The plant nutrients are extracted from the soil in water solution by the plant roots through capillary action.

If the plant's water is limited, the plant nutrients will also be limited despite the amount of nutrients stored in the soil.

If an abundant water supply is available and nutrients are limited, the plant will extract more water than would otherwise be necessary to supply its food needs.

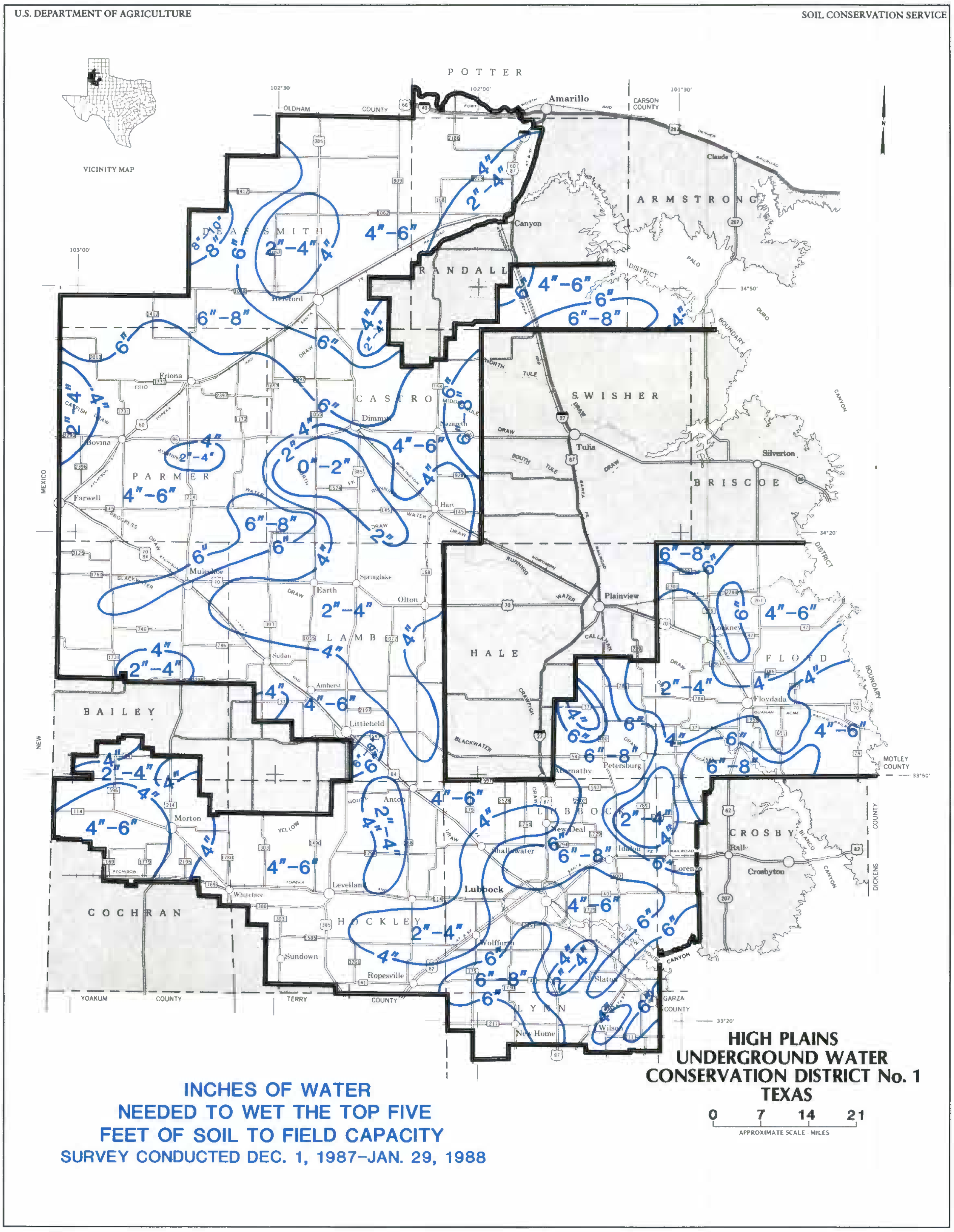
Soil samples from the top six inches, the second six inches and the second foot of the soil profile were collected from the farms which have soil moisture monitoring sites.

The samples were analyzed by the Texas Agricultural Extension Service Soil Fertility Laboratory in Lubbock, and the results show that 89 percent of the soil samples are low in nitrogen and 35 percent are low in phosphorus.

Risinger notes current regional soil fertility conditions are similar to last year's conditions and that most producers need to apply fertilizer to supply this year's crop requirements.

"My recommendation is to apply a small pre-plant application of nitrogen to get the crop off to a good healthy start, wait for extra rainfall or irrigation, and then sidedress

See AREA Next Page



Area producers urged to check their soil moisture levels

Continued From Page Two

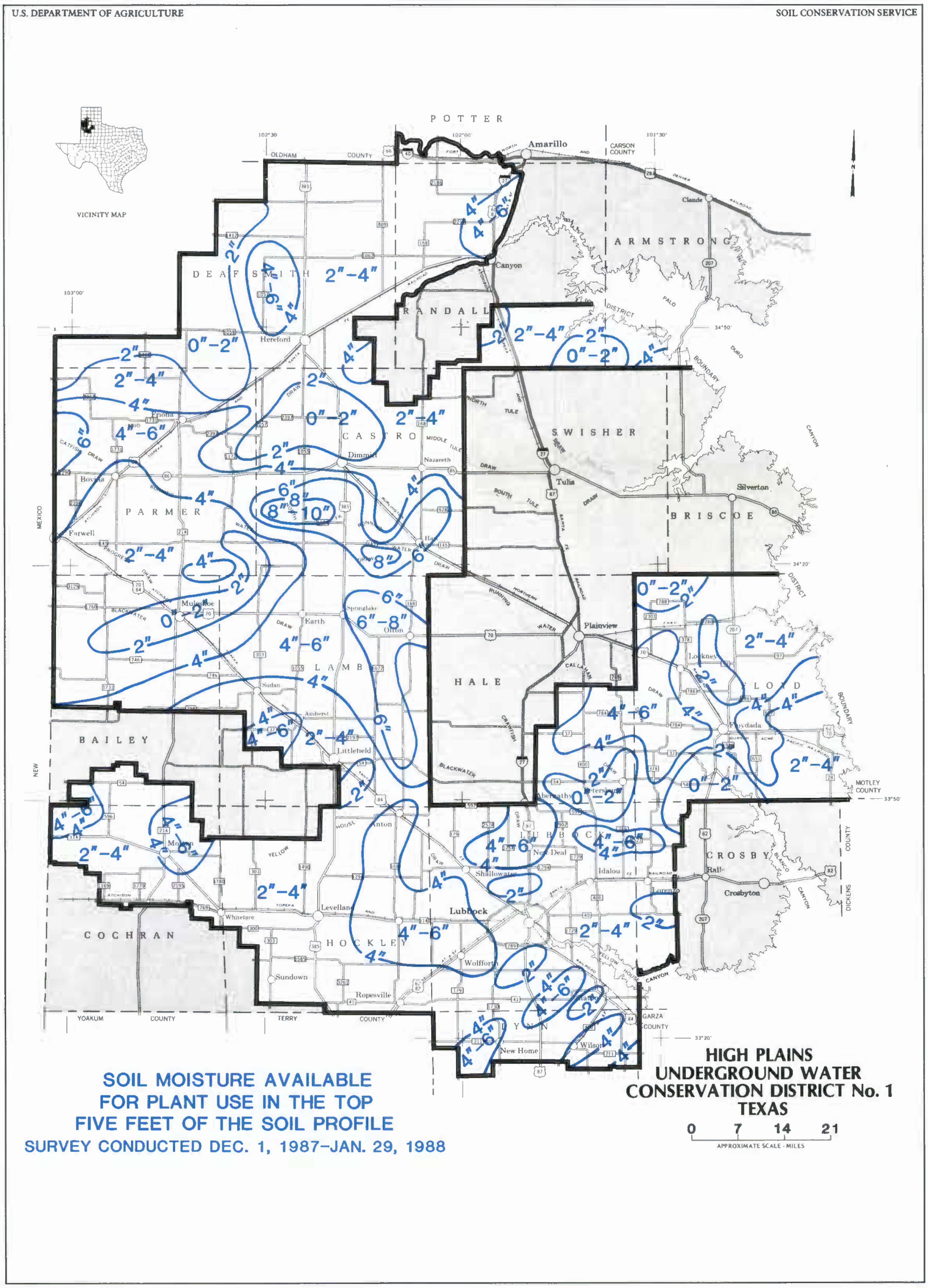
additional nitrogen as needed. The phosphorus needs to be placed below the cultivation level where the maximum root development occurs. Phosphorus does not move more than a tenth of an inch per year. Therefore, it will stay in place for use by the crop," Risinger says.

Risinger reminds producers that maximum water use efficiency is obtained through a proper balance of fertility and soil water conditions. He suggests that producers collect their own soil samples and have them analyzed.

Producers should also ask the laboratory to make fertilizer recommendations based on the soil sample analysis, the crop to be planted and the intended yield goal. By applying fertilizer based on the laboratory's recommendations, the producer should be assured that the crop will have an ample food supply to produce the desired yields.

Research indicates that cotton usually requires about four to five pounds of nitrogen and one to two pounds of phosphorus per inch of water received to obtain maximum water use efficiency. Grain sorghum requires 10 to 12 pounds of nitrogen and two to three pounds of phosphorus per inch of water it receives.

Research also indicates that split sidedress nitrogen fertilizer applications are more efficient than one-time applications. Split nitrogen applications applied along with irrigation or rainfall ensures that nutrients will be available when water is present and losses of nitrate nitrogen due to leaching will be reduced.



Revised Atlases Available

Continued From Page One

descriptive text and four county maps with contour lines depicting the altitude of the base of the Ogallala Formation, the water table altitude, the land surface altitude and the approximate saturated thickness of the Ogallala Formation.

Subtracting the altitude of the base of the formation from the altitude of the land surface gives a landowner the approximate depth to which a well must be drilled.

The land surface altitude minus the altitude of the water table will give the approximate depth at which water will be encountered. The difference between the elevation of the water table and the elevation of the base of the formation is the saturated thickness. Knowing the saturated thickness helps landowners estimate the expected yield from a well.

"These atlases will help landowners and residents of each county better understand their underground water resources. With this information, people can confirm their available water resources and select the best sites for future irrigation wells," says Don McReynolds, Geohydrologic Division Director.

Individual county atlases may be obtained by contacting the High Plains Underground Water Conservation District No. 1 office, 2930 Avenue Q, Lubbock, Texas 79405 or calling (806) 762-0181.

District offers New publications

How to Xeriscape and *Landscape Water Conservation ... Xeriscape* show how to conserve water in lawns and gardens through the use of mulches, low turf areas, efficient watering methods and low water demand native plants. Both publications are now available at the Water District. Write Carmon McCain or Beth Snell at 2930 Avenue Q, Lubbock, Texas 79405 or call (806) 762-0181.

Water District, Crosby County to vote on annexation

Continued From Page One

$100,000 valuation. This will provide the same maximum tax rate previously approved by residents of the current area of the Water District. The annual tax rate is set by the Water District's Board of Directors and levied uniformly throughout the District.

The Water District Board of Directors called the elections after receiving petitions requesting annexation and hearing testimony from Crosby County landowners in January and February.

Absentee Voting

Absentee ballots may be cast from March 14th through March 29th during normal business hours. Absentee polling places are as follows:

Armstrong County: Tulia Wheat Growers, Wayside, Texas; Harold Edwards, Clerk.

Bailey County: High Plains Water District Office, 224 W. 2nd Street, Muleshoe, Texas; Doris Wedel, Clerk.

Castro County: High Plains Water District Office, 200 Jones, Dimmitt, Texas; Dolores Baldridge, Clerk.

Cochran County: High Plains Water District Office, 108 N. Main Avenue, Morton, Texas; Mary Helen Butler, Clerk.

Crosby County (within the existing Water District boundaries): The Lorenzo Examiner, 513 Harrison Street, Lorenzo, Texas; Charlotte Gibbs, Clerk.

Deaf Smith County: High Plains Water District Office, 110 E. 3rd Street, Hereford, Texas; Gloria Escamilla, Clerk.

Floyd County: High Plains Water District Office, 108 W. Missouri, Floydada, Texas; Verna Lynne Stewart, Clerk.

Hale County: High Plains Water District Office, 1617 Main, Petersburg, Texas; J.B. Mayo, Clerk.

Hockley County: High Plains Water District Office, 609 Austin, Levelland, Texas; Jim Montgomery, Clerk.

Lamb County: High Plains Water District Office, 103 E. 4th, Littlefield, Texas; George Harlan, Clerk.

Lubbock County: High Plains Water District Office, 2930 Avenue Q, Lubbock, Texas; Becca Williams, Clerk.

Lynn County: City Hall Building, Ken Smith Agency, New Home, Texas; Nancy Smith, Clerk.

Parmer County: High Plains Water District Office, 323 North Street, Bovina, Texas; Pat Kunselman, Clerk.

Potter County: Bushland Grain Co-op, Bushland, Texas; Bruce Blake, Clerk.

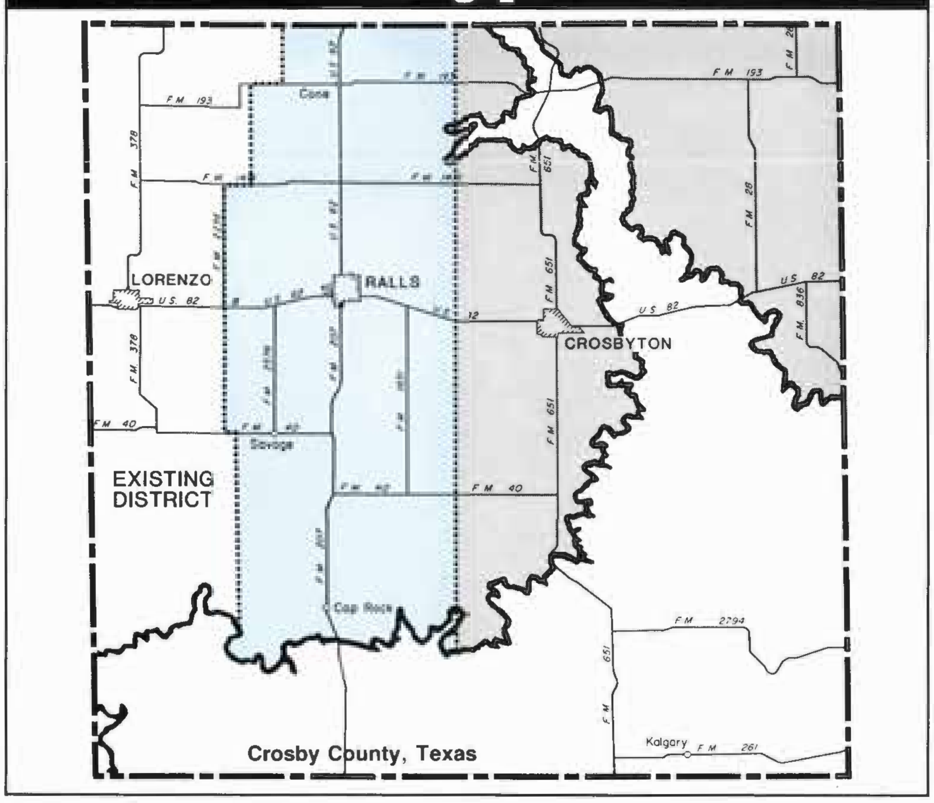
Randall County: Richardson Farm Supply, Hereford Highway, Canyon, Texas; Robert Tucek, Clerk.

Each municipality located within the proposed Crosby County annexation area must be a separate voting precinct and their election returns canvassed separately.

Absentee voting for both the **City of Crosbyton** and **the rural area** from the Crosby/Dickens County line to a line four miles west of F.M. Road 651, not including the territory below the Caprock, will be held at the Crosby County Fuel Association, Highway 82 West, Crosbyton, Texas; Monty Bevel, Clerk.

Absentee voting for the **City of Ralls** and **the rural area** from a line four miles west of F.M. Road 651 to the present boundary of the High Plains Water District, not including the territory below the Caprock, will be held at the Crosby County Fuel Association, Floydada Highway, Ralls, Texas; Bob Wideman, Clerk.

Annexation voting precincts



Polling Places

The polls will be open from 7 a.m. to 7 p.m. on Saturday, April 2, 1988. The polling places and election judges are as follows:

Armstrong County: Wayside Community Center, Wayside, Texas; Estelle Rogers, Presiding Judge.

Bailey County: Bailey County Courthouse, Muleshoe, Texas; Margrethe Taylor, Presiding Judge.

Castro County: City Hall, Alderman's Room, Dimmitt, Texas; Oleta Gollehon, Presiding Judge.

Cochran County: County Activities Building, Morton, Texas; Mary Lee Carter, Presiding Judge.

Crosby County (within the existing Water District boundaries): Lorenzo Library, 409 Van Buren, Lorenzo, Texas; Pat Yoakum, Presiding Judge.

Deaf Smith County: County Courthouse, Second Floor, Hereford Texas; Virginia Holmes, Presiding Judge.

Floyd County: County Courthouse, Floydada, Texas; Lorene Newberry, Presiding Judge.

Hale County: Community Center, Petersburg, Texas; Mildred Martin, Presiding Judge.

Hockley County: County Courthouse, Levelland, Texas; Suzanne Leggitt, Presiding Judge.

Lamb County: County Courthouse, Littlefield, Texas; Robbie Pass, Presiding Judge.

Lubbock County: County Courthouse, (East hallway entrance) 904 Broadway, Lubbock, Texas; Tom C. Ingram, Presiding Judge.

Lynn County: Wilson Co-op Gin, Intersection of Tahoka Highway and Highway 211, Wilson, Texas; Janet Davis, Presiding Judge.

Parmer County: County Courthouse, Farwell, Texas; Corolla Smith, Presiding Judge.

Potter County: School House, Bushland, Texas; Billie Walton, Presiding Judge.

Randall County: Consumers' Fuel Association, (elevator) West First Avenue, Hereford Highway, Canyon, Texas; Trent Johnson, Presiding Judge.

City of Crosbyton and **the rural area** from the Crosby/Dickens County line to a line four miles west of F.M. Road 651 not including the territory below the Caprock: Pioneer Memorial Building, Crosbyton, Texas; Brice Allen, Presiding Judge.

City of Ralls and **the rural area** from a line four miles west of F.M. Road 651 to the boundary of the present High Plains Water District not including the territory below the Caprock: Ralls Elementary School, Ralls, Texas; Steve Verett, Presiding Judge.

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LUBBOCK, TEXAS 79405

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Aquifer continues stabilization

District observation well levels indicate net rise

Ground water levels continue to rise in the Southern High Plains of Texas.

The average change in water levels in the 5.2 million acre service area of the High Plains Underground Water Conservation District during 1987 was a rise of nine-tenths of a foot. Depth to water measurements were made in a network of approximately 960 observation wells during January and February 1988 by District personnel. These measurements compared to measurements made in the same network of wells during the same months in 1987 revealed the rise in water levels.

This procedure is repeated each year to determine the annual change in the quantity of water in storage in the Ogallala Aquifer. The nine-tenths of a foot rise indicates an increase of 702,000 acre-feet of water in storage in the aquifer during the past year in the Water District service area.

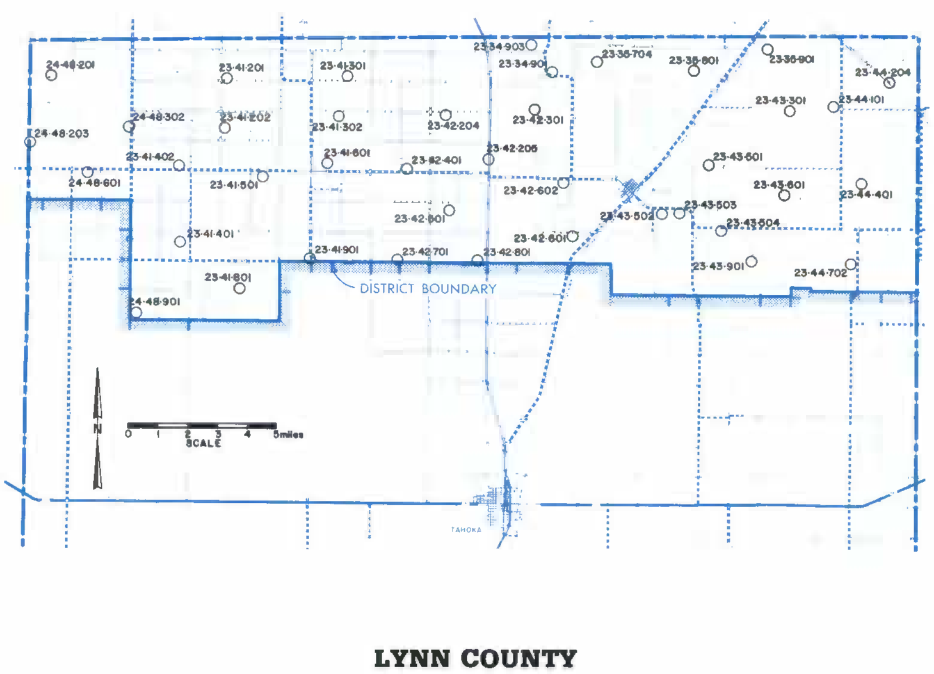
During the past three years, the changes in aquifer levels have reversed from a long term, continuous decline to a leveling, or zero change in 1985, to a rise of about one-half of a foot in 1986, and in 1987, to a rise of nine-tenths of a foot.

The ten-year change in water levels of 4.80 feet from 1978 to 1988 indicates an average decline of 0.48 of a foot per year. The past five-year average change of +0.07 of a foot indicates a significant reduction in the rate of decline in the aquifer.

Included in this issue of *The Cross Section* is a table illustrating the average depth to water changes on a county by county basis for the past 10 years, five years and this past year. Also included are county maps illustrating the location of the water level observation wells measured in each county with accompanying tables giving depth to water measurements for each observation well in the network.

Average Changes in Depths to Water in Observation Wells — 1988

	Number of Observation Wells Maintained	Average Annual Change-1978 to 1988	Average Annual Change-1983 to 1988	Average Annual Change-1987 to 1988
Armstrong	9	−0.26	+0.27	+0.47
Bailey	78	−0.68	−0.14	+0.30
Castro	89	−1.52	−0.93	−0.03
Cochran	52	+0.27	+0.53	+0.79
Crosby	24	−0.03	+1.42	+2.47
Deaf Smith	86	−0.74	−0.34	+0.38
Floyd	98	−0.69	−0 01	+0.89
Hale	27	−0.33	+0.80	+1.88
Hockley	88	+0.30	+0.60	+1.24
Lamb	99	−1.60	−0.78	+0.23
Lubbock	117	+0.33	+0.87	+1.83
Lynn	40	+1.10	+2.09	+4.02
Parmer	97	−1.51	−0.84	+0.36
Potter	6	−0.48	−0.11	+0.03
Randall	50	+0.11	+0.15	+0.37
District	**960**	**−0.48**	**+0.07**	**+0.90**



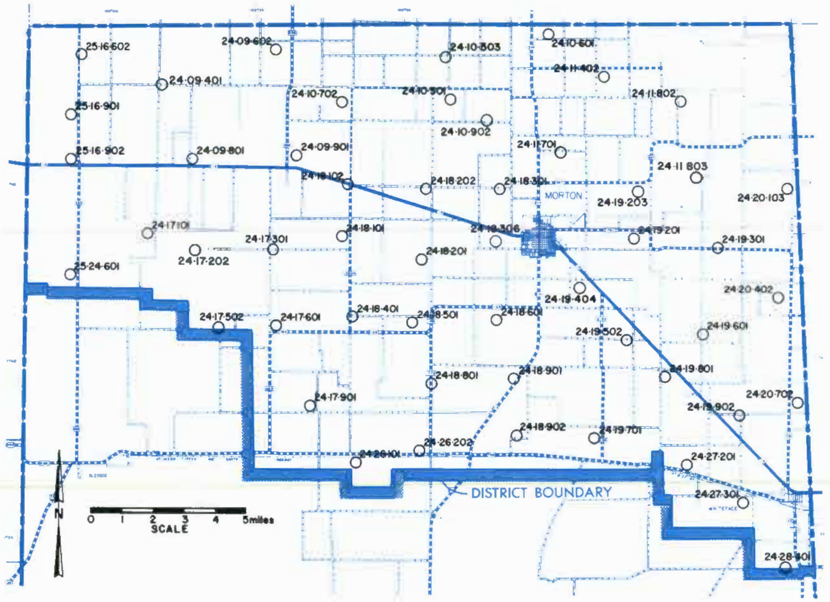
LYNN COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
23-34-901	144.26	149.12	140.88	136.69	+ 7.57	+ 12.43	+ 4.19
23-34-903	152.42	156.23	151.85	149.52	+ 2.90	+ 6.71	+ 2.33
23-35-704	133.16	139.49	133.43	130.76	+ 2.40	+ 8.73	+ 2.67
23-35-801	87.67	87.89	87.09	85.39	+ 2.28	+ 2.50	+ 1.70
23-35-901	90.22	91.22	90.67	87.81	+ 2.41	+ 3.41	+ 2.86
23-41-201	105.78	105.75	98.02	93.49	+ 12.29	+ 12.26	+ 4.53
23-41-202	N/A	N/A	108.96	105.85	N/A	N/A	+ 3.11

LYNN COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
23-41-301	N/A	133.67	130.84	127.64	N/A	+ 6.03	+ 3.20
23-41-302	N/A	N/A	108.38	106.72	N/A	N/A	+ 1.66
23-41-401	92.65	93.39	87.93	82.67	+ 9.98	+ 10.72	+ 5.26
23-41-402	N/A	105.20	96.50	93.40	N/A	+ 11.80	+ 3.10
23-41-501	70.73	69.60	62.59	59.45	+ 11.28	+ 10.15	+ 3.14
23-41-601	N/A	104.62	102.34	101.47	N/A	+ 3.15	+ 0.87
23-41-801	N/A	64.88	60.87	60.66	N/A	+ 4.22	+ 0.21
23-41-901	N/A	123.30	117.59	113.49	N/A	+ 9.81	+ 4.10
23-42-204	N/A	119.85	117.04	115.30	N/A	+ 4.55	+ 1.74
23-42-205	N/A	N/A	N/A	91.29	N/A	N/A	N/A
23-42-301	109.18	110.78	105.33	102.69	+ 6.49	+ 8.09	+ 2.64
23-42-401	113.98	111.22	107.05	103.92	+ 10.06	+ 7.30	+ 3.13
23-42-501	100.66	100.86	90.63	85.30	+ 15.36	+ 15.56	+ 5.33
23-42-601	41.40	39.40	35.01	30.23	+ 11.17	+ 9.17	+ 4.78
23-42-602	87.75	90.33	86.02	81.28	+ 6.47	+ 9.05	+ 4.74
23-42-701	98.12	88.28	83.38	79.08	+ 19.04	+ 9.20	+ 4.30
23-42-801	64.01	62.59	58.12	49.02	+ 14.99	+ 13.57	+ 9.10
23-43-301	28.66	21.05	11.75	12.46	+ 16.20	+ 8.59	− 0.71
23-43-501	71.85	71.48	66.60	61.71	+ 10.14	+ 9.77	+ 4.89
23-43-502	77.66	77.75	73.97	70.38	+ 7.28	+ 7.37	+ 3.59
23-43-503	84.81	84.78	81.25	78.11	+ 6.70	+ 6.67	+ 3.14
23-43-504	75.59	74.00	69.64	66.25	+ 9.34	+ 7.75	+ 3.39
23-43-601	N/A	37.45	29.03	27.96	N/A	+ 9.49	+ 1.07
23-43-901	57.53	52.61	48.15	45.47	+ 12.06	+ 7.14	+ 2.68
23-44-101	61.25	58.92	43.45	28.24	+ 33.01	+ 30.68	+ 15.21
23-44-204	N/A	152.17	129.37	113.97	N/A	+ 38.20	+ 15.40
23-44-401	41.27	38.51	34.35	30.03	+ 11.24	+ 8.48	+ 4.32
23-44-702	26.16	24.14	19.71	17.71	+ 8.45	+ 6.43	+ 2.00
24-48-201	99.74	100.06	93.58	90.70	+ 9.04	+ 9.36	+ 2.88
24-48-203	N/A	92.51	84.23	80.40	N/A	+ 12.11	+ 3.83
24-48-302	109.05	107.05	92.79	87.70	+ 21.35	+ 19.35	+ 5.09
24-48-601	88.15	87.75	78.29	71.40	+ 16.75	+ 16.35	+ 6.89
24-48-901	N/A	N/A	113.06	108.59	N/A	N/A	+ 4.47

NOTE: N/A Denotes data not available



COCHRAN COUNTY

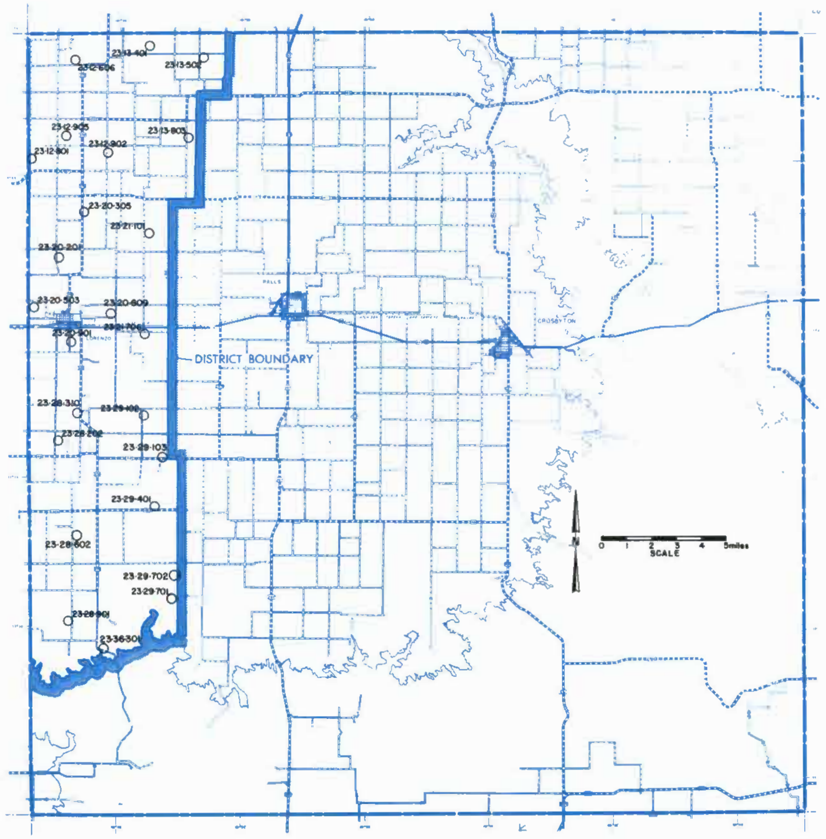
Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
24-09-401	92.58	95.48	96.72	96.45	– 3.87	– 0.97	+ 0.27
24-09-602	127.11	129.33	127.83	127.28	– 0.17	+ 2.05	+ 0.55
24-09-801	123.30	123.79	123.85	122.50	+ 0.80	+ 1.29	+ 1.35
24-09-901	107.13	108.58	106.12	105.20	+ 1.93	+ 3.38	+ 0.92
24-10-501	94.61	94.19	92.42	91.75	+ 2.86	+ 2.44	+ 0.67
24-10-503	N/A	105.53	103.67	103.21	N/A	+ 2.32	+ 0.46
24-10-601	92.70	92.48	90.76	89.97	+ 2.73	+ 2.51	+ 0.79
24-10-702	111.46	111.70	111.76	112.35	– 0.89	– 0.65	– 0.59
24-10-902	N/A	N/A	112.93	111.44	N/A	N/A	+ 1.49
24-11-402	N/A	126.45	124.92	124.37	N/A	+ 2.08	+ 0.55
24-11-701	126.38	126.39	125.04	124.70	+ 1.68	+ 1.69	+ 0.34
24-11-802	116.18	114.36	112.64	111.74	+ 4.44	+ 2.62	+ 0.90
24-11-803	N/A	130.51	128.69	128.01	N/A	+ 2.50	+ 0.68
24-17-101	N/A	134.93	132.17	132.22	N/A	+ 2.71	– 0.05
24-17-202	N/A	141.66	138.10	136.62	N/A	+ 5.04	+ 1.48
24-17-301	147.83	146.63	142.85	141.16	+ 6.67	+ 5.47	+ 1.69
24-17-502	158.89	155.53	151.52	152.58	+ 6.31	+ 2.95	– 1.06
24-17-601	152.05	151.20	149.14	147.77	+ 4.28	+ 3.43	+ 1.37
24-17-901	168.77	165.91	163.01	N/A	N/A	N/A	N/A
24-18-101	147.54	146.21	144.97	143.96	+ 3.58	+ 2.25	+ 1.01
24-18-102	155.17	153.79	151.03	150.25	+ 4.92	+ 3.54	+ 0.78
24-18-201	178.91	178.61	175.34	175.65	+ 3.26	+ 2.96	– 0.31
24-18-202	138.07	137.42	136.12	136.25	+ 1.82	+ 1.17	– 0.13
24-18-301	134.73	136.46	135.22	134.61	+ 0.12	+ 1.85	+ 0.61
24-18-306	N/A	N/A	166.06	165.10	N/A	N/A	+ 0.96
24-18-401	154.70	154.16	151.19	149.70	+ 5.00	+ 4.46	+ 1.49
24-18-501	198.61	198.49	196.28	194.95	+ 3.66	+ 3.54	+ 1.33
24-18-601	178.16	176.66	173.28	171.78	+ 6.38	+ 4.88	+ 1.50
24-18-801	194.27	194.19	189.62	187.97	+ 6.30	+ 6.22	+ 1.65
24-18-901	114.62	114.02	111.12	110.85	+ 3.77	+ 3.17	+ 0.27
24-18-902	N/A	139.62	138.95	137.37	N/A	+ 2.25	+ 1.58
24-19-201	149.13	150.09	149.49	148.03	+ 1.10	+ 2.06	+ 1.46
24-19-203	N/A	N/A	126.00	125.23	N/A	N/A	+ 0.77
24-19-301	169.25	170.87	164.18	161.67	+ 7.58	+ 9.20	+ 2.51
24-19-404	N/A	N/A	144.63	143.58	N/A	N/A	+ 1.05
24-19-502	176.14	174.41	170.87	169.99	+ 6.15	+ 4.42	+ 0.88
24-19-601	157.78	160.15	159.09	158.99	– 1.21	+ 1.16	+ 0.10
24-19-701	154.23	151.00	149.05	N/A	N/A	N/A	N/A
24-19-801	171.25	167.60	166.05	164.99	+ 6.26	+ 2.61	+ 1.06
24-19-902	129.82	130.24	130.04	129.65	+ 0.17	+ 0.59	+ 0.39
24-20-103	147.48	145.34	143.40	142.12	+ 5.36	+ 3.22	+ 1.28
24-20-402	150.89	156.80	158.51	157.76	– 6.87	– 0.96	+ 0.75
24-20-702	152.95	154.44	155.05	154.26	– 1.31	+ 0.18	+ 0.79
24-26-101	N/A	150.59	149.67	149.96	N/A	+ 0.63	– 0.29
24-26-202	163.84	160.09	157.18	156.92	+ 6.92	+ 3.17	+ 0.26
24-27-201	182.29	182.34	180.22	179.25	+ 3.04	+ 3.09	+ 0.97
24-27-301	181.00	181.94	180.11	179.67	+ 1.33	+ 2.27	+ 0.44
24-28-401	186.45	188.46	188.31	187.90	– 1.45	+ 0.56	+ 0.41
25-16-602	78.62	80.47	76.42	75.49	+ 3.13	+ 4.98	+ 0.93
25-16-901	92.48	93.99	91.13	90.25	+ 2.23	+ 3.74	+ 0.88
25-16-902	N/A	109.42	108.83	108.35	N/A	+ 1.07	+ 0.48
25-24-601	N/A	141.41	139.66	137.65	N/A	+ 3.76	+ 2.01

NOTE: N/A Denotes data not available

CROSBY COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
23-12-606	186.66	203.04	202.70	202.46	– 15.80	+ 0.58	+ 0.24
23-12-801	205.87	208.59	208.75	205.00	+ 0.87	+ 3.59	+ 3.75
23-12-902	231.74	238.52	234.40	231.25	+ 0.49	+ 7.27	+ 3.15
23-12-905	212.07	218.82	217.88	217.68	– 5.61	+ 1.14	+ 0.20
23-13-401	202.56	213.94	216.65	214.83	– 12.27	– 0.89	+ 1.82
23-13-502	221.04	230.37	232.81	231.27	– 10.23	– 0.90	+ 1.54
23-13-803	231.55	253.92	247.30	246.60	– 15.05	+ 7.32	+ 0.70
23-20-201	N/A	193.47	190.13	187.23	N/A	+ 6.24	+ 2.90
23-20-305	N/A	229.34	218.84	215.52	N/A	+ 13.82	+ 3.32
23-20-503	209.83	215.03	208.90	205.23	+ 4.60	+ 9.80	+ 3.67
23-20-609	N/A	N/A	N/A	216.73	N/A	N/A	N/A
23-20-901	210.59	219.14	205.95	202.41	+ 8.18	+ 16.73	+ 3.54
23-21-101	N/A	248.60	236.85	241.32	N/A	+ 7.28	– 4.47
23-21-706	209.86	210.96	208.40	204.35	+ 5.51	+ 6.61	+ 4.05
23-28-202	134.87	136.30	127.60	117.49	+ 17.38	+ 18.81	+ 10.11
23-28-310	N/A	176.92	174.20	169.50	N/A	+ 7.42	+ 4.70
23-28-602	N/A	N/A	N/A	109.19	N/A	N/A	N/A
23-28-901	N/A	101.32	90.21	87.77	N/A	+ 13.55	+ 2.44
23-29-102	N/A	185.10	176.80	176.91	N/A	+ 8.19	– 0.11
23-29-103	N/A	207.39	196.90	193.61	N/A	+ 13.78	+ 3.29
23-29-401	215.09	208.20	200.70	196.52	+ 18.57	+ 11.68	+ 4.18
23-29-701	N/A	105.60	112.90	111.62	N/A	– 6.02	+ 1.28
23-29-702	N/A	N/A	N/A	189.75	N/A	N/A	N/A
23-36-301	N/A	152.69	150.70	149.08	N/A	+ 3.61	+ 1.62
23-19-501	204.85	209.25	206.50	206.00	– 1.15	+ 3.25	+ 0.50
23-19-601	N/A	211.40	207.90	207.05	N/A	+ 4.35	+ 0.85
23-19-704	102.49	102.05	99.55	98.38	+ 4.11	+ 3.67	+ 1.17
23-19-804	111.87	115.24	109.49	107.79	+ 4.08	+ 7.45	+ 1.70
23-19-901	163.42	168.03	166.04	164.89	– 1.47	+ 3.14	+ 1.15
23-20-401	196.94	203.00	200.88	200.58	– 3.64	+ 2.42	+ 0.30
23-20-701	189.95	192.42	188.01	185.67	+ 4.28	+ 6.75	+ 2.34
23-20-805	N/A	N/A	N/A	201.89	N/A	N/A	N/A
23-25-304	37.20	30.75	28.47	27.73	+ 9.47	+ 3.02	+ 0.74
23-25-401	146.94	145.43	142.23	140.67	+ 6.27	+ 4.76	+ 1.56
23-25-704	131.91	131.18	126.28	125.03	+ 6.88	+ 6.15	+ 1.25
23-25-801	N/A	112.32	109.51	108.39	N/A	+ 3.93	+ 1.12
23-25-904	N/A	74.93	63.02	59.20	N/A	+ 15.73	+ 3.82
23-26-101	57.85	52.10	50.21	50.62	+ 7.23	+ 1.48	– 0.41
23-26-103	N/A	N/A	N/A	40.26	N/A	N/A	N/A
23-26-301	92.72	91.60	87.66	86.35	+ 6.37	+ 5.25	+ 1.31
23-26-603	15.44	18.35	N/A	9.12	+ 6.32	+ 9.23	N/A
23-26-604	50.25	48.18	47.06	45.97	+ 4.28	+ 2.21	+ 1.09
23-26-802	N/A	69.73	62.10	59.31	N/A	+ 10.42	+ 2.79
23-27-102	N/A	81.47	78.25	76.17	N/A	+ 5.30	+ 2.08
23-27-201	93.32	92.41	88.52	85.82	+ 7.50	+ 6.59	+ 2.70
23-27-204	93.04	91.90	88.60	86.39	+ 6.65	+ 5.51	+ 2.21
23-27-207	N/A	97.86	91.14	87.79	N/A	+ 10.07	+ 3.35
23-27-302	80.82	79.48	71.14	67.15	+ 13.67	+ 12.33	+ 3.99
23-27-402	73.49	71.16	70.45	67.58	+ 5.91	+ 3.58	+ 2.87
23-27-601	85.99	82.50	78.57	73.94	+ 12.05	+ 8.56	+ 4.63
23-27-603	N/A	84.87	79.94	78.21	N/A	+ 6.66	+ 1.73
23-27-701	N/A	62.97	54.91	52.40	N/A	+ 10.57	+ 2.51
23-27-801	N/A	127.15	122.59	121.55	N/A	+ 5.60	+ 1.04
23-28-203	N/A	163.57	152.17	143.94	N/A	+ 19.63	+ 8.23
23-28-501	N/A	87.97	84.02	80.94	N/A	+ 7.03	+ 3.08
23-28-701	60.83	56.04	43.50	41.69	+ 19.14	+ 14.35	+ 1.81
23-33-201	130.35	129.32	127.73	126.81	+ 3.54	+ 2.51	+ 0.92
23-33-301	N/A	102.14	96.40	95.62	N/A	+ 6.52	+ 0.78
23-33-401	105.21	105.61	103.71	102.65	+ 2.56	+ 2.96	+ 1.06
23-33-501	110.30	111.53	109.95	108.89	+ 1.41	+ 2.64	+ 1.06
23-33-601	105.91	105.88	103.21	101.31	+ 4.60	+ 4.57	+ 1.90
23-33-801	98.87	99.39	96.07	94.02	+ 4.85	+ 5.37	+ 2.05
23-33-901	120.36	118.30	116.22	114.96	+ 5.40	+ 3.34	+ 1.26
23-34-101	114.70	113.32	109.57	106.97	+ 7.73	+ 6.35	+ 2.60
23-34-202	N/A	94.13	88.05	83.92	N/A	+ 10.21	+ 4.13
23-34-402	117.40	116.52	114.70	112.93	+ 4.47	+ 3.59	+ 1.77
23-34-502	139.68	141.83	138.84	136.95	+ 2.73	+ 4.88	+ 1.89
23-34-503	121.88	121.75	117.89	115.12	+ 6.76	+ 6.63	+ 2.77
23-34-601	128.08	129.41	127.53	126.35	+ 1.73	+ 3.06	+ 1.18
23-34-801	148.13	147.98	145.14	142.17	+ 5.96	+ 5.81	+ 2.97
23-34-805	143.60	144.12	140.21	137.65	+ 5.95	+ 6.47	+ 2.56
23-34-902	136.57	138.65	136.78	134.76	+ 1.81	+ 3.89	+ 2.02
23-35-101	81.19	78.01	74.80	70.85	+ 10.34	+ 7.16	+ 3.95
23-35-301	112.84	110.73	107.39	106.76	+ 6.08	+ 3.97	+ 0.63
23-35-502	98.21	98.40	95.79	94.45	+ 3.76	+ 3.95	+ 1.34
23-35-503	126.99	128.75	126.41	123.41	+ 3.58	+ 5.34	+ 3.00
23-35-701	131.34	132.81	130.95	128.84	+ 2.50	+ 3.97	+ 2.11
23-35-703	135.62	137.82	132.43	131.35	+ 4.27	+ 6.47	+ 1.08
23-35-706	129.26	130.30	128.94	126.93	+ 2.33	+ 3.37	+ 2.01
23-35-707	N/A	132.83	130.83	128.90	N/A	+ 3.93	+ 1.93
23-35-802	117.19	117.84	115.22	113.72	+ 3.47	+ 4.12	+ 1.50
23-35-902	146.48	143.52	143.69	138.81	+ 7.67	+ 4.71	+ 4.88
23-35-903	148.88	151.34	144.71	134.62	+ 14.26	+ 16.72	+ 10.09
23-36-201	N/A	75.85	71.84	70.77	N/A	+ 5.08	+ 1.07
23-36-401	103.41	102.07	101.73	100.01	+ 3.40	+ 2.06	+ 1.72
23-36-701	117.91	117.05	118.13	115.17	+ 2.74	+ 1.88	+ 2.96
23-36-702	213.66	213.44	207.15	202.38	+ 11.28	+ 11.06	+ 4.77
23-36-703	204.56	201.85	197.56	192.43	+ 12.13	+ 9.42	+ 5.13
24-16-601	131.06	136.47	134.19	132.84	– 1.78	+ 3.63	+ 1.35
24-16-901	171.61	170.08	169.29	168.84	+ 2.77	+ 1.24	+ 0.45
24-24-201	69.13	70.02	67.12	65.30	+ 3.83	+ 4.72	+ 1.82
24-24-301	137.34	135.83	133.09	131.80	+ 5.54	+ 4.03	+ 1.29
24-24-602	85.28	86.50	82.13	80.89	+ 4.39	+ 5.61	+ 1.24
24-24-901	168.97	170.43	167.19	N/A	N/A	N/A	N/A
24-24-903	N/A	N/A	134.34	132.48	N/A	N/A	+ 1.86
24-32-201	N/A	103.63	102.39	102.68	N/A	+ 0.95	– 0.29
24-32-303	N/A	119.28	119.22	118.52	N/A	+ 0.76	+ 0.70
24-32-304	144.08	145.95	144.59	143.31	+ 0.77	+ 2.64	+ 1.28
24-32-305	N/A	N/A	125.06	N/A	N/A	N/A	N/A
24-32-502	N/A	121.10	117.68	116.73	N/A	+ 4.37	+ 0.95
24-32-601	134.14	134.53	134.57	132.49	+ 1.65	+ 2.04	+ 2.08
24-40-201	138.48	134.92	132.76	129.98	+ 8.50	+ 4.94	+ 2.78
24-40-301	146.48	146.97	144.75	143.39	+ 3.09	+ 3.58	+ 1.36
24-40-601	125.62	126.65	125.82	124.46	+ 1.16	+ 2.19	+ 1.36
24-40-603	N/A	88.28	86.49	85.82	N/A	+ 2.46	+ 0.67
24-40-901	69.40	69.93	64.09	62.45	+ 6.95	+ 7.48	+ 1.64

NOTE: N/A Denotes data not available



NOTE: N/A Denotes data not available

10-25-701	288.20	304.58	297.63	295.07	- 6.87	+ 9.51	+ 2.56
10-25-801	N/A	253.54	256.30	256.32	N/A	- 2.78	- 0.02
10-26-102	N/A	N/A	295.20	293.77	N/A	N/A	+ 1.43
10-26-201	N/A	287.28	290.77	290.70	N/A	- 3.42	+ 0.07
10-26-301	347.54	367.07	374.17	374.31	- 26.77	- 7.24	- 0.14
10-26-402	N/A	323.11	324.11	323.09	N/A	+ 0.02	+ 1.02
10-26-502	N/A	346.09	356.15	355.98	N/A	- 9.89	+ 0.17
10-26-603	N/A	N/A	341.40	341.78	N/A	N/A	- 0.38
10-26-702	228.43	241.64	244.83	245.01	- 16.58	- 3.37	- 0.18
10-26-802	242.74	261.69	264.67	265.62	- 22.88	- 3.93	- 0.95
10-27-102	291.51	308.03	316.66	308.93	- 17.42	- 0.90	+ 7.73
10-27-103	N/A	394.23	406.05	406.29	N/A	- 12.06	- 0.24
10-27-301	333.79	343.65	354.53	353.27	- 19.48	- 9.62	+ 1.26
10-27-501	368.62	388.75	404.88	398.72	- 30.10	- 9.97	+ 6.16
10-27-601	N/A	366.45	378.18	369.38	N/A	- 2.93	+ 8.80
10-27-702	N/A	302.25	308.75	305.24	N/A	- 2.99	+ 3.51
10-27-901	276.93	N/A	297.03	296.51	- 19.58	N/A	+ 0.52
10-28-102	N/A	340.24	348.90	348.96	N/A	- 8.72	- 0.06
10-28-202	304.41	319.42	329.22	324.54	- 20.13	- 5.12	+ 4.68
10-28-501	325.06	354.11	362.85	359.68	- 34.62	- 5.57	+ 3.17
10-28-703	N/A	282.68	291.16	293.41	N/A	- 10.73	- 2.25
10-28-801	N/A	310.56	319.70	318.52	N/A	- 7.96	+ 1.18
10-33-103	N/A	316.93	327.12	326.74	N/A	- 9.81	+ 0.38
10-33-310	N/A	280.26	282.06	283.22	N/A	- 2.96	- 1.16
10-33-501	289.51	310.82	N/A	N/A	N/A	N/A	N/A
10-33-502	N/A	338.64	345.84	345.32	N/A	- 6.68	+ 0.52
10-33-503	N/A	319.98	328.35	328.74	N/A	- 8.76	- 0.39
10-33-801	N/A	270.49	281.49	282.69	N/A	- 12.20	- 1.20
10-33-802	224.49	244.22	254.87	256.49	- 32.00	- 12.27	- 1.62
10-33-902	221.97	240.67	248.82	249.58	- 27.61	- 8.91	- 0.76
10-34-102	233.84	251.05	257.41	259.77	- 25.93	- 8.72	- 2.36
10-34-202	N/A	292.49	293.52	293.14	N/A	- 0.65	+ 0.38
10-34-302	230.88	249.48	253.64	253.34	- 22.46	- 3.86	+ 0.30
10-34-403	N/A	307.37	314.01	313.42	N/A	- 6.05	+ 0.59
10-34-404	300.77	317.93	324.35	323.33	- 22.56	- 5.40	+ 1.02
10-34-602	N/A	288.13	N/A	N/A	N/A	N/A	N/A
10-34-801	230.60	248.74	255.70	257.36	- 26.76	- 8.62	- 1.66
10-34-802	258.34	275.13	281.60	282.31	- 23.97	- 7.18	- 0.71
10-35-304	230.10	247.09	249.55	250.51	- 20.41	- 3.42	- 0.96
10-35-401	262.41	281.56	291.03	291.59	- 29.18	- 10.03	- 0.56
10-35-501	252.97	268.91	272.13	274.29	- 21.32	- 5.38	- 2.16
10-35-603	N/A	227.57	235.58	236.76	N/A	- 9.19	- 1.18
10-35-702	242.59	259.52	266.79	265.74	- 23.15	- 6.22	+ 1.05
10-35-802	N/A	270.58	278.38	279.22	N/A	- 8.64	- 0.84
10-35-901	269.22	284.79	292.53	292.12	- 22.90	- 7.33	+ 0.41
10-35-902	265.44	284.97	290.06	291.08	- 25.64	- 6.11	- 1.02
10-36-102	227.62	242.49	247.10	249.15	- 21.53	- 6.66	- 2.05
10-36-401	N/A	196.01	206.45	209.89	N/A	- 13.88	- 3.44
10-36-602	N/A	N/A	247.64	246.35	N/A	N/A	+ 1.29
10-36-702	N/A	232.15	242.43	245.20	N/A	- 13.05	- 2.77
10-36-801	210.09	230.40	236.20	237.20	- 27.11	- 6.80	- 1.00
10-41-209	208.14	225.34	231.70	231.43	- 23.29	- 6.09	+ 0.27
10-41-301	197.00	214.27	220.48	222.58	- 25.58	- 8.31	- 2.10
10-41-403	N/A	198.68	204.47	205.53	N/A	- 6.85	- 1.06
10-42-104	N/A	N/A	212.50	212.10	N/A	N/A	+ 0.40
10-42-202	219.53	237.69	241.79	242.52	- 22.99	- 4.83	- 0.73
10-42-302	N/A	205.35	212.03	210.60	N/A	- 5.25	+ 1.43
10-42-506	N/A	190.22	198.90	199.00	N/A	- 8.78	- 0.10
10-43-203	N/A	232.67	239.25	240.12	N/A	- 7.45	- 0.87
10-44-102	207.42	226.92	235.18	234.77	- 27.35	- 7.85	+ 0.41
10-44-202	220.58	238.29	244.80	244.63	- 24.05	- 6.34	+ 0.17
10-44-203	N/A	236.95	247.68	247.66	N/A	- 10.71	+ 0.02

NOTE: N/A Denotes data not available

ARMSTRONG COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
11-12-401	125.51	129.10	130.73	131.05	- 5.54	- 1.95	- 0.32
11-12-601	116.56	N/A	120.35	120.19	- 3.63	N/A	+ 0.16
11-12-701	143.28	149.28	148.43	146.80	- 3.52	+ 2.48	+ 1.63
11-12-702	153.24	157.51	155.38	154.49	- 1.25	+ 3.02	+ 0.89
11-12-801	151.36	152.48	150.97	150.01	+ 1.35	+ 2.47	+ 0.96
11-12-802	162.88	162.11	161.34	161.12	+ 1.76	+ 0.99	+ 0.22
11-12-803	139.25	144.94	145.65	145.75	- 6.50	- 0.81	- 0.10
11-12-901	131.47	134.84	135.34	134.89	- 3.42	- 0.05	+ 0.45
11-13-702	N/A	124.35	119.97	119.60	N/A	+ 4.75	+ 0.37

NOTE: N/A Denotes data not available

10-53-404	N/A	[illegible]	N/A	[illegible]	N/A	- [illegible]	N/A
10-53-602	65.05	79.67	85.68	86.44	- 21.39	- 6.77	- 0.76
10-53-608	N/A	98.54	102.78	102.09	N/A	- 3.55	+ 0.69
10-53-803	N/A	N/A	75.98	77.71	N/A	N/A	- 1.73
10-54-205	131.72	145.71	150.73	151.63	- 19.91	- 5.92	- 0.90
10-54-301	188.07	207.50	211.19	211.35	- 23.28	- 3.85	- 0.16
10-54-404	N/A	118.99	124.28	125.17	N/A	- 6.18	- 0.89
10-54-502	124.39	138.59	140.31	141.23	- 16.84	- 2.64	- 0.92
10-54-701	N/A	99.51	111.99	114.12	N/A	- 14.61	- 2.13
10-54-801	81.56	94.87	110.66	113.02	- 31.46	- 18.15	- 2.36
10-55-203	192.95	212.88	218.58	219.36	- 26.41	- 6.48	- 0.78
10-55-301	218.02	233.42	238.44	237.83	- 19.81	- 4.41	+ 0.61
10-55-404	195.07	207.67	N/A	N/A	N/A	N/A	N/A
10-55-701	100.20	110.65	118.48	119.62	- 19.42	- 8.97	- 1.14
10-55-802	105.25	122.61	130.58	132.48	- 27.23	- 9.87	- 1.90
10-55-902	169.20	192.84	198.54	198.41	- 29.21	- 5.57	+ 0.13
10-55-904	166.94	181.79	185.78	185.91	- 18.97	- 4.12	- 0.13
10-56-102	222.96	240.28	246.13	245.28	- 22.32	- 5.00	+ 0.85
10-56-403	208.70	233.83	239.06	238.55	- 29.85	- 4.72	+ 0.51
10-56-404	223.43	245.88	252.30	252.56	- 29.13	- 6.68	- 0.26
10-60-103	147.29	142.14	140.88	140.24	+ 7.05	+ 1.90	+ 0.64
10-60-304	91.36	107.01	111.00	110.11	- 18.75	- 3.10	+ 0.89
10-60-401	125.08	123.43	120.12	118.99	+ 6.09	+ 4.44	+ 1.13
10-60-604	N/A	96.79	93.68	92.71	N/A	+ 4.08	+ 0.97
10-60-904	137.69	134.49	132.22	N/A	N/A	N/A	N/A
10-61-101	92.54	109.38	117.84	117.74	- 25.20	- 8.36	+ 0.10
10-61-105	N/A	N/A	94.91	96.03	N/A	N/A	- 1.12
10-61-201	67.33	77.34	83.89	85.24	- 17.91	- 7.90	- 1.35
10-61-402	N/A	161.04	168.39	168.21	N/A	- 7.17	+ 0.18
10-61-602	108.05	123.98	133.62	136.42	- 28.37	- 12.44	- 2.80
10-61-701	138.38	148.55	150.35	148.64	- 10.26	- 0.09	+ 1.71
10-62-101	67.30	76.76	N/A	N/A	N/A	N/A	N/A
10-62-207	N/A	130.27	136.37	136.48	N/A	- 6.21	- 0.11
10-62-304	N/A	N/A	106.90	107.89	N/A	N/A	- 0.99
10-62-402	138.61	147.51	155.09	154.79	- 16.18	- 7.28	+ 0.30
10-62-603	N/A	112.89	116.71	117.27	N/A	- 4.38	- 0.56
10-63-102	N/A	98.89	106.01	107.75	N/A	- 8.86	- 1.74
10-63-202	N/A	116.90	124.35	124.48	N/A	- 7.58	- 0.13
10-63-306	N/A	150.09	161.37	156.92	N/A	- 6.83	+ 4.45
10-63-404	N/A	132.81	138.07	138.97	N/A	- 6.16	- 0.90
10-63-601	128.38	143.42	147.92	147.94	- 19.56	- 4.52	- 0.02
10-63-702	146.54	152.09	154.90	154.34	- 7.80	- 2.25	+ 0.56
10-63-801	N/A	131.06	131.85	132.25	N/A	- 1.19	- 0.40
10-64-103	N/A	165.38	171.77	167.46	N/A	- 2.08	+ 4.31
10-64-701	130.75	144.02	151.85	N/A	N/A	N/A	N/A
24-04-301	52.90	61.25	58.50	53.83	- 0.93	+ 7.42	+ 4.67
24-05-102	N/A	54.42	53.74	52.02	N/A	+ 2.40	+ 1.72
24-05-303	127.20	145.82	149.85	150.80	- 23.60	- 4.98	- 0.95
24-05-502	75.35	72.79	69.41	67.99	+ 7.36	+ 4.80	+ 1.42
24-06-101	N/A	141.16	144.18	144.45	N/A	- 3.29	- 0.27
24-06-203	N/A	N/A	149.97	145.54	N/A	N/A	+ 4.43
24-06-402	87.85	86.78	85.75	85.29	+ 2.56	+ 1.49	+ 0.46
24-06-507	N/A	83.02	81.64	80.85	N/A	+ 2.17	+ 0.79
24-06-604	139.60	148.15	149.10	149.39	- 9.79	- 1.24	- 0.29
24-06-902	99.64	102.63	102.63	101.49	- 1.85	+ 1.14	+ 1.14
24-07-101	N/A	143.37	145.39	144.08	N/A	- 0.71	+ 1.31
24-07-202	159.45	163.47	N/A	N/A	N/A	N/A	N/A
24-07-301	N/A	140.43	141.22	140.80	N/A	- 0.37	+ 0.42
24-07-602	N/A	N/A	147.45	149.22	N/A	N/A	- 1.77
24-07-701	144.25	146.41	147.30	147.05	- 2.80	- 0.64	+ 0.25
24-07-901	121.78	126.98	129.96	127.65	- 5.87	- 0.67	+ 2.31
24-08-402	N/A	156.98	158.52	157.81	N/A	- 0.83	+ 0.71
24-08-701	137.72	143.57	146.32	146.06	- 8.34	- 2.49	+ 0.26
24-14-301	N/A	58.06	56.70	57.48	N/A	+ 0.58	- 0.78
24-15-201	119.52	120.78	120.49	119.88	- 0.36	+ 0.90	+ 0.61
24-15-506	80.98	82.49	80.33	77.83	+ 3.15	+ 4.66	+ 2.50
24-15-609	136.54	140.81	136.70	135.41	+ 1.13	+ 5.40	+ 1.29
24-16-101	N/A	165.41	166.82	166.32	N/A	- 0.91	+ 0.50

NOTE: N/A Denotes data not available

11-60-902	213.32	225.76	232.70	225.57	- 12.25	+ 0.19	+ 7.13
11-61-110	N/A	N/A	233.94	233.38	N/A	N/A	+ 0.56
11-61-204	214.89	228.08	226.76	224.85	-9.96	+ 3.23	+ 1.91
11-61-406	236.46	245.01	248.42	245.70	- 9.24	- 0.69	+ 2.72
11-61-407	239.39	245.34	248.23	246.78	- 7.39	- 1.44	+ 1.45
11-61-603	88.77	91.09	90.80	87.90	+ 0.87	+ 3.19	+ 2.90
11-61-801	243.49	248.80	252.51	248.28	- 4.79	+ 0.52	+ 4.23
11-61-901	222.76	244.71	246.11	246.04	- 23.28	- 1.33	+ 0.07
11-62-201	144.98	145.08	143.29	142.54	+ 2.44	+ 2.54	+ 0.75
11-62-301	N/A	155.48	155.30	155.38	N/A	+ 0.10	- 0.08
11-62-401	63.43	63.68	60.65	58.67	+ 4.76	+ 5.01	+ 1.98
11-62-601	150.61	150.70	149.55	149.20	+ 1.41	+ 1.50	+ 0.35
11-62-602	157.03	157.90	155.30	156.08	+ 0.95	+ 1.82	- 0.78
11-62-701	130.87	132.59	135.01	N/A	N/A	N/A	N/A
11-62-702	106.03	108.80	108.88	108.25	- 2.22	+ 0.55	+ 0.63
11-62-801	115.70	116.64	107.14	105.47	+ 10.23	+ 11.17	+ 1.67
11-63-401	N/A	156.96	157.27	156.48	N/A	+ 0.48	+ 0.79
11-63-501	240.76	240.20	237.47	237.05	+ 3.71	+ 3.15	+ 0.42
11-63-801	218.39	212.98	214.67	212.73	+ 5.66	+ 0.25	+ 1.94
11-63-901	N/A	248.12	249.01	249.15	N/A	- 1.03	- 0.14
11-64-101	244.87	252.30	249.97	250.23	- 5.36	+ 2.07	- 0.26
11-64-403	N/A	N/A	252.24	251.94	N/A	N/A	+ 0.30
11-64-803	N/A	N/A	267.64	267.60	N/A	N/A	+ 0.04
23-04-301	N/A	208.08	209.71	211.13	N/A	- 3.05	- 1.42
23-04-504	N/A	214.15	215.65	215.75	N/A	- 1.60	- 0.10
23-04-602	209.07	222.58	222.52	222.38	- 13.31	+ 0.20	+ 0.14
23-04-603	207.99	213.39	221.78	221.85	- 13.86	- 8.46	- 0.07
23-04-802	200.42	210.46	213.85	214.39	- 13.97	- 3.93	- 0.54
23-05-202	219.36	239.96	243.55	242.40	- 23.04	- 2.44	+ 1.15
23-05-301	N/A	N/A	249.32	250.48	N/A	N/A	- 1.16
23-05-502	N/A	241.53	245.67	246.59	N/A	- 5.06	- 0.92
23-05-602	245.40	267.33	262.38	261.01	- 15.61	+ 6.32	+ 1.37
23-05-603	N/A	263.97	265.45	265.80	N/A	- 1.83	- 0.35
23-05-701	N/A	222.67	225.63	225.35	N/A	- 2.68	+ 0.28
23-05-802	229.05	244.98	242.81	240.34	- 11.29	+ 4.64	+ 2.47
23-06-302	193.85	194.14	194.08	193.48	+ 0.37	+ 0.66	+ 0.60
23-06-502	257.88	264.46	262.40	261.36	- 3.48	+ 3.10	+ 1.04
23-06-503	N/A	285.90	285.75	284.42	N/A	+ 1.48	+ 1.33
23-06-601	N/A	280.26	285.50	277.32	N/A	+ 2.94	+ 8.18
23-06-704	N/A	263.10	261.93	261.56	N/A	+ 1.54	+ 0.37
23-07-103	263.86	263.90	268.35	268.12	- 4.26	- 4.22	+ 0.23
23-07-202	N/A	281.19	287.60	286.59	N/A	- 5.40	+ 1.01
23-07-401	294.64	295.40	295.46	294.59	+ 0.05	+ 0.81	+ 0.87
23-07-501	296.86	296.80	295.80	295.31	+ 1.55	+ 1.49	+ 0.48
23-07-503	N/A	N/A	292.51	292.14	N/A	N/A	+ 0.37
23-07-601	301.33	302.67	302.25	301.47	- 0.14	+ 1.20	+ 0.78
23-07-702	N/A	211.17	213.78	214.77	N/A	- 3.60	- 0.99
23-07-801	N/A	N/A	292.60	N/A	N/A	N/A	N/A
23-07-901	N/A	283.05	284.73	284.03	N/A	- 0.98	+ 0.70
23-08-201	273.45	277.22	276.87	277.44	- 3.99	- 0.22	- 0.57
23-08-401	290.86	292.37	292.63	292.68	- 1.82	- 0.31	- 0.05
23-08-502	277.05	277.84	277.98	278.39	- 1.34	- 0.55	- 0.41
23-08-701	N/A	291.86	288.77	289.90	N/A	+ 1.96	- 1.13
23-12-301	213.27	217.95	219.80	219.46	- 6.19	- 1.51	+ 0.34
23-13-101	207.02	212.45	214.70	212.74	- 5.72	- 0.29	+ 1.96
23-13-302	247.79	258.14	255.15	254.64	- 6.85	+ 3.50	+ 0.51
23-13-303	N/A	238.67	240.10	237.89	N/A	+ 0.78	+ 2.21
23-14-101	N/A	264.94	264.02	262.03	N/A	+ 2.91	+ 1.99
23-14-301	246.53	252.69	253.58	253.75	- 7.22	- 1.06	- 0.17
23-15-203	N/A	N/A	301.96	N/A	N/A	N/A	N/A
23-15-302	307.89	308.03	307.20	305.50	+ 2.39	+ 2.53	+ 1.70
23-16-101	316.98	321.96	319.27	319.18	- 2.20	+ 2.78	+ 0.09
23-16-202	N/A	N/A	305.20	304.18	N/A	N/A	+ 1.02

NOTE: N/A Denotes data not available

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
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10-49-501	N/A	55.88	61.20	57.78	N/A	– 1.90	+ 3.42
10-49-602	66.34	84.32	93.95	98.17	– 31.83	– 13.85	– 4.22
10-49-603	N/A	66.90	69.57	70.52	N/A	– 3.62	– 0.95
10-49-801	80.14	81.85	83.94	83.18	– 3.04	– 1.33	+ 0.76
10-49-803	N/A	105.39	104.35	104.63	N/A	+ 0.76	– 0.28
10-50-104	N/A	114.72	124.29	123.10	N/A	– 8.38	+ 1.19
10-50-508	N/A	N/A	115.35	113.49	N/A	N/A	+ 1.86
10-50-602	N/A	81.85	81.54	81.04	N/A	+ 0.81	+ 0.50
10-50-703	N/A	N/A	105.19	104.50	N/A	N/A	+ 0.69
10-50-801	69.53	N/A	65.78	65.25	+ 4.28	N/A	+ 0.53
10-50-901	N/A	73.80	77.34	78.00	N/A	– 4.20	– 0.66
10-51-105	80.82	90.16	91.21	89.55	– 8.73	+ 0.61	+ 1.66
10-51-119	N/A	N/A	N/A	73.88	N/A	N/A	N/A
10-51-311	N/A	102.70	104.51	105.23	N/A	– 2.53	– 0.72
10-51-403	63.08	71.01	73.65	73.88	– 10.80	– 2.87	– 0.23
10-51-406	N/A	69.26	70.92	N/A	N/A	N/A	N/A
10-51-501	66.23	83.94	85.62	85.10	– 18.87	– 1.16	+ 0.52
10-51-507	N/A	81.98	86.32	85.88	N/A	– 3.90	+ 0.44
10-51-602	75.23	93.82	98.40	97.25	– 22.02	– 3.43	+ 1.15
10-51-609	N/A	N/A	113.42	113.25	N/A	N/A	+ 0.17
10-51-703	98.52	102.02	102.79	102.45	– 3.93	– 0.43	+ 0.34
10-51-704	N/A	N/A	85.62	86.32	N/A	N/A	– 0.70
10-51-808	N/A	N/A	100.42	103.35	N/A	N/A	– 2.93
10-51-908	N/A	112.09	115.19	116.19	N/A	– 4.10	– 1.00
10-51-909	N/A	N/A	122.25	123.28	N/A	N/A	– 1.03
10-51-910	N/A	N/A	118.47	117.52	N/A	N/A	+ 0.95
10-51-911	N/A	N/A	127.60	126.88	N/A	N/A	+ 0.72
10-52-408	90.18	101.45	103.97	103.42	– 13.24	– 1.97	+ 0.55
10-57-103	80.68	81.99	81.90	82.55	– 1.87	– 0.56	– 0.65
10-57-401	110.80	111.61	111.72	112.00	– 1.20	– 0.39	– 0.28
10-57-501	38.19	38.48	41.64	40.93	– 2.74	– 2.45	+ 0.71
10-58-201	N/A	30.57	27.29	26.70	N/A	+ 3.87	+ 0.59
10-58-502	68.93	68.08	63.91	60.43	+ 8.50	+ 7.65	+ 3.48
10-58-601	N/A	73.89	72.94	71.50	N/A	+ 2.39	+ 1.44
10-58-701	47.00	44.61	43.61	43.70	+ 3.30	+ 0.91	– 0.09
10-58-801	24.77	25.91	19.19	17.95	+ 6.82	+ 7.96	+ 1.24
10-59-106	N/A	113.27	113.19	112.52	N/A	+ 0.75	+ 0.67
10-59-107	N/A	101.18	101.00	100.35	N/A	+ 0.83	+ 0.65
10-59-302	112.42	113.38	112.19	111.39	+ 1.03	+ 1.99	+ 0.80
10-59-401	116.25	117.85	116.82	115.22	+ 1.03	+ 2.63	+ 1.60
10-59-402	N/A	N/A	N/A	126.90	N/A	N/A	N/A
10-59-501	97.50	95.53	94.83	92.99	+ 4.51	+ 2.54	+ 1.84
10-59-601	134.74	133.49	129.24	127.57	+ 7.17	+ 5.92	+ 1.67
24-02-701	52.65	49.45	47.11	45.62	+ 7.03	+ 3.83	+ 1.49
24-02-702	N/A	N/A	N/A	50.72	N/A	N/A	N/A
24-09-101	N/A	167.38	162.73	160.82	N/A	+ 6.56	+ 1.91
24-09-103	N/A	N/A	N/A	165.67	N/A	N/A	N/A
24-09-302	N/A	86.34	85.97	85.28	N/A	+ 1.06	+ 0.69
24-10-201	114.28	114.56	110.68	108.71	+ 5.57	+ 5.85	+ 1.97
24-10-303	139.08	126.34	110.98	108.00	+ 31.08	+ 18.34	+ 2.98
24-11-201	102.39	101.05	91.97	90.32	+ 12.07	+ 10.73	+ 1.65
24-11-202	N/A	84.82	84.22	83.52	N/A	+ 1.30	+ 0.70

NOTE: N/A Denotes data not available

10-30-701	N/A	[illegible]	[illegible]	[illegible]	N/A	[illegible]	– 0.79
10-30-802	223.36	245.10	254.67	255.88	– 32.52	– 10.78	– 1.21
10-31-201	187.79	194.47	196.65	196.77	– 8.98	– 2.30	– 0.12
10-31-301	185.91	N/A	188.29	188.33	– 2.42	N/A	– 0.04
10-31-501	222.56	227.10	228.63	228.91	– 6.35	– 1.81	– 0.28
10-31-601	175.59	187.69	192.73	193.35	– 17.76	– 5.66	– 0.62
10-31-701	267.16	267.85	263.18	263.20	+ 3.96	+ 4.65	– 0.02
10-31-803	N/A	263.70	272.55	272.95	N/A	– 9.25	– 0.40
10-32-201	176.12	177.64	177.98	178.45	– 2.33	– 0.81	– 0.47
10-32-301	N/A	178.44	175.30	175.16	N/A	+ 3.28	+ 0.14
10-32-501	141.30	143.62	145.63	145.70	– 4.40	– 2.08	– 0.07
10-32-601	N/A	130.26	133.81	133.89	N/A	– 3.63	– 0.08
10-32-703	256.87	266.52	269.79	269.60	– 12.73	– 3.08	+ 0.19
10-32-801	219.51	217.44	217.64	217.73	+ 1.78	– 0.29	– 0.09
10-36-301	N/A	224.69	230.59	230.40	N/A	– 5.71	+ 0.19
10-37-301	N/A	207.78	217.19	217.40	N/A	– 9.62	– 0.21
10-37-403	N/A	N/A	207.91	207.98	N/A	N/A	– 0.07
10-37-501	N/A	197.20	205.85	206.41	N/A	– 9.21	– 0.56
10-37-601	172.82	189.20	197.78	198.50	– 25.68	– 9.30	– 0.72
10-37-801	N/A	186.62	195.38	195.66	N/A	– 9.04	– 0.28
10-37-901	169.03	185.93	195.09	195.47	– 26.44	– 9.54	– 0.38
10-38-101	190.24	210.01	214.39	214.70	– 24.46	– 4.69	– 0.31
10-38-201	N/A	200.63	208.71	208.72	N/A	– 8.09	– 0.01
10-38-401	186.10	202.98	209.19	209.88	– 23.78	– 6.90	– 0.69
10-38-603	174.54	195.14	199.22	199.74	– 25.20	– 4.60	– 0.52
10-38-802	177.99	197.49	202.89	203.21	– 25.22	– 5.72	– 0.32
10-39-101	219.85	238.82	246.29	246.92	– 27.07	– 8.10	– 0.63
10-39-201	N/A	N/A	269.69	269.31	N/A	N/A	+ 0.38
10-39-302	249.29	269.37	281.72	285.10	– 35.81	– 15.73	– 3.38
10-39-402	N/A	N/A	220.03	219.99	N/A	N/A	+ 0.04
10-39-501	200.96	214.47	219.72	220.15	– 19.19	– 5.68	– 0.43
10-39-702	163.58	180.60	188.98	189.52	– 25.94	– 8.92	– 0.54
10-39-801	180.79	195.04	202.02	202.20	– 21.41	– 7.16	– 0.18
10-39-901	N/A	190.09	198.71	199.61	N/A	– 9.52	– 0.90
10-40-301	N/A	172.20	173.91	173.96	N/A	– 1.76	– 0.05
10-40-402	N/A	226.02	232.27	232.09	N/A	– 6.07	+ 0.18
10-40-502	232.55	251.34	261.62	261.38	– 28.83	– 10.04	+ 0.24
10-40-601	N/A	238.50	245.78	245.38	N/A	– 6.88	+ 0.40
10-40-803	207.38	227.15	235.21	235.54	– 28.16	– 8.39	– 0.33
10-44-601	N/A	196.14	204.31	204.66	N/A	– 8.52	– 0.35
10-45-102	184.20	199.26	208.57	208.95	– 24.75	– 9.69	– 0.38
10-45-301	190.68	208.50	216.44	216.95	– 26.27	– 8.45	– 0.51
10-46-101	169.49	187.58	193.16	193.75	– 24.26	– 6.17	– 0.59
10-46-302	160.38	176.69	186.25	187.55	– 27.17	– 10.86	– 1.30
10-46-303	N/A	N/A	193.97	195.04	N/A	N/A	– 1.07
10-46-405	192.53	N/A	N/A	N/A	N/A	N/A	N/A
10-47-101	155.22	174.01	183.55	184.18	– 28.96	– 10.17	– 0.63
10-47-201	192.78	207.85	214.52	214.70	– 21.92	– 6.85	– 0.18
10-47-302	178.21	193.65	201.85	200.36	– 22.15	– 6.71	+ 1.49
10-48-103	N/A	194.39	199.32	200.07	N/A	– 5.68	– 0.75
10-48-302	N/A	190.53	199.39	199.04	N/A	– 8.51	+ 0.35
10-48-303	N/A	209.76	215.49	216.03	N/A	– 6.27	– 0.54
10-48-603	174.22	196.94	202.96	202.82	– 28.60	– 5.88	+ 0.14

NOTE: N/A Denotes data not available

24-23-102	N/A	113.29	112.34	111.62	N/A	+ 1.67	+ 0.72
24-23-302	117.42	119.60	120.14	118.69	– 1.27	+ 0.91	+ 1.45
24-23-304	N/A	127.03	126.00	125.30	N/A	+ 1.73	+ 0.70
24-23-501	108.05	112.15	106.39	105.46	+ 2.59	+ 6.69	+ 0.93
24-23-701	107.75	108.62	108.85	107.53	+ 0.22	+ 1.09	+ 1.32
24-24-402	158.23	157.45	153.56	153.05	+ 5.18	+ 4.40	+ 0.51
24-24-703	N/A	N/A	121.46	121.10	N/A	N/A	+ 0.36
24-28-103	142.29	141.25	135.77	133.99	+ 8.30	+ 7.26	+ 1.78
24-28-203	N/A	144.60	147.29	146.50	N/A	– 1.90	+ 0.79
24-28-303	N/A	N/A	122.56	122.24	N/A	N/A	+ 0.32
24-28-501	152.56	154.87	153.56	152.51	+ 0.05	+ 2.36	+ 1.05
24-28-601	N/A	139.39	137.28	137.50	N/A	+ 1.89	– 0.22
24-28-901	168.81	168.90	166.95	165.83	+ 2.98	+ 3.07	+ 1.12
24-29-308	151.26	153.73	152.86	150.24	+ 1.02	+ 3.49	+ 2.62
24-29-312	N/A	138.96	139.12	139.07	N/A	– 0.11	+ 0.05
24-29-401	141.67	141.23	139.13	138.84	+ 2.83	+ 2.39	+ 0.29
24-29-603	N/A	135.13	133.60	134.74	N/A	+ 0.39	– 1.14
24-29-901	193.55	187.99	184.97	183.70	+ 9.85	+ 4.29	+ 1.27
24-30-10[illegible]	[illegible]40.2[illegible]	138.4[illegible]	133.77	131.75	+ 8.51	+ 6.73	+ 2.0[illegible]
24-30-304	109.62	110.02	108.25	107.35	+ 2.27	+ 2.67	+ 0.90
24-30-409	N/A	N/A	106.38	102.85	N/A	N/A	+ 3.53
24-30-502	N/A	133.60	128.80	125.58	N/A	+ 8.02	+ 3.22
24-30-801	177.92	178.79	178.42	177.35	+ 0.57	+ 1.44	+ 1.07
24-30-901	160.37	157.74	155.67	154.83	+ 5.54	+ 2.91	+ 0.84
24-31-101	N/A	69.20	69.14	67.90	N/A	+ 1.30	+ 1.24
24-31-304	N/A	N/A	105.45	104.21	N/A	N/A	+ 1.24
24-31-401	136.56	128.39	125.25	124.54	+ 12.02	+ 3.85	+ 0.71
24-31-501	79.02	77.91	74.02	71.55	+ 7.47	+ 6.36	+ 2.47
24-31-601	117.66	115.15	110.80	109.68	+ 7.98	+ 5.47	+ 1.12
24-31-801	148.68	149.87	147.83	147.81	+ 0.87	+ 2.06	+ 0.02
24-31-902	N/A	125.27	121.84	121.38	N/A	+ 3.89	+ 0.46
24-32-401	106.26	101.34	98.08	97.90	+ 8.36	+ 3.44	+ 0.18
24-32-702	N/A	N/A	126.61	126.01	N/A	N/A	+ 0.60
24-36-302	N/A	173.67	173.39	172.43	N/A	+ 1.24	+ 0.96
24-36-601	148.10	148.15	147.66	147.25	+ 0.85	+ 0.90	+ 0.41
24-37-101	154.55	158.94	157.55	156.28	– 1.73	+ 2.66	+ 1.27
24-37-204	153.96	155.14	153.69	151.85	+ 2.11	+ 3.29	+ 1.84
24-37-308	146.15	147.62	148.45	146.29	– 0.14	+ 1.33	+ 2.16
24-37-502	N/A	N/A	142.75	142.34	N/A	N/A	+ 0.41
24-38-201	176.75	175.89	176.04	174.30	+ 2.45	+ 1.59	+ 1.74
24-38-403	164.49	166.25	165.35	164.70	– 0.21	+ 1.55	+ 0.65
24-38-501	N/A	N/A	160.65	159.52	N/A	N/A	+ 1.13
24-38-602	N/A	120.64	118.80	118.65	N/A	+ 1.99	+ 0.15
24-38-801	163.65	160.85	157.44	153.88	+ 9.77	+ 6.97	+ 3.56
24-39-101	156.83	152.64	149.82	147.63	+ 9.20	+ 5.01	+ 2.19
24-39-302	150.27	148.45	147.86	147.51	+ 2.76	+ 0.94	+ 0.35
24-39-501	135.03	134.10	132.50	132.10	+ 2.93	+ 2.00	+ 0.40
24-39-701	116.92	105.72	103.51	99.28	+ 17.64	+ 6.44	+ 4.23
24-39-901	96.80	95.94	93.10	91.40	+ 5.40	+ 4.54	+ 1.70
24-40-401	144.50	146.59	144.49	143.90	+ 0.60	+ 2.69	+ 0.59
24-40-403	150.52	149.98	148.22	146.80	+ 3.72	+ 3.18	+ 1.42
24-40-702	N/A	113.02	111.69	110.10	N/A	+ 2.92	+ 1.59

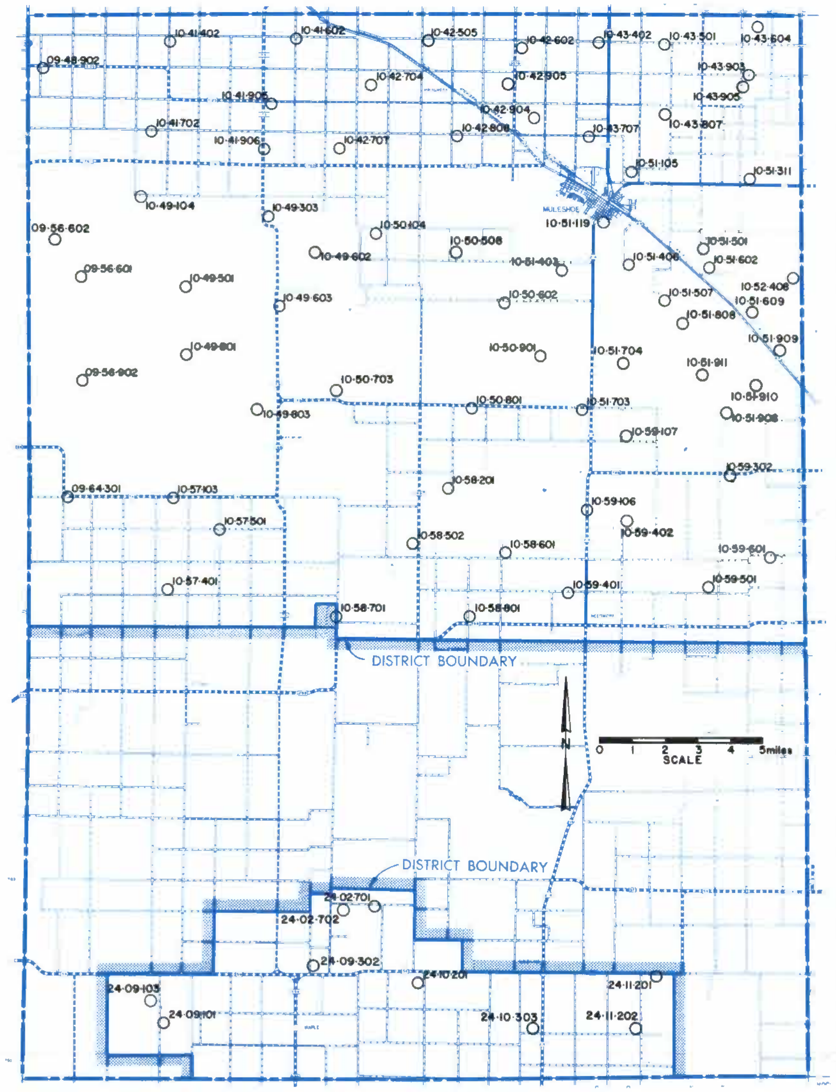
NOTE: N/A Denotes data not available

HALE COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
11-58-901	N/A	104.01	96.44	97.50	N/A	+ 6.51	– 1.06
11-59-402	90.00	92.14	74.57	75.65	+ 14.35	+ 16.49	– 1.08
11-59-404	N/A	191.03	196.44	196.00	N/A	– 4.97	+ 0.44
11-59-503	86.69	85.06	78.71	79.52	+ 7.17	+ 5.54	– 0.81
11-59-804	N/A	105.48	94.56	92.43	N/A	+ 13.05	+ 2.13
11-60-401	94.30	97.83	101.18	100.82	– 6.52	– 2.99	+ 0.36
11-60-802	N/A	185.30	178.24	177.18	N/A	+ 8.12	+ 1.06
23-02-302	110.35	114.42	112.93	111.05	– 0.70	+ 3.37	+ 1.88
23-02-501	191.57	205.97	207.75	204.77	– 13.20	+ 1.20	+ 2.98
23-02-901	N/A	192.60	192.47	189.25	N/A	+ 3.35	+ 3.22
23-03-103	117.14	118.66	111.89	110.40	+ 6.74	+ 8.26	+ 1.49
23-03-201	N/A	137.80	132.14	129.50	N/A	+ 8.30	+ 2.64
23-03-304	N/A	134.80	132.17	130.89	N/A	+ 3.91	+ 1.28
23-03-401	N/A	108.99	107.53	105.43	N/A	+ 3.56	+ 2.10

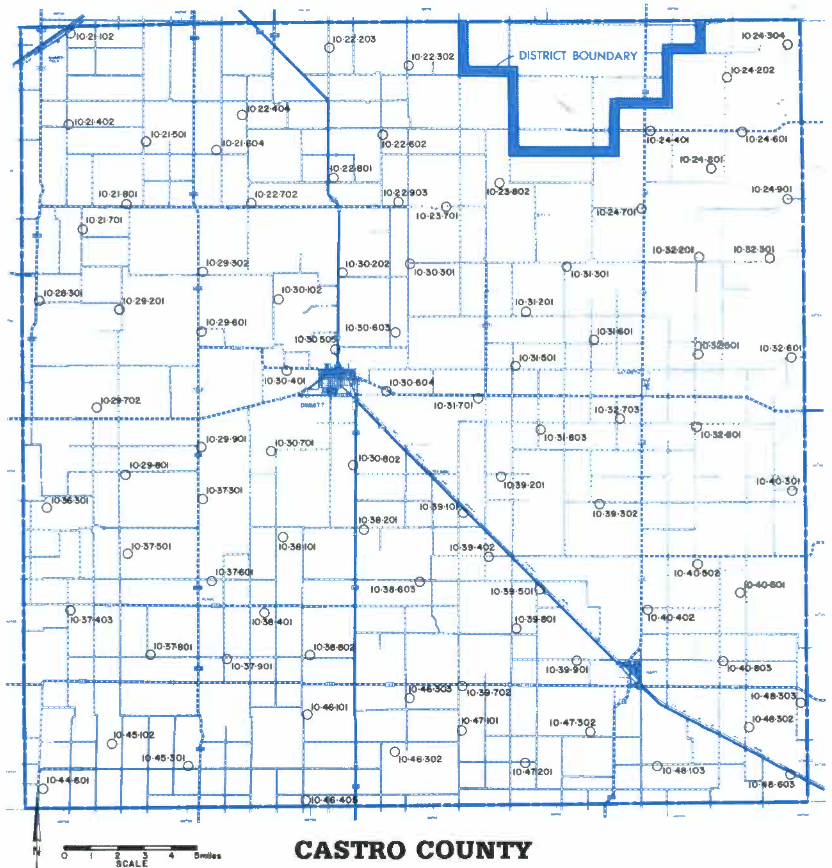
Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
23-03-505	N/A	126.02	115.73	111.90	N/A	+ 14.12	+ 3.83
23-03-702	N/A	187.51	188.53	181.18	N/A	+ 6.33	+ 7.35
23-03-802	189.24	202.09	206.80	205.45	– 16.21	– 3.36	+ 1.35
23-03-902	N/A	184.10	188.97	186.44	N/A	– 2.34	+ 2.53
23-04-106	N/A	208.83	208.60	207.68	N/A	+ 1.15	+ 0.92
23-04-404	N/A	N/A	133.69	128.08	N/A	N/A	+ 5.61
23-04-502	206.48	215.04	217.57	217.31	– 10.83	– 2.27	+ 0.26
23-04-701	158.17	163.08	162.15	161.67	– 3.50	+ 1.41	+ 0.48
23-10-201	N/A	165.46	163.11	155.73	N/A	+ 9.73	+ 7.38
23-10-203	N/A	169.96	168.52	166.95	N/A	+ 3.01	+ 1.57
23-11-103	N/A	216.10	216.62	216.20	N/A	– 0.10	+ 0.42
23-11-305	N/A	N/A	N/A	180.27	N/A	N/A	N/A
23-12-102	195.11	204.04	206.43	205.80	– 10.69	– 1.76	+ 0.63

NOTE: N/A Denotes data not available



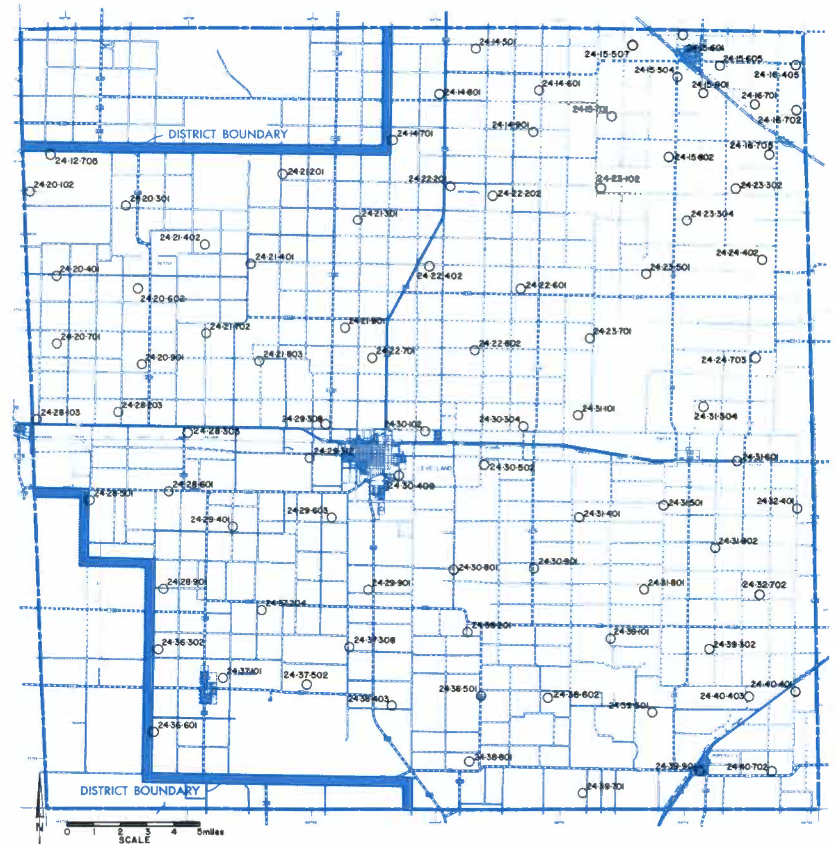
BAILEY COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
09-48-902	153.32	164.58	170.21	172.35	– 19.03	– 7.77	– 2.14
09-56-601	N/A	43.14	49.30	45.99	N/A	– 2.85	+ 3.31
09-56-602	N/A	N/A	65.95	67.15	N/A	N/A	– 1.20
09-56-902	42.78	45.29	47.53	48.13	– 5.35	– 2.84	– 0.60
09-64-301	65.85	74.47	65.35	62.23	+ 3.62	+ 12.24	+ 3.12
10-41-402	166.21	176.03	178.02	178.11	– 11.90	– 2.08	– 0.09
10-41-602	N/A	N/A	171.77	173.22	N/A	N/A	– 1.45
10-41-702	111.19	120.97	125.19	124.95	– 13.76	– 3.98	+ 0.24
10-41-905	123.05	134.90	135.39	135.20	– 12.15	– 0.30	+ 0.19
10-41-906	97.15	109.25	111.84	113.04	– 15.89	– 3.79	– 1.20
10-42-505	137.59	154.18	161.14	161.95	– 24.36	– 7.77	– 0.81
10-42-602	N/A	147.93	153.22	N/A	N/A	N/A	N/A
10-42-704	125.97	140.61	140.78	141.54	– 15.57	– 0.93	– 0.76
10-42-707	105.14	113.87	113.10	115.69	– 10.55	– 1.82	– 2.59
10-42-808	96.71	105.27	108.20	108.95	– 12.24	– 3.68	– 0.75
10-42-904	N/A	N/A	116.65	117.32	N/A	N/A	– 0.67
10-42-905	N/A	N/A	N/A	128.70	N/A	N/A	N/A
10-43-402	139.21	155.17	160.99	162.48	– 23.27	– 7.31	– 1.49
10-43-501	N/A	146.08	155.89	156.72	N/A	– 10.64	– 0.83
10-43-604	N/A	171.97	178.97	178.18	N/A	– 6.21	+ 0.79
10-43-707	104.73	116.09	117.39	117.44	– 12.71	– 1.35	– 0.05
10-43-807	N/A	114.23	118.12	117.43	N/A	– 3.20	+ 0.69
10-43-903	121.85	137.18	141.38	141.95	– 20.10	– 4.77	– 0.57
10-43-905	109.45	123.32	127.50	127.23	– 17.78	– 3.91	+ 0.27
10-49-104	N/A	N/A	N/A	94.92	N/A	N/A	N/A
10-49-303	58.36	77.62	86.67	86.67	– 28.31	– 9.05	0.00



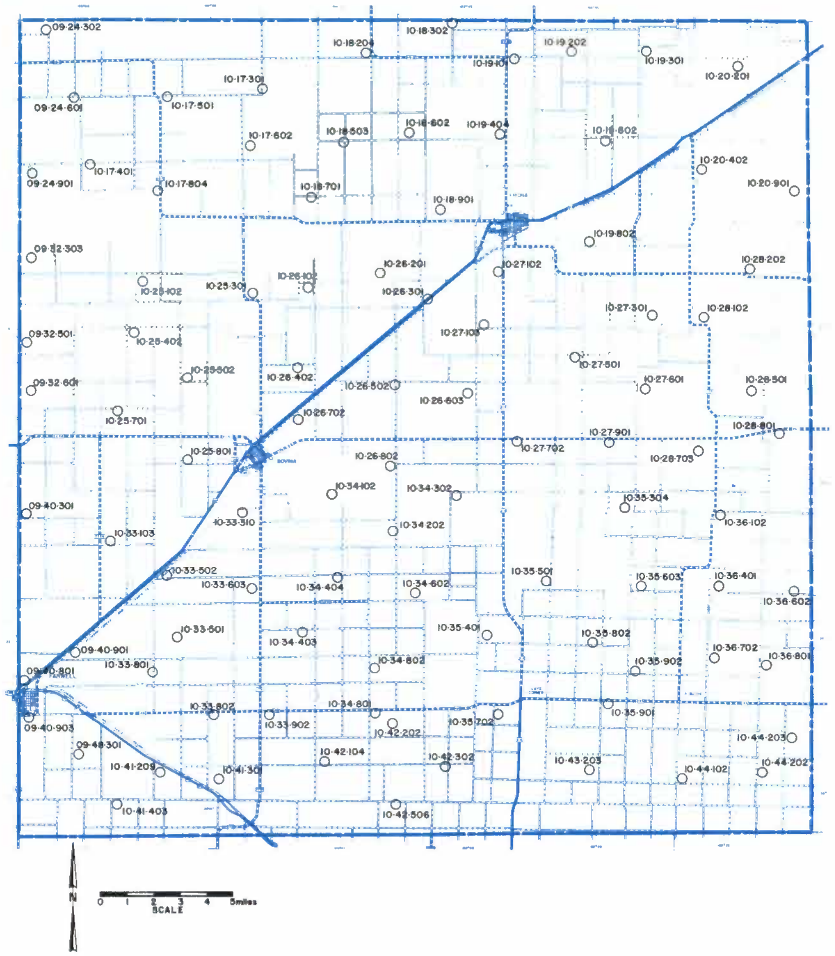
CASTRO COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
10-21-102	N/A	234.64	236.97	236.10	N/A	– 1.46	+ 0.87
10-21-402	182.81	198.79	208.52	208.88	– 26.07	– 10.09	– 0.36
10-21-501	172.65	184.40	188.82	189.05	– 16.40	– 4.65	– 0.23
10-21-604	152.97	163.32	166.62	165.85	– 12.88	– 2.53	+ 0.77
10-21-701	235.52	242.74	242.29	240.95	– 5.43	+ 1.79	+ 1.34
10-21-801	221.31	235.40	241.77	241.07	– 19.76	– 5.67	+ 0.70
10-22-203	175.86	185.45	191.18	189.38	– 13.52	– 3.93	+ 1.80
10-22-302	106.42	107.74	106.10	105.73	+ 0.69	+ 2.01	+ 0.37
10-22-404	N/A	N/A	190.78	189.60	N/A	N/A	+ 1.18
10-22-602	83.30	84.05	85.60	84.46	– 1.16	– 0.41	+ 1.14
10-22-702	N/A	192.67	197.51	197.15	N/A	– 4.48	+ 0.36
10-22-801	170.47	N/A	184.01	183.49	– 13.02	N/A	+ 0.52
10-22-903	150.35	152.10	153.38	151.75	– 1.40	+ 0.35	+ 1.63
10-23-701	115.54	113.43	112.39	109.63	+ 5.91	+ 3.80	+ 2.76
10-23-802	N/A	139.92	140.68	140.20	N/A	– 0.28	+ 0.48
10-24-202	176.60	177.18	177.96	178.20	– 1.60	– 1.02	– 0.24
10-24-304	N/A	165.06	165.58	165.56	N/A	– 0.50	+ 0.02
10-24-401	192.26	191.61	191.04	190.92	+ 1.34	+ 0.69	+ 0.12
10-24-601	161.00	161.48	161.35	161.26	– 0.26	+ 0.22	+ 0.09
10-24-701	190.90	189.67	188.26	187.80	+ 3.10	+ 1.87	+ 0.46
10-24-801	186.78	186.15	185.09	184.75	+ 2.03	+ 1.40	+ 0.34
10-24-901	N/A	199.81	196.88	195.97	N/A	+ 3.84	+ 0.91
10-28-301	293.38	305.86	311.41	312.93	– 19.55	– 7.07	– 1.52
10-29-201	N/A	270.43	271.31	272.98	N/A	– 2.55	– 1.67
10-29-302	293.82	298.65	302.58	302.02	– 8.20	– 3.37	+ 0.56
10-29-601	275.45	285.86	N/A	N/A	N/A	N/A	N/A
10-29-702	303.37	325.86	334.73	334.85	– 31.48	– 8.99	– 0.12
10-29-801	N/A	251.03	260.42	261.10	N/A	– 10.07	– 0.68
10-29-901	N/A	257.02	266.04	265.97	N/A	– 8.95	+ 0.07
10-30-102	264.75	273.72	277.95	277.45	– 12.70	– 3.73	+ 0.50
10-30-202	246.62	258.50	259.25	261.10	– 14.48	– 2.60	– 1.85
10-30-301	N/A	173.06	172.67	169.20	N/A	+ 3.86	+ 3.47
10-30-401	277.11	288.90	292.71	293.05	– 15.94	– 4.15	– 0.34
10-30-505	239.31	245.61	247.58	248.35	– 9.04	– 2.74	– 0.77
10-30-603	214.05	218.78	218.55	217.53	– 3.48	+ 1.25	+ 1.02
10-30-604	N/A	276.96	277.94	276.73	N/A	+ 0.23	+ 1.21



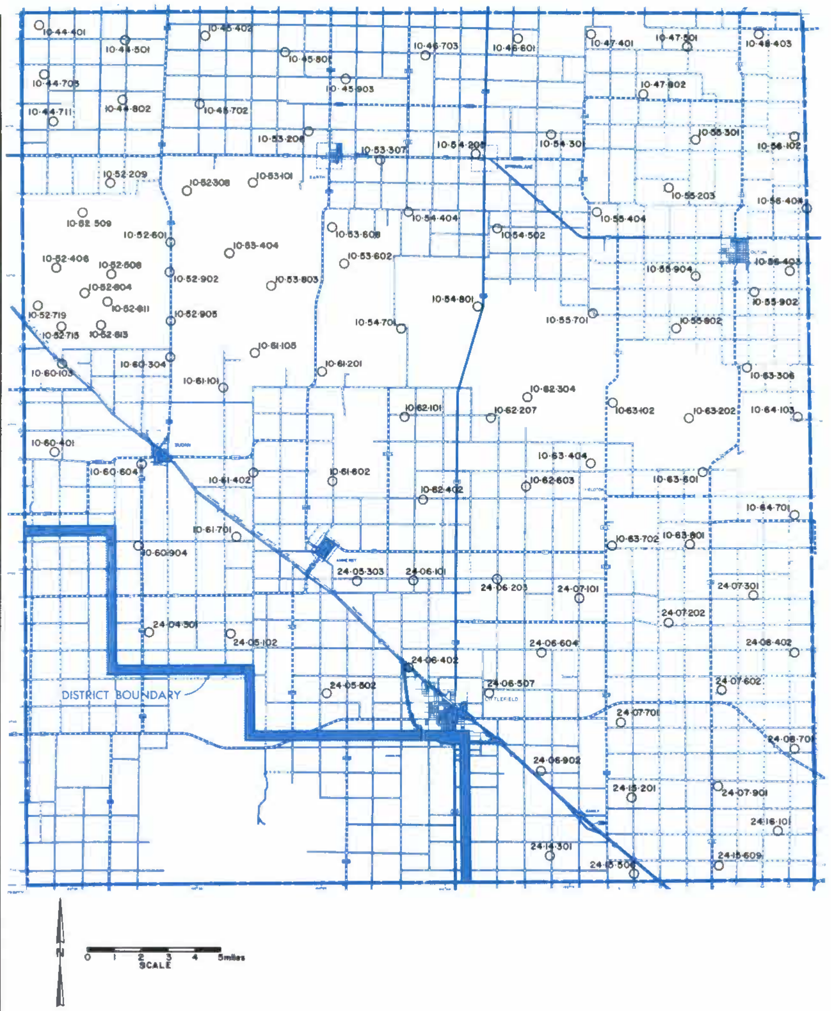
HOCKLEY COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
24-12-705	N/A	140.94	140.51	138.98	N/A	+ 1.96	+ 1.53
24-14-501	103.35	101.17	97.38	95.36	+ 7.99	+ 5.81	+ 2.02
24-14-601	N/A	129.83	127.56	125.58	N/A	+ 4.25	+ 1.98
24-14-701	N/A	44.74	39.52	33.12	N/A	+ 11.62	+ 6.40
24-14-801	50.98	51.45	45.25	43.46	+ 7.52	+ 7.99	+ 1.79
24-14-901	99.54	100.31	99.73	99.19	+ 0.35	+ 1.12	+ 0.54
24-15-504	70.12	71.39	69.27	68.17	+ 1.95	+ 3.22	+ 1.10
24-15-507	81.99	86.02	81.37	81.25	+ 0.74	+ 4.77	+ 0.12
24-15-601	110.89	115.90	112.78	111.90	– 1.01	+ 4.00	+ 0.88
24-15-605	100.88	102.29	102.55	102.05	– 1.17	+ 0.24	+ 0.50
24-15-701	N/A	102.15	99.28	97.27	N/A	+ 4.88	+ 2.01
24-15-802	183.37	181.30	176.36	174.72	+ 8.65	+ 6.58	+ 1.64
24-15-901	50.07	53.03	50.77	51.12	– 1.05	+ 1.91	– 0.35
24-16-405	133.20	134.51	133.28	131.38	+ 1.82	+ 3.13	+ 1.90
24-16-701	70.28	74.47	74.77	73.63	– 3.35	+ 0.84	+ 1.14
24-16-702	101.74	102.75	99.81	98.87	+ 2.87	+ 3.88	+ 0.94
24-16-705	N/A	94.24	92.02	91.50	N/A	+ 2.74	+ 0.52
24-20-102	149.19	150.32	150.71	147.55	+ 1.64	+ 2.77	+ 3.16
24-20-301	136.68	137.28	138.91	137.75	– 1.07	– 0.47	+ 1.16
24-20-401	124.30	129.79	133.28	132.43	– 8.13	– 2.64	+ 0.85
24-20-602	154.50	156.25	158.57	158.92	– 4.42	– 2.67	– 0.35
24-20-701	148.37	150.85	151.72	151.40	– 3.03	– 0.55	+ 0.32
24-20-901	150.58	153.08	154.17	153.20	– 2.62	– 0.12	+ 0.97
24-21-201	44.95	45.46	43.65	42.28	+ 2.67	+ 3.18	+ 1.37
24-21-301	94.39	N/A	93.86	92.48	+ 1.91	N/A	+ 1.38
24-21-401	156.65	156.24	155.83	154.71	+ 1.94	+ 1.53	+ 1.12
24-21-402	N/A	140.10	139.18	139.12	N/A	+ 0.98	+ 0.06
24-21-702	N/A	149.53	149.38	148.19	N/A	+ 1.34	+ 1.19
24-21-803	169.43	169.84	168.04	166.31	+ 3.12	+ 3.53	+ 1.73
24-21-901	166.17	169.65	169.70	167.75	– 1.58	+ 1.90	+ 1.95
24-22-201	72.44	74.13	71.06	70.16	+ 2.28	+ 3.97	+ 0.90
24-22-202	85.40	84.85	83.86	82.82	+ 2.58	+ 2.03	+ 1.04
24-22-402	N/A	N/A	67.39	65.39	N/A	N/A	+ 2.00
24-22-601	102.75	100.93	98.83	97.70	+ 5.05	+ 3.23	+ 1.13
24-22-701	178.55	177.20	175.45	173.90	+ 4.65	+ 3.30	+ 1.55
24-22-802	123.67	119.94	114.44	111.67	+ 12.00	+ 8.27	+ 2.77



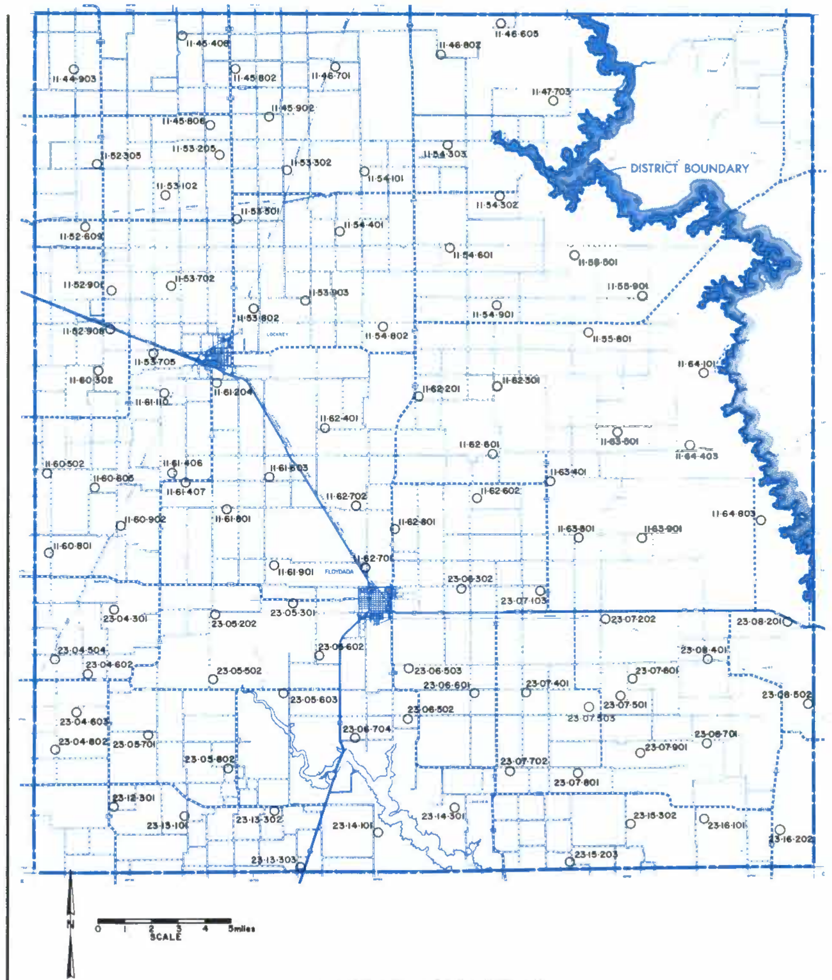
PARMER COUNTY

Well Number	Depth to Water Below Land Surface In Feet				Total Change In Water Levels In Feet		
	1978	1983	1987	1988	1978 to 1988	1983 to 1988	1987 to 1988
09-24-302	N/A	289.43	288.05	288.04	N/A	+ 1.39	+ 0.01
09-24-601	336.14	336.15	335.12	334.35	+ 1.79	+ 1.80	+ 0.77
09-24-901	N/A	290.84	293.30	292.68	N/A	− 1.84	+ 0.62
09-32-303	344.70	341.65	334.74	333.59	+ 11.11	+ 8.06	+ 1.15
09-32-501	N/A	356.57	358.35	356.97	N/A	− 0.40	+ 1.38
09-32-601	315.38	322.48	324.35	324.87	− 9.49	− 2.39	− 0.52
09-40-301	315.55	329.50	320.79	320.36	− 4.81	+ 9.14	+ 0.43
09-40-801	N/A	260.80	269.99	271.70	N/A	− 10.90	− 1.71
09-40-901	280.30	299.47	308.48	310.42	− 30.12	− 10.95	− 1.94
09-40-903	255.84	269.97	276.51	279.15	− 23.31	− 9.18	− 2.64
09-48-301	236.84	247.61	253.87	254.32	− 17.48	− 6.71	− 0.45
10-17-301	194.82	192.46	N/A	194.78	+ 0.04	− 2.32	N/A
10-17-401	284.25	281.96	281.94	281.65	+ 2.60	+ 0.31	+ 0.29
10-17-501	268.23	262.40	260.60	260.11	+ 8.12	+ 2.29	+ 0.49
10-17-602	N/A	192.64	191.51	190.24	N/A	+ 2.40	+ 1.27
10-17-804	N/A	219.22	217.17	214.97	N/A	+ 4.25	+ 2.20
10-18-204	N/A	313.67	307.71	307.02	N/A	+ 6.65	+ 0.69
10-18-302	N/A	248.55	247.35	245.99	N/A	+ 2.56	+ 1.36
10-18-503	N/A	N/A	262.72	262.04	N/A	N/A	+ 0.68
10-18-602	311.29	308.00	304.95	304.12	+ 7.17	+ 3.88	+ 0.83
10-18-701	258.97	256.45	251.49	250.32	+ 8.65	+ 6.13	+ 1.17
10-18-901	279.32	272.76	268.62	266.48	+ 12.84	+ 6.28	+ 2.14
10-19-101	290.15	292.57	293.36	292.62	− 2.47	− 0.05	+ 0.74
10-19-202	N/A	311.03	315.08	314.43	N/A	− 3.40	+ 0.65
10-19-301	281.14	279.55	278.74	278.05	+ 3.09	+ 1.50	+ 0.69
10-19-404	N/A	236.93	242.52	242.48	N/A	− 5.55	+ 0.04
10-19-602	259.84	274.76	280.75	278.44	− 18.60	− 3.68	+ 2.31
10-19-802	N/A	230.16	234.07	234.14	N/A	− 3.98	− 0.07
10-20-201	N/A	190.73	192.27	192.62	N/A	− 1.89	− 0.35
10-20-402	257.70	257.06	260.74	253.47	+ 4.23	+ 3.59	+ 7.27
10-20-901	N/A	199.04	204.87	203.92	N/A	− 4.88	+ 0.95
10-25-102	293.42	287.17	282.97	281.97	+ 11.45	+ 5.20	+ 1.00
10-25-301	302.41	304.61	303.69	303.27	− 0.86	+ 1.34	+ 0.42
10-25-402	N/A	265.83	265.44	265.18	N/A	+ 0.65	+ 0.26
10-25-502	174.62	182.00	179.87	184.19	− 9.57	− 2.19	− 4.32



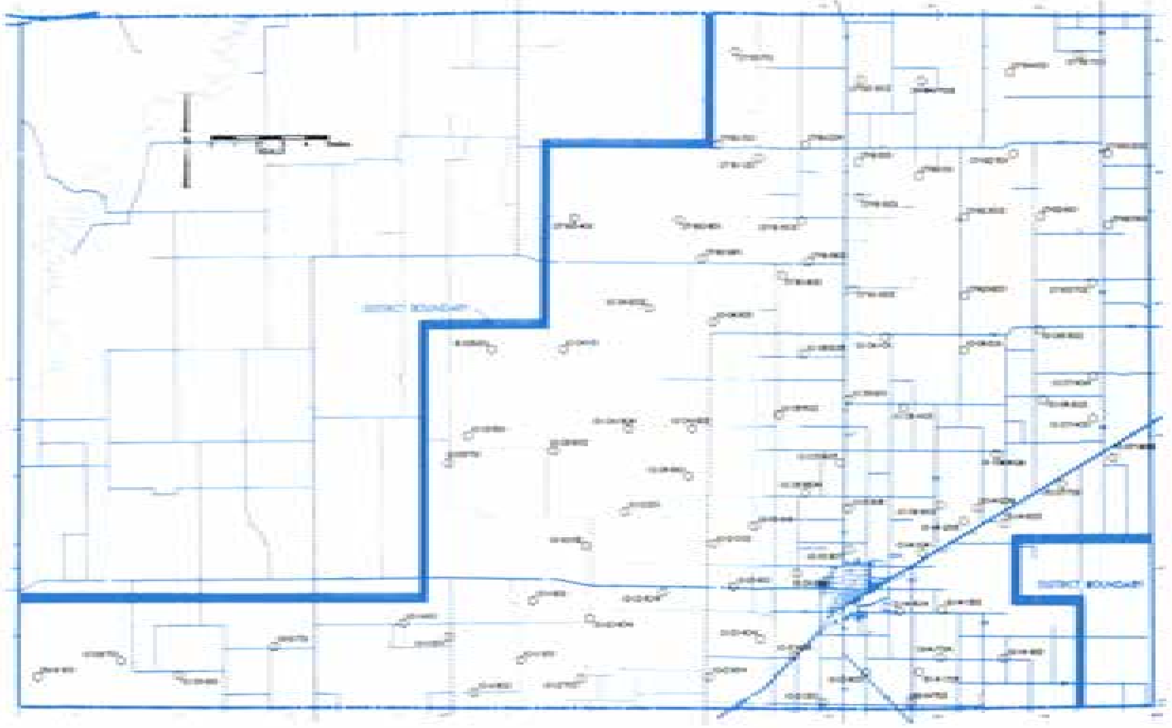
LAMB COUNTY

Well Number	Depth to Water Below Land Surface In Feet				Total Change In Water Levels In Feet		
	1978	1983	1987	1988	1978 to 1988	1983 to 1988	1987 to 1988
10-44-401	155.81	182.42	188.34	190.30	− 34.49	− 7.88	− 1.96
10-44-501	158.15	177.58	186.50	186.82	− 28.67	− 9.24	− 0.32
10-44-703	118.30	132.82	141.75	138.57	− 20.27	− 5.75	+ 3.18
10-44-711	99.80	108.54	112.65	113.00	− 13.20	− 4.46	− 0.35
10-44-802	99.00	111.17	116.19	116.99	− 17.99	− 5.82	− 0.80
10-45-402	N/A	179.82	189.75	188.91	N/A	− 9.09	+ 0.84
10-45-702	112.16	122.38	128.30	128.83	− 16.67	− 6.45	− 0.53
10-45-801	178.86	192.96	195.99	195.58	− 16.72	− 2.62	+ 0.41
10-45-903	N/A	N/A	192.75	192.39	N/A	N/A	+ 0.36
10-46-601	194.59	215.56	222.95	221.28	− 26.69	− 5.72	+ 1.67
10-46-703	190.73	204.18	207.00	210.11	− 19.38	− 5.93	− 3.11
10-47-401	172.44	188.24	N/A	200.19	− 27.75	− 11.95	N/A
10-47-501	172.34	187.21	194.40	194.15	− 21.81	− 6.94	+ 0.25
10-47-802	N/A	218.24	225.61	222.66	N/A	− 4.42	+ 2.95
10-48-403	189.77	205.44	211.40	211.06	− 21.29	− 5.62	+ 0.34
10-52-209	83.70	103.92	109.00	105.46	− 21.76	− 1.54	+ 3.54
10-52-308	N/A	101.26	104.56	104.67	N/A	− 3.41	− 0.11
10-52-406	N/A	N/A	113.90	113.79	N/A	N/A	+ 0.11
10-52-508	N/A	N/A	77.58	77.86	N/A	N/A	− 0.28
10-52-509	N/A	N/A	85.64	85.92	N/A	N/A	− 0.28
10-52-601	39.70	45.99	51.06	52.52	− 12.82	− 6.53	− 1.46
10-52-715	N/A	N/A	133.12	135.74	N/A	N/A	− 2.62
10-52-719	N/A	N/A	124.99	124.98	N/A	N/A	+ 0.01
10-52-804	N/A	N/A	119.04	118.59	N/A	N/A	+ 0.45
10-52-811	N/A	N/A	88.63	88.29	N/A	N/A	+ 0.34
10-52-813	N/A	N/A	85.29	85.11	N/A	N/A	+ 0.18
10-52-902	56.31	60.53	64.30	65.15	− 8.84	− 4.62	− 0.85
10-52-905	N/A	98.84	99.73	97.56	N/A	+ 1.28	+ 2.17
10-53-101	80.45	92.89	97.19	94.91	− 14.46	− 2.02	+ 2.28
10-53-206	N/A	142.80	146.32	145.91	N/A	− 3.11	+ 0.41
10-53-307	122.25	135.81	139.47	139.63	− 17.38	− 3.82	− 0.16
10-53-404	N/A	68.04	N/A	75.64	N/A	[illegible] 6.70	N/A



FLOYD COUNTY

Well Number	Depth to Water Below Land Surface In Feet				Total Change In Water Levels In Feet		
	1978	1983	1987	1988	1978 to 1988	1983 to 1988	1987 to 1988
11-44-903	N/A	177.65	188.12	188.10	N/A	− 10.45	+ 0.02
11-45-408	N/A	207.65	213.74	211.70	N/A	− 4.05	+ 2.04
11-45-802	180.62	190.58	194.70	194.62	− 14.00	− 4.04	+ 0.08
11-45-806	170.01	175.28	175.65	175.70	− 5.69	− 0.42	− 0.05
11-45-902	184.27	187.67	190.15	188.50	− 4.23	− 0.83	+ 1.65
11-46-605	N/A	N/A	215.55	214.00	N/A	N/A	+ 1.55
11-46-701	214.53	221.49	223.95	223.66	− 9.13	− 2.17	+ 0.29
11-46-802	254.49	260.38	260.85	262.14	− 7.65	− 1.76	− 1.29
11-47-703	230.84	236.45	239.45	238.23	− 7.39	− 1.78	+ 1.22
11-52-305	181.36	188.50	192.05	192.55	− 11.19	− 4.05	− 0.50
11-52-609	N/A	208.35	214.40	215.35	N/A	− 7.00	− 0.95
11-52-901	202.28	218.75	225.50	226.45	− 24.17	− 7.70	− 0.95
11-52-908	197.69	226.93	229.90	231.29	− 33.60	− 4.36	− 1.39
11-53-102	195.06	200.02	198.86	197.70	− 2.64	+ 2.32	+ 1.16
11-53-205	156.08	159.46	161.00	161.38	− 5.30	− 1.92	− 0.38
11-53-302	N/A	198.77	203.80	199.42	N/A	− 0.65	+ 4.38
11-53-501	214.04	222.50	222.34	220.88	− 6.84	+ 1.62	+ 1.46
11-53-702	183.84	197.94	201.45	201.60	− 17.76	− 3.66	− 0.15
11-53-705	212.94	237.27	236.60	235.10	− 22.16	+ 2.17	+ 1.50
11-53-802	N/A	152.92	152.76	152.78	N/A	+ 0.14	− 0.02
11-53-903	162.97	163.38	162.06	159.35	+ 3.62	+ 4.03	+ 2.71
11-54-101	212.78	218.72	218.85	218.97	− 6.19	− 0.25	− 0.12
11-54-302	257.83	265.91	266.10	265.92	− 8.09	− 0.01	+ 0.18
11-54-303	N/A	251.68	253.64	252.44	N/A	− 0.76	+ 1.20
11-54-401	182.10	183.60	N/A	N/A	N/A	N/A	N/A
11-54-601	N/A	247.70	246.42	245.13	N/A	+ 2.57	+ 1.29
11-54-802	N/A	N/A	175.44	173.64	N/A	N/A	+ 1.80
11-54-901	223.79	223.27	225.50	222.25	+ 1.54	+ 1.02	+ 3.25
11-55-501	N/A	283.44	280.04	278.90	N/A	+ 4.54	+ 1.14
11-55-801	N/A	243.84	244.90	244.25	N/A	− 0.41	+ 0.65
11-55-901	294.20	N/A	289.94	289.24	+ 4.96	N/A	+ 0.70
11-60-302	204.37	232.00	234.06	233.19	− 28.82	− 1.19	+ 0.87
11-60-502	208.02	232.86	229.15	224.25	− 16.23	+ 8.61	+ 4.90
11-60-605	222.51	235.12	234.51	233.43	− 10.92	+ 1.69	+ 1.08
11-60-801	N/A	153.64	154.20	151.90	N/A	+ 1.74	+ 2.30

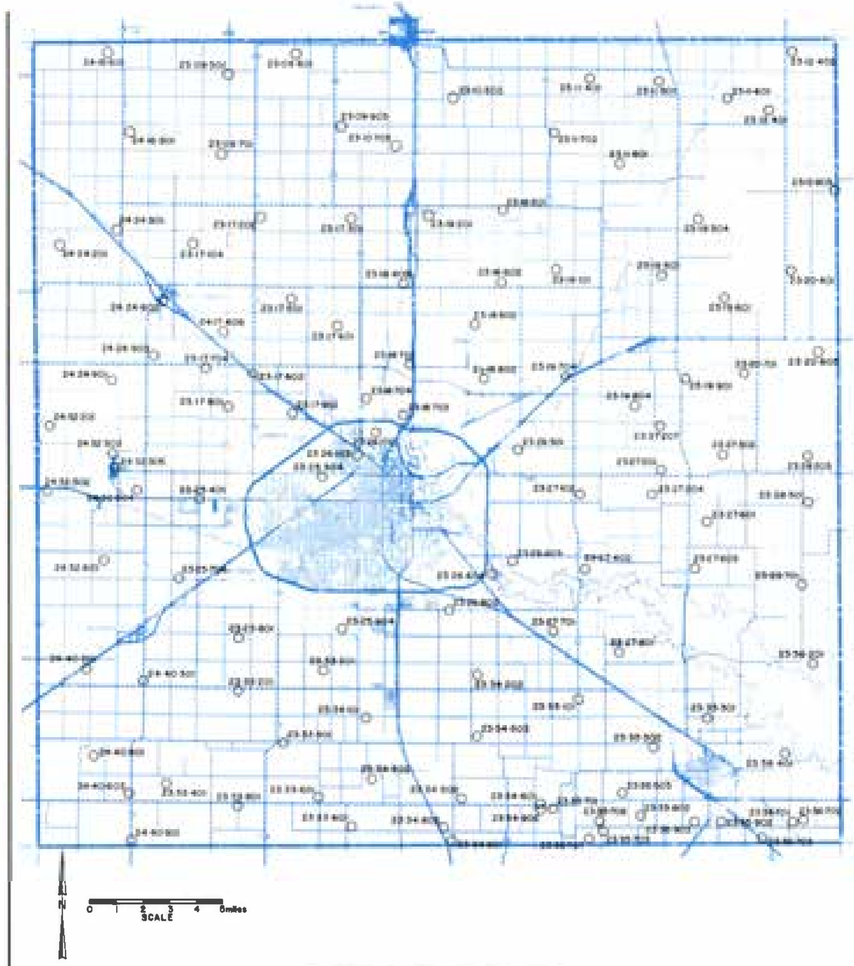


DEAF SMITH COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
07-53-701	233.12	236.29	236.73	237.40	– 4.28	– 1.11	– 0.67
07-53-902	230.04	236.18	237.28	236.59	– 6.55	– 0.41	+ 0.69
07-54-702	N/A	N/A	170.42	171.00	N/A	N/A	– 0.58
07-54-901	178.92	186.93	190.34	190.45	– 11.53	– 3.52	– 0.11
07-55-701	228.68	235.16	236.67	236.07	– 7.39	– 0.91	+ 0.60
07-60-301	285.80	294.10	298.68	298.58	– 12.78	– 4.48	+ 0.10
07-60-401	301.19	308.45	307.68	307.29	– 6.10	+ 1.16	+ 0.39
07-60-601	252.58	261.77	266.60	N/A	N/A	N/A	N/A
07-60-901	228.49	241.19	247.02	248.45	– 19.96	– 7.26	– 1.43
07-61-120	N/A	N/A	N/A	237.90	N/A	N/A	N/A
07-61-224	N/A	260.18	263.20	265.25	N/A	– 5.07	– 2.05
07-61-301	219.56	227.02	230.33	231.36	– 11.80	– 4.34	– 1.03
07-61-502	220.87	226.00	230.47	230.73	– 9.86	– 4.73	– 0.26
07-61-601	209.32	N/A	222.62	225.32	– 16.00	N/A	– 2.70
07-61-802	N/A	N/A	220.88	222.25	N/A	N/A	– 1.37
07-61-803	N/A	N/A	N/A	259.51	N/A	N/A	N/A
07-61-902	N/A	N/A	212.32	215.30	N/A	N/A	– 2.98
07-62-101	226.98	232.84	232.49	232.70	– 5.72	+ 0.14	– 0.21
07-62-301	187.40	189.04	192.24	194.00	– 6.60	– 4.96	– 1.76
07-62-502	N/A	N/A	209.10	208.75	N/A	N/A	+ 0.35
07-62-601	199.78	203.37	207.83	203.95	– 4.17	– 0.58	+ 3.88
07-62-823	N/A	183.43	191.07	189.54	N/A	– 6.11	+ 1.53
07-63-202	193.54	191.58	195.32	194.46	– 0.92	– 2.88	+ 0.86
07-63-501	140.90	148.14	156.27	154.45	– 13.55	– 6.31	+ 1.82
07-63-702	163.39	175.98	177.97	177.85	– 14.46	– 1.87	+ 0.12
09-16-901	N/A	127.11	130.63	131.00	N/A	– 3.89	– 0.37
10-03-201	290.74	299.29	300.50	300.19	– 9.45	– 0.90	+ 0.31
10-03-501	257.40	258.20	258.23	257.67	– 0.27	+ 0.53	+ 0.56
10-03-701	223.48	225.10	226.14	225.85	– 2.37	– 0.75	+ 0.29
10-03-902	271.13	273.27	269.77	267.68	+ 3.45	+ 5.59	+ 2.09
10-04-101	335.30	342.18	327.28	325.97	+ 9.33	+ 16.21	+ 1.31
10-04-202	295.72	305.66	307.19	307.10	– 11.38	– 1.44	+ 0.09
10-04-301	297.87	307.10	310.94	310.53	– 12.66	– 3.43	+ 0.41
10-04-504	N/A	N/A	281.48	281.82	N/A	N/A	– 0.34
10-04-603	N/A	266.35	268.68	268.20	N/A	– 1.85	+ 0.48
10-04-901	209.22	215.80	215.23	212.35	– 3.13	+ 3.45	+ 2.88
10-05-225	N/A	N/A	241.58	242.48	N/A	N/A	– 0.90
10-05-502	208.25	215.47	217.73	216.72	– 8.47	– 1.25	+ 1.01
10-05-601	160.47	173.05	181.46	181.25	– 20.78	– 8.20	+ 0.21
10-05-804	N/A	171.60	184.01	186.36	N/A	– 14.76	– 2.35
10-05-905	N/A	N/A	204.72	205.02	N/A	N/A	– 0.30
10-06-101	N/A	176.25	184.50	185.02	N/A	– 8.77	– 0.52
10-06-201	167.39	175.03	179.47	180.13	– 12.74	– 5.10	– 0.66
10-06-302	170.54	181.44	190.83	186.90	– 16.36	– 5.46	+ 3.93

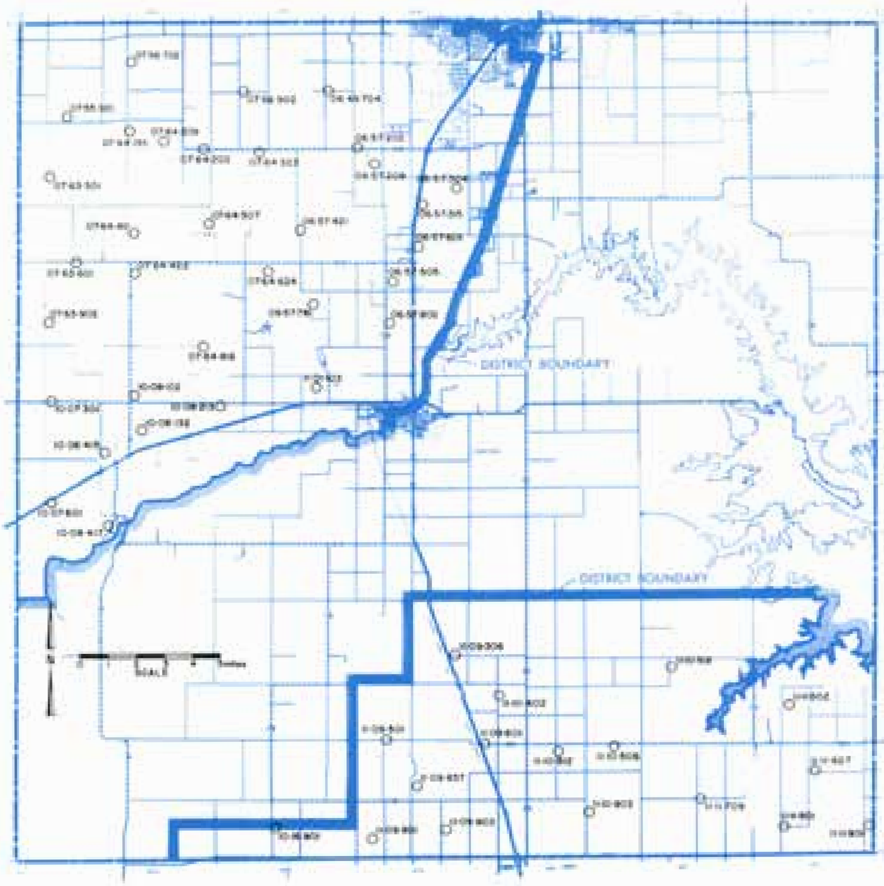
Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
10-06-403	182.96	193.28	197.81	196.79	– 13.83	– 3.51	+ 1.02
10-06-602	182.20	189.71	194.57	192.75	– 10.55	– 3.04	+ 1.82
10-06-801	80.54	81.42	82.13	81.35	– 0.81	+ 0.07	+ 0.78
10-06-909	153.38	158.05	160.25	160.01	– 6.63	– 1.96	+ 0.24
10-07-403	157.53	163.61	169.54	168.10	– 10.57	– 4.49	+ 1.44
10-07-404	166.44	176.32	185.75	184.00	– 17.56	– 7.68	+ 1.75
10-07-701	126.20	113.38	109.65	109.13	+ 17.07	+ 4.25	+ 0.52
10-07-805	N/A	N/A	137.60	138.60	N/A	N/A	– 1.00
10-09-701	N/A	136.73	137.68	137.48	N/A	– 0.75	+ 0.20
10-09-801	N/A	53.93	53.85	53.55	N/A	+ 0.38	+ 0.30
10-10-701	162.10	162.28	161.41	160.90	+ 1.20	+ 1.38	+ 0.51
10-11-401	189.54	192.20	194.40	193.68	– 4.14	– 1.48	+ 0.72
10-11-501	196.63	200.08	200.90	200.75	– 4.12	– 0.67	+ 0.15
10-11-601	164.95	161.61	161.32	161.25	+ 3.70	+ 0.36	+ 0.07
10-11-802	227.61	235.88	236.89	235.85	– 8.24	+ 0.03	+ 1.04
10-11-901	190.70	198.93	200.88	N/A	N/A	N/A	N/A
10-12-102	162.90	170.07	173.60	173.35	– 10.45	– 3.28	+ 0.25
10-12-201	71.76	72.65	72.82	71.30	+ 0.46	+ 1.35	+ 1.52
10-12-302	191.32	201.59	206.96	206.50	– 15.18	– 4.91	+ 0.46
10-12-404	N/A	224.23	222.10	219.18	N/A	+ 5.05	+ 2.92
10-12-504	224.72	230.87	228.15	226.20	– 1.48	+ 4.67	+ 1.95
10-12-703	N/A	N/A	196.66	N/A	N/A	N/A	N/A
10-12-904	176.06	188.65	195.19	194.12	– 18.06	– 5.47	+ 1.07
10-13-104	N/A	N/A	235.48	236.47	N/A	N/A	– 0.99
10-13-230	N/A	N/A	244.85	242.52	N/A	N/A	+ 2.33
10-13-305	171.63	186.10	190.11	189.88	– 18.25	– 3.78	+ 0.23
10-13-307	N/A	N/A	181.93	181.25	N/A	N/A	+ 0.68
10-13-401	N/A	205.87	213.20	213.29	N/A	– 7.42	– 0.09
10-13-404	N/A	178.04	187.24	N/A	N/A	N/A	N/A
10-13-806	N/A	N/A	189.78	189.01	N/A	N/A	+ 0.77
10-13-903	190.82	203.38	209.19	209.10	– 18.28	– 5.72	+ 0.09
10-14-104	81.90	79.11	77.93	77.34	+ 4.56	+ 1.77	+ 0.59
10-14-205	N/A	111.52	104.54	103.17	N/A	+ 8.35	+ 1.37
10-14-206	N/A	N/A	N/A	120.89	N/A	N/A	N/A
10-14-303	78.09	74.40	71.34	70.00	+ 8.09	+ 4.40	+ 1.34
10-14-404	152.73	163.65	160.80	158.90	– 6.17	+ 4.75	+ 1.90
10-14-513	N/A	N/A	N/A	100.60	N/A	N/A	N/A
10-14-702	189.33	197.93	199.54	199.30	– 9.97	– 1.37	+ 0.24
10-14-704	153.84	159.10	161.59	161.87	– 8.03	– 2.77	– 0.28
10-14-705	N/A	N/A	192.61	193.00	N/A	N/A	– 0.39
10-14-901	112.70	111.00	111.35	111.28	+ 1.42	– 0.28	+ 0.07
10-21-201	214.47	228.73	232.53	233.46	– 18.99	– 4.73	– 0.93

NOTE: N/A Denotes data not available



LUBBOCK COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
23-09-501	168.82	169.11	167.62	166.96	+ 1.86	+ 2.15	+ 0.66
23-09-601	145.63	145.69	145.21	145.33	+ 0.30	+ 0.36	– 0.12
23-09-701	167.72	169.06	167.98	165.73	+ 1.99	+ 3.33	+ 2.25
23-09-903	N/A	169.16	168.12	162.58	N/A	+ 6.58	+ 5.54
23-10-502	198.09	204.19	207.00	207.48	– 9.39	– 3.29	– 0.48
23-10-703	N/A	170.88	169.97	164.95	N/A	+ 5.93	+ 5.02
23-11-401	210.53	216.45	217.28	217.19	– 6.66	– 0.74	+ 0.09
23-11-501	N/A	195.54	196.15	194.75	N/A	+ 0.79	+ 1.40
23-11-601	172.51	174.40	175.21	175.10	– 2.59	– 0.70	+ 0.11
23-11-702	193.71	201.45	203.04	202.69	– 8.98	– 1.24	+ 0.35
23-11-801	208.27	212.99	214.75	216.98	– 8.71	– 3.99	– 2.23
23-12-401	179.17	185.43	187.42	187.02	– 7.85	– 1.59	+ 0.40
23-12-402	198.89	211.32	213.65	213.93	– 15.04	– 2.61	– 0.28
23-12-803	197.15	199.40	197.08	194.30	+ 2.85	+ 5.10	+ 2.78
23-17-104	N/A	137.15	137.45	136.74	N/A	+ 0.41	+ 0.71
23-17-202	161.07	164.58	162.70	160.58	+ 0.49	+ 4.00	+ 2.12
23-17-301	N/A	165.96	165.92	163.32	N/A	+ 2.64	+ 2.60
23-17-406	N/A	77.83	79.78	80.29	N/A	– 2.46	– 0.51
23-17-501	130.55	132.30	132.48	132.72	– 2.17	– 0.42	– 0.24
23-17-601	N/A	118.80	119.68	118.88	N/A	– 0.08	+ 0.80
23-17-704	76.97	78.00	76.95	77.49	– 0.52	+ 0.51	– 0.54
23-17-801	89.53	87.53	86.56	85.99	+ 3.54	+ 1.54	+ 0.57
23-17-802	78.92	80.50	84.26	N/A	N/A	N/A	N/A
23-17-901	71.05	68.42	61.42	60.09	+ 10.96	+ 8.33	+ 1.33
23-18-201	165.66	168.86	168.53	167.24	– 1.58	+ 1.62	+ 1.29
23-18-301	197.74	201.51	202.49	203.79	– 6.05	– 2.28	– 1.30
23-18-409	N/A	151.24	150.07	146.97	N/A	+ 4.27	+ 3.10
23-18-502	138.06	135.58	135.04	131.44	+ 6.62	+ 4.14	+ 3.60
23-18-602	N/A	152.62	151.38	148.35	N/A	+ 4.27	+ 3.03
23-18-701	87.38	88.44	88.55	87.69	– 0.31	+ 0.75	+ 0.86
23-18-703	80.23	77.68	76.59	76.20	+ 4.03	+ 1.48	+ 0.39
23-18-704	80.74	80.65	79.71	77.49	+ 3.25	+ 3.16	+ 2.22
23-18-802	N/A	98.60	97.32	95.50	N/A	+ 3.10	+ 1.82
23-19-101	190.91	192.37	192.09	188.88	+ 2.03	+ 3.49	+ 3.21
23-19-304	212.16	215.58	213.44	212.42	– 0.26	+ 3.16	+ 1.02



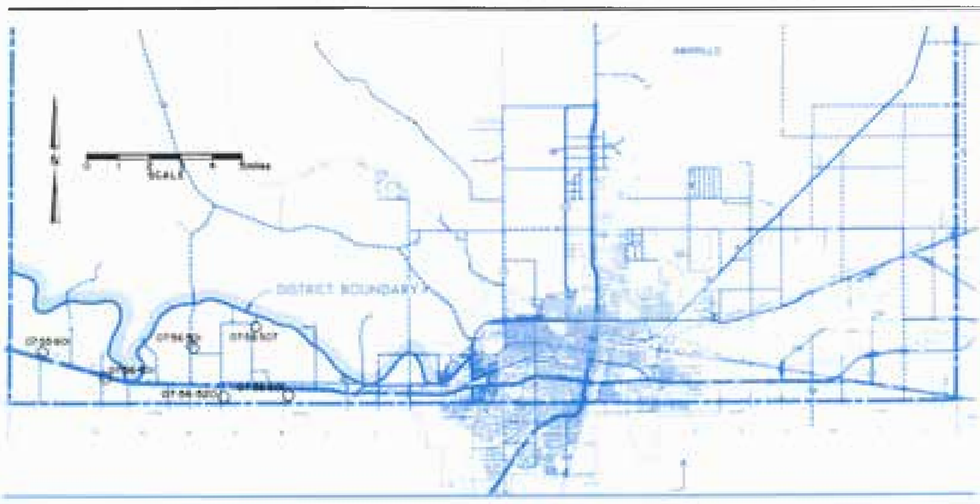
RANDALL COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
06-49-704	N/A	N/A	214.59	214.98	N/A	N/A	− 0.39
06-57-202	201.47	201.30	202.37	202.12	− 0.65	− 0.82	+ 0.25
06-57-208	N/A	200.35	199.45	196.68	N/A	+ 3.67	+ 2.77
06-57-304	N/A	163.20	160.48	159.98	N/A	+ 3.22	+ 0.50
06-57-315	N/A	152.04	153.42	153.74	N/A	− 1.70	− 0.32
06-57-421	N/A	191.07	189.25	189.58	N/A	+ 1.49	− 0.33
06-57-505	N/A	186.44	184.82	182.98	N/A	+ 3.46	+ 1.84

RANDALL COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
06-57-601	186.58	188.29	186.71	185.56	+ 1.02	+ 2.73	+ 1.15
06-57-716	N/A	167.67	169.64	170.20	N/A	− 2.53	− 0.56
06-57-802	163.38	157.13	156.79	156.13	+ 7.25	+ 1.00	+ 0.66
07-55-921	N/A	225.85	230.99	229.21	N/A	− 3.36	+ 1.78
07-56-702	248.29	245.80	251.86	249.91	− 1.62	− 4.11	+ 1.95
07-56-902	212.26	215.90	215.67	215.61	− 3.35	+ 0.29	+ 0.06
07-63-301	234.06	233.70	232.93	232.32	+ 1.74	+ 1.38	+ 0.61
07-63-601	174.04	184.44	190.58	189.94	− 15.90	− 5.50	+ 0.64
07-63-902	160.03	159.29	165.67	164.25	− 4.22	− 4.96	+ 1.42
07-64-135	N/A	N/A	222.22	220.62	N/A	N/A	+ 1.60
07-64-202	N/A	184.97	186.23	185.74	N/A	− 0.77	+ 0.49
07-64-209	N/A	178.79	180.49	180.22	N/A	− 1.43	+ 0.27
07-64-323	N/A	N/A	161.30	165.19	N/A	N/A	− 3.89
07-64-411	N/A	N/A	119.67	120.24	N/A	N/A	− 0.57
07-64-422	N/A	N/A	108.08	107.92	N/A	N/A	+ 0.16
07-64-507	173.10	164.66	160.37	159.34	+ 13.76	+ 5.32	+ 1.03
07-64-624	N/A	170.09	172.18	173.73	N/A	− 3.64	− 1.55
07-64-816	N/A	167.85	138.61	141.56	N/A	+ 26.29	− 2.95
10-07-301	136.67	136.91	138.98	139.03	− 2.36	− 2.12	− 0.05
10-07-601	102.66	102.64	104.23	103.88	− 1.22	− 1.24	+ 0.35
10-08-102	144.07	147.46	148.64	149.98	− 5.91	− 2.52	− 1.34
10-08-132	N/A	176.24	175.79	176.53	N/A	− 0.29	− 0.74
10-08-213	N/A	131.10	131.38	131.97	N/A	− 0.87	− 0.59
10-08-415	N/A	113.64	114.79	N/A	N/A	N/A	N/A
10-08-417	N/A	N/A	97.08	97.63	N/A	N/A	− 0.55
10-16-901	182.33	184.43	185.09	184.98	− 2.65	− 0.55	+ 0.11
11-01-103	N/A	83.35	83.53	83.88	N/A	− 0.53	− 0.35
11-09-306	N/A	162.26	162.77	162.45	N/A	− 0.19	+ 0.32
11-09-501	186.69	187.24	186.19	185.56	+ 1.13	+ 1.68	+ 0.63
11-09-601	199.60	198.33	196.35	195.44	+ 4.16	+ 2.89	+ 0.91
11-09-801	196.35	196.34	195.08	192.98	+ 3.37	+ 3.36	+ 2.10
11-09-837	N/A	N/A	178.35	177.85	N/A	N/A	+ 0.50
11-09-902	212.43	204.01	199.46	198.04	+ 14.39	+ 5.97	+ 1.42
11-10-301	N/A	130.20	128.88	127.67	N/A	+ 2.53	+ 1.21
11-10-402	175.80	175.76	174.57	174.44	+ 1.36	+ 1.32	+ 0.13
11-10-506	N/A	141.20	143.47	142.83	N/A	− 1.63	+ 0.64
11-10-512	N/A	179.02	181.71	178.02	N/A	+ 1.00	+ 3.69
11-10-802	187.31	180.69	178.86	177.07	+ 10.24	+ 3.62	+ 1.79
11-11-502	170.83	166.95	166.49	167.29	+ 3.54	− 0.34	− 0.80
11-11-709	N/A	N/A	184.71	183.24	N/A	N/A	+ 1.47
11-11-801	N/A	134.71	137.15	136.30	N/A	− 1.59	+ 0.85
11-11-901	134.62	134.35	135.05	135.02	− 0.40	− 0.67	+ 0.03
11-11-927	N/A	148.79	147.70	147.72	N/A	+ 1.07	− 0.02

NOTE: N/A Denotes data not available



POTTER COUNTY

Well Number	Depth to Water Below Land Surface In Feet 1978	1983	1987	1988	Total Change In Water Levels In Feet 1978 to 1988	1983 to 1988	1987 to 1988
07-55-601	N/A	255.83	255.30	254.99	N/A	+ 0.84	+ 0.31
07-56-307	222.92	223.77	225.22	224.53	− 1.61	− 0.76	+ 0.69
07-56-401	233.30	239.05	242.70	243.32	− 10.02	− 4.27	− 0.62
07-56-501	226.79	229.35	230.75	231.38	− 4.59	− 2.03	− 0.63
07-56-520	N/A	244.99	243.09	242.90	N/A	+ 2.09	+ 0.19
07-56-601	218.20	222.10	221.46	221.25	− 3.05	+ 0.85	+ 0.21

NOTE: N/A Denotes data not available

THE CROSS SECTION (USPS 564-920)
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Special issues will highlight District pivots

Newcomers flying over the Texas High Plains often wonder "what all those green circles are down there." The circles, or center pivot systems, represent a major advance in the irrigation industry. Area producers are not only reducing their labor and fuel costs with these sprinkler systems, but conserving the underground water resources of the Ogallala Aquifer as well.

In this special issue of the *Cross Section,* we will be highlighting the history of center pivot sprinklers as well as some of the producers who use these water-saving devices on their farms in the southern counties of the High Plains Underground Water Conservation District No. 1. The June issue of the *Cross Section* will continue the center pivot theme by highlighting producers in the northern portions of the District.

During the past few months, High Plains Underground Water Conservation District Engineer Technicians Obbie Goolsby and Arnold Husky, along with District Draftsman Keith Whitworth, have studied aerial photographs and constructed center pivot inventory maps for each county within the Water District. Eight of these maps appear in this issue and the remaining seven maps will run in June.

Goolsby and Husky noted 3,384 center pivots operating in the District at the end of March. Center pivot totals ranged from 836 in Lamb County to three in Potter County.

Individual county totals may be found with each map.

We salute the area producers for their hard work and willingness to implement new water conservation ideas, such as the center pivot.

Center pivot irrigation increases

WATER SAVINGS — Conversion of center pivot systems from above line discharge to crop height discharge helps reduce water losses as much as 20 percent.

Lyle improves pivot efficiency

Improving irrigation efficiencies has been a way of life for Dr. William M. Lyle, agricultural engineering professor, with the Texas Agricultural Experiment Station in Lubbock.

Lyle grew up on an irrigated farm, and this may have influenced his decision to specialize in irrigation.

"I knew I wanted to work with soil and water, so I began studying agricultural engineering. I noticed several discrepancies between school theories and actual farm practices concerning furrow irrigation, such as non-uniform water application rates and lack of control over the water. These inefficiencies are unavoidable a lot of the time; but in many cases, improved water management can be achieved," he says.

Dr. William M. Lyle

The agricultural engineer observed that center pivot irrigation offered many advantages for the irrigator. However, he documented water evaporation losses of 20 to 30 percent when water was sprayed under high pressure 10 feet above the plants during hot, windy days.

In the early 1970s, Lyle began farming and experimenting with furrow diking. He redesigned a furrow diker, using an idea originally developed in the 1930s, but which was found to be impractical and discarded.

He also began developing his idea of an irrigation system similar to center pivot systems, which would eliminate evaporation losses, deliver the water exactly where he wanted it in the furrow, and operate on low pressure which would reduce the energy needed to operate the system. In essence, he created the Low Energy Precision Application (LEPA) irrigation system.

He found that center pivot systems could be modified with drop nozzles to improve water placement. Lyle says he knew he needed to use furrow dikes to hold the water in place in the furrow until it had time to soak into the soil. Delivering the water directly into the diked furrows eliminated most of the irrigation losses, but often washed out the furrow dikes.

"We began work on the dropline

See LYLE Page Three

Center pivot development reviewed

Irrigation systems have come a long way from the hand-moved sprinkler pipe of the 1940s and 1950s to the Low Energy Precision Application System (LEPA) of the 1980s.

The early hand-moved sprinklers required great amounts of labor. Farmers and their helpers had to move 30 to 40 foot long pipe sections and lock them into the end of another pipe section before making a "set." Two "sets" per day could require up to four hours of labor by the irrigation crew.

Many producers rigged skids under the pipe joints and towed them back and forth across the field with a tractor. This made the job somewhat easier, but still required lots of pipe and labor.

Early motorized side roll systems helped get the pipe off the ground and above the crops. However, this still required a great amount of time to start the engine every few hours to move to a new irrigation set.

Frank Zybach, a Colorado dryland tenant farmer, noticed hired hands working in the mud to disassemble and reconnect the hand-moved pipe sections. As a result, he designed an automatic, self-propelled sprinkler irrigation system. The first center pivot prototype was a small, two-tower, water-driven system built in 1948. Four years later, he was awarded a patent for the "Zybach Self Propelled Irrigation Apparatus."

Zybach built a five-tower center pivot that could irrigate 40 acres in 1952. By 1954, he had manufactured 10 center pivot systems and had raised the main pipeline 10 feet above the ground to water taller crops.

The Colorado producer was interviewed in the January 1981 issue of *Irrigation Age.* He recalled that he had had quite a time selling the concept of center pivot irrigation to skeptical producers.

"Even if I could get the farmers interested in buying a pivot, the next problem was getting banks and agricultural lenders to agree to lend

See CENTER Page Four

Wolfforth producer reduces labor costs with sprinklers

In 1981, James Mitchell of Wolfforth was one of the first area producers to install a LEPA (Low Energy Precision Application) center pivot irrigation system on his land. Seven years later, he is still satisfied with the water use efficiency provided by the modified center pivot system.

"Everybody feels the need to reduce their labor and be more efficient," explains Mitchell, who is the President of the High Plains Underground Water Conservation District No. 1 Board of Directors.

"We knew there had to be a better way than spraying water up in the air and wetting the total ground. Our water volume is limited and LEPA irrigates the most efficiently. People with a lot of water can overcome some losses. But if you don't have much water to begin with, it's hard to overcome any losses," Mitchell says. By watering more efficiently, LEPAs allow irrigators to water more acreage with the same water amount.

Mitchell modified his existing center pivot with LEPA nozzles for about $5,000 to $6,000. Mitchell says the water saved is well worth the initial conversion cost.

"If you go to drop lines and drop the lines down into the furrow dikes, you get water application efficiency percentages in the 90s. We checked my pivot's efficiency one time and it was 98 percent. Of the water you're applying, that's hardly wasting a drop," he says.

The LEPA system also saves Mitchell labor. "The labor savings is the big thing. We've found our LEPA pivot to be relatively trouble-free. We only have to check it in the morning and at night. This leaves more time for our other farming operations. Without the center pivot, we'd still spend a lot of time checking rows.

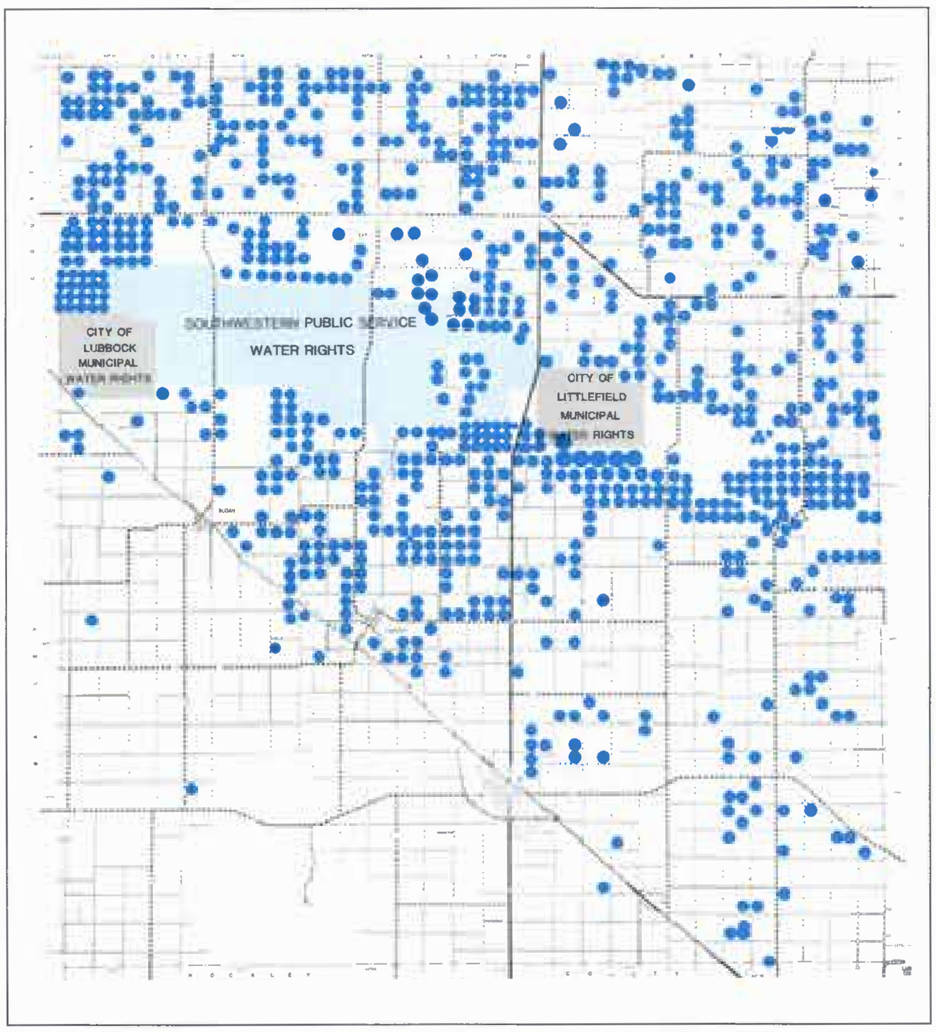
"A center pivot is a big investment. However, the labor savings alone will pay for it in a few years time. Also, the uniform water application is probably greater than any other way you can irrigate."

Mitchell notes other center pivot benefits. "It's been real flexible. We started with the spray system, then went to drop lines. Now we've put this farm in grass and run our livestock operation under the same pivot system."

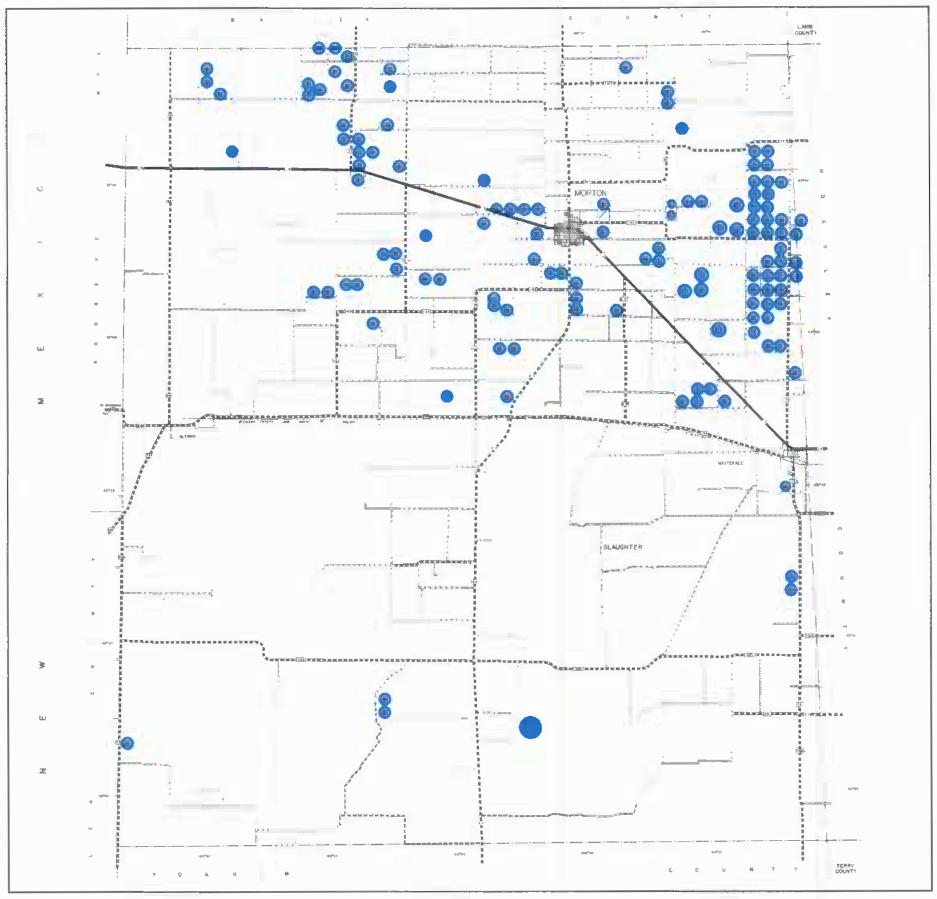
Although more than 12 years old, Mitchell's pivot still runs well. "There's very little trouble and expense. There's not been any expense since we put the LEPA onto it."

Mitchell uses his towable LEPA center pivot to water grass and wheat on two 125-acre circles. "With the 13 low-capacity wells I have, the only way I can irrigate them is to put them all together in one pivot. I wish I had more pivots because you do such a better job irrigating."

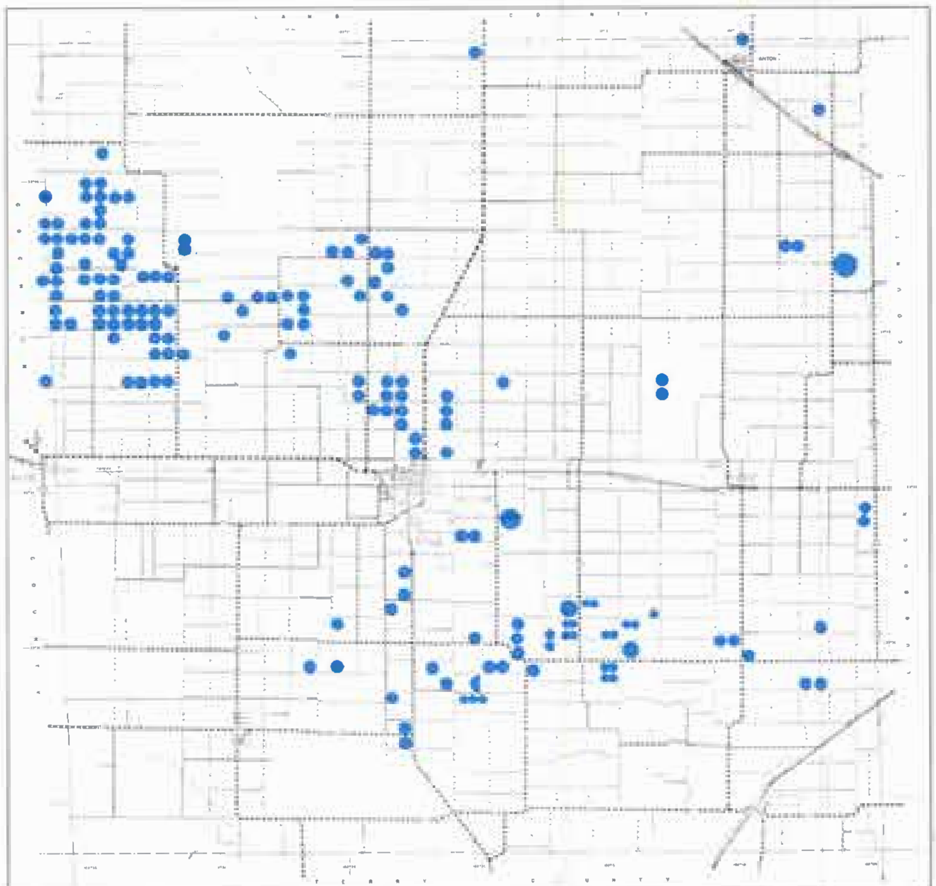
Lamb County **836 Center Pivots**



Cochran County **125 Center Pivots**



Hockley County **163 Center Pivots**



THE Cross SECTION

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Lyle continues research on center pivot water-use efficiency

Continued From Page One

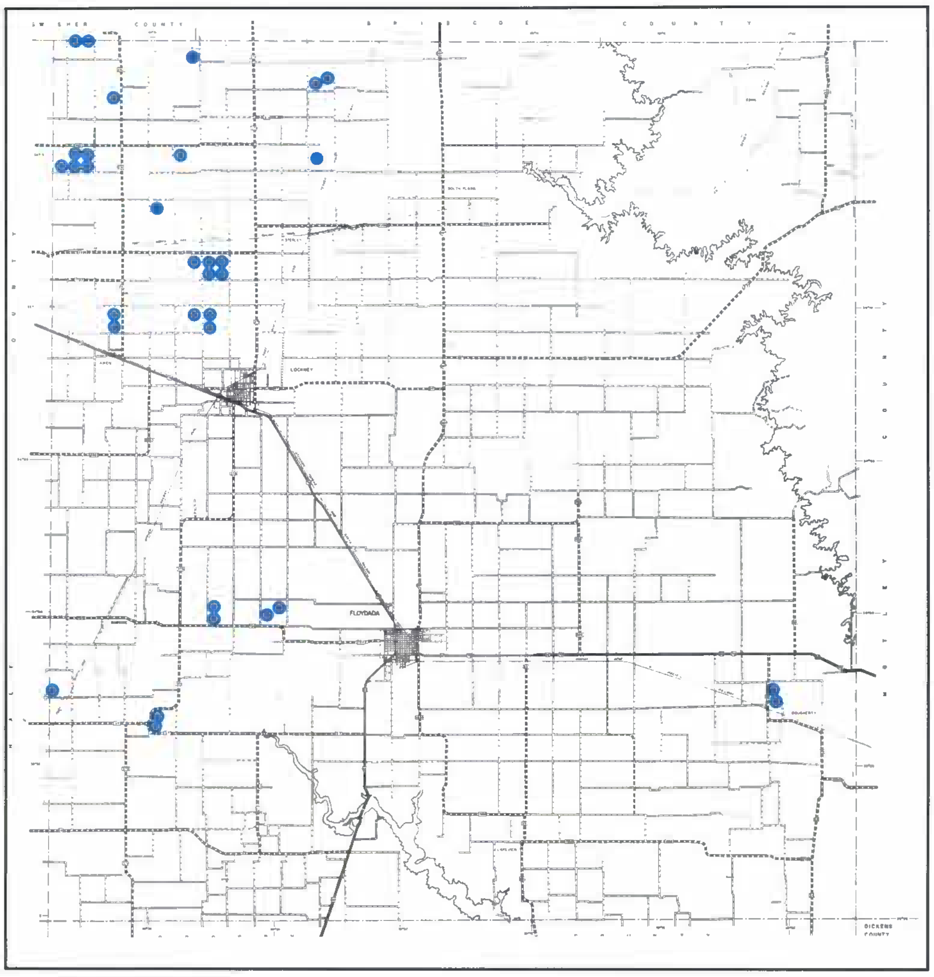
nozzles to find one which would be the most efficient and non-erosive to the furrow dikes. A lot of lab work was done before we determined that a bubble pattern would work the best. Instead of the individual droplets, this bubble stays together and doesn't drift or mist," he says.

Despite the success of the LEPA system, Lyle says they needed to develop a second generation system which would not only irrigate, but also apply antitranspirants, plant growth regulators and other chemicals as well.

In the early 1980s, Lyle and his co-workers developed the Multifunction Irrigation System (MFIS) which allows farmers precise chemical application abilities from their irrigation equipment. "The dynamic movement or ability to move the nozzle vertically through the crop canopy got two times better coverage than conventional over-the-top spraying. MFIS also provides four times better coverage than aerial spraying," Lyle says.

In reflecting on the LEPA system's success, Lyle says he wishes more producers would convert their center pivots to LEPA systems. "Research data shows such a tremendous advantage that LEPA has over the traditional pivot system. We can achieve better crop yields, improved water use efficiency and energy savings through LEPA systems."

Floyd County **33 Center Pivots**



Crosby County annexation approved

Voters ratified the annexation of the eastern portion of Crosby County above the Caprock into the High Plains Underground Water Conservation District No. 1 recently.

Separate elections were held April 2nd in the Water District and in the proposed annexation area of Crosby County. The Water District Board of Directors declared the annexation election results official at their April 5th meeting.

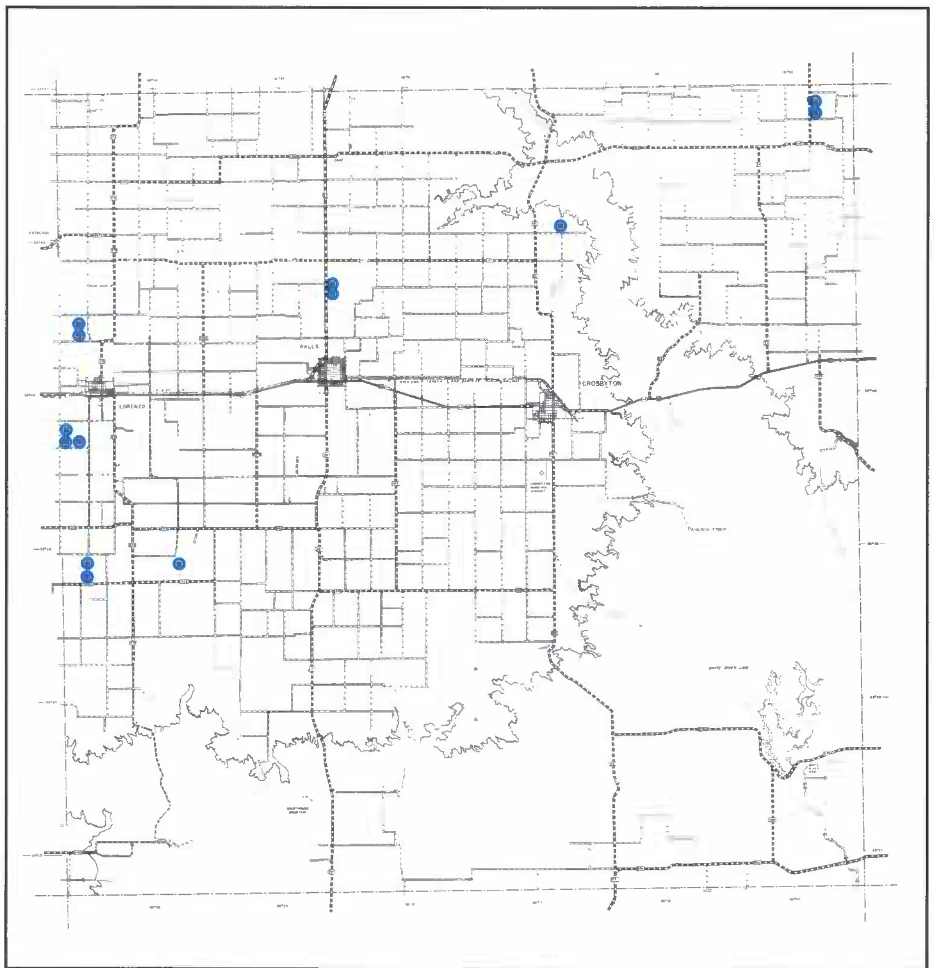
The new addition to the Water District includes the parts of Crosby County Commissioners Precincts One, Two and Four located above the Caprock. The annexed territory adds about 428 square miles to the Water District and increases the total District area to more than 8,577 square miles. Crosby County Precinct Three joined the Water District in April 1969.

Crosby County voters also approved a maximum ad valorem tax rate of $0.05 per $100 valuation, which is equal to the original maximum ad valorem tax rate approved by the voters when the District was formed in 1951. A uniform tax rate is levied throughout the Water District, and the newly annexed territory will be taxed at the same rate as the remainder of the District. The current Water District tax rate is $0.007 per $100, or $7 per $100,000 valuation.

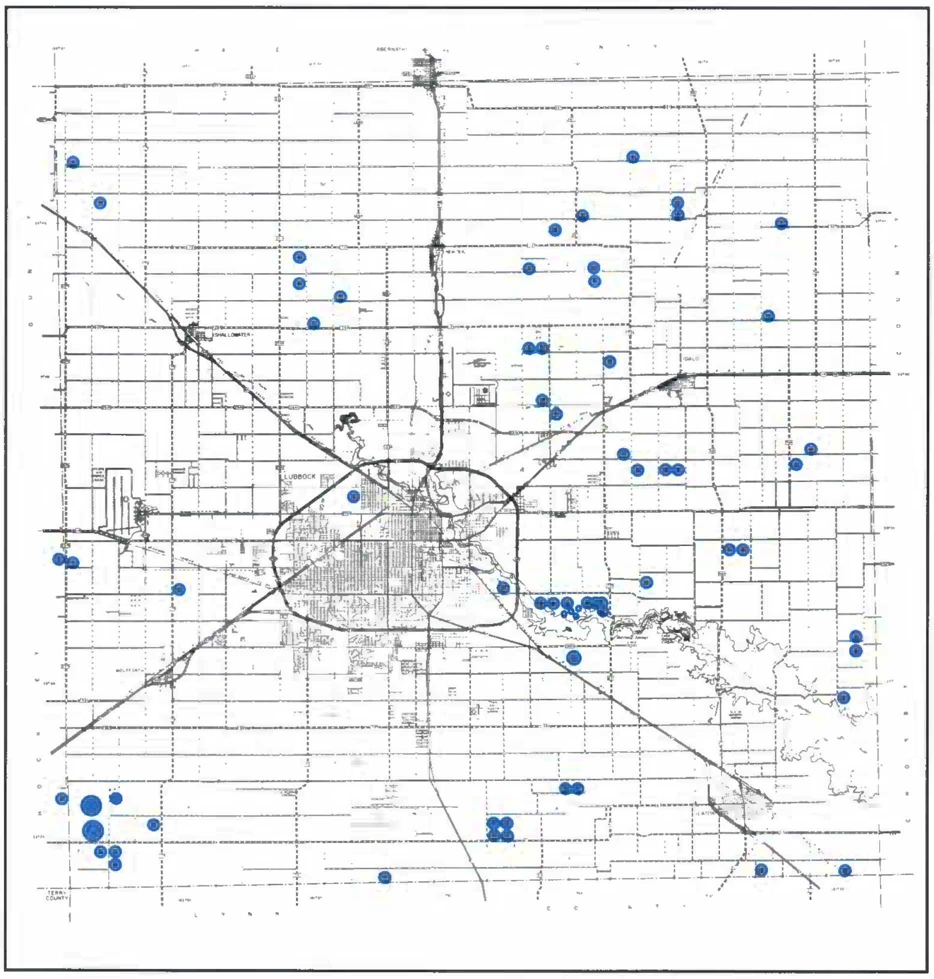
David Appling of Crosbyton, a primary instigator of the annexation movement and a Crosby County Farm Bureau Board Member, says he is pleased with the election results.

"We needed to get into the Water District several years ago. We're certainly relieved that we were annexed before any action by the Texas Legislature put us under state control." he says.

Crosby County **14 Center Pivots**



Lubbock County **68 Center Pivots**



Center pivot irrigation system improvements reviewed

Continued From Page One

money for it," he said. Zybach also noted that one irrigation expert called the center pivot a "Rube Goldberg contraption" and said that "the concept and system weren't practical."

These "impractical contraptions" have provided area producers with an efficient means of reducing water and energy waste, since the center pivot sprinkler was introduced on the Texas High Plains in the 1960s and 1970s.

In 1977, the 46 counties of the Texas High Plains had a total of 3,645 pivots. The average system was equipped with 42 spray nozzles and irrigated a quarter section on a seven day schedule. Average pressure was 75 pounds at 800 gpm.

Many local, state and federal agencies were concerned with improving irrigation water use efficiencies through better irrigation practices and management in the late 1970s.

From 1978 to 1981, almost all of the drop line center pivot systems in use were evaluated to check their efficiency. The study, conducted by the USDA-Soil Conservation Service (USDA-SCS), revealed that center pivots improve water application efficiencies enough to irrigate 20 to 25 percent more acreage than can be covered with other systems using the same volume of water.

Hundreds of on-farm irrigation efficiency evaluations were conducted by the USDA-SCS using mobile field laboratories provided by the High Plains Underground Water Conservation District No. 1. These evaluations revealed that a great deal of improvement needed to be made in irrigation efficiencies in all types of systems.

These efficiency evaluations showed an average center pivot system efficiency of 61 percent, a 47 percent efficiency for side-roll sprinklers and a 60 percent efficiency for furrow-irrigation. Following the on-farm efficiency evaluations, a large number of irrigation systems were repaired or modified to improve their water use efficiency.

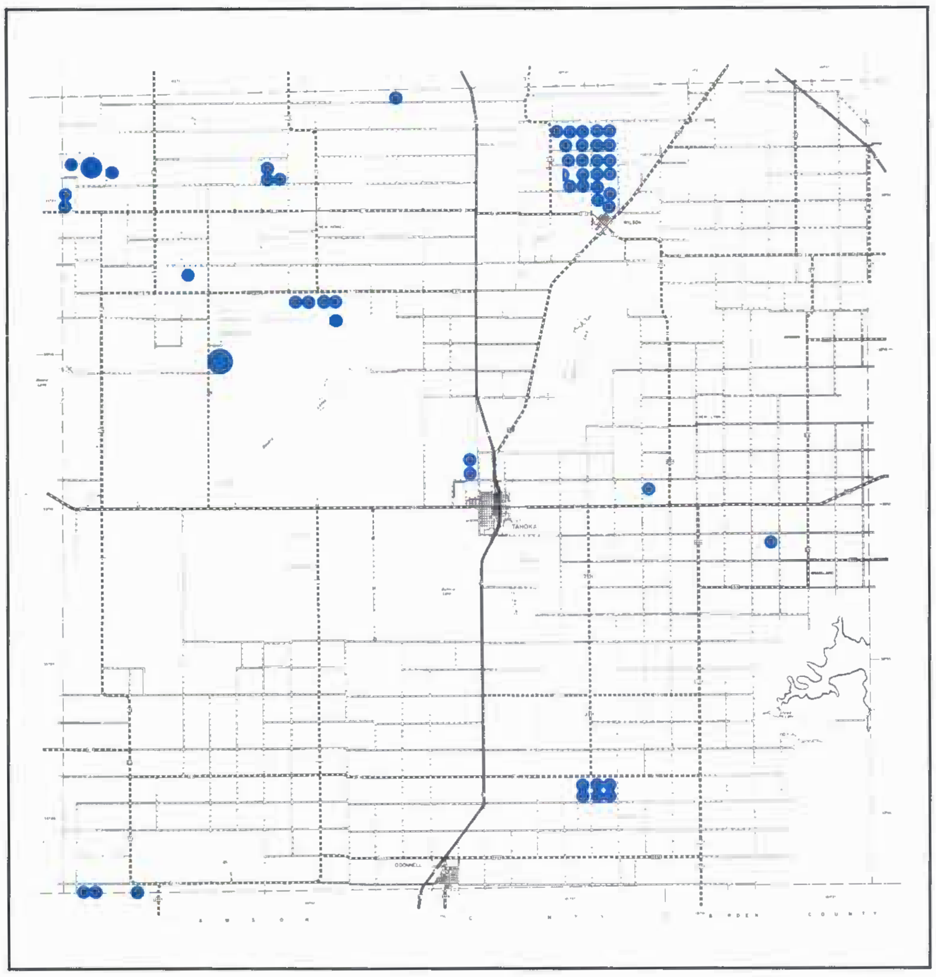
In 1988, almost 40 years after Frank Zybach's prototype was created, a total of 3,384 center pivot sprinkler systems currently operate within the 15-county High Plains Underground Water Conservation District No. 1 service area.

Water District Engineer Technicians have studied aerial photographs of the Water District and plotted the location of center pivot systems on county maps.

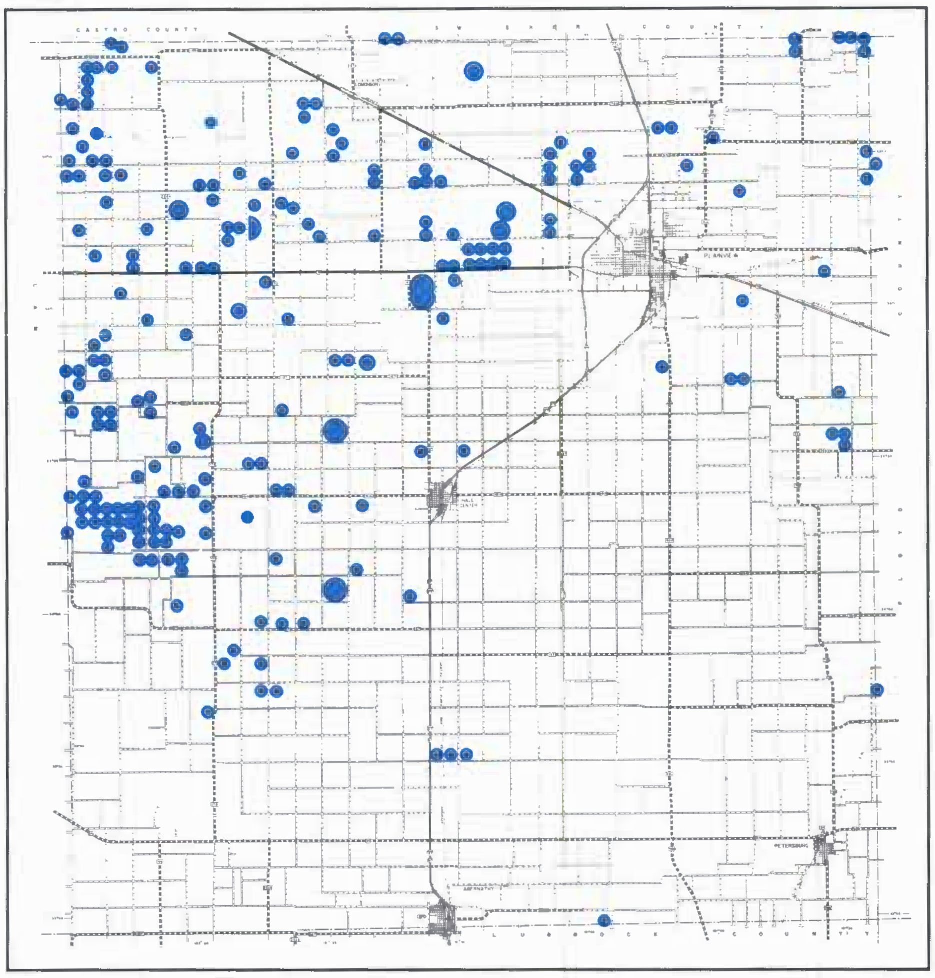
These center pivot sprinkler systems, given a value of $30,000 each, represent over a $100 million dollar commitment by farmers toward conserving the underground water resources of the Ogallala Aquifer in the Water District.

We salute them for their hard work and dedication to water conservation.

Lynn County **53 Center Pivots**



Hale County **217 Center Pivots**



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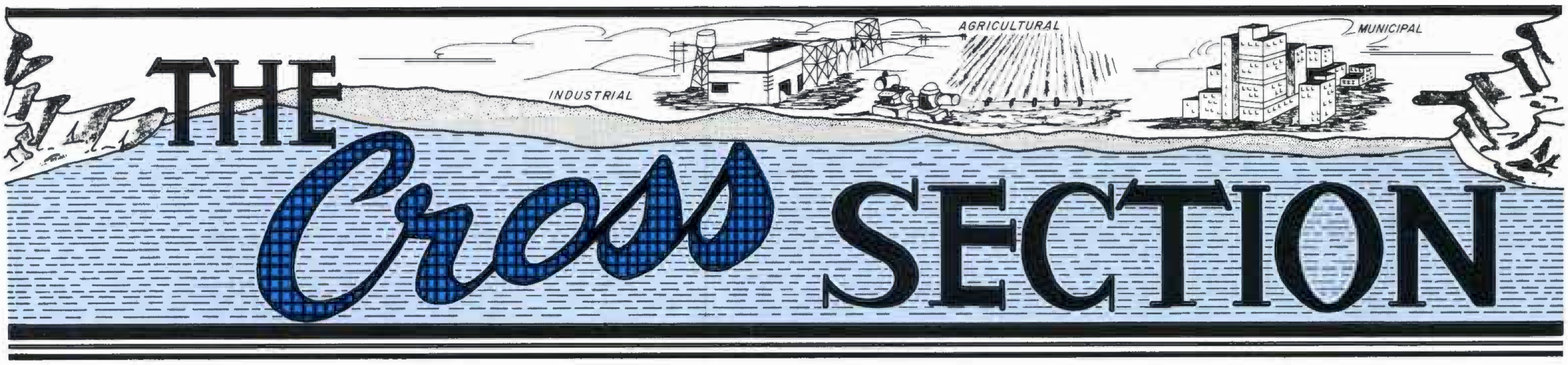

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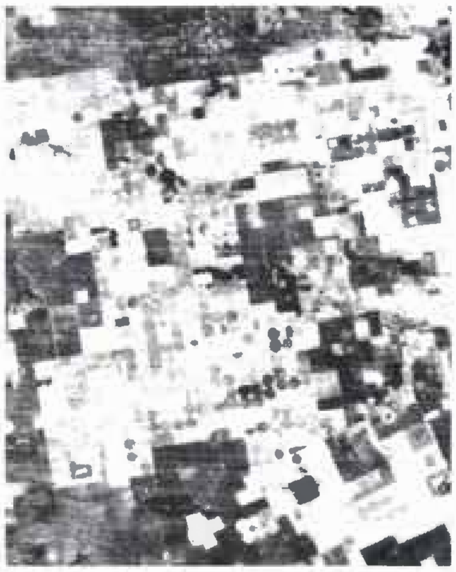


VIEW FROM SPACE — Center pivot circles are visible in this NASA satellite photo taken above the Texas-New Mexico border.

New improves irrigation spray nozzles

After initial attempts toward reducing center pivot pressure to offset high irrigation pumping costs, Leon New has now focused on the development of spray nozzles for the Low Energy Precision Application, or LEPA, center pivot system. These spray heads, designed for both water and chemical application, are helping make the modified center pivot system a multifunctional piece of equipment for area producers.

The irrigation specialist with the Texas Agricultural Extension Service in Amarillo explains his initial involvement with center pivot irrigation systems. "We had worked with center pivots in our pumping plant efficiency testing programs. We began exploring ways we could reduce their operating pressure because of the fuel price increases in the 1970s."

In 1983, researchers revealed a new low pressure irrigation system that modified existing center pivots by dropping the nozzles down to a few inches above the ground. The LEPA system was developed by Dr. William Lyle, an agricultural engineer working with irrigation systems at the Texas Agricultural Experiment Station in Lubbock.

"When Dr. Lyle's LEPA research came out, we started looking at how we could modify existing high pressure systems with droplines that would work under low pressure."

"The first complete LEPA modification I worked with was tested in 1985 on Phil Johnson's farm near the Hub Community in Parmer County. Before the droplines were installed, Johnson operated his pivot at about 35 pounds of pressure per square inch (psi) with a 40 horsepower booster. "He now runs at about 14 pounds at the pivot and has eliminated the booster with the system modified to incorporate the LEPA principle. He operates at a reduced pressure, and this lowers pumping costs," New says. New

See IRRIGATION Page Three

Center pivot review ends

Approximately 3,384 center pivot irrigation systems are operating in the counties served by the High Plains Underground Water Conservation District No. 1, according to pivot inventory maps constructed by Water District staff.

Through center pivot use, area producers are not only reducing their labor and fuel costs, but conserving the underground water resources of the Ogallala Aquifer.

In this special issue of the *Cross Section,* we complete our look at these water-saving devices by highlighting some of the producers who use center pivots in the seven northern counties of the Water District.

Center pivot inventory maps for Armstrong, Bailey, Castro, Deaf Smith, Parmer, Potter and Randall Counties are featured in this issue. Individual county center pivot totals may be found with each map.

Center pivot locations in Cochran, Crosby, Floyd, Hale, Hockley, Lamb, Lubbock and Lynn Counties were mapped in the May *Cross Section.*

Once again, we salute our area producers for their hard work and their willingness to implement new water conservation ideas, such as the center pivot system.

Gallman believes in sprinkler system use

Reduced labor costs, better water distribution efficiency and increased yields are just a few of the reasons for Robert Gallman's enthusiasm over center pivot sprinkler systems.

"The center pivot sprinkler has the greatest influence on a farmer's net return and is the most important management tool farmers can use today. I'm sold on these systems, and I'm just tickled that our people are using last year's profits to purchase more sprinklers," he says.

Gallman serves as a Parmer County Committeeman for the High Plains Underground Water Conservation District No. 1, and water conservation is of vital interest to him.

"Lynn County had only one observation well with a water level decline last year," Gallman said, pointing to the April *Cross Section.* "However, Parmer County had 10 to 15 percent of its observation wells showing declines. We have to look at it and say 80 to 85 percent of those wells had positive readings. These positive readings show that we are doing our part to conserve water with these pivots, and I feel that the county will have a continued rise in the water levels next year as a result," he says.

See CENTER Page Three

System conversion improves water use efficiency

HIGH PRESSURE irrigation systems with impact nozzles have a 60 percent water application efficiency rating.

WITH MODIFIED DROPLINES, producers can improve the water application efficiency rating to 80 percent.

LEPA systems apply water close to the ground and provide up to a 98 percent water application efficiency rating.

Minimum tillage complements center pivot irrigation systems

When Troy Sublett of Hereford began watering with a center pivot irrigation system, he found it increased his irrigation efficiency and made it possible for him to change his farming practices.

Sublett implemented minimum tillage as a way to rotate crops under pivot irrigation. Minimum tillage complements center pivot irrigation because it conserves soil moisture and controls runoff by leaving stubble in the field.

"I didn't really want to minimum till, but I saw some neighbors do it and became interested in it," Sublett says. Fields look messy to farmers unaccustomed to minimum tillage, and Sublett says he was no different.

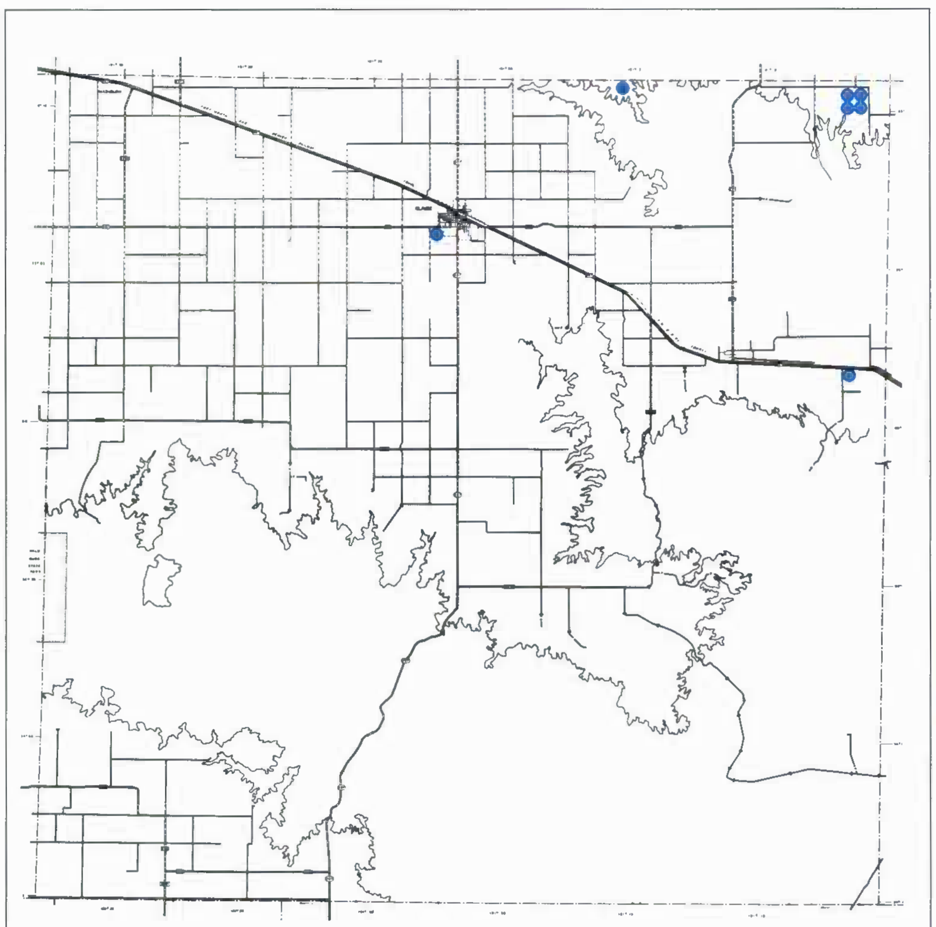
"At first, I didn't like the looks of it, but I soon realized that minimum tillage can save a pre-plant irrigation and reduce both fuel costs and the number of trips across the field.

"I changed from an intense farm management system to minimum tillage with milo, corn and sugar beets. Under center pivot irrigation, I planted wheat into corn stalks or grain sorghum into wheat stubble to rotate the crops. By farming with minimum tillage, I saved a lot of moisture," he says.

See SOIL Page Four

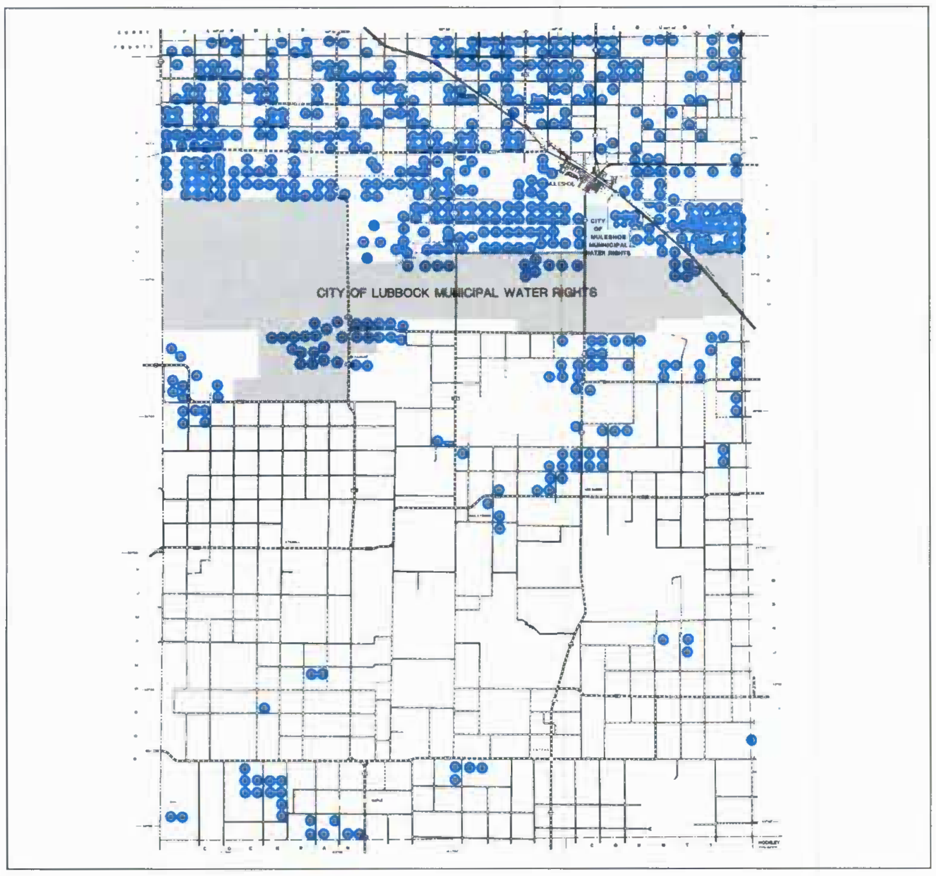
WATER RESOURCES SAVED — Troy Sublett of Hereford uses this LEPA system to help conserve water while irrigating wheat on his Deaf Smith County farm.

Armstrong County **7 Center Pivots***

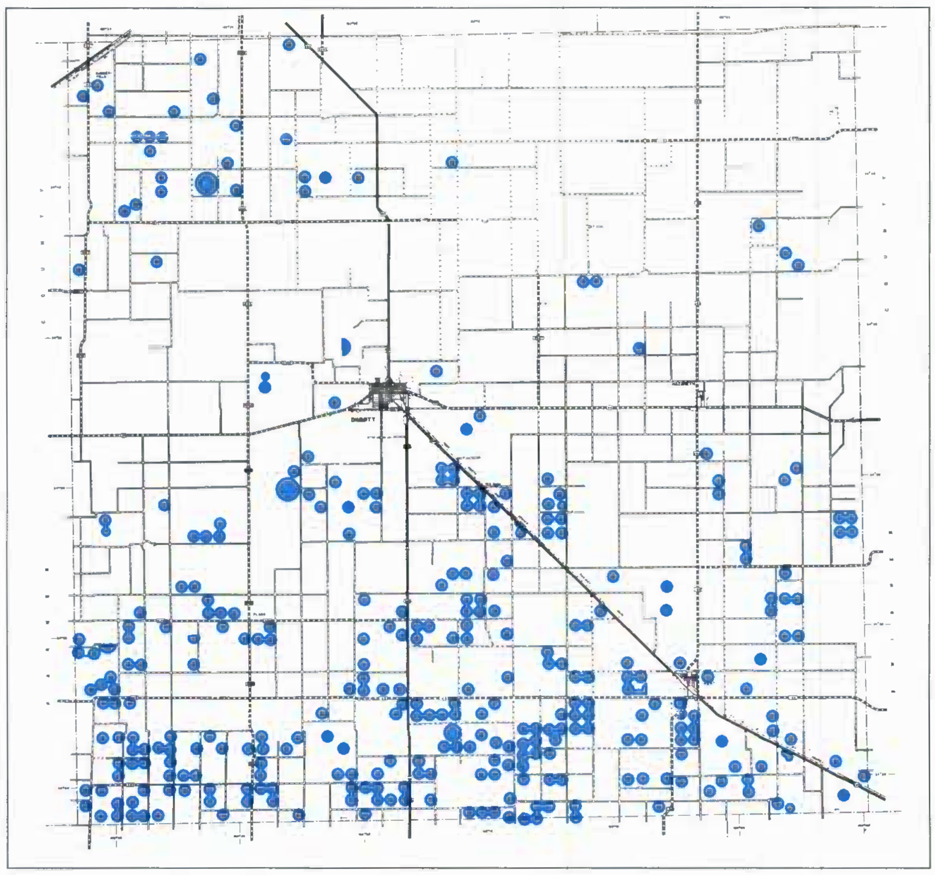


***Center Pivots are located outside Water District boundaries.**

Bailey County **581 Center Pivots**



Castro County **336 Center Pivots**



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Irrigation specialist developing multipurpose spray head

Continued From Page One

helped design the modified system for optimum operation at nine psi at the outer end of the system. "If the pressure at the end of the system is adequate, then the pressure at the pivot will be adequate." The pressure gauge that regulates the system was installed in the end drop.

However, New discovered that the conventional center pivot impact spray heads would not work well with the LEPA system. A different spray head was needed to take full advantage of the system's high water application efficiency and low pressure operation. One of the first shop-made spray head prototypes used a Coca-Cola™ bottle to help apply the water.

"We finally got the bubble and spray modes working fairly well; and then along came chemigation and it looks promising." New is working with LEPA head manufacturers, growers, entomologists and injection equipment manufacturers to develop an easy to-use, multipurpose head which will bubble, spray or chemigate. This step is important in making the LEPA a multifunctional system, New says.

In addition to his work with LEPA operating pressures, New has also researched tillage requirements for the modified system.

The LEPA system was originally designed by Dr. Lyle for use with furrow dikes to control runoff. However, New says he encountered some producer resistance to installing the dikes. Some producers complained that rain can wash out the furrow dikes. Also, corn growers objected to the furrow dikes because the conservation technique makes it difficult to harvest their crop, especially if the corn falls, he says.

"Furrow dikes are not for everyone, and I learned to live with that. We weren't trying to say LEPA irrigation is only for growers who use furrow dikes. We tried to find an alternate solution to the runoff. That's when we started using ripping and chiseling. Half the systems are working with furrow dikes and half are not. However, some sort of tillage operation definitely needs to be incorporated with the LEPA system to control runoff," he says.

LOOKING OVER THE SYSTEM — Leon New, Texas Agricultural Extension Service Irrigation Specialist, examines a LEPA system equipped with Rainbird heads during the 1987 Randall County field demonstration day.

Center pivots reduce Parmer County producer's labor costs

Continued From Page One

He noted that in some areas of Parmer County, the farmers had conservative attitudes toward the center pivot systems, while in other areas, the farmers were more aggressive and were installing the systems as quickly as possible.

"I could count the number of center pivot systems in the county on the fingers of one hand 15 years ago. Now, there are more than 675 pivot systems operating in the county. You would see one or two sprinkler systems go up in a particular area, then the systems would blossom out from there," he says.

"These sprinklers have been a salvation to me since they have helped put me back into a profitable farming situation." Gallman estimates a 20 percent return on his net investment.

"I can now graze cattle and double crop with the labor savings from center pivots. I couldn't do that with row watering," he says.

Gallman uses six center pivot sprinklers on his 840 acre operation. His starter system, a 1975 Zimmatic center pivot, is located atop a hill, and he credits the sprinkler with making the land tract farmable.

"This pivot really sold me on these sprinkler systems. When we row watered, the water would break out at a certain point on the hill, go around the sides of the hill and then run down the turnrow. You can just imagine the erosion this caused. Two large tailwater return pits were located at the bottom the hill to catch the runoff. Another problem in farming this land was the irrigation ditches we had zig-zagging down the hill.

"The center pivot has eliminated all these problems and turned this hill into a farmable piece of land. As a matter of fact, we yielded about 35 tons of ensilage last year from this land. Our county average last year was about 25 tons of ensilage," he says.

Gallman was so impressed with the center pivot systems' benefits that he turned back the furrow-irrigated land he had been farming. "No one wants to rent a farm without a sprinkler. After I turned back the land, I tried to convince the owner to install a center pivot system — but he refused," he says.

Center pivot systems have helped Gallman reduce his labor costs as well. "With eight irrigation wells, it was tough to furrow irrigate and do anything else. The center pivot has helped eliminate a lot of the labor associated with irrigation. I know that's difficult on the farm hands, but it helps the producers and that's the bottom line. If the farmers go out of business, then a lot of other folks will go down the tubes as well," he says.

The Parmer County producer adds, "The fuel costs saved with a center pivot sprinkler can equal a $5,000 to $6,000 payment on a system. A system will pay for itself in fuel cost savings alone."

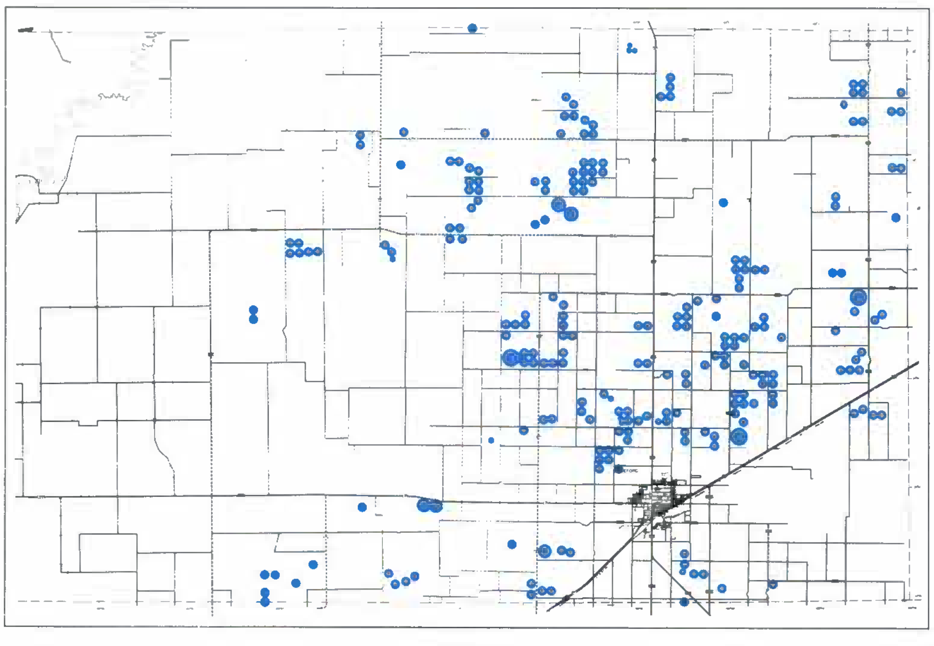
Soil moisture monitoring devices are also a vital part of Gallman's center pivot system management plan, since it gives him an idea of soil moisture conditions before irrigating.

"There is no reason not to use soil moisture monitoring devices, but less than 10 percent of the farmers do. Gypsum blocks and tensiometers are inexpensive and easy to install. They give producers data on moisture availability, water amounts pulled out by the crop and the exact time when the moisture needs to be replenished through irrigation," he says.

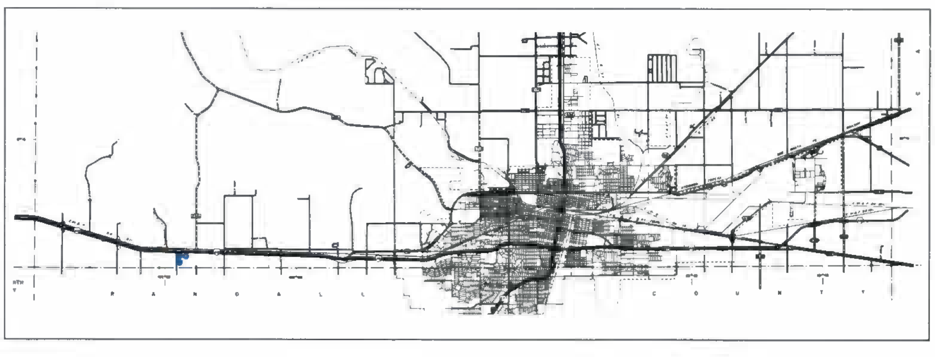
With corn prices slowly edging back up, Gallman remains optimistic about the future of center pivots in Parmer County.

"The years from 1979 to 1986 were the toughest economic times for area farmers. They kept on going and finally got these sprinkler systems up and running. The sprinklers aren't what got them into trouble, but they are sure going to help get them out of it," he says.

Deaf Smith County **237 Center Pivots**



Potter County **3 Center Pivots**



Soil moisture monitoring important with center pivot use

Continued From Page One

Sublett first used a center pivot in 1976 after his landlord installed a system on the land he farmed. A year later, drop lines were added to the first pivot, and the landlord purchased a second drop-line center pivot. By 1978, Sublett was irrigating corn, grain sorghum and wheat with four drop-line center pivot systems. Six wells, pumping from 200 to 500 gallons per minute, supplied water to two pivots which watered summer crops and two pivots which watered winter wheat.

Sublett notes that center pivot water distribution is more efficient than furrow irrigation. "On the rented land, I irrigated about a third more acreage with the same amount of water with the pivot."

In 1986, Sublett purchased a 320-acre farm which had a Low Energy Precision Application, or LEPA, system installed on it. He says the irrigation system works especially well with crops like sugar beets and corn, which require large amounts of water.

"Last year was the first time I had sugar beets under the LEPA system, and it worked really well. I was afraid of crusting with the drops right on the ground, but I didn't notice any problems. I really have enjoyed using it," he says.

Sublett says he has a low water situation on his farm and the LEPA system allows him to save his water resources.

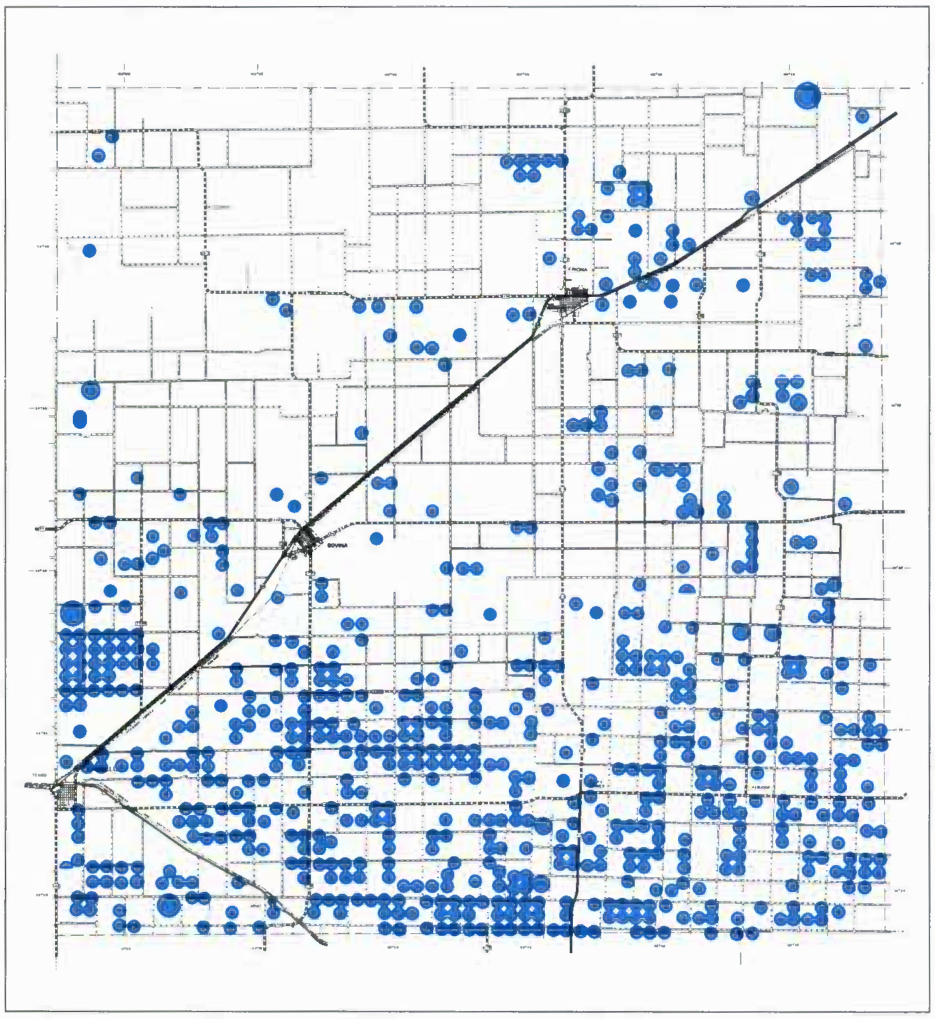
"You have to throw your wells together if you're going to do anything in a low water situation. With the LEPA center pivot, I can run two wells part of the season and then, when the water level draws down, I can put one or two more wells on the system." Sublett notes that he has three wells pumping an average 250-300 gallons per minute to supply water for the LEPA system. A fourth well can also be tied into the system if needed.

Sublett highly recommends soil moisture monitoring in conjunction with center pivots. "I think anyone who's starting to use center pivots really needs to use soil moisture monitoring devices, such as tensiometers or gypsum blocks. It helps to know the amount of water in the soil profile before you start irrigating. If you know how much is in the profile, then you can calculate how much water you need to apply and not over-irrigate.

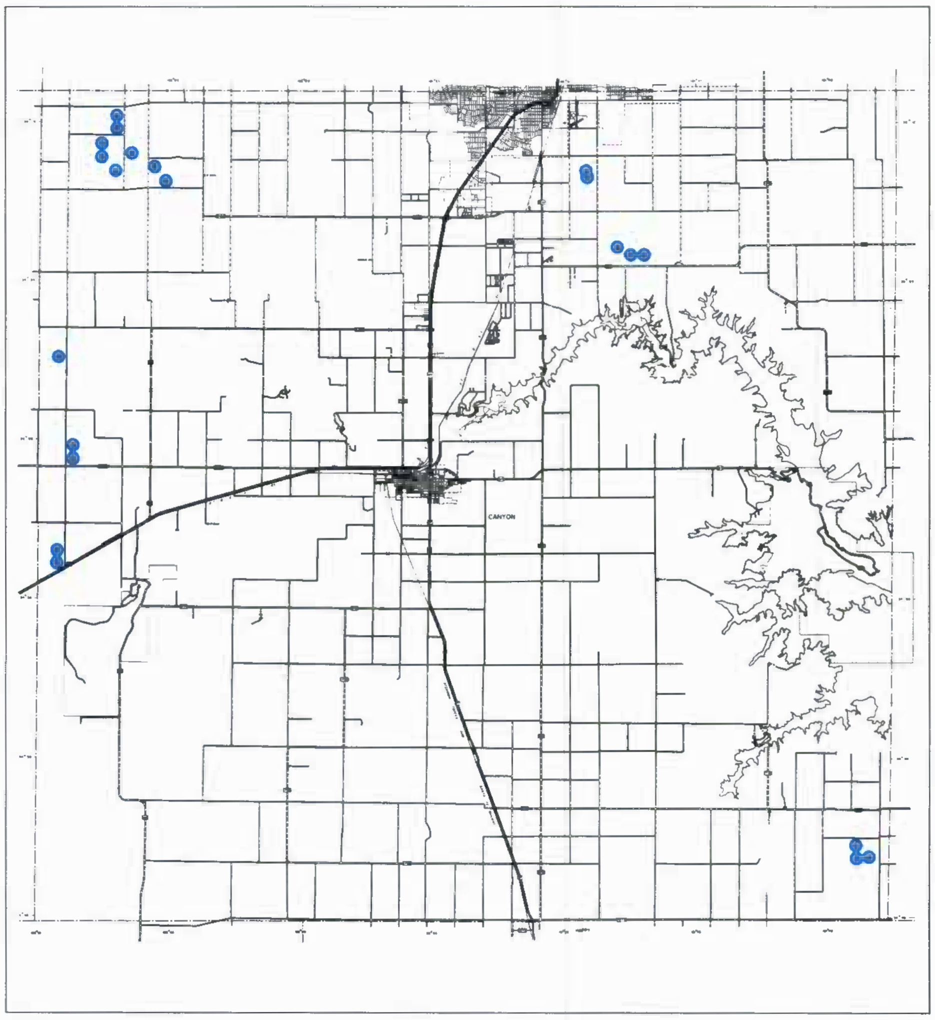
"Using moisture blocks with the LEPA system has been really surprising. I'd be ready to start watering, and the blocks would say that I didn't need to."

Sublett serves as a Deaf Smith County Committeeman for the High Plains Underground Water Conservation District No. 1. Sublett and Robert Gallman (who is also profiled in this issue) are examples of the kind of folks who serve as County Committeemen for the Water District.

Parmer County **690 Center Pivots**



Randall County **21 Center Pivots**



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Counties begin Water District annexation bid

Terry County and Yoakum County Soil and Water Conservation District Board members discussed the possible annexation of the two counties into the High Plains Underground Water Conservation District No. 1 at a joint meeting held recently in Brownfield.

After discussion of the Water District's purpose, programs and tax structure, the Soil and Water Conservation Board members voted to petition the Water District for annexation.

Petitions seeking annexation of the two counties into the Water District are now available for landowners to sign at the respective County Soil and Water Conservation District offices. Soil and Water Conservation Board members in each county will also have petitions available.

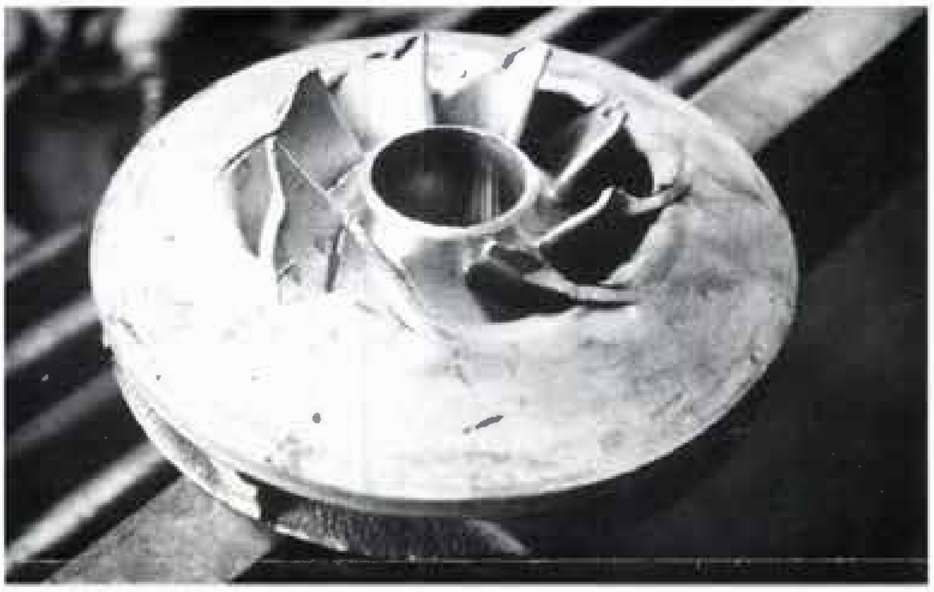
In order to add land to the High Plains Water District, a petition must be signed by a majority of persons holding title to the land within the proposed addition. If more than 50 persons hold title to the land within the proposed addition, a minimum of 50 signatures is required.

After the petition is filed with the Water District Board of Directors, public hearings will be called within the proposed addition to determine if this action would mutually benefit the Water District and the landowners in the area seeking annexation. A notice of the meeting time and place will be published and all interested parties will be invited to give public testimony and ask questions about the District at that time.

If the Water District Board of Directors finds the addition to be feasible, an election will be called for January 1989 to allow voters within the new area as well as the existing Water District to decide upon the annexation. A majority vote within both areas is required before new land may be added to the Water District.

The most recent addition to the Water District took place in April 1988 when voters overwhelmingly approved the annexation of Precincts One, Two and Four above the Caprock in Crosby County.

Poor pump performance raises fuel costs



BUT IT WAS STILL PUMPING WATER — Worn-out or damaged pump parts, such as this impeller, will reduce pump performance and increase the monthly fuel cost to area producers. A careful watch of operating costs and periodic pump plant efficiency testing can signal a need for pump adjustments or repairs.

Irrigators in the High Plains Underground Water Conservation District No. 1 service area can determine when an irrigation pump plant efficiency test is needed by keeping a close watch on fuel costs and their pumpage each month.

Poor pump performance results in higher than necessary fuel costs to the irrigator for the amount of water pumped. These higher fuel bills have caused producers to become energy cost-conscious, according to area pump company representatives.

"I think the irrigator has paid more attention to pump efficiencies during the past five years," says Ben Virgin, sales representative for Goulds Pumps, Inc. in Lubbock. "The energy costs have risen, and many have switched over from furrow watering to center pivot use. The producers are becoming more thrifty-minded," Virgin says.

Don McElroy of Irrigation Pumps and Power in Muleshoe echoes the feeling. "We're in much better shape with pump efficiencies than we were a few years ago. Before the center pivot came along, farmers who row watered had a difficult time determining the cost per acre-inch of water. The amount of water put down the rows could vary from eight to 15 inches. Center pivot use eliminated this and has given the irrigator a common denominator for comparing efficiencies from farm to farm." he says.

Producers should be aware of their pumpage in terms of either acre-feet or acre-inches, says McElroy. "They need to compare the pumpage with their monthly energy bills. By doing so, they will become aware of their operating costs," he says.

"For example, let's say it costs $3.50 to pump an acre-inch of water from Pump A and $5.00 to pump the same amount of water from Pump B. If the irrigator pumps 3,000 acre-inches of water, the cost will be $10,500 for Pump A and $15,000 for Pump B. If the irrigator is a good manager, he should be able to recognize this trend and know which pump is inefficient. He can then take action to correct the situation," McElroy says.

Results from more than 1,000 pump plant efficiency tests on the

See HIGH FUEL Page Two

Chemigators are encountering stricter safety regulations

EDITOR'S NOTE: More than one billion pounds of pesticides and millions of tons of nitrogen fertilizers are used annually in the United States. Recently, the presence of 17 pesticides were found in the ground water supplies of 23 states. These initial test results have sparked increased ground water quality testing and stricter regulations controlling agricultural chemical use.

This article addresses some of the regulations facing those High Plains producers who use chemigation in their farming operation. It originally appeared in the March 15, 1988 issue of the *Texas Farmer-Stockman* and is reprinted with their permission.

By Jim Steiert
Associate Editor
Texas Farmer-Stockman Magazine

The practice of applying herbicides and insecticides through sprinkler irrigation systems, or "chemigation," has become popular with many center pivot and sideroll sprinkler operators in Texas.

While there is a lot to be said for chemigation's effectiveness and low cost, the process is now coming under tighter regulation.

Concern over potential hazards of ground water contamination, pesticide exposure, and possible misapplication of chemicals have prompted the Environmental Protection Agency (EPA) to act.

EPA's Label Improvement Program for pesticides applied to crops through irrigation became effective April 30 of this year. It will have implications for Texas farmers who plan to use chemigation this growing season.

Leon New, extension agricultural engineer from Amarillo, says many of the safety requirements under the program were already being met by sprinkler operators in the High and Rolling Plains, but there are some new wrinkles this year that must be complied with.

EPA's new guidelines start with the labels on pesticides. Requirements state that registrants of pesticides must specify on the label if the product is intended for chemigation, or if use of the product in chemigation is prohibited.

Labels will state through what type of irrigation systems the products can legally be applied and warn of hazards due to non-uniform application. A reminder about the importance of proper calibration will be included.

Also included on the labels will be a warning not to connect a pesticide

See NEW REGULATIONS Page Two

New regulations guard against possible ground water pollution

Continued From Page One

injection system to any public water supply and to closely monitor any chemigation system.

EPA will become a stickler about several mechanical measures this season. New says the agency will expect a number of items to be in place on any chemigation system this growing season. These include:

- A check valve between the injection point and the well in order to prevent any pesticide from backflowing into the well.
- A vacuum relief valve, intended to alleviate potential for chemicals to be suctioned into the well if the well shuts down.
- Low pressure drain to avoid backflow contamination.
- An automatic, quick-closing check valve upstream on the pesticide injection source to serve as an anti-backflow measure. The pesticide pump must open this valve in order to inject.
- An automatic shutoff for the pesticide injection pump. New says the electrical motor of the injection pump must be interlocked with the pump power. Many producers have already interlocked the injection pump with power to the pivot, so when the sprinkler shuts down, so does the injection pump.
- The water pump must have a pressure switch to automatically shut down the well motor when pressure drops to such a level that application accuracy would be adversely affected.
- A normally-closed solenoid valve must go on the suction side of the injection pump, between the injection pump and chemical tank. This valve must also be interlocked with the injection pump and water well pump power. This solenoid valve is aimed at preventing fluid from being withdrawn from the chemical tank when the system is either automatically or manually shut down.

"The only big change in these requirements, where fellows who have been chemigating for a while are concerned, is in the call for a normally-closed solenoid. These can be purchased from several irrigation suppliers in the High Plains. We're also still trying to figure out how to make a system that will work with these requirements in some irrigation applications.

An identical set of safety requirements are in place for drip irrigation systems through which chemicals are injected. The same safety equipment is again in place to prevent groundwater contamination and other hazards.

Along with the mechanical aspect, New says producers will be looking at requirements for posting their fields under chemigation in some instances.

When the label on a chemical in Toxicity Category I contains the signal word "DANGER" and is used in chemigation, affected fields must be posted.

New says posting of areas to be chemigated is required when:

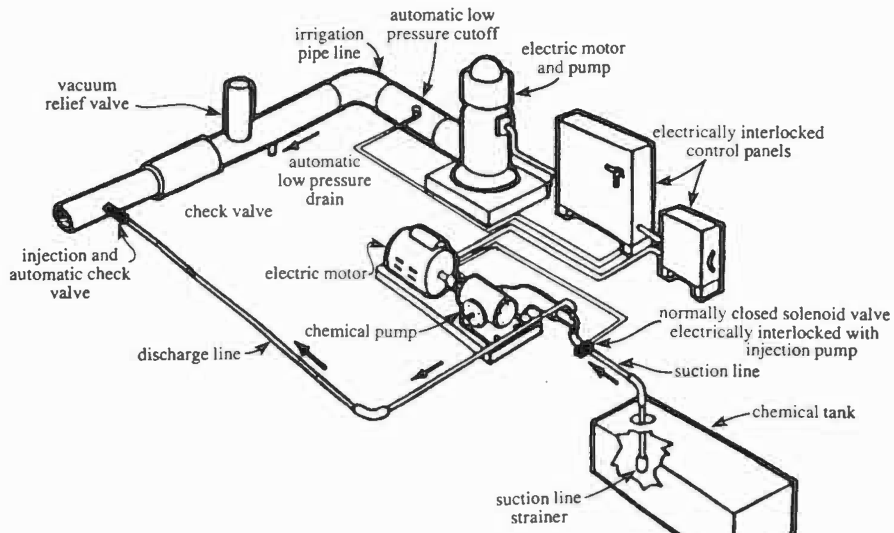
1. Any part of a treated area is within 300 feet of sensitive areas such as residential areas, labor camps, businesses, health care facilities, or public facilities such as schools, parks, and playgrounds, but not including public roads.
2. When the chemigated area is open to the public area, such as a golf course or retail greenhouse.

Treated areas must be posted with signs at all usual points of entry and along likely points of approach from sensitive areas. If there are no usual points of entry, signs must be posted in the corners of treated areas and at any other point giving maximum visibility to sensitive areas.

"Signs must be posted prior to application and must remain posted until foliage is dry and soil surface water has disappeared," says New.

Chemical injection safety regulations

Chemical injection safety connections (Electric motor)



High fuel bills can signal need for pump efficiency test

Continued From Page One

Texas High Plains show an average pump efficiency of 45 percent. Producers who bring their pumps up to the current industry standards can reduce their energy costs significantly, says Ken Carver, High Plains Water District Assistant Manager.

"There is a 75 percent industry standard efficiency for turbine pumps, with some ranging as high as 82 percent. If a producer brought his pump efficiency up from 45 percent to 75 percent, he could reduce the fuel consumption by as much as 40 percent," Carver says.

There are several things which can cause reduced pump plant efficiency. These include a significant drop in the water table since the pump was installed, pumping of sand, surging or pumping of air.

McElroy urges irrigators to keep a close watch on their pump conditions on a monthly basis. "These problems can pop up almost overnight, so irrigators have to watch their own situation and not wait until an annual efficiency test to troubleshoot the problem," he says.

Pump plant efficiency testing is available free of charge to irrigators residing within the Water District and are handled on a first-come, first-served basis. USDA-Soil Conservation Service personnel use equipment in the Water District's field water conservation laboratories to check overall pumping plant efficiencies as well. If desired, irrigators may conduct the test themselves using formulas and instructions provided by the Water District.

During a field test, the well yield in gallons per minute, the water level in the well as it is being pumped, the pressure which the pump is working against in a closed system, and the fuel used during a given time period are measured to calculate the overall pumping plant (pump and motor) energy use efficiency. A special drive shaft inserted between the pump and internal combustion engine allows for separate checks of the efficiency of the pump and motor.

After the testing, the irrigator is furnished with a written report of the test results. The District also provides a calculation of the fuel savings in dollars that the irrigator could expect if he has the pump repaired to perform at its maximum efficiency.

Carver notes that pump plant efficiencies may be increased through simple adjustments or may require replacement of the entire unit.

"On electric units where belts are used to drive a turbine, farmers will need to check the belts for cracking and slippage. The belts may need to be tightened or replaced. This is an easy way to increase pump efficiency at a minor cost," he says.

With an open impeller, adjustments can sometimes be made to increase the pump efficiency. On units utilizing a semi-open or closed impeller, an increase or decrease in the amount of drag on the pump shaft would have little results, he notes.

If minor adjustments do not increase the pump efficiency, the entire pump may have to be pulled. "The bowls may need to be rebuilt or replaced. New impellers may need to be put in as well. Depending on the number of stages, bowls and impeller size, it could cost the irrigator between $5,000 and $7,000 to bring the pump up to maximum efficiency. While this is a major cost, the irrigator can usually realize a payback from energy savings in one to three years," Carver says.

Carver notes that pump plant energy use efficiency is one phase of the irrigator's overall farm operation that needs to be as efficient as possible.

"Efficiency is the key to the 1980s and one of the most important things to consider today if the producer wants to stay in business," he says.

THE Cross SECTION

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Proper water and fertilization maximizes crop yield potential

Cotton yields of two bales per acre can become routine on the Texas Southern High Plains, if plants are provided with 20-22 inches of total water from either irrigation or rainfall, 90-110 pounds of nitrogen and 35-40 pounds of phosphate per acre during the growing season, says Dr. Dan Krieg, Professor of Crop Physiology at Texas Tech University.

He identified water, heat unit accumulation and soil nutrients as the three main factors limiting cotton production. While heat unit accumulation depends upon weather conditions during the growing season, water and soil nutrient inputs can be controlled through irrigation and fertilization. A proper balance of soil nutrients and water increases water use efficiency and improves the opportunity for maximum crop yields, he says.

With support from the High Plains Underground Water Conservation District No. 1, the Fluid Fertilizer Foundation and the Texas Tech Water Resources Center, Krieg is conducting research aimed at developing a management system to maximize cotton yields and water use efficiency. Krieg is studying the effects of timing and application rates of both irrigation and fertilization on cotton yields. The research has targeted several factors affecting cotton production.

- The water supply is the first limitation to cotton production, but yields will respond to additional water only if adequate nutrient supplies are available.
- Split nitrogen applications, including a mid-season application at the beginning of reproductive development, are more effective than total pre-plant applications.
- Relatively high pre-plant phosphorus applications of 50 pounds per acre results in either no yield response or a slight yield reduction. This response may reflect a zinc deficiency, especially in sandy soils. Zinc influences the production of auxins, a plant hormone which affects plant growth. Sidedress applications of phosphate are beneficial if water is available in the root zone.

An adequate water supply maximizes the number of fruiting sites, and nitrogen availability is mainly responsible for young fruit retention, explains Krieg. The most important time to avoid cotton stress is during the early reproductive stage.

Water Management

Good water management is important to prevent plant stress during the critical reproductive time. Particular care should be taken to avoid stress of the cotton plant from the time of square production through the second week of flowering. It is during this time that the crop's yield potential is set. Establishing the yield potential early is important because of the short growing season, notes Krieg.

"If the farmer waits until the first bloom to irrigate, it's too late. Don't let the cotton stress at the front end of the growing season. Our growing season is not long enough to make up for stress at the beginning of the season," he says.

Water supplies must be adequate until the first of August to get as many flowers produced as possible before August 20th. "Otherwise, the yield potential will be reduced," explains Krieg. "If you wait too long to water, the plant will shed the young fruit and start over. The new fruit has no chance to mature and therefore produces poor quality fiber at harvest." he says.

Soil Fertility

Inadequate soil fertility may be the reason for declining cotton yields over the past 20 years. Pre-plant soil fertility sampling conducted by the High Plains Water District, in conjunction with the USDA-Soil Conservation Service, showed low to very low nitrogen levels in the top two feet of the soil profile over much of the Water District's service area during the past two years.

"Nitrogen is critical not only for good growth but especially for fruit retention. If you have a good flower production, you need to maintain plenty of nitrogen in the soil so that the young fruit will be retained. Otherwise, nitrogen stress will cause fruit abortion," he explains.

Krieg recommends applying one-third of the 90-110 pounds of nitrogen per acre at pre-plant, one-third at square initiation and one-third at first flower. The nitrogen may be applied through side-dress applications in the soil or through the irrigation water. The nitrogen rate should be adjusted to the amount of available water, if water supplies are limited.

Phosphorus should be applied prior to first square. "Phosphorus is necessary to stimulate early season growth. Because of its cost, farmers often wait until a stand of cotton is established before applying phosphorus. Phosphorus should be applied as soon as possible once the stand is established and prior to square initiation," says Krieg. The phosphorus requirements are about 40 percent of the nitrogen requirements. "Apply two pounds of phosphate (P_2O_5) for every five pounds of nitrogen and every inch of available water. A total of 35 to 45 pounds of P_2O_5 are required to make a two bale per acre crop," he says.

Prospects for High Plains irrigated cotton look good due to the favorable early season weather. However, producers will need to time their irrigations and maintain good soil fertility to capitalize on the opportunity for another bumper crop, Krieg says.

WATER AND FERTILIZATION BENEFITS COTTON — Producers can capitalize on the opportunity for another bumper cotton crop by timing their irrigations and maintaining good soil fertility levels during this growing season.

Surge valves improve furrow irrigation efficiency rates

SURGE VALVES USED ACROSS TEXAS — More than 3,000 surge valves are currently used across the Texas High Plains to irrigate cotton, corn and soybeans. Surge irrigation improves furrow irrigation efficiencies by 10 to 40 percent.

Furrow irrigators who want to improve their water use efficiencies and can't afford the large capital outlay needed to purchase a center pivot system may wish to consider using a surge valve irrigation system.

Surge irrigation can improve furrow irrigation efficiencies from 10 to 40 percent for a relatively low initial cost. Purchase costs range from $600 to $1,600 per unit, based upon the size and sophistication of the system.

Surge irrigation consists of a timed control valve which directs water between two irrigation sets in alternating timed cycles. Instead of continuously running water down the furrow, surge valves irrigate one set of furrows for a specific time and then switch to the other set of furrows.

The alternating cycles allow the water to travel, or "surge" more quickly over previously watered ground, due to the smoothing of the surface of the furrow and clay expansion during the initial surge.

With proper management, irrigation time and labor costs are reduced; deep percolation below the root zone is decreased; and runoff, or "tailwater" at the end of the field is greatly reduced or eliminated.

Additional information about surge irrigation is available by contacting the USDA-Soil Conservation Service or the High Plains Underground Water Conservation District No. 1.

Castro County producer reclaims runoff water for pivot use

Give Gerald Elkins a used cotton gin lint dryer, some wire mesh, some underground pipe and a playa basin which collects water. In return, he'll show you how to provide two center pivots with water and reduce the amount of ground water pumped from the Ogallala Aquifer.

Elkins, who farms near Sunnyside in Castro County, first realized the potential for water savings with his playa lake in 1973. "The land slopes toward the lake area and I needed a way to control the runoff water. I started to build a tailwater pit, but I decided to try something else," he says.

A used 5x5 cotton gin lint dryer, covered with fine wire mesh, now rests near the edge of one of Elkins' playa basins. Water from the lake is pumped through this homemade sand filter and into a series of underground pipelines. These pipelines eventually either connect with center pivot sprinklers or run into ditches. Start the irrigation pump, and a simple turn of a squeeze valve directs the water to the distribution system Elkins desires.

"I have put in all sorts of gate valves. I guess I went gate-crazy, but if I have a well that's broken down and a crop which is burning up, then I want a way to get the water to the field," he says.

Elkins uses two eight-inch irrigation wells and two Valley quarter-mile center pivot sprinklers to irrigate alfalfa, corn, cotton, wheat and triticale on his 400-acre farming operation. He uses the lake system for two days and two nights a week to irrigate crops during the growing season.

Maintenance of the lake system is minimal. A periodic cleaning of the lake bottom is done every three years. The wire mesh covering the lint dryer rusts out every two to three years depending on the amount of sand suspended in the lake water.

"You've got to watch the screen. If holes start forming, then the salamanders will get in there and get sucked up by the pump and into the pivot. When the pivot nozzles clog up, that's a sure sign to check the wire mesh for holes."

Elkins also stresses the importance of keeping the lake area free of weeds. "I try to keep the weeds around the lake cleared off. If they get into the lake and float on the surface of the water, they can clog the mesh on the filter." Elkins says he would like to install a gate valve in the system near the pump, so that he can raise a handle to backflush the sand filter and remove any debris which might be clinging to it.

He estimates the lake system has cost him between $5,000 and $10,000 with the earth moving and pipe-laying. Yet he feels the system has made him money. "I guess I have saved about $1,000 a year which I would have normally spent on water pumpage. Over 15 years, I have saved about $15,000 with this system. In one way, it's like having another eight-inch irrigation well on my place," he says.

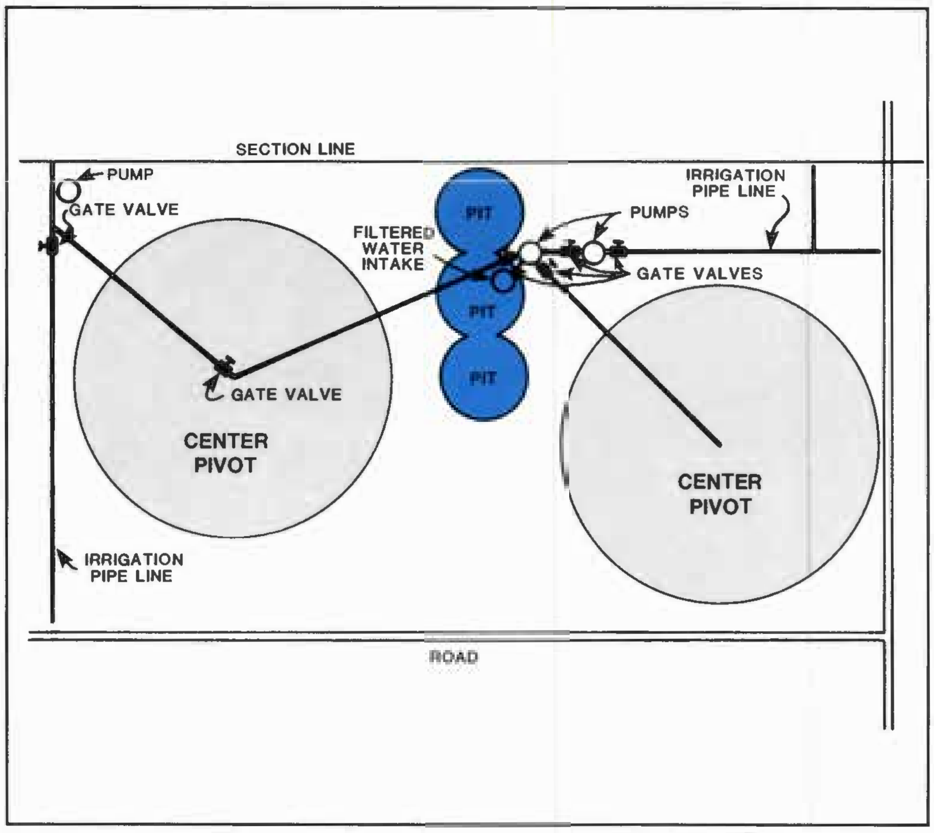
While playa basin water is beneficial to crops, Elkins says he really can't tell a difference in his plants irrigated with the lake water. "I know the water contains fertilizer, but I can't really tell much of a difference in the crop. I thought I could at first, but I can't now."

Elkins says he is very pleased with the lake system and would highly recommend using playa lake water for irrigation.

"It doesn't cost a whole lot of money to do some of these modifications. People can check their junkyards for scrap materials, and if they can weld, then they can do just about anything," he says.

"Using the playa water for irrigation is one reason why I'm still in business. There are a lot of ex-farmers who turned their water on and then left it unattended to go to Ruidoso and other places. This really put a burden on the hired hands who couldn't keep up with the watering, plus their other chores. As a result, the tailwater ran off the fields. There's no sense in wasting water like that. By using playa basins or tailwater pits to collect the runoff, we can re-use the water which would be wasted and conserve our ground water," he says.

PLAYA LAKE OFFERS WATER SAVINGS — Gerald Elkins of Sunnyside uses a cotton gin lint dryer covered with wire mesh to filter playa basin water for re-use with his two center pivot sprinkler systems. He says the savings from the reclaimed playa basin water is like having another eight-inch irrigation well on his farm.



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District Directors honor McCleskey for TWDB service

McCLESKEY RECOGNIZED — George W. McCleskey, left, is presented a resolution honoring him for his dedication to water conservation during his 12-year term on the Texas Water Development Board. Making the presentation is High Plains Water District Board President James P. Mitchell.

The High Plains Underground Water Conservation District No. 1 Board of Directors presented Lubbock lawyer George W. McCleskey with a resolution at their August meeting commending him for his 12-year service as a member of the Texas Water Development Board (TWDB).

In making the presentation, Board President James P. Mitchell and Water District Manager A. Wayne Wyatt praised McCleskey's leadership and his involvement with numerous water-related projects during his career.

Wyatt noted that McCleskey served as lead counsel for the 1962 landmark case, Marvin Shurbet, Et Ux vs. United States of America, which established the cost-in-water income depletion allowance for landowners within the High Plains Underground Water Conservation District No. 1 boundaries to claim on their federal income tax return.

"This allows our taxpayers to save from three to five million dollars annually on their federal income tax returns," said Wyatt.

He also mentioned that many area towns and cities obtained water supply and waste water treatment low interest rate loans from the TWDB during the time McCleskey served as a member.

Wyatt credited McCleskey for his role in changing TWDB rules which resulted in loans for the purchase and development of ground water by towns and cities throughout Texas.

McCleskey was appointed as a member of the TWDB on Jan. 16, 1976, by Governor Dolph Briscoe. He was re-appointed to the Board by Governor Bill Clements in 1982 and served as Vice-Chairman from 1982 to 1986.

He retired from the partnership of McCleskey, Harriger, Brazill and Graf in 1980 and currently serves as a consultant for the law firm. He is a graduate of the University of Texas Law School and has lived in Lubbock since 1940.

He has served on a number of advisory boards, including the High

See McCLESKEY Page Three

State representatives will tour Panhandle water districts

Members of the Texas House of Representatives Natural Resources Committee and other water interest groups will tour the High Plains Aug. 17-19 to learn more about the water conservation techniques used by area producers.

Officials from the High Plains Underground Water Conservation District No. 1, the North Plains Groundwater Conservation District No. 2 and the Panhandle Groundwater Conservation District No. 3 invited the Committee members and guests to tour the region following public hearings on water conservation and water quality held during March and April in Lubbock.

"With the knowledge from this tour, the legislators should have a better understanding of the farmer and the water resources he works with to produce his crops. I hope the end result will be positive legislation which will benefit the High Plains farmer," says A. Wayne Wyatt, High Plains Water District manager.

At press time, the Committee members expected to attend were Representatives Terral Smith, R-Austin; Jerry Yost, R-Longview; and Dan Shelley, R-Crosby in Harris County.

Members of the Texas Water Commission, the Texas Water Develop-

See LEGISLATORS Page Four

Representative Terral Smith

Midlander appointed to TWDB

Wesley E. Pittman of Midland has been appointed by Governor Bill Clements to succeed George W. McCleskey of Lubbock as a member of the Texas Water Development Board.

Pittman is the general manager of Wagner and Brown, an independent oil and gas producer with diversified interests in real estate, applied research, investments and light manufacturing.

Pittman received a Bachelor of Arts degree and a Bachelor of Science degree in chemical engineering from Rice University. After graduation, he was employed by Shell Oil as a petroleum engineer until 1964.

Pittman was later a petroleum engineer, loan officer, Senior Vice-President and Manager of the Trust Division of the Midland National Bank.

In 1974, he was named President and Chairman of the Board of the First City National Bank of San Angelo. He held that position until becoming General Manager of Wagner and Brown.

Pittman has served on the boards of various community and civic organizations in Midland and San Angelo. He is a registered professional engineer and a member of the Society of Petroleum Engineers. His term on the Water Development Board will expire in December 1993.

Wesley E. Pittman

Aging underground pipelines may cause hidden water losses

"Irrigators may be losing more water through concrete underground pipeline leaks than they think," says Ken Carver, assistant manager of the High Plains Underground Water Conservation District No. 1.

Thousands of miles of mortar-jointed underground pipeline are still in use today on the High Plains. Most of these pipelines have been in place since the 1950s and 1960s and need to be checked for leaks caused by deterioration.

Large pipeline leaks are easy to detect when puddles form on the land surface. In other instances, leaks may occur on the bottom side of the mortar joint in the pipeline which was laid in a trench cut into the caliche. The caliche, being more porous than the top soil and containing minerals which dissolve, making it even more porous, will absorb the lost water; and a wet spot may never appear on the land surface.

Water losses in underground pipe have been measured which equaled 50 percent or more of the well's yield. Generally, a large number of small leaks are involved in these extreme situations.

One way to check to see if your pipeline is leaking is to close all the gates or valves on the pipeline, except the one at the highest point on the line. Pump water until it flows out of the valve, cut off the well and close the valve. Wait one hour, then open the valve on the high point and restart the well. If water does not immediately flow out of the line, then you have a leak in the pipeline. Continue to pump until water flows out of the valve.

The longer it takes to refill the line, the more serious the leak is likely to be. A leak test of one hour that requires pumping more than 5 minutes to refill the line should have a field test using flow meters to determine the actual extent of the leak.

This would require installing a flow meter on the well discharge and another meter on the discharge from the underground pipeline. The difference between the two readings in gallons per minute would indicate the pipeline loss.

The Water District has just purchased an electronic transit-flow meter for use by field staff to check underground pipeline leaks. The new meter eliminates the need to disassemble the pipe to obtain meter readings. Sensors are attached to the pipe exterior, and readings are obtained as the water flows between the two sensors.

"It is real common in the High Plains area to find several wells tied into one underground pipeline. In order to determine how much water is being pumped into the line, each pump has to be shut down, a flow meter installed on each well, and then the wells restarted. A time lag or waiting period is required for the pumping levels to stabilize in addition to letting the water in the pipeline stabilize. This is very time-consuming. However, with the new meter, all we have to do to obtain a flow reading is connect the sensors to the exterior of the discharge pipe on the pump and to the discharge line from the pipe valve. The wells do not have to be stopped," says Carver.

He adds that underground pipeline leak tests with the new meter will soon become one of the services offered by the District field staff. There will be no charge for this service, and requests will be handled on a first-come, first-served basis.

For those who wish to check their own pipelines, the older model flow meters are available on a free-loan basis to irrigators within the Water District's 15-county service area.

The water lost from underground pipe which does not wet the surface of the ground eventually returns to the aquifer. However, the irrigator receives little or no benefit from pumping the water. The obvious benefits he can expect from repairing the leak or replacing the pipeline are an increase in his water supply for his crop by an amount equal to that which he was previously losing to pipeline losses; reduced fuel cost per unit of water applied to his crop; reduced labor costs by being able to cover the field in a shorter period of time; and in all probability, increased production as a result of irrigating the field on a more timely basis.

Assuming a fuel cost of $3 per acre-inch to pump the water, a loss of 100 gallons per minute for a 120-day pumping season would result in paying out an extra $1,909 in fuel cost for water leaks.

"Once the irrigator determines what his pipeline losses are, then replacement of the line is fairly inexpensive. If there is 500 feet of leaking pipeline, the irrigator can replace it for an average of $2.75 per foot, or $1,375 total cost," says Carver.

Carver encourages producers who desire more information on underground pipeline losses to contact the High Plains Water District, 2930 Avenue Q, Lubbock, TX 79405 or call (806) 762-0181.

Water audit workbook available

The "Water Resources Audit — A Workbook for Small Communities," by Kathleen M. Trauth, Billy J. Claborn, and Lloyd V. Urban is now available through the American Water Works Association (AWWA).

The volume, which contains 36 pages of introductory text and 149 pages of worksheets covering basic information on Water Supply, Wastewater Management, Stormwater Management and Conservation, may be obtained by contacting the AWWA, 6666 West Quincy Avenue, Denver, CO 80235.

The workbook is order number 20239 and costs $29.50 for AWWA members or $37.00 for non-members plus $2.25 postage in either case.

THE CROSS SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
2930 Avenue Q, Lubbock, Texas 79405
Telephone (806) 762-0181

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NOTICE: Information regarding times and places of the monthly County Committee meetings can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name.

Proper fall lawn care helps minimize winter plant damage

Many homeowners conscientiously care for their lawns, trees and shrubs throughout the summer. However, lawn care usually diminishes as temperatures cool in the fall. With proper "winterizing," lawns and other vegetation will be protected against winter injury, and plants will be healthier in the springtime.

Lawn Watering

Shorter days, cooler temperatures and increased precipitation usually reduce fall grass watering requirements. However, a fall or winter watering will be beneficial to the turf if precipitation does not occur.

"The grass root system is still alive and still needs water, even though the top is not green," advises Tommy Bartley, local franchise owner of a national lawn care company.

In the fall, grass which has become water stressed will show the same symptoms as in the summer. These signs include curling leaf blades, a grayish-green turf color, or footprints remaining on the grass after someone has walked across it. If these symptoms are noted, the lawn should be watered until the soil is wet to a six-inch depth. Homeowners may determine the wetted depth by pushing a metal rod or wooden dowel into the soil until it cannot be pushed further and then measuring the depth that the rod or dowel penetrated the earth.

Cool-season grasses, such as Tall Fescue and Kentucky Bluegrass, are used mainly in the Amarillo area. These grasses continue to grow during the winter and may require more water in the winter months than Buffalograss, bermudagrasses and other warm-season grasses which are dormant in winter.

Lawn Fertilization

September and October are the best times for fall fertilizer applications. The fertilizer applied in early-spring or mid-summer will be used up, and there will not be enough nutrients left in the soil to supply the plant adequate nutrients for storing food for the winter months.

Fall fertilizer applications should not exceed two pounds of nitrogen per 1,000 square feet. Fertilizer amounts beyond this recommendation will promote excessive leaf growth at the expense of the root system and will increase turf susceptibility to stresses caused by disease and dry periods.

Mowing

Along with water and fertilizer, mowing is an important factor in fall lawn maintenance. Leaving an inch or more of grass height will help conserve water and offer insulation against a freeze. Scalping or clipping the lawn short in late fall often leads to winterkill of roots as well as promoting a lush growth of winter weeds.

Winter Weeds

Fall is also the time to control winter weeds. Apply preemergence herbicides such as atrazine or simazine from mid-August through mid-September to control weeds such as chickweed, henbit or annual bluegrass. These weeds emerge in September and October and can overtake lawns in the spring.

Watering Trees and Shrubs

Like grass, trees and shrubs also need water year-round to survive. Usually, the average normal precipitation in the area will supply the plant's water needs during the fall and winter. Average precipitation totals from August to December equal 7.95 inches in the Amarillo area and 7.21 inches in the Lubbock area. However, if dry conditions prevail during this time, supplemental watering will be needed.

Educational materials teach students about water use

This summer's drought conditions, which have caused water rationing, strangled barge traffic, and withered crops in some portions of the country, have also reinforced the importance of water to people across the United States.

Since water awareness can never begin too early, the High Plains Underground Water Conservation District No. 1 offers free educational materials on water and water conservation to students within Water District boundaries. Films and slide shows are also available on a free-loan basis or may be presented by Water District staff members.

The Story of Drinking Water

Since January 1986, more than 17,000 copies of the comic book, *The Story of Drinking Water* have been distributed to students from kindergarten through ninth grade in 33 school districts within the District's 15-county service area. *The Story of Drinking Water* introduces students to the processes needed to bring drinking water to their home. Special emphasis is placed on the hydrologic cycle, water sources, water treatment plants, and water meters.

The accompanying teachers' guides contain lesson plans and exercises designed to inform students about the importance of water and its wise use. The primary guide is designed for grades one through three and assists teachers in introducing younger students to water uses, people who work with water and water as a necessity for life. The intermediate teachers' guide is designed for students in grades four through six and discusses the hydrologic cycle, chlorine, water treatment, water meters and household plumbing.

Advanced Teacher's Guide Now Available

An advanced teacher's guide for *The Story of Drinking Water* is now available for the first time through the Water District. Aimed at grades seven through nine, this guide includes lessons and information about water storage, governmental water regulations and the effects of a water shortage on a community.

Water: The Basis of Life

Another comic book, *Water: The Basis of Life,* is available for use in junior high school classrooms. This comic book introduces students to the importance of water to life; municipal and agricultural water use; water pollution; soil erosion; and watersheds. The teacher's guide offers student exercises dealing with personal water use, local water sources and water treatment.

Audio-Visuals

The Water District's audio-visual library contains 16 different films which address various water conservation topics. These 16mm films are suitable for various age groups and are available on a free-loan basis either from the Water District or the Education Service Centers in Amarillo or Lubbock. Slide shows on many subjects are also available upon request from the District.

McCleskey honored by Board

Continued From Page One

Plains Research Coordinating Board, the West Texas Water Institute Advisory Board and the Lieutenant Governor's Water Resources Advisory Committee. McCleskey is a former co-chairman of the Underground Water Law Committee of the Environmental Law Section for the State Bar of Texas. He is also the immediate past chairman of the Texas Supreme Court Advisory Committee.

McCleskey is a past chairman of the Board of Trustees of Methodist Hospital and was named Lubbock's Executive of the Year in 1975. He is also a past president of the Lubbock Chamber of Commerce, the Lubbock Board of City Development and the Lubbock Industrial Foundation.

The resolution presented to McCleskey by Board President Mitchell reads as follows:

"WHEREAS, George W. McCleskey has represented his state and nation as a concerned citizen and dedicated member of the Texas Water Development Board since his appointment by Governor Dolph Briscoe on January 16, 1976; and

"WHEREAS, he continued to serve the Board following his reappointment by Governor William P. Clements, Jr., on March 22, 1982, at which time he assumed the position of vice chairman, an office to which he was re-elected in June 1982 and May 1984; and

"WHEREAS, the people of the High Plains of Texas have especially benefited from his service as a member of the Texas Water Development Board as a result of his extensive knowledge of the area, its people and its needs; and

"WHEREAS, through his initiative, leadership and personal contribution of time and expertise, the people of Texas have benefited and shall continue to benefit for decades to come;

"NOW THEREFORE BE IT UNANIMOUSLY RESOLVED by the Board of Directors of the High Plains Underground Water Conservation District No. 1 that the Board expresses to George W. McCleskey its appreciation for his dedication to ensuring that there will be sufficient quantities of clean water for all Texans for all time.

"BE IT FURTHER RESOLVED that this Resolution be recorded in the official minutes of the High Plains Underground Water Conservation District No. 1 and that a copy be transmitted to George W. McCleskey with gratitude for his service in developing and managing the water resources of Texas.

"IN WITNESS WHEREOF, we do hereby cause our signatures and the seal of the High Plains Underground Water Conservation District No. 1 to be affixed hereon, this the 12th day of July, 1988, in Lubbock, Texas."

James P. Mitchell, President — Mack Hicks, Vice President
A.W. Gober, Secretary/Treasurer — Gilbert L. Fawver, Member
James C. Conkwright, Member

Loan funds still available for water conservation equipment

Area landowners and operators are showing increased interest in obtaining low-interest loans from the High Plains Underground Water Conservation District No. 1 for the purchase of agricultural water conservation equipment to improve water use efficiencies.

Under the Agricultural Water Conservation Equipment Pilot Loan Program, the Water District borrows funds from the Texas Water Development Board (TWDB) to lend to qualified applicants for the purchase of center pivot sprinkler systems and other agricultural water conservation equipment.

"People who have just found out about the Pilot Ag Loan Program call us daily," says Becca Williams, Water District Ag Loan coordinator. She says extra money from a profitable crop last year, a low loan interest rate and increased publicity have probably increased irrigators' interest in the program.

More than $1.2 million has been loaned to 49 applicants since the first loans were processed by the Water District in 1986. Most of the funds have helped purchase center pivot systems, underground pipe, surge irrigation systems and gated pipe. The majority of the equipment has been installed in Parmer, Castro, Lubbock and Lamb counties.

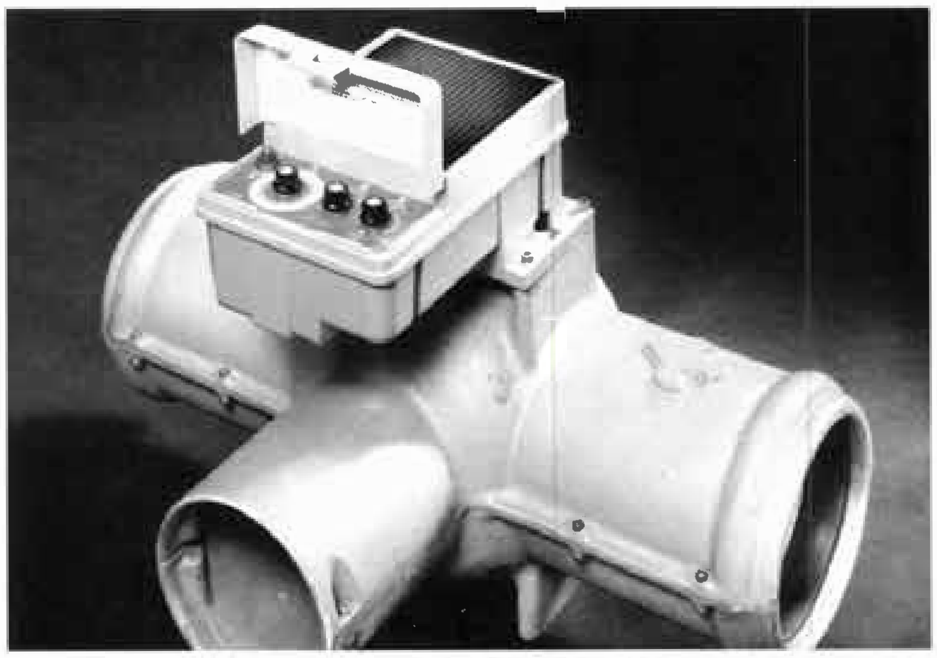
The Water District has committed the entire $1 million of its third loan obtained from the TWDB. However, it received approval in July for a fourth $1 million loan. Money from the fourth loan will be available beginning in August 1988. The Water District lends the money at the same interest rate it pays to the state for the loan. The current interest rate is 7.27 percent. A one-time service fee of 2.5 percent of the loan amount is charged to cover administrative costs.

Applicants may borrow up to 75 percent of the purchase price of permanently-installed equipment and up to 50 percent of the cost of contract services, installation and nonrecoverable items. A maximum of $100,000 may be borrowed by any one individual. The repayment schedule is from three to eight years, based on the loan amount.

Equipment eligible for purchase with loan funds includes low pressure center pivot sprinkler systems, surge valves, drip irrigation systems, underground pipe, gated pipe, furrow dikers and soil moisture monitoring equipment.

The Pilot Ag Loan Program was created when Texas voters approved Propositions One and Two of the Water Package in 1985. The program was originally set to expire in August 1987, but was extended until 1989 for further evaluation. At that time, a two-thirds majority vote in both houses of the Texas Legislature will be required to approve a permanent loan program which would involve the sale of up to $200 million in Agricultural Water Conservation Bonds.

Additional information on loan guidelines and applications may be obtained by contacting Williams at the Water District office, 2930 Avenue Q, Lubbock, Texas 79405 or by calling (806) 762-0181.



ELIGIBLE EQUIPMENT — Although most loans have been made for center pivot sprinkler systems, surge valves and control boxes may also be purchased with proceeds from the Agricultural Water Conservation Equipment Pilot Loan Program.

Legislators schedule area tour

Continued From Page One

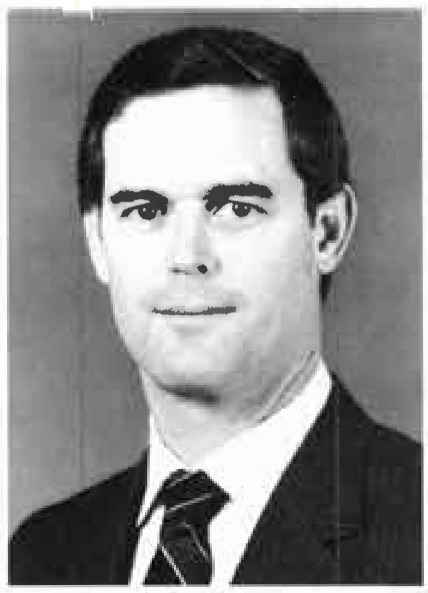
ment Board, the Texas Water Conservation Association, the Texas Farm Bureau, the Texas Sierra Club and the League of Women Voters are also expected to attend.

During the tour, the legislators and guests will receive information on water well quality testing, well permitting, depth to water measurements of the Ogallala Aquifer and the Internal Revenue Service's cost-in-water depletion allowance.

The group will also view center pivot sprinkler systems at the North Plains Research Field at Etter. Additional stops will include a tour of the feedlot operation at Cactus Feeders and the Lyndon Wagner farm at Bushland.

A similar fact-finding tour was held in July with Cliff Johnson, an aide to Governor Bill Clements, and Doc Arnold, chief of staff for Texas House Speaker Gib Lewis, visiting farms and agri-businesses in the Lubbock, Amarillo and Hereford areas.

Representative Jerry Yost



Representative Dan Shelley

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District collects water samples for pesticide analysis

WATER SAMPLES ANALYZED
Engineer Technician Dan Seale measures the pH and temperature of a water sample as part of the Water District's ground water testing for the presence of herbicides and pesticides.

Members of the High Plains Underground Water Conservation District No. 1 Technical Division were very busy during July and August collecting water samples from wells to determine if any pesticide and/or herbicide contamination of the Ogallala Aquifer has occurred within the District's 15-county service area and to establish a baseline for future comparison of water quality.

Water samples are being collected from wells located in each county served by the Water District and transported to an independent laboratory for analysis. The samples will be scanned for the presence of 20 of the most commonly used pesticides and herbicides from the past two decades.

Technical Division staff are attempting to collect water samples from approximately 89 wells scattered throughout the counties within the Water District based on the ratio of acreage in the county to the total acreage within the Water District.

The number of wells sampled in each county are as follows: Armstrong, 1; Bailey, 6; Castro, 9; Cochran, 4; Crosby, 6; Deaf Smith, 6; Floyd, 9; Hale, 2; Hockley, 9; Lamb, 9; Lubbock, 9; Lynn, 3; Parmer, 9; Potter, 1; and Randall, 6.

Chemical analyses will check

See HERBICIDE Page Four

Ogallala water level/water quality reports now available

A new series of reports containing detailed information on the quantity and quality of the ground water stored in the Ogallala Aquifer have just been released by the High Plains Underground Water Conservation District No. 1.

The reports, *Observation Well Water Level Data* and *Water Quality Data From Selected Wells (Historical and Current)* contain actual water level measurements and water quality analyses from selected wells located throughout the High Plains Water District.

"The reports contain almost all of the water level and water quality records the Water District maintains," says Geologist Cindy Gestes, who authored the reports. "The reports were compiled to make the records accessible to anyone who needs to use them," she says. A separate report has been prepared for each of the 15 counties in the Water District service area.

The format of all the reports is identical and contains data on water levels, water quality and precipitation.

Water Levels

- A map showing the location of each observation well measured. Each well has been assigned a unique number and is plotted at the well location on the face of the map.
- A table of water level records which lists the identifying well number followed by yearly measurements from 1975 to 1988 for each well measured in the county.
- A graph depicting the water level changes in feet from 1963 to 1988 for the county. The graph also includes the maximum and minimum water changes, the year they occurred and the overall water level change.
- A table listing by county the number of observation wells maintained in the Water District and the 10, five and one-year average annual water level changes.
- A table listing by county the maximum and minimum water level changes in feet for each county and the year they occurred, along with

See TECHNICAL Page Four

Safe Drinking Water Act establishes new water quality criteria

EDITOR'S NOTE: In June 1986, Congress amended the Safe Drinking Water Act of 1974, calling for speedier and more comprehensive regulation of drinking water. The Environmental Protection Agency (EPA) was directed to (1) require disinfection of all public water supplies; (2) require filtration of all surface water supplies except those naturally meeting high standards of clarity; (3) set maximum limits on 83 contaminants (as compared to the 25 contaminants previously controlled); (4) ban the use of lead piping and joints in public water systems; (5) establish new standards to protect groundwater, particularly around wellheads and (6) monitor for the presence of additional (as yet unregulated) contaminants.

In Texas, the EPA delegated responsibility to the Texas Department of Health (TDH) to enforce the Federal Safe Drinking Water Act. Failure of the state agency to enforce these rules would result in withholding all federal tax dollars allocated for water supply and waste water treatment projects for the state of Texas. Additionally, the EPA would enforce the law within the state by using heavy administrative fines without regard to the ability of the public water supplier to afford the expenditures.

The State of Texas, through the TDH, has required chlorination and filtration of public surface water supplies since the late 1930s. Neither filtration or chlorination was required for ground water used in a public water system. However, the new law now requires the public water supply owner to disinfect ground water.

The TDH performs the chemical analysis for the 83 known contaminants at state taxpayer expense. However, if a problem is found, it is the responsibility of the local public water supply owner to finance the water treatment cost needed to bring the system into compliance. The impact of such a compliance is examined in this article reprinted from the *TIA Update*, the monthly newsletter of the Trinity (River) Improvement Association in Irving, Texas — **CEM**.

Since mid-1986, EPA has been working with the water industry and environmentalists to develop regulations to implement the new law. Water utility managers have been participating in workshops to learn the impact of the new regulations on their operations and on their water rates.

A concensus is developing that the impact of the new rules will be felt least by customers of large municipal water systems (10,000 customers and above) which comprise about 5 percent of the total U.S. water treatment plants and serve about 75 percent of the U.S. population. Most of these depend on surface water as

See LAW Page Three

NEW DRINKING WATER STANDARDS — The Safe Drinking Water Act of 1974 and its 1986 amendments sets the maximum safety limits on 83 contaminants which may be found in the nation's drinking water supplies. The Texas Department of Health conducts statewide analyses of water from public water supply systems. If problems are found, the Texas Department of Health advises local public water suppliers that they must upgrade their treatment system to comply with the new drinking water standards.

Bushland producer named state winner in award competition

Mr. and Mrs. Lyndon Wagner of Bushland have been selected to represent Texas in the sixth annual National Soil and Water Conservation Awards program.

The program, created in 1983 by the Du Pont Company and the National Endowment for Soil and Water Conservation, honors those farmers/ranchers who are using and adapting innovative, cost-effective soil and water conservation techniques on their land.

"Many more Americans need to understand what these remarkable farm families accomplish," says Emmett Barker, president of the Farm and Industrial Equipment Institute, who chairs the Endowment. "They safeguard our agricultural future, and they also help reduce many natural resource problems by showing their neighbors by example what can be done to conserve soil and water."

Wagner uses several soil and water conservation management techniques in his 1,118 acre farming operation. These techniques include minimum tillage, land leveling, furrow diking, crop rotation, soil moisture monitoring, underground pipeline use, surge irrigation, LEPA system operation and pollution abatement.

In addition, Wagner has allowed the Texas Agricultural Extension Service, the USDA-Soil Conservation Service and the High Plains Water District to demonstrate new soil and water conservation techniques on his farm.

"We are all fortunate that we have been left good soil and water resources by our forefathers. It is only right that we do the same. Our future generations deserve to have adequate natural resources. By using the conservation techniques in my farm management plan, I can do my small part to save our water and land for the future," he says.

Wagner has served two terms as a board member of the Bushland Independent School District. He is currently serving as a Randall County Committeeman for the High Plains Water District.

Finalists were selected by committees of public and private agricultural organizations in each state. The 1988 honorees will be further evaluated for national honors by a technical advisory committee and by former award winners. A group of 10 national finalists will be selected, and they will attend an awards ceremony on October 30 in St Louis.

From these 10 finalists, three national winners will be chosen to receive a $1,000 cash award and certificate at special ceremonies in Washington D.C. in December.

This marks the second year that a producer residing within the High Plains Underground Water Conservation District No. 1 service area has been chosen for this honor. Mr. and Mrs. Ronald Schilling of Slaton represented Texas in the national awards program in 1987.

Wright joins District staff as bookkeeper/cost accountant

"Math was always my least favorite subject," says Marci Wright, who joined the High Plains Underground Water Conservation District No. 1 staff as Bookkeeper/Cost Accountant in June. "But there's more to accounting than just math. I enjoy the organizational aspects of accounting," she says.

Marci brings a variety of accounting experience to the Water District. She has previously worked for a construction company, a company which designs and services municipal water and waste water facilities, and the City of Lubbock Memorial Civic Center.

"Every place I've worked has been different. I've learned about things as diverse as construction and advance show bookings. I've never been involved in agriculture before, but through the Water District, I have become aware not only of agriculture's major impact on the economy, but also of the importance of ground water to agriculture in this area. I think the services the Water District provides are very beneficial," she says.

Marci, 25, was born in Morgantown, West Virginia, and moved to Lubbock in 1972. She graduated from Coronado High School in 1981 and from Texas Tech University in 1984 with a Bachelor of Business Administration degree in accounting. While in college, Marci played the flute and piccolo in the Tech Marching and Concert Bands. She was also named to the Dean's List.

Marci married David Wright in March 1984. He is employed by Rix Funeral Directors. In her spare time, Marci enjoys reading, cooking, water and snow skiing, music, and entertaining.

Marci Wright

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Katy Wright, 1992 .... Box 65, Dimmitt
Robert Benton, 1992 .... Rt. 4, Dimmitt

Cochran County
W.M. Butler, Jr., Secretary
Western Abstract Co., 108 N. Main Ave., Morton

Douglas Zuber, 1990 .... Rt. 2, Box 35, Morton
Richard Greer, 1990 .... Star Rt. 1, Box 4, Morton
Donnie B. Simpson, 1990 .... 292 SW 3rd St., Morton
Kenneth G. Watts, 1990 .... Box 636, Morton
L.T. Lemons, 1990 .... Rt. 2, Morton

Crosby County
Becca Williams, Secretary
2930 Avenue Q, Lubbock

Marvin Schoepf, 1990 .... Star Rt., Box 88, Ralls
Ronald C. Smith, 1990 .... Box 247, Lorenzo
Loyd Gregory, 1990 .... Star Rt., Box 65, Ralls
Tracy Don Hancock, 1990 .... 302 Van Buren, Lorenzo
Bobby Brown, 1990 .... Rt. 1, Box 267C, Lorenzo

Deaf Smith County
B.F. Cain, Secretary
110 East Third, Hereford

J.F. Martin, 1992 .... Box 1306, Hereford
Troy Sublett, 1992 .... 123 Mimosa, Hereford
Virgil P. Walker, 1992 .... Star Rt., Hereford
R.D. Hicks, 1992 .... Rt. 4, Hereford
Rex Lee, 1992 .... 304 Centre, Hereford

Floyd County
Verna Lynne Stewart, Secretary
108 W. Missouri, Floydada

John Lee Carthel, 1990 .... Rt. 1, Lockney
Cecil Jackson, 1990 .... Rt. 3, Floydada
D.R. Sanders, 1990 .... Star Rt., Floydada
Bill Glasscock, 1990 .... Rt. 1, Box 153, Lockney
Kenneth Willis, 1990 .... Rt. 4, Box 103, Floydada

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J.B. Mayo, Secretary
Mayo Ins., 1617 Main, Petersburg

Harold W. Newton, 1990 .... Box 191, Petersburg
Jim Byrd, 1990 .... Rt. 1, Petersburg
Ray Porter, 1990 .... Box 193, Petersburg
Larry B. Martin, 1990 .... Box 189, Petersburg
W.T. Leon, 1990 .... Box 10, Petersburg

Hockley County
Jim Montgomery, Secretary
609 Austin Street, Levelland

W.C. McKee, 1990 .... Box 514, Sundown
Randy Smith, 1990 .... Box 161, Ropesville
R.H. Reaves, 1990 .... 403 Holly, Levelland
Marion Polk, 1990 .... Rt. 2, Box 226, Levelland
Hershel Hill, 1990 .... Rt. 3, Box 89, Levelland

Lamb County
George Harlan, Secretary
103 E. Fourth Street, Littlefield

J.D. Bamun, 1990 .... Box 215, Springlake
Arlen Simpson, 1990 .... Rt. 1, Box 179, Littlefield
Belinda Thompson-Beavers, 1990 .... Rt. 1, Box 42, Anton
Harold Mills, 1990 .... Box 73, Olton
Stanley Miller, 1990 .... Rt. 1, Box 163A, Amherst

Lubbock County
Becca Williams, Secretary
2930 Avenue Q, Lubbock

Billy Walker, 1990 .... Rt. 5, Box 183, Lubbock
Richard Bednarz, 1990 .... Rt. 1, Box 143, Slaton
Danny Stanton, 1990 .... Box 705, Shallowater
G.V. (Jerry) Fulton, 1990 .... 3219 23rd, Lubbock
Pierce H. Truett, 1990 .... Rt. 1, Box 44, Idalou

Lynn County
Becca Williams, Secretary
2930 Avenue Q, Lubbock

Leland Zant, 1990 .... Rt. 1, Wilson
David D. Vied, 1990 .... Box 68, Wilson
Willie A. Nieman, 1990 .... Rt. 4, Tahoka
Lonnie Paul Donald, 1990 .... Box 297, Wilson
Danny Nettles, 1990 .... Rt. 4, Tahoka

Parmer County
Pat Kunselman, Secretary
City Hall, 323 North Street, Bovina

Wendell Christian, 1992 .... Rt. 1, Farwell
John R. Cook, 1992 .... Box 506, Friona
Robert Gallman, 1992 .... Rt. 1, Friona
Billy Lynn Marshall, 1992 .... 903 8th St., Bovina
Jerry Lenthon, 1992 .... 1210 Jackson, Friona

Potter County
Bruce Blake, Secretary
Bushland Grain, Bushland

Frank Wiezner, 1992 .... Box 41, Bushland
Bob Lolley, 1992 .... Rt. 1, Box 445B, Amarillo
L.C. Moore, 1992 .... Box 54, Bushland
Charles S. Henderson, 1992 .... P.O. Box 74, Bushland
Marshall Cutright, Jr. .... P.O. Box 3176, Amarillo

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Farm Bureau, 1714 Fifth Ave., Canyon

Gary Wagner, 1992 .... Box 219, Bushland
Charles Kuhnert, 1992 .... Box 80, Umbarger
Lyndon Wagner, 1992 .... Rt. 1, Box 494, Amarillo
Tim Payne, 1992 .... Rt. 1, Box 18, Happy
Tom Payne, 1992 .... Rt. 1, Box 306, Canyon

NOTICE: Information regarding times and places of the monthly County Committee meetings can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name.

COUNTY SECRETARY RETIRES — Mrs. Doris Wedel of Muleshoe retired September 1, 1988 after serving for 14 years as the Bailey County Secretary for the High Plains Underground Water Conservation District No. 1. A dinner in her honor was held September 1st at the Old Corral Restaurant in Muleshoe, with members of the Bailey County Committee, the Water District Board of Directors and staff in attendance.

Teachers request water educational materials

Teachers preparing for the 1988-89 school year are eagerly returning their requests for free water conservation educational materials available from the High Plains Underground Water Conservation District No. 1.

In July, the Water District notified area schools that the educational comic books, *The Story of Drinking Water* and *Water: The Basis of Life,* were once again available for use in their classrooms.

Principals and teachers began requesting the materials immediately. Since August, a total of 19 School Districts have requested more than 6,300 copies of *The Story of Drinking Water* and more than 3,600 copies of *Water: The Basis of Life* from the Water District.

"We appreciate your assistance in helping us provide quality education for our future, the adults of tomorrow. Please keep us on your mailing list for any future information," wrote one teacher.

"Sounds great! Looking forward to it," says another educator. "Thank you very much for this service to our students. I know this information will be meaningful," was the comment on another order request received by the District's Information/Education Division staff.

The Story of Drinking Water introduces basic water concepts including the hydrologic cycle, waste water treatment and household water use. Teacher's guides for primary (grades 1-3), intermediate (grades 4-6), and advanced (grades 7-9) levels contain lesson plans, student exercises and classroom activities. The advanced teacher's guide is available for the first time this year.

Water: The Basis of Life follows students on a field trip where they learn about ground water, surface water, and ways to conserve this resource. The teacher's guide also contains lesson plans, student exercises, classroom activities and suggested field trips.

Teachers may order comic books and teachers' guides by contacting the High Plains Underground Water Conservation District No. 1 at 2930 Avenue Q, Lubbock, Texas 79405 or by calling (806) 762-0181.

Law requires public water suppliers to disinfect ground water

Continued From Page One

a source of supply. At the other end of the spectrum, where the new law will have the most impact, are the small plants (serving 25 to 3,300 customers) which constitute 77 percent of the U.S. water systems and serve 15 percent of the population. Most of these depend on groundwater as a source.

Disinfection

The new requirement that all public water supplies be disinfected will cause many small systems to install disinfection facilities for the first time. Most systems which use groundwater as a supply have not disinfected the water before putting it into the distribution system. The most common and least costly method of disinfection is chlorination. It is simple and effective and leaves a chlorine residual in the treated water which combats reinfection. Other disinfection processes involve ozonation or exposure to ultraviolet light waves. Neither of these has any residual disinfection capability.

Filtration

Most, but not all, large surface water plants employ filters to remove silt as well as contaminants such as giardia, viruses, legionella and bacteria. Large cities not filtering their water include New York, Boston, San Francisco and Seattle.

Under the new law, unless an exemption can be obtained, these and the 1,200 other cities providing unfiltered surface water will be required to install filtration equipment. The new regulations propose a maximum turbidity level of 0.5 NT units, 95 percent of the time.

MCL's and BAT's

By June, 1989, EPA is to establish maximum contaminant levels (MCL's) for 83 contaminants and designate BAT's (Best Available Technologies) for the removal of each. Every three years, 25 more contaminants are to be added to the regulated list.

The contaminant lists include volatile and synthetic chemicals, inorganic chemicals (metals), and radionuclides. An MCL is set at a level at which no known or anticipated human health effect will occur, allowing an adequate margin of safety.

For example, the MCL for carbon tetrachloride, a volatile organic chemical, now 100 parts per billion, is expected to be lowered to 50 parts per billion or less. Water treatment processes being considered for BAT designation include: granular activated carbon filtration; ion exchange; lime softening; ozonation and oxidation-disinfection.

Currently, few water treatment plants include any of these BAT processes. If any of the 83 contaminants are found to exceed the allowable MCL, additional treatment facilities will be required.

Lead

The new law bans the use of pipe containing more than eight percent lead or lead based solder in drinking water systems. The prohibition will impact older cities in the North and East, which use lead pipe in their distribution systems and household plumbing, more than in the West and the South, where copper and plastic pipe are in general use.

Wellhead Protection

The new law strengthens the protection of groundwater by establishing wellhead protection areas, but leaving it up to the states to delineate the protected areas and to determine protection procedures.

Unregulated Contaminants

EPA proposes that all community water systems monitor for some 50 organic chemicals which are not now regulated and report findings at least once every five years. This requirement will create a heavy financial burden on smaller systems which use multiple well systems which will have to be monitored.

Both EPA and the American Water Works Association (AWWA) have made estimates of the cost impact in complying with the new rules. EPA estimates that the new filtration requirements will necessitate an investment of $2 billion nationwide and increased annual operating costs of $325 million.

In terms of monthly water rates, EPA estimates that customers of small systems may see increases of $17 to $32 per month, whereas the bills of large city customers should increase no more than $4 per month.

AWWA believes that deferred replacement costs, growth and drinking water compliance needs will cost water utilities at least $10 billion per year and AWWA President Jack Robinson has stated his fear that real costs may be even higher.

The AWWA data base indicates that the average price paid for water in the U.S. is about $1.35 per 1,000 gallons. For a system serving 10,000 customers, treatment for organic chemicals would add $0.50; disinfection, $0.10; and addition of granular activated carbon treatment, another $0.40. Collectively, these improvements would add $1.00 per 1,000 gallons or in round terms for an average customer, about $100 per year. In the East, where there is a critical need to overhaul water distribution systems, the cost would be greater, and in the South where there is less need for system upgrading, the cost would be less.

Both EPA and AWWA hold the view that the majority of the public will be willing to pay more for higher quality water, provided they understand what they are paying for and why. The public may not realize what a small proportion of the water it purchases is used for human consumption, and it is this part that necessitates the new regulations.

Of the approximately 190 gallons of water per person per day that is furnished for residential use, less than one gallon is ingested into the human system through drinking, cooking and brushing teeth. The remaining 189 gallons are used for bathing, laundry, flushing toilets, air conditioning and yard use.

It is not essential that water used for these purposes be of drinking water quality. If dual water systems, one for potable and one for non-potable water, were available in residences and municipal distribution systems, significant savings in water treatment costs could be achieved. However, the capital costs in retrofitting existing systems would be enormous. Moreover, it is likely that the Federal Government would oppose dual systems because of the danger that some might drink the water from the non-potable system. EPA also opposes so called "point-of-use" water treatment, that is, connecting a water treatment apparatus to the kitchen tap that would be capable of producing potable water in lieu of treating all the water brought into the house.

Economic necessity may someday require that we as a nation rethink the problem of furnishing water for household use. When traveling in foreign countries, one is warned not to drink the tap water or even use it for brushing teeth.

The question is, can we continue to treat all the water used in an American household to the exotic standards now being proposed, only to use 99 percent of it for such mundane purposes as yard sprinkling, laundry or sanitation?

Experiment Station schedules field day

The Texas Agricultural Experiment Station and Extension Center at Lubbock will host its 79th annual Field Day from 11 a.m. to 3 p.m. on Tuesday, September 13, 1988.

The Experiment Station is located north of Lubbock International Airport. Visitors should exit Interstate 27 at FM 1294 and travel east approximately one-half mile to the principal office of the Experiment Station.

Highlights of the Field Day will include agronomic cropping systems, weed and Russian wheat aphid research, cotton and sorghum genetics, and grape production. Specialists will be stationed throughout the displays and will be available to discuss any specific problems producers might have.

Other agencies located at the Lubbock-Halfway Center and cooperating in the Field Day include the Texas Agricultural Extension Service, the High Plains Research Foundation, the Texas Forest Service, and the USDA-ARS.

Counties file District annexation petitions

Petitions requesting the annexation of Terry and Yoakum Counties into the High Plains Underground Water Conservation District No. 1 have been filed with the District's Board of Directors.

A total of 53 signatures were received from Terry County and 62 signatures were received from Yoakum County. A minimum of 50 signatures of landowners is required by law within a territory requesting annexation into a Water District.

Public hearings will be held September 27th in Plains at the District Courtroom of the new Yoakum County Courthouse and September 29th in Brownfield in the District Courtroom of the Terry County Courthouse.

These hearings will provide testimony to be used by the Board of Directors to determine if the annexation is of mutual benefit to the Water District and to the territory within the two counties. Interested parties are encouraged to give public testimony and ask questions about the Water District at that time.

If the Water District Board of Directors finds the addition to be feasible, two separate elections will be called on January 21, 1989, to give voters within the two counties and within the existing Water District the opportunity to vote on the annexation. A majority vote within both areas is required for new land to be added to the Water District.

Herbicide analysis under way

Continued From Page One

water samples for the presence of Alachor, Metolachor, Chlorpyrifos, Diazinon, Phorate, Diuron, Bromacil, Atrazine, Propazine, DDT, Aldicarb Sulfone, Picloram, Arsenic Acid, Treflan, Glyphosate and Paraquat. The laboratory analysis cost for each sample is $1337.

Analysis of the water samples should be completed by the end of October.

The current testing for herbicides and pesticides is an expansion of the Water District's efforts to monitor and protect the ground water quality of the aquifer.

In 1985-86, the District explored the possibility that over-use of nitrogen fertilizer could be a potential source of contamination to the aquifer.

The Water District, in conjunction with the USDA-Soil Conservation Service, collected soil samples at one-foot intervals to a depth of four feet at 225 randomly selected sites throughout the District. Analysis revealed little nitrate nitrogen in the top four feet of the soil profile. In fact, deficiencies were noted. The District recommended additional fertility to assist crop production. In the fall of 1986 and the spring of 1987, the District resampled at these same sites and found that there was no significant change in the nitrate nitrogen concentration.

Possible salt accumulation in the plant root zone caused by more efficient irrigation was another concern. Such an accumulation would decrease the plant's ability to extract available water, reduce germination and possibly reduce the yield of some crops normally grown in the area. However, analysis revealed no significant increase in salinity in the root zone.

Water samples are collected at three to five year intervals to determine if any significant change in the chemical quality of the water in the aquifer has occurred as a result of Man's activities.

In 1987, 250 water samples were collected for routine chemical analysis to determine if any significant changes had occurred in the quality of the ground water in the Ogallala Aquifer within the Water District service area. Even though some increase in chemical quality was noted, most analyses did not reveal significant increases as compared to previous analyses. Only six of the 250 wells sampled had nitrate levels ($N0_3$) that exceeded the 44.3 milligrams per liter (mg/1) limit recommended by the U.S. Environmental Protection Agency (EPA) for public consumption.

Technical Division completes county ground water reports

Continued From Page One

the overall water level change in feet.

- A table showing the average change in the county's depth to water by calendar year from 1963 to 1988 and the yearly change in acre-feet of water.
- A table showing the yearly change in acre-feet of the volume of water in storage from 1963 to 1988 for the entire Water District. The table also includes five-year average changes in the volume of water in storage.

Water Quality

- A fact sheet describing the source and significance of chemical constituents measured in water quality analyses.
- A map illustrating the location of observation wells sampled for water quality analysis with the unique well number plotted beside the well location.
- A table listing each well's unique number, the dates the well was sampled and the amount of each constituent in each of the analyses from water collected in the well in milligrams per liter (mg/L).

Water samples are analyzed for: silica, calcium and magnesium, sodium and potassium, bicarbonate and carbonate, sulfate, chloride, fluoride, nitrate ($N0_3$) and nitrate (as nitrogen - N), dissolved solids, hardness - calcium carbonate, specific conductance, or the degree of mineralization in the water, and hydrogen ion concentration, or pH.

Precipitation

Each report also contains average precipitation amounts for Lubbock and Amarillo from 1964 to 1987. The annual precipitation is also illustrated on graphs.

The reports will be updated annually with new water level measurements. Additional water quality analyses will be added when the wells are resampled.

Copies of these individual county reports may be obtained by contacting the High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405 or by calling (806) 762-0181. Please specify the county report you wish to receive.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

SECOND CLASS PERMIT

THE Cross SECTION

Published monthly by High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405—Ph. 762-0181

Volume 34—No. 10 Publication Number USPS 564-920, Second Class Postage paid at Lubbock, Texas *October 1988*

FURROW DIKERS SAVE RAINFALL and are among equipment which may be purchased with Pilot Agricultural Water Conservation Equipment Loan funds. Since the program's inception in 1986, loans have been made to High Plains Water District producers for the purchase of 79 low-pressure center pivot systems, 40 surge valves, two furrow dikers and one laser land leveling machine.

Water District supports Ag Loan program

EDITOR'S NOTE: The following paper was prepared and submitted to the Governor's Committee on Water Resources Management by Ken Carver, Assistant Manager, and Becca Williams, Director of Administration, for the High Plains Underground Water Conservation District No. 1. Becca handles the loan applications, and Ken conducts the inventories of equipment purchases, plus the evaluation of improved water efficiencies resulting from the purchase of the agricultural water conservation equipment — **CEM.**

Mr. Chairman and Members of the Committee:

The voters of Texas ratified Texas Constitutional Amendment Propositions 1 and 2 in November 1985. The amendments authorized several additions to the State's water financing and water conservation programs for irrigated agriculture. Key financial assistance programs that were authorized included a $5 million Pilot Agricultural Water Conservation Equipment Loan Program and a $200 million Agricultural Conservation Bond Program.

Since receiving statewide voter approval, the Texas Water Development Board (Board) has implemented the $5 million Pilot Loan Program. The Pilot Ag Loan Program has been used to make loans to local conservation districts who, in turn, have made low interest loans totaling almost $2 million to irrigation farmers to purchase and install more efficient irrigation systems. In 1987, the Texas Legislature expanded the Pilot Loan Program to allow surface water irrigation districts to make loans to farmers and also to receive loans to improve the irrigation district's distribution system and extended the Pilot Loan Program for an additional two years.

Results from the Pilot Ag Loan Program are to be used by the Legislature as the basis for writing legislation to initiate the $200 million bond-supported loan program. We would like to present to the Committee the results of the agricultural water conservation loan program administered by the High Plains Underground Water Conservation District No. 1 for your consideration in recommending that the program be extended.

Loans for 79 low-pressure center pivot sprinkler systems, 40 surge valves, 2 furrow dikers and one laser land leveling machine have been made or approved by this Water District as of September 15, 1988. Each

See DISTRICT Page Three

"Right to Capture" law threatened by Edwards water shortage

EDITOR'S NOTE: The following article discussing the Regional Water Resources Plan was written by Henry Krausse and is reprinted with permission from the *Austin American Statesman* — **CEM.**

A decision in July by San Antonio officials to build the city's first surface water reservoir has strengthened a regional agreement that would limit pumping from the Edwards Aquifer to save the two largest natural springs in Texas.

The agreement, which was given final approval by the San Antonio City Council on July 28, is an effort by the Council and the Edwards Underground Water District to balance the competing water needs of drought-stricken farmers, the growing metropolis of San Antonio and environmentally sensitive springs in San Marcos and New Braunfels, major tourist attractions.

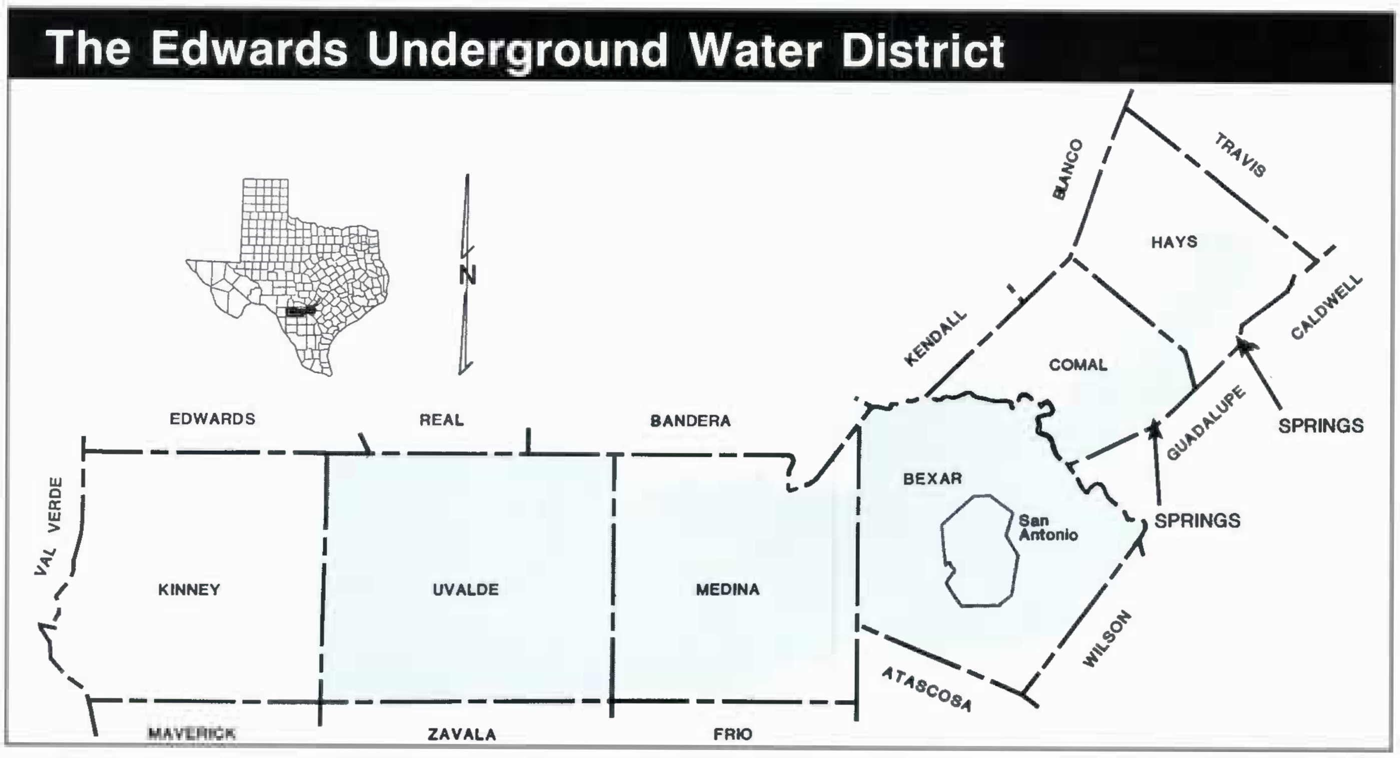
But the Regional Water Resources Plan, as the agreement is called, faces many other hurdles, including a legislative fight and possible court challenges, officials said.

The aquifer is a water-bearing limestone formation that is the sole source of water for about 1.3 million people, including all of San Antonio. Officials who worked on the plan said the compromises that led to it were difficult because the economic, environmental, and political stakes of the debate are enormous. "If this plan is adopted by San Antonio and the District, it will become the No. 1 water issue in the Legislature next year," said John Sprecht, manager of the Guadalupe-Blanco River Authority, before the July 28 vote.

The Water District, covering Uvalde, Medina, Bexar, Comal and most of Hays Counties, has played a steadily widening role in protecting the aquifer from pollution and drought since its creation in 1959. A separate section of the Edwards Aquifer continues northward through Travis and Williamson Counties, but does not fall under the Water District's jurisdiction.

As population in the district has grown, so has water pumpage from wells. Without an agreement to limit pumping, researchers predict the ground water levels in the

See EDWARDS Page Four



Governor names Buck Wynne to chair Water Commission

Buck J. Wynne III of Dallas was appointed Chairman of the Texas Water Commission (TWC) by Governor Bill Clements effective August 5th.

Wynne received a Bachelor of Science degree in biology from Tulane University and a law degree from Southern Methodist University. He was associated with a Dallas law firm where he specialized in federal civil litigation and administrative practice prior to joining Governor Bill Clements' staff.

He was serving as legislative counsel to the Governor at the time of his appointment to the TWC in August 1987.

Chairman Wynne replaces Paul Hopkins of LaMarque, who will continue to serve as a Commissioner until his term expires in August 1989.

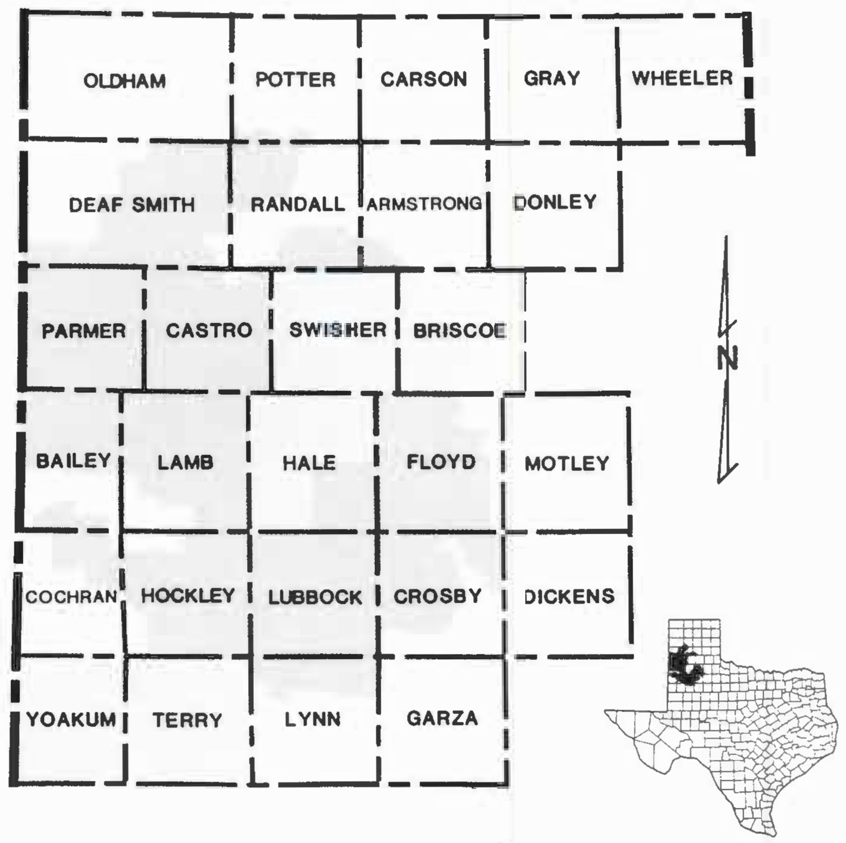
"I have, and will continue to enjoy, a very productive and effective association with Paul Hopkins," Wynne said. "Without question, it has been a beneficial experience for me to be part of this Commission under his leadership."

Hopkins served as TWC Chairman during its reorganization in 1985-86. The Commission assumed many of the duties of the abolished Texas Department of Water Resources.

Hopkins said Wynne's appointment was an excellent choice. "The Governor certainly needs to work with someone who is familiar with him and his legislative goals during this coming session. It is a very understandable change," he said.

Buck J. Wynne

Proposed Annexation Areas



Annexation petitions filed

At their September 13th meeting, the Board of Directors of the High Plains Underground Water Conservation District No. 1 received two petitions requesting annexation of territory from Swisher County and the portion of Briscoe County lying above the escarpment.

Sixty-seven Briscoe County landowners signed petitions while 81 landowners' signatures appear on petitions from Swisher County. State law requires a minimum of 50 signatures of landowners within a territory requesting annexation into a Water District.

The Board of Directors has set a public hearing to be held in Briscoe County, October 25th at 7 p.m. in the First State Bank Pioneer Room, 500 Main Street, in Silverton.

A public hearing in Swisher County was set for October 27th at 7 p.m. in the Swisher County Extension Meeting Room, Courthouse Annex, Broadway and Briscoe Streets, in Tulia.

The Board of Directors will officially receive petitions requesting annexation of the portion of Hale County not currently within the Water District at their October 11th board meeting and will consider calling a public hearing to receive testimony from Hale County residents and landowners.

Interested parties are encouraged to give public testimony and ask questions about the Water District at these hearings. Testimony given at the hearings will be used by the Board of Directors to determine whether the annexation is of mutual benefit to the Water District and to the territory within the petitioning counties.

If the Board finds the additions to be feasible, separate elections will be called on January 21, 1989, to give voters within the petitioning counties and within the existing Water District the opportunity to vote on the annexation.

Herbicides may damage lawns

In the August **Cross Section,** Atrazine or Simazine were recommended as pre-emergence herbicides for the control of winter weeds.

However, Dr. John Abernathy, weed and herbicide specialist at the Texas Agricultural Experiment Station in Lubbock, cautions homeowners that Atrazine or Simazine use can cause plant damage when used in the High Plains area.

"Atrazine and Simazine are labeled for use on bermudagrass in East and Central Texas. However, in our area, we have sandy soils with low organic matter and high pH values; and under these conditions, Atrazine and Simazine can cause serious injury to bermudagrass lawns," he says.

Abernathy recommends a herbicide, such as Surflan, Balan, or Dacthal instead. These herbicides should be applied during the late fall or early spring before the weed seed can germinate. He reminds homeowners that these herbicides should be uniformly applied to the lawn and thoroughly watered into the sod.

"Surflan provides the best winter weed control when it is applied to a healthy, well-covered bermudagrass lawn. This herbicide should last through the following summer," he says. Abernathy says that Surflan may inhibit runner growth if bermudagrass has blank areas without grass runner cover.

Roundup is another herbicide which may be used to control winter weeds. Roundup should be applied to weeds in late winter or early spring before the bermudagrass begins to turn green. If the bermudagrass has any green runners, Roundup can cause injury to them.

Abernathy also reminds homeowners to exercise caution when using fertilizers that contain weed control chemicals. "It is very important to make accurate applications of granular material since overlapping application areas and high fertilizer application rates will result in severe injury to the bermudagrass," he explains.

Additional weed control information may be obtained from the Texas Agricultural Extension Service, local nurseries or other lawn and garden stores. Commercial lawn care services in the Lubbock and Amarillo areas can help homeowners with their winter weed problems as well.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
2930 Avenue Q, Lubbock, Texas 79405
Telephone (806) 762-0181

CARMON McCAIN, Editor
DIRECTOR, INFORMATION/EDUCATION

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District Office at Lubbock

Water District operations manual under development

An operations manual for newly-formed and existing water conservation districts is being developed by Texas Tech University, the High Plains Underground Water Conservation District No. 1 and the Texas Water Commission.

"The manual is designed to answer questions that water conservation districts might have and to shorten the time needed for them to set goals and to implement necessary programs," says Dr. Lloyd Urban, Texas Tech University Water Resources Center Director. "It is designed as a generic operational tool for districts to adapt to suit their individual circumstances," he says. Urban says the need for an operations manual was evidenced by the number of new water conservation districts being formed in the state. Also, at meetings of the Texas Groundwater Conservation Districts Association, members have expressed the need for information on all phases of operation.

Dr. James Jonish, Tech Professor of Economics and Deputy Director of the International Center for Arid and Semiarid Land Studies (ICASALS), and Urban submitted a proposal to the Texas Water Commission for a grant to fund the project.

The Texas Water Commission, represented by Harry Pruitt and Bill Klemt, and the High Plains Water District, represented by Wayne Wyatt, agreed to participate as co-principal investigators. In addition, the Texas Water Commission agreed to provide funds to help cover the cost of the research, writing and printing of the first edition of the manual.

The working outline of the manual deals with various facets of water district creation, annexation and operation. Topics which will be addressed include rules, procedures, programs, practices, budgeting and financing, as well as duties and responsibilities of water district managers and directors.

Researchers have completed the first phase of the project by adopting a working outline which has been approved by the Advisory Committee. The format of a questionnaire to be used to gather information from representatives of water conservation districts all over the state is currently being finalized.

Phase Two will begin with interviews with representatives from various water districts. The data collected from these interviews will pinpoint unique problems of districts as well as common problems facing water districts. A final outline will then be developed. A draft version of the manual will be written and submitted to the Advisory Committee members for comment.

The Advisory Committee includes representatives from the Texas Water Commission, the Texas Water Development Board, the House and Senate Natural Resources Committees, the League of Women Voters, the Sierra Club, the Texas Water Alliance, the Governor's Office and several members from the Texas Groundwater Conservation Districts Association.

Phase Three of the project will consist of a final manuscript review by the Advisory Committee, final copy revisions and printing. Urban notes that the project is on schedule, and the manual should be completed by the end of February.

Bailey County office unchanged

The Bailey County office for the High Plains Underground Water Conservation District No. 1 will continue to be located at the H & R Block office, 224 W. Second Street in Muleshoe. The office telephone number, 272-3332, will remain unchanged.

Ms. Peggy Ray is the new owner of the income tax preparation franchise. Ms. Ray and Ms. Mary Hanna will be sharing the workload of the office. They will also issue permits for water wells, provide information to the public regarding Water District programs and maintain the County records of water well logs. Water District publications will also be available to the public through the office.

Mrs. Doris Wedel, former franchise owner, served as the Bailey County Secretary for 14 years until her retirement September 1, 1988.

District staff offers testimony in favor of Ag Loan program

Continued From Page One

piece of equipment has the capability of improving water use efficiency by 20 percent or more each year over the irrigation practice being replaced. The expected life of each piece of equipment is 10 years or more.

An average water savings of 50 acre-feet per year for each of the 122 upgraded systems would equal 6,100 acre-feet per year or about 61,000 acre-feet in 10 years. Before the end of the 10-year period, the $1,828,288.78 loaned to purchase the equipment will be repaid to the State with interest. The major long-term economic benefits to the farmer, the region and the State will be gained when the conserved water is used for agricultural production.

The saved water used in the future should increase agricultural production over dryland production with a product value of at least $100 per acre-foot. The 61,000 acre-feet of water should return about $6 million to the farmers by increasing crop production, while stimulating the local, regional and Texas economy by a multiple of three or about $18 million dollars. Again, this equipment was purchased with loans, not grants, and will be repaid in full, plus interest.

Background

In 1979, the Water District began a program of evaluating the efficiencies of irrigation equipment in the High Plains. The District began this effort by training its staff and USDA-Soil Conservation Service (USDA-SCS) staff to conduct on-farm irrigation efficiency evaluations.

Thousands of dollars of equipment was purchased to conduct the efficiency evaluations. The equipment was housed in small trailers, known as "mobile field water conservation laboratories." At least one mobile lab is stationed in each of the 15 counties served by the Water District. Financial assistance was provided by the Texas Water Development Board to purchase the equipment. The USDA Soil Conservation Service continues to provide technical assistance to conduct the irrigation efficiency evaluations. From 1979 through 1984, several hundred systems were evaluated, and the results were published in 1985 by the Texas Water Development Board in Publication No. LP-191.

These hundreds of evaluations revealed that high-pressure center pivot sprinkler systems averaged 61 percent in system efficiency. When the high-pressure systems were modified with drop lines and the operating pressures reduced, they operated at an efficiency of 82 percent. When they were replaced with a low-energy precision application system (LEPA), the improved system operated at a 95 percent or higher efficiency. Twenty to 35 percent improvements in water use efficiency were found to be consistently possible by upgrading the irrigation equipment.

In the evaluation of furrow irrigation, the average system efficiency was 60 percent. When time control surge valves were added to the irrigation system, the system efficiency could be increased to about 80 percent for a water savings of 20 percent.

When the irrigation application and distribution efficiency effort began in 1979, there were less than one hundred partial drop line systems, less than a dozen modified LEPA systems and only one true LEPA system in use in the Water District service area. Time control surge valves were yet to be introduced in the area.

The evaluation and demonstration efforts resulted in a serious effort by the irrigation equipment manufacturers to upgrade their equipment to obtain a much higher water-use efficiency. Adoption of the more efficient equipment by irrigators was hindered by a depressed farm economy.

The implementation of the Agricultural Water Conservation Loan Program stimulated the adoption of the more efficient irrigation equipment. First, it provided funds at a low interest rate. Second, it provided a platform for the Water District to conduct meetings to explain the benefits of the more efficient equipment; and third, those purchasing the more efficient equipment lost no time in conveying to their friends and neighbors the benefits of the improved irrigation systems in water, energy and labor savings.

The Water District's latest center pivot inventory revealed 3,384 center pivot systems in operation in the Water District. One of our county committeemen in Parmer County recently remarked that fifteen years ago he could count the number of center pivots in the county on the fingers of one hand. Today there are more than 690 center pivots in Parmer County. The majority of these systems have modified drop lines or LEPA systems. There are only a few high-pressure systems left in the county.

The depressed agricultural economy seems to be improving; and with further improvement, we anticipate a much greater demand for low-interest loans to upgrade irrigation equipment. The results of the program thus far and the apparent long-term benefits to the local, regional and State economy from the increased agricultural production from the water conserved when used in the future are our justification for respectfully requesting the Governor's Committee on Water Resource Management to recommend to the Texas Legislature that they extend the Agricultural Water Conservation Loan Program by approving the sale of the $200 million bond package approved by Texas voters in 1985 for this purpose.

Based on the results of this District's Pilot Program, it appears that for each dollar loaned, the Texas economy will be stimulated by about $9 when the conserved water is used in the future. The loans will be repaid. Therefore, the cost to the state will be very little.

District water waste rule amended by Board of Directors

The High Plains Underground Water Conservation District No. 1 Board of Directors amended District Rule 1 (h), which defines water waste, during their regular meeting on September 13, 1988.

The rule was changed to conform more closely to the definition of water waste in Chapter 52 of the Texas Water Code as amended by the 69th Legislative Session in 1985.

The amended District rule, which took effect on October 1st, reads as follows:

Rule 1—Definitions

Unless the context hereof indicates a contrary meaning, the words hereinafter defined shall have the following meaning in these rules:

(h) The word "waste" as used herein shall have the same meaning as defined by the Legislature, as follows:

(1) The withdrawal of underground water from an underground water reservoir at a rate and in an amount that causes or threatens to cause the intrusion into the reservoir of water unsuitable for municipal, industrial, agricultural, gardening, domestic, or stock raising purposes;

(2) The flowing or producing of wells from an underground water reservoir when the water produced therefrom is not used for a beneficial purpose;

(3) The escape of underground water from one underground water reservoir to any other reservoir not containing underground water;

(4) The pollution or harmful alteration of the character of the underground water in an underground water reservoir of the District by salt water or other deleterious matter admitted from another stratum or from the surface of the ground; or

(5) Willfully or negligently causing, suffering, or permitting underground water to escape into any river, creek, or other natural watercourse, depression, or lake, reservoir, drain, sewer, street, highway, road or road ditch, or onto land other than that of the owner of the well.

Edwards Aquifer shortages may cause change in water laws

Continued From Page One

aquifer will decline past the point of no return for Aquarena Springs in San Marcos and Comal Springs in New Braunfels as early as the mid-1990s, certainly by 2010. At the other end of the district, irrigation farmers in Uvalde, Medina and Bexar Counties are opposed to giving up their "right of capture" under Texas law to all the ground water they can pump.

San Antonio City Council members, including Mayor Henry Cisneros, want the pumpage limited in exchange for the city's commitment to an expensive and politically unpopular conservation and reservoir-construction program.

Comal and Hays County Directors on the district board, with Cisneros' support, have so far succeeded in making the long-term preservation of the springs the plan's central goal. The springs are home to five endangered species of fish, salamanders and plant life that exist nowhere else. Spring-fed rivers support a major tourist industry in New Braunfels and San Marcos. Because they form the main tributaries of the Guadalupe River, both springs are also vital to downstream industries, agriculture and cities — Luling, Gonzales, Victoria — and the marine ecology of coastal bays and estuaries, Sprecht said.

"The plan attempts to guarantee spring flow in an average year and to ensure water for the next 50 years for all the counties," said Jeri Martin, a Hays County member of the district's board of directors.

As a first step in the plan, the San Antonio council voted 8-3 on July 21 to construct the Applewhite reservoir on the Medina River in south Bexar county. The plan also calls for three other reservoirs in Wilson, Gonzales and Dewitt Counties to be built after the turn of the century, but does not specify who would build them.

Officials agreed that the Applewhite decision will keep the fragile concensus of Edwards district directors from falling apart and credited Cisneros with forging the consensus and convincing a council majority to approve the Applewhite project. Nelson Wolff, a San Antonio City Council member who helped negotiate the agreement with the District, said the Applewhite vote was a "linchpin for the whole future of the plan" and would soon be followed by city conservation ordinances called for by the plan.

One opponent of the plan, Maurice Rimkus of Knippa in Uvalde County, said San Antonio should build reservoirs without asking farmers to sacrifice their water rights. "We don't want to see the springs dry up. No one out there has that attitude," Rimkus said. "But if it came to a choice between our rights and the springs going down the tube, we'd certainly say, 'Let them go down the tube.' "

The springs are the most vulnerable part of the aquifer in dry years, said Glenn Longley, director of the Edwards Aquifer Research and Data Center at Southwest Texas State University in San Marcos. If the plan to "manage" aquifer pumpage fails, the springs will go dry years before wells in San Antonio or the District's western counties, he said.

Since 1934, the aquifer has had an average recharge of 631,000 acre-feet per year, but no year is "typical" because of the unpredictability of rainfall in Central Texas, Longley said. An acre-foot is the amount of water required to cover one acre to the depth of one foot.

Last year saw a record recharge of 2 million acre-feet, but 1984 was a drought year, with 197,000 acre-feet of recharge and a record pumpage of 529,000 acre-feet. As a result, the Comal Springs were reduced to a trickle for several weeks. The proposed regional plan includes an allocation system to eventually limit pumpage in the district to 450,000 acre-feet per year, leaving enough water in the aquifer to ensure spring flow during years of average rainfall.

The plan calls for a transition period before enforcing pumpage limits. It would allow wells existing in 1995 to pump no more than their highest historic annual pumpage rates in any future year. It would allow well owners to sell reduced pumpage rights to others in the district including cities. Longley said the plan was flawed because landowners will sink as many new wells as possible before the 1995 cutoff date, raising the pumpage allowable under the plan past the goal of a 450,000 acre-foot limit. Rodney Reagan, a Uvalde County representative on the district board, said only landowners who could afford the $20,000 cost of a new well would take advantage of the transition period.

Specht said he believes the Edwards Aquifer may qualify as an underground stream, which would be exempt from a landowner's right to pump it, but said he would rather see a cooperative agreement than a long court battle to decide the issue.

The district already has the authority to implement a separate drought management plan, which would go into effect during dry years. That plan does not guarantee spring flow and would set mandatory conservation measures for different classes of water users under different drought conditions.

If the regional plan becomes a statewide issue because it would change Texas' ground water law, then it may not have a chance of passing the Legislature, said Wolff.

"It was very difficult to get this far. Very difficult. And what we recommend is one thing. What the Legislature does may be something else again," Wolff said.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

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Pesticide trace amounts found in a few samples

The results from water samples collected from 90 irrigation wells and analyzed for the presence of the 19 herbicides/pesticides that have been used in the largest quantities over the longest period of time in the High Plains Underground Water Conservation District service area reveal no chemical residue above the detection limit of the laboratory analysis procedure in 575 of the analyses. The remaining 14 contain only trace amounts of six different chemicals. These trace amounts all fell below the U.S. Environmental Protection Agency's proposed health advisory limits for each identified chemical.

To quote an EPA explanation of these limits, "Health Advisories describe nonregulatory concentrations of drinking water contaminants at which adverse health effects would not be anticipated to occur over specific exposure durations." These somewhat flexible guidelines recommend limits of exposure below which an average individual would not expect to be adversely affected by a specific chemical.

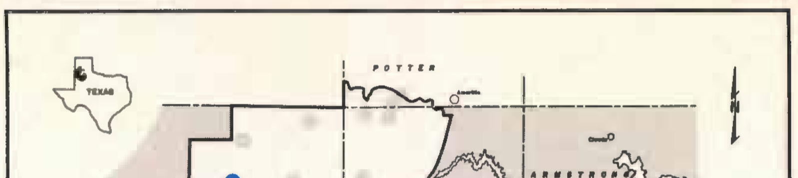
Those wells for which analysis revealed trace amounts of chemicals will be resampled in an effort to determine if the chemicals found occurred as a result of point source contamination (through the well) or if, in fact, there are trace amounts of chemicals in the aquifer.

Samples were compiled from groups of two to three wells to reduce the laboratory cost of the analysis. The wells from which a composite sample revealed the presence of any chemical will be resampled and analyzed for the chemical found in the first test. The quantities of chemicals found in the first sample analysis are so low that, in all probability, nothing will be found in the resampling effort. However, if any chemicals are found in the second sampling effort, the suspect well or wells will be sampled a third time.

The third sample effort will involve collection of several water samples from each suspect well at timed intervals. If the analyses reveal a decrease in the amount of chemical in the samples through time, it will indicate that the contaminant occurred through the well. If the amount of chemical remains constant or increases through time, it will indicate that the chemical is coming from the aquifer.

Additionally, those landowners/operators whose wells show trace amounts of chemicals will be recontacted and advised of the findings. By having a specific chemical identified as being present, they can provide specific details of the

See WELL SITES Page Four



PESTICIDE SAMPLING SITES SHOWN—Water samples from 90 well sites were taken during the High Plains Underground Water Conservation District's pesticide testing effort. From these original samples, 31 composite groups (shown above) were analyzed for the presence of 19 pesticides. Test results from the composite samples revealed trace amounts of six chemicals in 14 of the 589 analyses that were conducted. This water sampling effort by the District is believed to be the most extensive testing over the largest area for pesticides conducted to date in the United States.

District pesticide sampling procedures described

By Don McReynolds, Director Technical Division

During the late spring and early summer of 1988, plans were initiated by the Water District to begin a program of monitoring of groundwater for the presence of pesticides. Emphasis was placed upon a survey-type project to determine possible contamination of the Ogallala Aquifer by specific pesticides. This group of chemicals commonly called pesticides includes herbicides, insecticides and fungicides.

The primary goal of this project was to collect a sufficient number of groundwater samples for analysis for a selected group of pesticides within the District's service area. This sampling project was initiated to give an adequate indication of a need for further testing of the Ogallala Aquifer or to indicate a low priority to continue such a program.

Almost immediately, it was realized that dealing with this issue is a complicated and potentially expensive endeavor. Because of the historical variety and extent of use of pesticides in the High Plains, it became an immediate problem to decide which pesticides for which to analyze. To aid in this decision process, experts from Texas Tech University and Texas A&M University Agricultural Research and Extension Center at Lubbock were contacted for their opinions as to which pesticides should be investigated. (The accompanying chart contains a listing of the resulting compromise of opinions.)

Deciding the extent of sampling to attempt during this first effort was also one of the early decisions to be made. Consideration was given to two major options. One plan called for extensive sampling within a limited area, as that of a single county. The second option and the one selected was District-wide sampling with a limited number of samples collected within the District area of each county. Several conditions guided the selection of a total number of samples to be collected for analysis. This decision was probably most influenced by the cost of analyses for pesticides and the possibility of completion of the sampling during the irrigation season. Analyses cost estimates for the 19 pesticides chosen ranged from approximately $1,200 to $1,400 for each sample. These estimates varied with the support services offered by individual companies. These estimates did not include the sampling procedures and preliminary research which additionally involved a substantial

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Pesticide sampling offered unique problems for District field staff

Continued From Page One

man-hour expenditure.

This appears to be an appropriate point to thank the Texas Water Commission for their support of personnel and funds for this cooperative effort of our two agencies. This cooperation demonstrates the concern of both state and a local agency for a mutual issue.

Sampling Methods Determined

It was decided in June and July that between 90 and 100 wells was a realistic total number to be sampled for the pilot project. Based upon the service area of each county compared to the total District area, the number of wells to be sampled in each county was set to range from two to nine for a total of 90 wells. Because of the cost of each analysis, it was concluded that for survey purposes, compositing of samples with a maximum of three wells contributing to each composite sample would be cost effective and scientifically appropriate for this project.

During August, 90 wells were sampled and 31 composite samples were prepared for analysis from those samples. The wells whose samples were selected to produce individual composites were grouped as closely together as the well distribution and sampling capability would allow.

Prior to the field sampling of wells, an attempt to select prospective wells to sample was made within the limited time constraints. Owners and/or operators of wells that appeared to be appropriate to sample were contacted and as much data concerning these wells as was available were collected. The owner or other persons familiar with the use of pesticides near the prospective wells to be sampled were asked to respond to a questionnaire regarding present and historical use of chemicals. Also included for this person's review was a list of the pesticide trade names for which analyses would be made. The person answering the questionnaire was asked to indicate any use of these chemicals, method of application and approximate period(s) of use. The well tentatively selected to be sampled was visited to determine the capability of sample collection and to decide whether the wellsite or wellhead offered the possibility of point source pollution. If it appeared that chemicals could have readily entered the well in the past, the prospective well was disqualified for sampling for this project. The main objective of this project was to test the aquifer water quality rather than test for point source pollution.

Sampling groundwater for pesticide analyses presented problems not previously experienced in other District groundwater sampling projects. Recognized procedures for this type of sample handling involves maintaining the samples chilled from sampling to analysis. It is also recommended procedure that the samples not be stored for longer than seven to ten days before extraction and analysis procedures begin. All samples collected for this project were delivered to the laboratory within seven days of collection.

To ensure that water representative of the aquifer was being sampled rather than potentially stagnant water standing within the well, specific field procedures were completed prior to collection of the six one liter bottles of water collected at each well. Instruments to determine temperature, pH and specific conductance of the pumped water were used at each sampled well. Prior to collecting samples for delivery to the laboratory, at least three consecutive readings of the three parameters listed above were made at five minutes apart. Each of the three parameter readings had to be very similar or additional determinations were made. Similar consecutive readings of these parameters are generally accepted indications that water being pumped is representative of the aquifer. If consecutive similar readings had not been attained, the well would have been disqualified for sampling.

The above discussion involved sampling of wells that were being pumped upon arrival for the sampling process. If pumps of wells to be sampled were not operating when visited for sampling, estimates of the length of time of pumpage required to purge three casing volumes of standing water in the well was the first consideration. Following the determined length of pumpage, readings of the parameters as described above were completed to verify pumpage of aquifer water or to justify the disqualification of the well.

In addition to the sampling procedures at each well, a checklist questionnaire was completed by sampling personnel in order to document any indication of possible point source pollution at the well. Obvious evidence would have disqualified the well for sampling, but suspicious indications would help provide an explanation of the source of some contaminant that may be identified by the analyses.

Chemical Trace Amounts Noted

Preliminary analysis results indicate the presence of some of the historically-used agriculturally-related chemicals in well water sampled during this project. The good news is that most of the positive results would most accurately be described as occurring in trace amounts. These values have mostly been equivalent to a few parts per billion of concentration.

In the interest of clarity and based upon the assumption that most people are similar to us in our difficulty to grasp the concept of reporting results in "parts per billion" or the nearly equivalent "micrograms per liter", please allow for a somewhat crude example. It was recently reported that a concentration of one part per billion would be approximately equivalent to a common aspirin tablet dissolved and equally dispersed in 100,000 gallons of water. This example demonstrates the extremely small units associated with pesticide analyses.

On returning to the discussion of the sampling project, it is probably appropriate to anticipate and try to answer an obvious and common question relating to this type of project. Why should we have concern about the presence of pesticides or other such chemicals in groundwater? First and foremost is the human health aspect of this issue. Most pesticides have been demonstrated or present indications of being some threat to human health. The degree of this threat varies with the specific chemicals or mixtures present, concentrations of the chemicals, time and frequency of exposure to the chemicals, the sensitivity of individuals to particular chemicals and probably other factors. In summary, most pesticides at even small concentrations are, to some degree, detrimental to human health. They are, in essence, poisons designed primarily to eliminate some pest.

As indicated above, a preliminary review of the analysis results appears to report good news. The included chart of analyses results shows a sparsity of the analyzed constituents as being present in quantities above the detection limit of the laboratory's analysis procedures for those constituents. Those chemicals with a reported value would generally be described as trace amounts or lower and generally considerably lower than health advisory levels that the United States Environmental Protection Agency (EPA) has considered hazardous for the majority of these chemicals. Admittedly, it would be more personally satisfying if all analyses reported had indicated total absence of the chemicals, but realistically the results could have been much more disturbing. Have we been fortunate or have the uses of pesticides in this area generally been safe? We prefer to believe that the latter is true and strongly urge all users of chemicals to keep up the good work.

Because of the wide-spread use of pesticides in the District's service area for several years, it seemed logical to assume that the potential exists for some of these chemicals to have reached the aquifer when this sampling project was being planned. It is probably unlikely that percolation of solutions of these chemicals from the land surface through several feet of geological materials above the water table to reach the aquifer is a primary means of contamination. Direct access by way of wells is most likely the principal route of potential chemical contamination to the aquifer. Substandard well construction and careless use of chemicals near wells probably account for a large percentage of the causes of aquifer contamination by chemicals.

Abandoned Wells Allow Access

Related to poor well construction is the abandonment of wells that are not properly sealed at the surface. These improperly covered and sealed wellbores provide direct and easy access of chemicals to the aquifer. In spite of improper sealing and covering of abandoned wells being a violation of both District rules and State law, some unused wellbores continue to be left in improper condition. The District maintains a continuous program to cause these abandoned wells to be properly sealed, but unfortunately, they continue to be located. It is also likely that some of these abandoned wells have been improperly covered for some period of time prior to action being directed to their closure. During that period, the wells may have provided access to the aquifer for any number of substances. A particular danger to the aquifer from unsealed abandoned wells is probably not the likelihood of overspraying or similar low quantity introduction of toxic substances, but the potential utilization of such wells as a disposal site for larger quantities of toxic substances. Whether as an act of ignorance or one of negligence, the resulting harm to the aquifer could be very serious.

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Water analyses show chemical traces in a few samples

Continued From Page Two

Improperly Covered Wells Add To Problem

Improper covering and sealing of wells is not restricted to abandoned wells. During the District's recent groundwater sampling project, a number of improperly covered and sealed wells were noted. Concrete well pads with animal burrows or caved-in areas under them that provide access to the wellbore were observed. Turbine pump bases that do not fit snugly on the concrete bases thereby allow cracks and holes to be established that can be direct access points of any foreign substances to the wellbore were found. Some "air line" holes or "air vent" holes provided in the pumpbases of several manufacturers were designed as open access passages or had been modified during or after installation of the equipment to allow access to the wellbore. These holes could, under some circumstances, provide for direct entry of spilled or carelessly applied chemicals to the well. Steel plates designed to support the downhole equipment of submersible pump-equipped wells have been observed that do not totally cover the well access hole or the casing protruding through the surface concrete pads. These uncovered areas could allow for any spill to readily enter the well. Even when these steel plates cover the entire wellbore area, holes are constructed through the plates for specific purposes. Access holes for the electrical wires supplying power to submersible pumps are often excessively large as compared to that needed for the wires. A weatherproof electrical cable access port would be more appropriate. Uncovered access holes for measuring depths to water in the well are also commonly present.

Faucet Use Can Wash Chemicals Into Well

Combining any of the previously discussed open accesses to the wellbore from the surface with another common habit of well users in this area there is potential for well contamination. A substantial number of wells are equipped with faucets installed in the discharge pipes. These faucets are used to provide a convenient source of water for various purposes. From the shortsighted viewpoint of a person who is attempting to collect a water sample from a well, faucets can be very helpful. These faucets can usually be safely used if a hose is attached to direct the excess flow of water away from the well's concrete pad. If, however, the faucet allows the water to flow across the top of the concrete pad or below the pad where some access hole to the wellbore is available and some substance as a pesticide may have been spilled in either location, the water may pick up this substance and wash it into the well. Unfortunately, a high percentage of the faucets are installed in areas over the concrete pads or very near the pads. This installation almost ensures that any uncontrolled flow from the faucet can dissolve any available substance and thereby convey it into the well.

Use Care When Filling Spray Tanks

Filling of chemical spray tanks directly from the well can be a risk that may not always be considered. The absence of a check valve in a filling hose that is directly connected to a well while filling spray tanks can lead to back-siphoning of pesticide mixtures directly into the well should the flow of liquids be accidently reversed.

The safety of filling chemical spray tanks near wells can be increased by observing and adhering to several recommended procedures. The use of additional lengths of hose to allow the filling operation to proceed several yards away from the well will prevent washing of chemicals into the well should a spill or other accident occur. The use of check valves will prevent back-siphoning of chemicals from the spray tank into the well. Adding the chemicals after the tanks have been filled with water and after movement to the field to be sprayed will limit the chances of a concentrated chemical mix being spilled into or back-siphoned into the well. The recommended triple rinsing of chemical containers and emptying this rinse water into the spray tanks will decrease the chances that some residual chemicals in their shipping containers will be spilled and find their way into the well. This procedure will also ensure that every drop of an expensive chemical is utilized and not wasted. Additionally, when cleaning spray equipment after use, always try to use a minimum amount of rinse water and be sure to spray the rinse water back on the field or properly dispose of it away from wells. It is also recommended that users read and follow the product's label directions and use the recommended lowest effective rate. This not only decreases chances of contamination, but should help to limit expenses.

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Composite Residue Analyses Report

High Plains Underground Water Conservation District No. 1

Composite Residue Analyses Report
Prepared by A&L Plains Agricultural Laboratories, Inc.

COUNTY	COMPOSITE NUMBER	ALACHLOR (LASSO)	METOLACHLOR (DUAL)	CHLORPYRIFOS (LORSBAN)	DIAZINON (DIAZINON)	PHORATE (THIMET)	DIURON (KARMEX)	BROMACIL (DIREX)	ATRAZINE (AATREX)	PROPAZINE (MILOGARD) (MILO-PRO)	DDT (DDT)	ALDICARB SULFONE (TEMIK)	2,4-D (2,4-D)	DICAMBA (BANVEL)	SILVEX (SILVEX)	PICLORAM (TORDON) (GRAZON PC)	ARSENIC ACID	TRIFLURALIN (TREFLAN)	GLYPHOSATE (ROUNDUP)	PARAQUAT (PARAQUAT)
ARMSTRONG	011-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BAILEY	017-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BAILEY	017-2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CASTRO	069-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CASTRO	069-2	N	N	N	N	N	N	0.10 ppb	N	N	N	N	57.1 ppb	N	N	N	N	N	N	N
CASTRO	069-3	N	N	N	N	N	N	N	0.23 ppb	N	N	N	N	N	N	N	N	N	N	N
COCHRAN	079-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CROSBY	107-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CROSBY	107-2	N	N	N	N	N	N	N	N	N	N	N	N	0.06 ppb	N	N	N	N	N	N
DEAF SMITH	117-1	N	N	N	N	N	N	0.10 ppb	N	N	N	N	N	N	N	N	N	N	N	N
DEAF SMITH	117-2	N	N	N	N	N	N	N	1.08 ppb	N	N	N	N	N	N	N	N	N	N	N
FLOYD	153-1	N	N	N	N	N	N	0.10 ppb	N	N	N	N	N	N	N	N	N	N	N	N
FLOYD	153-2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FLOYD	153-3	N	N	N	N	N	N	N	0.27 ppb	N	N	N	N	N	N	N	N	N	N	N
HALE	189-1	N	N	N	N	N	N	N	N	N	N	N	6.58 ppb	N	N	N	N	N	N	N
HOCKLEY	219-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
HOCKLEY	219-2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
HOCKLEY	219-3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LAMB	279-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LAMB	279-2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0.15 mg/l	N
LAMB	279-3	N	N	N	N	N	N	N	0.21 ppb	N	N	N	N	N	N	N	N	N	N	N
LUBBOCK	303-1	N	N	N	N	N	0.01 ppm	N	N	N	N	N	N	N	N	N	N	N	N	N
LUBBOCK	303-2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LUBBOCK	303-3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LYNN	305-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PARMER	369-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PARMER	369-2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PARMER	369-3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
POTTER	375-1	N	N	N	N	N	0.02 ppm	0.11 ppb	N	N	N	N	N	N	N	N	N	N	N	N
RANDALL	381-1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
RANDALL	381-2	N	N	N	N	N	N	N	0.27 ppb	N	N	N	N	N	N	N	N	N	N	N
DETECTION LIMITS		0.05 ppb	0.05 ppb	0.05 ppb	0.05 ppb	1 ug/l	0.01 ppm	0.10 ppb	0.20 ppb	0.20 ppb	0.05 ppb	1 ug/l	0.05 ppb	0.05 ppb	0.05 ppb	1.0 ppb	0.01 mg/l	0.05 ppb	0.02 ppm	0.02 ppm
METHODS		GC-ECD	GC-ECD	GC-ECD	GC-ECD	GC-NPD	UV-VIS	GC-ECD	GC-NPD	GC-NPD	GC-ECD	GC-NPD	GC-ECD	GC-ECD	GC-ECD	GC-ECD	AA-HC	GC-ECD	GC-NPD	UV-VIS

N - none of the constituent was detected above the detection limit of the laboratory analysis procedure
ppb - parts per billion
ppm - parts per million
mg/l - milligrams per liter
ug/l - micrograms per liter

NOTE: One part per billion is about the same as the addition of a finely-ground five grain aspirin tablet to 100,000 gallons of water. A 69.4 gallon per minute well would have to be pumped 24 hours to produce 100,000 gallons of water.

District congratulates producers for reducing contamination risk

Continued From Page Three

Ag Chemical Safety Procedures Noted

Additional recommended practices in the handling of agricultural chemicals may indirectly decrease the chances of groundwater contamination by these chemicals. The use of reusable chemical shipping containers will serve to decrease chances of spills and spread of chemicals by limiting the need to handle the shipping containers. Triple rinsing and disposal as required for non-returnable chemical shipping containers would be eliminated by reusable containers. Care in the application of pesticides near bodies of water should directly prevent surface water contamination. Most groundwater was originally some form of surface water before being recharged to an aquifer.

Additional Contamination Method

An additional potential method of aquifer contamination by chemicals being introduced by some wells can be discussed. Oil-lubricated vertical shaft turbine pumps are a common type of equipment utilized in wells in this area. The system consists of a small reservoir of lubricating oil which is usually attached to the pump gearhead. A tube directs a small rate of flow of oil from the reservoir to the top of the shaft of the pump. The oil percolates down through an oil-permeable bearing system to lubricate the whole length of the shaft. Excess oil commonly exits the lower end of the shaft housing to be deposited in the well water. The general principle of the oil-lubricated system has hopefully been adequately explained to demonstrate how a potential avenue of chemical contamination of a well might occur. It was observed during the field sampling of wells that well users seemed to have a fondness for the use of disposable pesticide containers as storage or transfer containers for the lubricating oil. In some cases, these containers have themselves been utilized as the oil reservoir to directly supply the oil to the lubricating system. The potential exists for re-use of containers that may not have been adequately cleaned prior to their being utilized as oil containers. If the container retained some of the original chemical prior to being filled with oil, it seems reasonable to be concerned that the chemical could be mixed with the oil and be injected into the well with the oil. A considerable accumulation of oil can sometimes occur in wells that have had long term use of oil-lubricated turbine pumps. This is particularly true when the well user has neglected to shut off this flow of oil after stopping the well pump.

Undoubtedly, there are other ways that chemicals may be introduced into wells and affect the quality of groundwater. It is at this point that as a result of the analysis results we generally believe that aquifer contamination other than point source means by way of wells is limited.

Producers Congratulated For Keeping Contamination To Minimum

It seems appropriate at this point to congratulate this area's groundwater users on their apparent safe use of chemicals in the vicinity of their wells. With the large quantities of chemicals used each year and the several years' use of these substances, the potential for having contaminated the groundwater supplies would seem to be present, but the results of the District's sampling and analysis for a considerable number of these substances would indicate that chemical users and well users are being protective of the groundwater of our area.

Farmers reminded of safe pesticide handling procedures

These suggested procedures can help avoid potential groundwater contamination.

1. Avoid spills when filling nurse tanks or spray tanks near wells.
   A. Use check valves in hoses to prevent back-siphoning of the liquid from the tanks back into the well.
   B. If you do not have a check valve in the fill hose, secure the hose used to fill the tank above and out of the liquid, particularly if it is necessary to put the pesticide into the tank first.
   C. Never leave a filling tank unattended. It may overflow, and liquid may enter the well.
   D. If possible, fill the tank with water at a safe distance from the well, and then move the tank to the field where it will be used before adding pesticides.
   E. Attach two or more hoses together to extend the distance from the well when filling the nurse tank.
2. Never store chemicals near wells.
3. Don't carry an inventory of pesticides. Buy as needed to prevent possible spills.
4. Always read and follow the product's label directions. Also, it's a good practice to use the recommended lowest effective rate.
5. When cleaning spray equipment after use, try to use a minimum amount of rinse and be sure to spray rinse water back on your field.
6. Pressure rinse or triple rinse pesticide containers and add the rinse water to the solution which will be sprayed on the field. Do not re-use pesticide containers, even though they have been rinsed properly, for any other use other than to secure a new supply of chemicals.
7. Be sure that pesticide containers and spray equipment are leak free, particularly in transport, and be sure that the containers are secured during transport.
8. Be careful in applying pesticides near ponds, playa basins or streams.

These recommendations were primarily adapted from the public service videotape, *"Ground Water and Agricultural Chemicals — Understanding the Issues,"* sponsored by the American Soybean Association and the National Corn Growers Association.

Well sites will be resampled to determine pesticide pollution source

Continued From Page One

chemicals used on the farm, particularly in the area of the sampled well. As an example, if the well site was recently sprayed for weed control with the identified chemical, this would indicate a possible source for the chemical. The site would then be examined to determine if there was any way the chemical could have entered the well. If a way is found, then the reason for finding the chemical in the water sample would be evident. The results of the resampling effort will be reported in a future issue of the *Cross Section.*

Even though it appears at this time that the aquifer has not been contaminated with agricultural chemicals, we all must do our utmost to see that it does not occur in the future. This issue of the *Cross Section* contains a list of recommendations for the safe use of chemicals. Additional suggestions can be found in the story providing details of the sampling effort which was written by Don McReynolds, Director of the Technical Division of the Water District.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

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Continuing water research summarized

EDITOR'S NOTE: Since 1965, the Texas Tech University Water Resources Center has promoted research activities designed to increase the supply of available water, reduce water demand by increasing water use efficiency and prevent the pollution of existing water supplies.

State appropriations to support the Water Resources Center total less than $200,000 annually. Therefore, most research projects are funded at a level of $10,000 or less. All research projects submitted to the Water Resources Center are reviewed by members of an Advisory Board. Those receiving the highest ranking are approved for funding by Dr. Lloyd Urban, Water Resources Center Director. Most of the research projects require additional financial support from some other source or else serve to develop an idea or theory far enough to gain additional funding from another source later.

The 11-member Advisory Board, composed of representatives of water interest groups as well as academic, municipal, industrial, and agricultural leaders, meets regularly to review the Center's research activities. A. Wayne Wyatt, High Plains Underground Water Conservation District No. 1 Manager, is Chairman of the Board, and Mack Hicks, Vice-President of the District's Board of Directors, is the member representing irrigated agriculture.

In October, the Advisory Board heard progress reports on research projects currently being funded by the Water Resources Center. The following are summaries of some of this on-going research — **CEM.**

Development and Evaluation of Emerging Technologies for Agricultural Water Conservation (Part II — Secondary Recovery)

This project is building upon earlier secondary recovery research completed in conjunction with the High Plains Underground Water Conservation District No. 1.

The earlier research showed that water trapped above the water table in the "dewatered" zone could be forced to drain into the water table by injecting air into the formation under pressure. Present indications are that less than 25 percent of the water in the saturated part of the aquifer is available for recovery by conventional pumpage, leaving large amounts of water trapped in the "dewatered zone." The previous work suggests that another 25 percent of the water can be recovered through air injection in some circumstances.

Another application that has emerged is to use air injection to

See ON-GOING Page Two

Hunting fees offer playa management incentive

WATERFOWL HUNTING ON PLAYAS MAY PROVIDE INCOME — By enhancing waterfowl habitats near playa lakes, landowners can earn additional income through the hunting of ducks and geese that overwinter on the Texas High Plains each year. These ducks were photographed at a playa lake located in Castro County.

Two to three million ducks and geese and about 400,000 sandhill cranes overwinter annually on the Texas High Plains. Tens of millions of birds pass through the Playa Lakes Region of the Southern Great Plains, which includes the Texas High Plains, during spring and fall migrations. The ducks include the American wigeon, the northern pintail, mallards and green-winged teals.

These birds are all desirable for hunting by sportsmen and represent a largely untapped economic resource to landowners in the High Plains. In addition, some landowners may be able to earn income off their playas by participating in U.S. Fish and Wildlife Service projects to enhance regional playa lakes as waterfowl habitats. The projects are being undertaken as part of the North American Waterfowl Management Plan, a United States-Canadian agreement to establish, preserve and maintain quality habitats to preserve continental waterfowl populations. The Plan will be implemented locally through the Playa Lakes Region Waterfowl Habitat Concept Plan.

"The U.S. Fish and Wildlife Service wants to make sure there is a dependable supply of ducks and geese on an annual basis, much like irrigation helps ensure dependable crop yields," says Wayne Wyatt, Manager of the High Plains Underground Water Conservation District No. 1.

The migratory birds, led by the green-winged teal and the northern pintail, usually begin their journey south from northern breeding grounds in September, and most birds arrive in the Texas High Plains by November. Blue-winged teals sometimes rest in the area before continuing their migration to South America. The ducks commonly return to northern breeding grounds in the Dakotas, Montana, and the Canadian provinces of Alberta, Manitoba and Saskatchewan in March. The geese commonly nest further north in the Arctic. In some cases, mallards may remain in Texas and nest here in the spring. The U.S. Fish and Wildlife Service comments that regional nesting in the Playa Lakes region may be greater than

See DUCK Page Four

Soil moisture monitoring begins

Field staff from the High Plains Underground Water Conservation District No. 1 and the USDA-Soil Conservation Service (USDA-SCS) are measuring soil moisture at sites throughout the 15-county Water District service area.

The soil moisture measurements will be used to construct annual soil moisture availability and deficit maps for each county or portion of a county served by the Water District. These maps will illustrate to producers how much moisture is available in the soil profile for plant use, the water distribution in the soil profile, and the amount of water that must be applied to bring the soil profile to field capacity.

These measurements should be completed in time to publish the maps in February, so that producers can use this information to determine if pre-plant irrigation will be necessary. The Water District provides individual soil moisture readings to those producers who have soil moisture monitoring sites on their land.

More than 220 soil moisture sites within the Water District's service area will be measured this year. "We have added approximately 50 new soil moisture monitoring sites during 1988. There are 21 new sites located within the portion of Crosby County annexed into the Water District last April. The other new monitoring sites either replace some that have been destroyed or will help fill in gaps in our data collection," says Ken Carver, High Plains Water District Assistant Manager.

Neutron moisture meters are used by the staff to obtain soil moisture data by inserting a probe into a previously installed aluminum access tube. Readings are taken at six-inch intervals throughout the five-foot soil profile.

Soil moisture monitoring sites are chosen to represent areas typical of surrounding dryland or irrigated farming practices and are selected based upon the soil type, the quantity of water available for irrigation as indicated by the saturated thickness of the Ogallala Aquifer, and the type of crop grown. The crop grown at the site is very important in evaluating the significance of the location of the soil moisture in the soil profile, since different crops have different water requirements and different growing seasons.

Along with their soil moisture monitoring duties, Water District and USDA-SCS personnel will take soil

See SOIL Page Two

On-going Texas Tech Water Resources Center research noted

Continued From Page One

remove localized ground water contamination caused by spills and leakage from underground storage tanks. Air injection can be used to cause lighter contaminants in the unsaturated zone to pass off as vapor. Also, air injection can furnish needed oxygen to microorganisms capable of converting contaminants into harmless by-products.

Two other possibilities also exist for the use of air injection in dealing with contaminated groundwater. The plume of contaminated groundwater may be forced back toward its source by injecting air just ahead of the plume. Also, a cyclic raising and lowering of the water through air injection may bring more microorganisms into contact with the contaminant and allow biodegradation to take place.

The researchers are Dr. Billy J. Claborn of the Texas Tech Department of Civil Engineering and Dr. Lloyd Urban, Water Resources Center Director. Additional sponsors for the research are the Texas Advanced Technology Research Program, the High Plains Underground Water Conservation District No. 1 and the Texas Water Development Board.

Air Injection for Removal of Contaminants in the Unsaturated Zone

This research deals with in situ volatization (the natural vaporization of contaminants from the aquifer when contamination has occurred). In a controlled laboratory environment, researchers will observe how residual hydrocarbon liquids react under radial airflow in large unsaturated soil columns. From this, they hope to further understand the in situ process and to develop a model for developing efficient contaminant removal schemes.

The volatilization experiments have been going on for more than a year, with 50 to 60 percent of the hydrocarbons removed. In January, the soil columns will be examined for the presence of any residual hydrocarbons. A proposal for an additional $340,000 for further related research has been submitted to the Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE).

Researchers are Dr. Billy J. Claborn and Dr. Ken Rainwater in the Tech Department of Civil Engineering and Dr. Harry W. Parker of the Department of Chemical Engineering.

In-Situ Oxidation for Rehabilitation of Aquifers — Laboratory Investigation and Numerical Modeling

A major objective of this research is to measure oxidation rates for organic compounds in sand-water mixtures simulating a contaminated valdose zone (the part of the water bearing formation from which the free-flowing water has been pumped). Secondly, this data will be used to numerically simulate the oxidation processes which are expected to occur at an actual field site.

Information gained through this research can be used to design processes utilizing oxidation at actual contamination sites to clean up soils and aquifers contaminated with organic materials. Such applications would include contamination caused by leaking fuel storage tanks, pipeline leaks and oil production activities.

Oxidation rate tests begun last year are still continuing, and selected new tests will be started this semester.

Principal investigators include Dr. Harry W. Parker of the TTU Chemical Engineering Department and Dr. Ken Rainwater of the Civil Engineering Department. The additional sponsor of the research is the Phillips Petroleum Company.

Maximizing Water Use Efficiency in Cotton

The goal of this project is to maximize cotton yields within the limits of the available water supply. First, a relationship between the water supply and the total nutrient requirements with special emphasis on nitrogen and phosphorus must be developed. Then, the project is expected to develop a better understanding of application timing effects on nitrogen use efficiency within each water supply.

Water is the single most important production resource for crop production in Texas, particularly on the Texas High Plains. Cotton is the single most important crop grown on the Southern High Plains. When the water supply is adequate to support high cotton growth rates, the nutrient supply becomes a limiting factor. Maximum water use efficiency can be achieved by maintaining a balanced system of water and nutrients.

Field experimentation, as well as GOSSYM (the cotton crop simulation model), have been used to develop a relationship between cotton lint yield and the water and nutrient supply. Major emphasis has been placed on the timing of nitrogen application in relation to the water supply, since nitrogen is the most commonly deficient nutrient in area soils. Also, large amounts of nitrogen are necessary to produce seed in the cotton fruit. Application timing treatments have included pre-plant, early reproductive stage and mid-reproductive stage.

The relationship between the water supply and nitrogen requirements has been developed. The nitrogen application timing has been tested for a year and needs an additional year for verification. Water use efficiency of irrigated cotton has been increased from 13 pounds per acre-inch (High Plains average) to over 50 pounds of lint per acre-inch with satisfactory nitrogen application within limits of the available water supply.

Principal investigator for this project is Dr. Dan R. Krieg, Professor of Crop Physiology in the Tech Plant and Soil Science Department. Additional sponsors include the High Plains Underground Water Conservation District No. 1 and the Fluid Fertilizer Foundation.

Determining The Bimodal Water Infiltration Pattern in Playa Lakes

This project examines two water infiltration rates in playa lakes. The initial infiltration rate (Stage 1) is quite large as compared to the final (Stage 3) infiltration rate.

By understanding the primary points for Ogallala Aquifer recharge, researchers can develop means to allow the greater use of rainfall to recharge the aquifer while minimizing evaporation losses. Also, this will provide better knowledge of the potential for contamination of the Ogallala Aquifer by agricultural products such as fertilizers, herbicides and insecticides.

Infiltration rates will be determined using double ring infiltrometers. Each inner ring will have a 130mm diameter and each outer ring will have a 300mm diameter. The infiltration rates will be determined at five-second intervals for 30 seconds and at 15-second intervals for five minutes. Water will be applied for 72 hours and the Stage 3 infiltration will be determined at the end of that time.

Currently, one playa has been located, and two additional playas are being sought.

Principal investigators are Dr. Richard E. Zartman in the TTU Department of Agronomy and Dr. R. Heyward Ramsey in the Civil Engineering Department.

Demonstration of Carbon Dioxide Scale Control Technique in Water Systems with Very Hard Water

Controlled laboratory experiments will test the effects of carbon dioxide injection on the removal of calcium carbonate scale. Also, the carbon dioxide injection system will be demonstrated at a small campus building with large hot water usage and existing scale problems.

Calcium carbonate scale can cause severe problems in hot water lines. In areas with very hard water, the problem can be very expensive to repair. The U.S. Army Construction Engineering Research Laboratory staff is concerned with calcium carbonate scale in military installations around the world. The High Plains of Texas also has natural waters with elevated hardness levels and existing scale problems.

The first phase of this project is laboratory testing of the carbon dioxide scale removal technique, using pipe materials similar to those found in campus buildings. Researchers will determine optimal

See TECH Page Three

Soil moisture survey begins

Continued From Page One

density measurements to determine if hardpan layers have formed as a result of 1988 farming operations. If not corrected by deep chiseling, these compacted soil layers will keep rainfall or irrigation water from reaching the lower part of the root zone. Plant growth will be stunted by the inability of the roots to penetrate the hardpan, and crop yields will be reduced as a result.

Happy Holidays!

FROM THE BOARD OF DIRECTORS AND STAFF

OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
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Tech water research noted

Continued From Page Two

carbon dioxide injection levels needed to limit scale and prevent corrosion. The second phase will be performed in the hot water system of a campus building with a present scale problem. The progress of the carbon dioxide injection for removal and prevention of scale will be monitored.

The project is in its first quarter. The devices needed for the laboratory simulation are being assembled, and an appropriate building is being sought with the help of the Texas Tech Building Maintenance and Utilities department.

Principal investigators are Dr. Ken Rainwater of the Texas Tech Civil Engineering Department and Dr. Lloyd Urban, Water Resources Center. The additional sponsor is the U.S. Army Construction Engineering Research Laboratory.

South Lubbock Drainage Study

This project will analyze the drainage provided by playa lakes in South Lubbock, compare their capacity to typical rainfall events, and furnish alternatives to solve flooding problems.

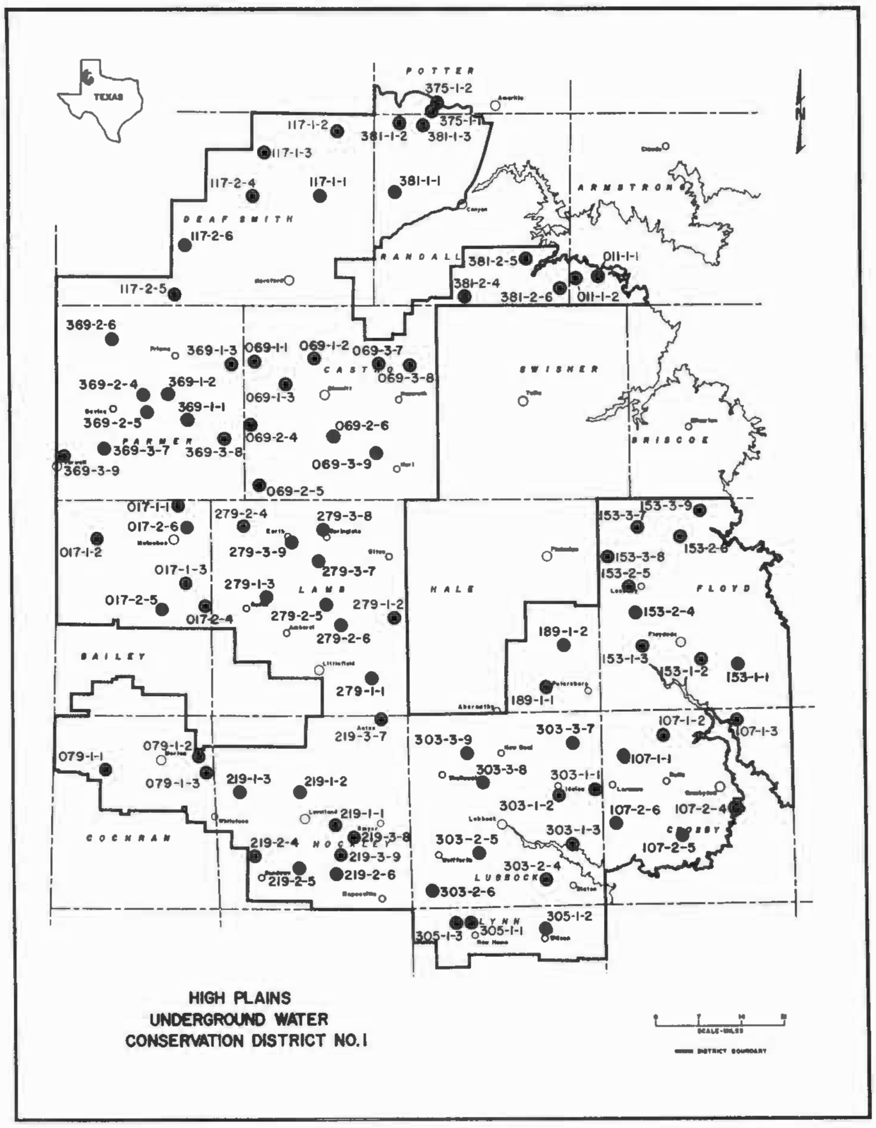
As the City of Lubbock has developed to the southwest, increased flooding has occurred around the playa lake at Quaker Avenue and Loop 289, the playa lake adjacent to Trinity Church on Loop 289 between University Avenue and Indiana Avenue, and the playa lake at University Avenue and 66th Street.

The research sponsor has evaluated several structural means to solve the problem. The Water Resources Center, through the work of graduate students, has been able to suggest two non-structural approaches to improve both the drainage and the water supply problems.

The non-structural approaches include on-site storage of the storm water on individual lots for later use to irrigate the landscape. However, some incentive would be needed from the City of Lubbock to the homeowner for this concept to be implemented. Another suggested approach is to drill water supply wells in these areas and pump the ground water for municipal use. This would provide low cost water for the City, while providing space beneath the lakes for water to infiltrate between storms and preventing the water from reaching damaging levels.

The Water Resources Center will review the final report from the sponsor as soon as it is available.

Researchers are Dr. Billy J. Claborn of the Department of Civil Engineering and Dr. Lloyd Urban, Water Resources Center Director. The additional research sponsor is Albert H. Halff Associates, Inc.



Approximate Locations of Wells Sampled For Pesticide Analysis In August, 1988

NITRATE SAMPLING SITES SHOWN — Groundwater samples taken during the Water District's pesticide sampling effort in August were also analyzed for the presence of nitrates. While these water wells (shown above) are used primarily for irrigation, all fell below the U.S. Environmental Protection Agency's recommended maximum contaminant level of 44.3 milligrams per liter of nitrate (NO_3).

Groundwater analyses do not indicate nitrate contamination

Water samples were collected for nitrate analyses from the same 90 wells sampled for pesticide analyses, as reported in the November issue of the *Cross Section*.

The purpose of this sampling effort was to determine if nitrate contamination of the aquifer has occurred as a result of the overuse of fertilizers. The analyses of these water samples do not indicate that nitrate contamination has occurred.

Even though most of the wells sampled are used for irrigation, the nitrate levels all fell below the recommended maximum contaminant level of 44.3 milligrams per liter of nitrate (NO_3) set by the U.S. Environmental Protection Agency's drinking water standards.

This issue of the *Cross Section* contains the results of the analysis for each well sampled and a map illustrating the general location of the sampled wells with the identifying well site number printed on the face of the map.

This same group of wells will be resampled in three to five years to determine if any significant change has occurred in the nitrate levels.

HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1

Nitrate Analyses Report
Prepared by
A&L Plains Agricultural Laboratories

County	Sample No.	Nitrate (NO_3) (milligrams per liter)
ARMSTRONG	011-1-1	2.82
ARMSTRONG	011-1-2	2.50
BAILEY	017-1-1	5.33
BAILEY	017-1-2	3.80
BAILEY	017-1-3	2.37
BAILEY	017-2-4	2.92
BAILEY	017-2-5	2.00
BAILEY	017-2-6	0.76
CASTRO	069-1-1	0.40
CASTRO	069-1-2	0.06
CASTRO	069-1-3	1.30
CASTRO	069-2-4	0.96
CASTRO	069-2-5	2.39
CASTRO	069-2-6	2.85
CASTRO	069-3-7	0.70
CASTRO	069-3-8	1.00
CASTRO	069-3-9	1.57
COCHRAN	079-1-1	1.22
COCHRAN	079-1-2	0.13
COCHRAN	079-1-3	6.38
CROSBY	107-1-1	0.75
CROSBY	107-1-2	1.28
CROSBY	107-1-3	0.42
CROSBY	107-2-4	0.66
CROSBY	107-2-5	6.24
CROSBY	107-2-6	13.89
DEAF SMITH	117-1-1	1.04
DEAF SMITH	117-1-2	1.12
DEAF SMITH	117-1-3	2.50
DEAF SMITH	117-2-4	2.69
DEAF SMITH	117-2-5	0.45
DEAF SMITH	117-2-6	2.20
FLOYD	153-1-1	1.25
FLOYD	153-1-2	1.10
FLOYD	153-1-3	0.97
FLOYD	153-2-4	0.49
FLOYD	153-2-5	1.71
FLOYD	153-2-6	0.70
FLOYD	153-3-7	0.63
FLOYD	153-3-8	0.27
FLOYD	153-3-9	0.37
HALE	189-1-1	0.61
HALE	189-1-2	0.45
HOCKLEY	219-1-1	2.77
HOCKLEY	219-1-2	6.22
HOCKLEY	219-1-3	3.32
HOCKLEY	219-2-4	2.89
HOCKLEY	219-2-5	0.54
HOCKLEY	219-2-6	1.78
HOCKLEY	219-3-7	7.85
HOCKLEY	219-3-8	3.46
HOCKLEY	219-3-9	3.02
LAMB	279-1-1	1.41
LAMB	279-1-2	11.25
LAMB	279-1-3	1.07
LAMB	279-2-4	4.93
LAMB	279-2-5	3.14
LAMB	279-2-6	3.89
LAMB	279-3-7	2.78
LAMB	279-3-8	5.62
LAMB	279-3-9	11.27
LUBBOCK	303-1-1	1.24
LUBBOCK	303-1-2	1.21
LUBBOCK	303-1-3	10.12
LUBBOCK	303-2-4	14.49
LUBBOCK	303-2-5	3.11
LUBBOCK	303-2-6	10.42
LUBBOCK	303-3-7	2.26
LUBBOCK	303-3-8	6.98
LUBBOCK	303-3-9	8.46
LYNN	305-1-1	7.17
LYNN	305-1-2	3.61
LYNN	305-1-3	9.18
PARMER	369-1-1	5.73
PARMER	369-1-2	2.49
PARMER	369-1-3	1.09
PARMER	369-2-4	1.35
PARMER	369-2-5	3.99
PARMER	369-2-6	2.93
PARMER	369-3-7	2.57
PARMER	369-3-8	4.84
PARMER	369-3-9	3.31
POTTER	375-1-1	1.81
POTTER	375-1-2	1.30
RANDALL	381-1-1	1.64
RANDALL	381-1-2	1.48
RANDALL	381-1-3	1.78
RANDALL	381-2-4	1.18
RANDALL	381-2-5	0.55
RANDALL	381-2-6	1.15

NOTE — Recommended Maximum Contaminant Level (RMCL) by Environmental Protection Agency (EPA) Drinking Water Standards is 44.3 milligrams per liter (mg/l) as Nitrate (NO_3).

Duck hunting offers a market for waste grain and playa water

Continued From Page One

supposed, as production estimates currently come from relatively incomplete surveys made several years ago.

Hunting provides economic incentives for waterfowl habitat management. It generates income from hunting leases and therefore improves land values. Some playas may return more from hunting than grazing. Also, hunting balances bird populations with the habitat carrying capacity and landowner tolerance limits, especially those landowners raising agricultural crops.

"People across the country don't realize the duck and geese hunting here (the Texas High Plains) is as good as anywhere in the country, and the best in Texas," says Dr. Loren Smith, Associate Professor of Wildlife Science in the Range and Wildlife Department at Texas Tech University in Lubbock. "The Texas High Plains provides some of the best crane hunting in the country.

"The hunting in the Texas High Plains is cheap compared to the coast, where it costs about $100 per gun per day for duck hunting and $200 per gun per day for geese. Geese hunting here ranges from $50-$100 per gun per day, including a guide," Smith says.

Local duck day leases run from $20-$50 per gun per day and seasonal leases range from $500-$1,000 per gun. Crane hunting leases are about $25-$75 per gun per day.

"Landowners can increase the number of hunting clients by providing services such as blinds, dogs, places to stay and guide services. This is a way to make more money, remembering that people like to be comfortable." Smith says.

According to the Fish and Wildlife Service, playas supporting a habitat which attracts large numbers of game birds can command higher lease fees. Shallow playas featuring emergent vegetation will attract hunter-preferred ducks such as the mallard or green-winged teal. These playas are also liked by hunters for the quality of the hunting experience. Playas with maintained open water and moderate emergent plant growth may bring in a $600 lease fee for the hunting season.

The leased value of bare lakes, which attract geese and sandhill cranes, can be increased with hunting blinds. Bare, open-water playas may lease at $500 with a blind for the hunting season or $400 without a blind. Daily fees on guided hunts run from $75-$200, including all expenses such as transportation, lodging, guide and decoys.

"Geese shouldn't be hunted off the open lakes as this will cause the geese to leave. The lakes are where the geese rest. It is best to hunt the geese in the fields by setting up a blind," cautions Smith.

Birds feed on waste grain in neighboring fields, usually within 10 miles of the resting lake. Farmers who leave their corn residue unplowed should also capitalize on the duck and geese hunting leases. A dependable food supply for the ducks and geese is at least equal to the importance of water in the playa.

Smith suggests that farmers look at waterfowl as a crop that they can capitalize on and make dependable money flow into the area with very little expense involved.

"If we provide opportunities for sportsmen to hunt, they will come and bring their money. In addition to landowners leasing their land for hunting, other industries that would benefit include airlines, gas stations, motels, equipment suppliers and restaurants," Smith says. Duck and geese hunting has the potential to generate more than $7.5 million in the local economy through these related services, according to some estimates.

The duck hunting season is from November 12, 1988 through January 1, 1989. The goose hunting season runs from October 22, 1988 to January 22, 1989 west of U.S. Highway 81, and from November 12, 1988 to February 5, 1988 east of U.S. Highway 81. The crane hunting season is from November 26, 1988 to February 5, 1989 on locations east of U.S. Highway 87, and from November 12, 1988 through February 12, 1989 on lands west of U.S. Highway 87.

Efforts are under way to start a duck and geese hunting tradition in the Texas High Plains. The Texas Hunting Clearinghouse is a joint effort of the Texas Department of Agriculture (TDA), the Texas Parks and Wildlife Department and the Texas Farm Bureau which links hunters with farmers and ranchers wishing to lease their land for hunting. Landowners provide the TDA locale information such as acreage, distance from the nearest airport type of game, hunting dog or guide availability and boarding opportunities. The information is organized by region and sent to interested hunters.

Three types of hunting leases are commonly used — daily or weekly rates charged per gun, seasonal leases contracted for hunting a particular game species in a specified area for the entire hunting season, or an organizational lease. The organizational lease usually consists of an outfitter, shooting club or other organization which secures the hunting rights on a land tract and manages the leased area. The organization collects hunting fees, posts signs, polices the site, and sometimes modifies the area to improve habitat values. This method may be preferred by landowners reluctant to deal directly with hunters and the prospect of property damage, litter or injury liability. This practice is more common on large playas which accommodate large numbers of birds and hunters.

The Texas Parks and Wildlife Department requires landowners to obtain a shooting preserve license before they lease land for hunting. The license allows the landowner to charge a fee for hunters entering his property to hunt birds. Annual license fees are $15 for 500 acres or less, $40 for 500-1,000 acres and $60 for more than 1,000 acres.

Board votes against annexation

At a special November 17th meeting, the High Plains Underground Water Conservation District No. 1 Board of Directors decided against the annexation of Swisher County, Terry County, Yoakum County, the portion of Briscoe County above the escarpment, and the portion of Hale County not already a part of the Water District.

The Board received petitions from each of these areas requesting annexation into the District earlier in the year. Hearings were then held in each county. Testimony from these hearings was considered in the deliberations to determine if the annexation would be of benefit to both the territory requesting annexation and to the existing Water District. The Board also considered whether the existing Water District facilities could support the proposed territorial additions without jeopardizing the quality of service being provided to landowners currently within the District.

Board members cited low attendance and lack of strong support at four of the five public hearings in their decision not to continue with the annexation process.

They noted that the areas seeking annexation would require consideration expense to start Water District programs and bring them to the operating level of the existing Water District. Cost projections indicated that a 25 to 40 percent increase in the Water District's operating budget would be needed to offer full service to the annexed territories without a lessening in the quality of service in the District as a whole. Under the tax code, no tax revenue could be received from the annexed territories until October 1990, which would have put the Water District into a debt position.

"We appreciate the support given to us by the residents of the Water District during the past 35 years," said Board President James P. Mitchell of Wolfforth. "We did not feel that increasing their Water District taxes in order to take on an additional 2.5 million acres in territory would be fair to them."

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
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