THE Cross SECTION

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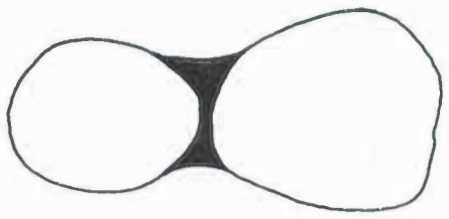
SECONDARY RECOVERY OF WATER STUDIED

In an unprecedented investigation, the High Plains Underground Water Conservation District is seeking to confirm the availability of additional ground-water reserves still in storage in the dewatered areas of the Ogallala Formation which could come near to or equal the quantity of water already pumped from storage by gravity (approximately 200 million acre feet). If the assumption is confirmed, the second phase of this study will include methods to recover this water.

The water that is estimated to still be in storage in the dewatered section is "capillary water" held by surface tension around the clay, sand and gravel deposits of the formation already exhausted of its "free water" reserves by gravity pumping. The amount of water that hydrologists speculate may



CAPILLARY WATER in the unsaturated zone held by tension.

be contained as "capillary water" in the formation could rival the estimated 500 million acre feet of water originally thought to be recoverable from the Ogallala Formation in Texas. If their theories prove correct, an additional 500 million acre feet of water may still be clinging to the wetted sands and other materials in the geologic deposit when the formation will no longer yield water to wells through the natural forces of gravity. The value of this additional water, if capturable by some method of secondary recovery and estimated at $100 per acre foot, could be as much as fifty billion dollars.

One idea for recovering this capillary water involves the drilling of small diameter wells down into the formation to below a clay lens, sealing the well and then injecting compressed air into the wet sand section below. This will theoretically result in the release of the capillary water, allowing it to move by the force of gravity down to the existing water table for capture by existing wells.

A simple air compressor propelled by a wind driven device similar to the old time windchargers on the High Plains, could provide power for such a secondary recovery operation, and take advantage of the natural winds of the area to conserve energy.

The total volume of water in storage in the Ogallala Formation can be calculated as the product of the volume of saturated material times the porosity, (or the ratio expressed in percentage of void space to total volume). Unfortunately, much of the water will not drain from the formation material by the forces of gravity for capture by wells. Therefore, the quantity of water in storage that is available to wells by gravity flow is computed by multiplying the volume of saturated material by the specific yield (the quantity of water that the formation will yield under the

TRAPPED WATER remains in the sand and gravel above the free water table.

force of gravity if it is first saturated and then allowed to drain—the ratio being expressed in percentage of this water to the volume of material drained). The specific yield of the Ogallala Formation in Texas is about 15 percent. On hundred feet of saturated material would contain about 15 acre feet of water per surface acre. An acre foot of water is 325,851 gallons.

More Regulations For Ground Water Wanted By EPA

The culmination of a series of recent public hearings conducted by the U.S. Environmental Protection Agency suggest the federal government rules and regulations for the protection of water are still not sufficient to provide an adequate work load for the myriad of etiological environmentalists serving on the federal payroll.

The decade of the 70's brought us the Clean Water Act, the Safe Drinking Water Act, the 1977 Amendments to the Clean Water Act, the Resource Conservation and Recovery Act, the Underground Injection Control Act, two dozen reports on the President's Water Policy Initiatives, several "Reports to Congress" covering water by the Comptroller General, the Second National Water Assessment by the U.S. Water Resources Council, reports from the Council on Environmental Quality, the Bureau of Land Management, USDA ..... *adinfinitum.*

One of the stated objectives of this latest incursion into the ground-water arena is "to ensure that appropriate levels of protection are provided for the ground-water resources in each state and that each state has a complete program fully implemented to manage all ground water."

Does some of this sound familiar? We will point out that these are the same public servants who have tried to make the determination that prairie potholes and playas were navigable waters of the United States. If you feel that you want their help on managing our ground water, then don't write your congressman.

VOTERS RE-ELECT BOARD DIRECTORS

A. W. "WEBB" GOBER

A. W. "Webb" Gober and James C. (Jim) Conkwright have been elected to the Board of Directors of the High Plains Underground Water Conservation District No. 1 according to complete but unofficial returns from the balloting conducted on Saturday, January 17. Also elected were twenty-one (21) County Committeemen.

Gober was elected from Director's Precinct Three which is composed of Bailey, Castro and Parmer Counties, for his fifth term on the Board. He lives northeast of Farwell and farms 480 acres of irrigated land.

Conkwright, from Hereford, will be serving as a Director for his second term and is representing Director's Precinct Four which is composed of the water district areas in Armstrong, Deaf Smith, Potter and Randall Counties. Conkwright is engaged in the production of Registered Hereford cattle and in farm production.

County Committeemen elected in the balloting were as follows:

in Precinct Three—
BAILEY COUNTY
Lloyd Haire
David Stovall
Ernest Ramm

JAMES C. CONKWRIGHT

CASTRO COUNTY
Dan Petty
W. A. Baldridge
Garnet Holland

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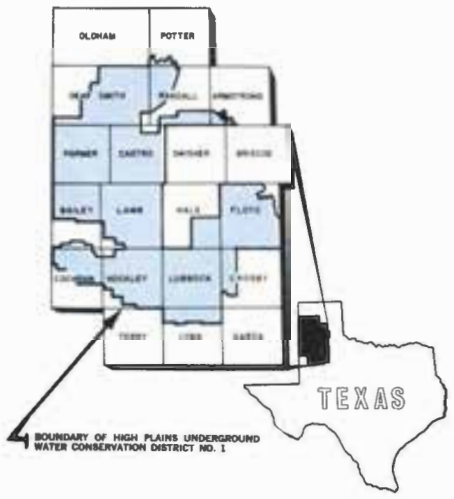

BOARD OF DIRECTORS

Precinct 1
(CROSBY, LUBBOCK and LYNN COUNTIES)
James P. Mitchell, President ..... Wolfforth

Precinct 2
(COCHRAN, HOCKLEY and LAMB COUNTIES)
Mack Hicks ..... Levelland

Precinct 3
(BAILEY, CASTRO and PARMER COUNTIES)
A. W. Gober ..... Farwell

Precinct 4
(ARMSTRONG, DEAF SMITH, POTTER and RANDALL COUNTIES)
Jim Conkwright, Secy.-Treas. ..... Hereford

Precinct 5
(FLOYD and HALE COUNTIES)
Malvin A. Jarboe, Vice President ..... Floydada

COUNTY COMMITTEEMEN

Armstrong County
Carroll Rogers, Secretary
Wayside, Texas

Guy Watson, 1981 ..... Wayside
Bill Heisler, 1981 ..... Wayside
M. L. McGehee, 1981 ..... Wayside
James Bible, 1983 ..... Wayside
James Stockett, 1983 ..... Wayside

Bailey County
Doris Wedel, Secretary
H&R Block, 224 W. 2nd, Muleshoe

Eugene Shaw, 1981 ..... Rt. 2, Muleshoe
David Stovall, 1981 ..... Rt. 2, Muleshoe
Ernest Ramm, 1981 ..... Rt. 2, Muleshoe
D. J. Cox, 1983 ..... Enochs
Marshall Head, 1983 ..... Muleshoe

Castro County
Dolores Baldridge, Secretary
City Hall, 120 Jones St., Dimmitt

Jackie Clark, 1981 ..... Rt. 1, Box 33, Dimmitt
W. A. Baldridge, 1981 ..... 608 W. Grant, Dimmitt
Frank Wise, 1981 ..... Rt. 4, Box 10, Dimmitt
George Elder, 1983 ..... Dimmitt
Floyd Schulte, 1983 ..... Dimmitt

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

Keith Kennedy, 1982 ..... Star Route 2, Morton
Robert Yeary, 1982 ..... Route 2, Box 66, Morton
Hershel M. Tanner, 1984, Route 2, Box 36, Morton
Richard Greer, 1984 .... Star Rt. 1, Box 4, Morton
Donnie B. Simpson, 1984, 292 SW 3rd St., Morton

Crosby County
Clifford Thompson, Secretary
2930 Avenue Q, Lubbock

Mike Carlisle, 1982 ..... Route 1, Box 274, Lorenzo
Alvin C. Morrison, 1982 ..... Box 6, Lorenzo
Tommy McCallister, 1984 ..... 209 N. Van Buren, Lorenzo
Edward S. Smith, 1984 ..... 102 N. Van Buren Lorenzo
Pat Yoakum, 1984 ..... Box 146, Lorenzo

Deaf Smith County
B. F. Cain, Secretary
County Courthouse, 2nd Floor, Hereford

James E. Higgins, 1981 ..... 200 Star St., Hereford
Garland Solomon, 1981 .... 303 Sunset Dr., Hereford
Tom Robinson, 1981 .... 211 Cherokee Dr., Hereford
Bill Cleavinger, 1983 ..... Wildorado
W. L. Davis, Jr., 1983 ..... Hereford

Floyd County
Verna Lynne Stewart, Secretary
Floyd Co. Abstract, 215 W. California, Floydada

Charles Huffman, 1982 ..... Route 1, Lockney
Gilbert L. Fawver, 1982 ..... Route 4, Floydada
C. O. Lyles, 1984 ..... Route 4, Floydada
Cecil Jackson, 1984 ..... Route 3, Floydada
D. R. Sanders, 1984 ..... Star Route, Floydada

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

Gaylord Groce, 1982 ..... Box 314, Petersburg
Bill John Hegi, 1982 ..... Route 2, Petersburg
Harold W. Newton, 1984 ..... Box 191, Petersburg
Jim Byrd, 1984 ..... Route 1, Petersburg
Ray Porter, 1984 ..... Box 193, Petersburg

Hockley County
Jim Montgomery, Secretary
609 Austin Street, Levelland

J. E. Wade, 1982 ..... Route 2, Littlefield
Jack Earl French, 1982, Rt. 3, Box 125, Levelland
W. C. McKee, 1984 ..... Box 514, Sundown
Leon Young, 1984 ..... Route 1, Ropesville
Robert Phillips, 1984 ..... 218 Redwood, Levelland

Lamb County
Robert Richards, Secretary
402 Phelps Avenue, Littlefield

Billy J. Langford, 1982 ..... Box 381, Olton
Edward Fisher, 1982 ..... Box 67, Sudan
P. A. Washington, 1984 ..... Box 124, Springlake
Jack Stubblefield, 1984 ..... Box 397, Spade
Larry Lockwood, 1984 ..... Star Rt. 2, Littlefield

Lubbock County
Clifford Thompson, Secretary
2930 Avenue Q, Lubbock

Owen Gilbreath, 1982 ..... 3302 23rd St., Lubbock
Clifford Hilbers, 1982 ..... Route 1, Box 14, Idalou
Don Bell, 1984 ..... Box 114, Wolfforth
Ronald Schilling, 1984 ..... Route 1, Slaton
Granville Igo, 1984 ..... 1304 8th St., Shallowater

Lynn County
Clifford Thompson, Secretary
2930 Avenue Q, Lubbock

Gary Houchin, 1982 ..... Box 54, Wilson
Freddie Kieth, 1982 ..... Box 283, New Home
Leland Zant, 1984 ..... Route 1, Wilson
David R. Wied, 1984 ..... Box 68, Wilson
Wendell Morrow, 1984 ..... Route 1, Wilson

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

Troy Christian, 1981 ..... Rt. 1, Farwell
Dalton Caffey, 1981 ..... P.O. Box 488, Friona
Ronald Elliott, 1981 ..... Rt. 3, Muleshoe
Floyd Reeve, 1983 ..... Friona
Ralph Roming, 1983 ..... Bovina

Potter County
Jim Line, 1981 ..... Box 87, Bushland
Albert Nichols, 1981 ..... Rt. 1, Box 491, Amarillo
Weldon Rea, 1981 ..... Bushland
Sam Line, 1983 ..... Bushland
Mark Menke, 1983 ..... Rt. 1, Box 476, Amarillo

Randall County
Mrs. Louise Tompkins, Secretary
Farm Bureau, 1714 Fifth Ave., Canyon

Harry LeGrand, 1981 ..... 4700 S. Bowie, Amarillo
Jack Brandt, 1981 ..... Rt. 1, Box 280, Canyon
Johnny Sluder, 1981 ..... Box 56, Bushland
Bill Dugan, 1983 ..... Happy
Roger B. Gist, III, 1983 ..... Happy

NOTICE: Information regarding times and places of the monthly County Committee meeting 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, except for Potter County; in this county contact Jim Line.

WHO'S DOING WHAT:

The district staff is 15 strong. Our combined tenure represents 136 years of service and experience; our job responsibilities are both diverse and specialized. In the continuing effort to keep you informed on what's going on at the district, we will be spotlighting each staff member in coming months to introduce you to their contributions to district programs and services.

KEITH WHITWORTH—THE PEN WORKETH MIGHTILY

Keith's expertise is drafting. He has worked with the district staff for three years and has spent much of that time bent over a light table with a pen in his hand. His first priority for the past two years has been drafting, from rough copy, sixty contour and data point maps developed by staff geologists. A district contract with the Texas Department of Water Resources called for constructing the sixty maps by the fall of 1980, and the deadline was met.

Wielding his Rapidograph, Keith has also created fifteen legal description maps for the counties in our service area. These are being used in providing water depletion allowance tax information at the district. And, Keith has drafted observation well maps, water quality data point maps, and water table decline maps as well.

Says Keith, "it takes a lot of patience, coordination, accuracy, and a steady hand."

Keith's artistic talent is also applied to graphics production, displays, art work and photography for the Information/Education Division. He has learned darkroom processing and printing techniques there.

When an extra pair of hands is needed, Keith is often the man called in. He worked with the neutron logging team during a 52 week contract period. His work on this project included several trips to area counties to get data readings for a natural recharge study being made by TDWR in Austin. The district took on a grant to make pumping plant efficiency evaluation tests last Spring and Keith was among several staff who trained to help perform these efficiency tests.

As nineteen mini-field water labs for the district's irrigation water management evaluation program, moved from production to fully equipped trailers, Keith helped with carpentry and finish work necessary to get the mobile water conservation laboratories on the road.

Keith's next major event? He's getting married on Valentine's Day.

EVERYMAN'S ELIXIR . . .

Water is the most abundant of all created commodities. It is older than the human race; it is known to the language of every land, and has followed the adventurous footsteps of man around and above the world. It is indestructible. Not since the spirit moved on the face of the waters and they were gathered into the seas has there been one drop lost.

From the sea all rivers come and into the sea all rivers run. The liquid that I now hold in my hand may have lashed the land of the pharaohs, may have glistened on the golden oars of Ceopatra's courtly canoe as she hastened to meet and greet her lord and lover, or may have splashed in the baptismal waves of Him whom they call the Saviour of man.

Nature placed with a lavish hand through, under and around the land, streams, lakes and rivers of this ancient, indestructible, universal and health-giving water. From the day Moses smote the rock and water gushed forth to quench the thirst of the children of Israel it has been the one commodity of the world that has most made the human race akin. It alone bridges the seeming chasms between the classes and the masses. The rich and the poor, the loved and forsaken, the learned and the ignorant, the aristocratic and the democratic meet on a common level at the water fountain.

There may at times be those even within these walls who from habit will thirst for the billowy beakers of the

brewers' beer, but one drink of nature's beverage, mellowed in the granite of a million years, will prove that a cup of pure water is a more delightful and delectable draft than the best beer that was ever bought before the bar.

Brewed by God in the divine distilleries of the skies, poured by nature's hand from the cistern of the clouds, purified by the percolations of the ages through the hidden sands of the earth, and brought forth by the hand of man to glisten in the sunlight, that alchemist of time, it is indeed the beverage of life. A cup of crystal water mirrors in each translucent drop the image of its maker and reflects back to the drinker the stamp of divinity. In it no germs generate to steal away the grain, no demon lurks to destroy a good name, no poison pollutes it, no blood stains it, and around it there are no tears.

In the name of this good gathering, I select from the numerous drinks that might be placed before us, this glass of sparkling water, man's best friend while in health, and man's best gift to man even at the hour of death, and to the health, wealth and happiness of this association, its officers, members and friends, I would toast and salute you with this, the people's most popular drink—the beverage best loved, the elixir of life, a glass of pure water.

(As adapted from the oratorical essays of Pat M. Neff, Governor of Texas, 1921-1925).

Water Rights Battles Fought In The Courts

Surface water users in Texas are finding competition for water rights keen as more people and industries locate in the State. Who decides who may use surface water . . . and how?

The Texas Water Commission (TWC) has the difficult job of making these decisions. The TWC is burdened in this process by the ambiguity of Texas law on the subject of surface water rights. Early settlers in Texas brought with them the Common Law of England which advocates the "Riparian Doctrine." This is a doctrine of abundance, the right of a landowner next to a waterway to use whatever he needs from the available supply. This doctrine soon caused problems because Texas does not have an abundant surface water supply.

A more popular "Appropriative Doctrine" of Spain and Mexico, a doctrine of scarcity, thereby came to use. This doctrine holds that surface water is the property of the State and the State can grant permits for fixed amounts at given times for stated purposes. Thus, Texas operates under two divergent and conflicting doctrines . . . which appear to be on a collision course with collision more eminent as water demands increase and unused supplies decrease.

Another problem facing the TWC is the question of ownership of water as it passes through the "hydrologic cycle" . . . during its journey from earth to clouds and through rainfall back to surface and ground-water systems. Battles are already being fought among

Mr. Commissioner, ARTHUR DUGGAN

farmers, ranchers, cloud seeders, upstream and downstream users, well diggers, communities suffering from subsidence, industrial users, municipalities, et al.

In an attempt to bring some order to these conditions, the Texas Legislature in 1967, enacted the Water Rights Adjudication Act to record claims and to limit exercise of claims to actual use. This procedure progresses from studies and reports, field hearings, preliminary determinations, contest hearings and appeals to final certification. The basic criterion in determining rights of users from the same source when there is not enough for all is "the first in time is the first in right."

Adjudication is ongoing. October 1980 statistics note 8,336 parties involved in Texas with 48% having received preliminary determination (with 38% reaching final determination by TWC and 29% reaching final judgment by the courts).

Excerpt of remarks by Felix McDonald, TWC Chairman to the Texas Water Conservation Association Annual Convention 1979.

COUNTIES ELECT 21 COMMITTEEMEN

(continued from page 1)

PARMER COUNTY
Wendal Christian
Ronald Elliott
John R. Cook

in Precinct Four—
ARMSTRONG COUNTY
Tom Ferris
Larry Stevens
Kent Scroggins
DEAF SMITH COUNTY
J. F. Martin
Troy Sublett
Tom Robinson
POTTER COUNTY
Frank Beznar
Ronnie Johnson
Weldon Rea
RANDALL COUNTY
Jack Brandt
Johnny Sluder
Gary Wagner

Official vote totals will be available after the District Directors canvass the votes at their Board meeting on February 2.

RECOGNITION PAST DUE

By TOM McFARLAND

Back in the days when the words of a popular old West Texas ballad started something like this: "twenty miles to water—forty feet in sand". . . a son was born to Senator and Mrs. A. P. Duggan of Littlefield, Texas, who was destined to become a tremendous influence in water conservation and water law in the state.

By the time he had gotten his degree from the University of Texas, young Duggan had developed the curiosity, concern and deep loyalty over his state that was so profound in the life of his father. Young Duggan also lived with the fear that the state of Texas might attempt to lay claim to the underground water within its boundaries the same as it had laid claim to all surface waters.

Through persuasion, his contacts across the state, and his long hours of hard work, Duggan enlisted support from the East to the West and from the North to the South in drafting legislation that, in essence, declared a landowner's absolute right to the water under his property, and reaffirmed that it could not be taken without due remuneration. Major oil companies also became interested in protecting their ground-water rights and supplied additional legal mind to assist Duggan in drafting and passing the legislation necessary to protect a man and his water supply.

In 1949 a bill passed the Texas Legislature, was signed into law, and was codified as V.A.C.S. 7880-3C.

Duggan's activities did not end there. He traveled the state helping defend the new legislation. He spent hours with his law books researching and helping create groundwater conservation districts in keeping with the language and intent of the new law.

To list the number of public meetings and hearings he has attended would stagger the imagination. Wherever or whenever Arthur Duggan's attendance was requested to discuss the future of ground water in Texas, he would be there. And, his enthusiasm and influence is still felt across the state.

Looking for a person knowledgeable of West Texas and her water problems as well as in state water law, Governor Dolph Briscoe appointed Arthur Duggan in 1976 as Compact Commissioner to represent Texas on the Canadian River Compact Commission, a position he still holds.

The Board of Directors of the West Texas Chamber of Commerce, in its wisdom, named Duggan as chairman of its water and natural resources committee last year—a job he pursues with the same vigor and enthusiasm with which he began forty years ago.

One of the guiding principles in this public-spirited Texan seems always to have been, "You don't have to finish a job, but you can't stop trying."

Crop Mulching Increased Yields

Bushland, Texas — Having a crop mulch in growing sorghum increases grain and forage yield. As little as one ton per acre increased yield of dryland sorghum as much as 180 pounds per acre. This discovery was made by two USDA Soil Scientists, Dr. Paul Unger and O. R. Jones at the Research Laboratory at Bushland. Unger described this research at the American Society of Agronomy meeting in Detroit on December 1, 1980. The American Society of Agronomy meets annually and serves as a forum for soil and crop scientists to discuss and evaluate their research. About 3000 scientists and specialists from universities and industry participate in the meeting.

The research reported by Unger was prompted by the fact that wheat straw mulches in the fallow period from wheat harvest to sorghum planting increased yield of dryland sorghum about 1000 pounds per acre as compared to sorghum where mulch was destroyed with tillage. He speculated that mulch in the growing crop contributed to the yield increases.

The study was started in 1977 and continued for three crop seasons. Each year areas received none, one or two preplant irrigations to set up low, medium and high reserves of water in the soil. About one month after irrigation, sorghum was planted. After the crop emerged, smaller areas in each moisture level area were covered with none and one, two or four tons of wheat straw per acre.

Sorghum yield on unmulched soil for the three moisture levels were 2200, 2100 and 740 pounds per acre. With four tons of mulch, yields increased to 2400, 2400 and 910 pounds per acre. This made an average increase of 210 pounds per acre. The one ton per acre mulch increased yield about 160 pounds per acre. The largest increase was 290 pounds per acre with four tons of mulch per acre on the medium soil moisture level.

Unger says that mulches did not affect sorghum forage production on the high soil moisture level plots. Regardless of soil moisture level at planting, forage yield was 2800 pounds per acre with four tons of mulch per acre yield. With no mulch on the low water level, it was only 1900 pounds per acre. "The 900 pound per acre increase with mulch on the low water level was a 50 percent increase in forage yield," Unger said.

Unger says 160 to 200 pounds per acre is not a lot of grain to gain from a cultural practice, but it comes free to anyone using chemical fallow. Wheat stubble can be left intact to serve as a mulch until sorghum planting if atrazine and 2,4-D are used to control weeds. Some of the straw will be left to help increase the yield of sorghum. Previous research has shown that intact wheat straw on the soil during the fallow between wheat harvest and sorghum planting will increase soil moisture storage about the same as a preplant irrigation.

Unger concluded his presentation at Detroit by saying that keeping a mulch on the soil surface not only prevents erosion, but also increases yield.

ANNUAL PRECIPITATION MEASUREMENTS AND AVERAGES--1911-1980...

AMARILLO PRECIPITATION—National Weather Service

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1911	.13	2.88	.50	2.76	5.88	.20	3.85	2.97	.83	.84	.94	.95	22.73
1912	*	1.94	.82	.72	1.67	1.90	1.88	2.28	2.28	.39	.02	1.18	15.08
1913	.11	.55	.59	1.76	1.41	2.32	1.80	.61	4.19	.81	1.98	2.84	18.97
1914	.06	.10	.15	.95	4.43	.84	3.07	2.97	1.07	4.46	*	1.17	19.27
1915	.72	1.60	1.00	5.05	1.70	1.04	4.14	5.85	4.69	1.55	.18	.13	27.65
1916	.36	.02	.57	1.71	.89	2.18	.94	3.82	1.76	2.90	.40	.88	16.43
1917	.69	.22	.25	.71	2.49	.83	2.68	6.17	2.05	.34	.59	.04	17.06
1918	1.01	.26	1.06	.48	2.23	1.44	2.23	2.36	.64	2.47	1.16	2.78	18.12
1919	*	.73	1.73	2.56	2.08	2.94	1.75	3.21	4.58	.67	1.26	.50	22.01
1920	1.11	.18	.51	.64	2.57	2.56	1.85	5.52	3.04	1.87	1.33	.64	21.82
1921	2.10	1.19	.68	.39	2.09	7.75	4.17	5.77	.76	.28	*	.06	25.24
1922	.78	1.44	4.06	3.25	1.60	3.77	1.04	.78	1.41	.23	1.39	.10	19.85
1923	.00	1.71	2.97	3.22	1.70	9.76	1.85	1.54	6.42	7.34	2.13	1.11	39.75
1924	.13	.56	1.75	.87	.67	2.82	3.66	3.57	1.13	.86	1.25	.63	17.90
1925	.51	.06	.11	1.33	1.94	1.71	5.13	3.19	4.88	3.35	.95	.37	23.53
1926	.48	.06	1.67	3.74	3.98	3.17	2.27	1.76	5.72	2.15	.29	.96	26.25
1927	.18	.23	.46	1.95	.07	1.51	1.68	5.31	3.40	.14	.02	.47	15.42
1928	*	1.11	.86	.77	6.48	3.45	5.39	6.15	1.31	2.77	3.54	.51	32.34
1929	.16	.34	1.84	*	3.19	.77	1.76	4.54	1.97	3.28	.91	.11	18.87
1930	.57	.00	1.27	2.19	1.49	4.47	2.42	1.61	.20	2.57	.33	.46	17.58
1931	.31	1.83	1.69	1.57	3.11	.69	1.40	2.19	.51	.92	2.89	1.24	18.35
1932	1.60	.41	.42	2.21	1.02	9.24	1.22	.70	2.79	.64	.02	.87	21.14
1933	.02	.29	.56	.64	2.01	.05	.66	6.02	.88	.49	.58	.02	12.22
1934	.09	.09	2.83	.77	3.21	1.94	.19	1.51	.96	.21	1.13	.40	13.33
1935	.75	.22	1.14	.05	2.57	.28	.81	5.32	2.03	.87	1.27	.18	15.49
1936	1.02	.25	*	.25	9.02	.84	.51	1.39	4.74	.82	*	.88	19.72
1937	.29	.18	1.10	.39	6.83	2.83	1.49	.64	2.61	.31	.14	.29	17.10
1938	.18	2.87	1.24	1.07	4.03	2.49	1.88	.15	1.62	3.06	.43	.08	19.10
1939	2.51	.17	.25	2.30	1.75	7.59	.57	3.28	.45	1.10	.06	.98	21.01
1940	.52	.88	.24	1.10	2.68	1.64	.88	.71	.54	.29	3.87	.27	13.62
1941	.40	.94	2.55	1.29	7.47	5.07	3.36	3.18	4.30	7.64	.33	.68	37.21
1942	.06	.63	.42	3.74	.91	2.29	.80	3.95	1.45	6.18	*	1.18	21.62
1943	.08	*	.01	1.06	1.82	1.01	6.64	2.09	.79	.72	.39	3.77	18.38
1944	1.67	.72	*	1.83	3.72	4.33	5.06	1.40	2.08	.84	.75	1.20	23.60
1945	.77	.28	.41	1.58	.42	1.61	1.62	5.17	4.02	1.31	*	*	17.19
1946	1.05	.33	.66	.55	.82	2.37	.12	3.96	3.25	5.73	.78	1.18	20.80
1947	.32	.07	.77	2.07	4.59	3.19	1.54	.39	.24	.12	.92	1.26	15.48
1948	.63	1.83	.72	.73	2.82	4.92	1.52	5.16	1.27	2.58	2.11	.09	24.38
1949	2.04	.59	.57	1.99	6.43	2.82	3.90	3.78	1.69	1.03	.01	.30	25.15
1950	*	.20	*	.64	1.83	3.25	7.32	4.54	5.02	*	.03	.35	23.18
1951	.38	1.17	.55	.43	9.81	4.34	2.01	1.52	2.01	2.37	.25	.45	25.29
1952	.53	.24	.56	2.46	2.05	1.75	1.36	.88	.32	.00	1.44	.50	12.15
1953	.64	.53	.38	.62	.70	.01	1.81	2.00	.26	4.56	.56	.98	13.05
1954	.25	.09	.17	2.31	4.44	1.95	.55	2.91	.30	.73	*	.19	13.89
1955	.53	.06	.33	.38	2.70	1.49	3.35	1.49	3.13	.13	.02	.10	13.71
1956	.09	1.10	.03	.23	1.99	2.03	2.82	.79	.48	.38	*	*	9.94
1957	.33	1.11	2.82	2.69	4.36	.53	.13	4.85	.88	2.57	.94	.03	21.24
1958	1.05	.58	2.36	1.74	2.45	4.22	6.16	2.08	1.60	.15	.60	.30	23.29
1959	.16	.06	.26	1.18	4.82	2.19	2.85	2.24	2.29	2.10	.14	4.52	22.81
1960	1.30	.95	1.66	1.66	.82	9.85	7.59	3.15	4.22	4.82	*	.65	36.67
1961	.12	.27	2.55	.24	3.40	3.42	4.10	3.14	1.87	.91	2.26	.16	22.44
1962	.47	.39	.02	1.48	1.76	10.16	7.51	3.29	2.66	.85	.53	.64	29.76
1963	.06	.67	.28	.47	3.66	3.60	2.04	3.93	.43	1.54	.33	.29	17.30
1964	*	1.37	.03	*	1.69	1.90	.94	5.69	3.95	.08	1.53	.79	17.97
1965	.55	.47	.72	.23	1.88	10.73	1.54	1.71	.79	1.02	.07	.38	20.09
1966	.43	.69	.01	.87	.19	4.62	1.37	3.77	2.40	.29	.08	.19	14.91
1967	*	.15	.42	1.95	1.40	2.55	3.70	1.81	2.47	1.61	.28	.51	16.85
1968	2.33	.73	.45	.93	2.84	1.68	2.96	3.35	.62	.90	.92	.26	17.97
1969	.02	.50	1.15	.30	2.93	4.09	2.55	4.51	2.77	2.56	.34	.83	22.55
1970	.02	.02	2.10	1.33	.23	1.54	1.39	1.27	.34	1.06	.26	*	9.56
1971	.10	1.65	.10	.77	.91	4.17	1.75	3.33	4.70	2.59	2.08	.89	23.04
1972	.21	.11	.11	.03	2.81	3.87	2.59	1.73	.71	1.66	1.19	.32	15.34
1973	.56	.42	3.99	1.88	1.43	.84	4.08	2.31	1.22	1.05	.10	.17	18.05
1974	.33	.24	.60	.04	4.06	3.33	1.31	7.55	1.65	3.44	.12	.42	23.09
1975	.28	1.33	.51	1.02	2.47	4.15	5.19	3.97	.76	.33	.92	.15	21.08
1976	*	.10	.79	1.65	1.36	2.94	1.77	1.78	4.28	1.14	.43	*	16.24
1977	.64	.53	.24	2.74	4.01	2.06	3.14	4.94	.03	.26	.32	.27	19.18
1978	.63	.80	.21	.55	5.76	6.50	1.82	1.61	2.42	.97	.47	.27	22.01
1979	.92	.28	1.46	1.29	3.94	3.19	2.03	5.08	.52	1.28	.40	.07	20.46
1980	.85	.55	1.38	.82	2.88	1.30	.65	1.80	1.55	.42	.84	.35	13.39
Average	.54	.65	.94	1.35	2.88	3.17	2.55	3.10	2.10	1.70	.75	.66	20.39

*Trace

LUBBOCK PRECIPITATION—National Weather Service

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1911	.38	5.83	.43	2.36	.72	.28	6.75	.21	1.33	1.08	.22	1.55	21.14
1912	.02	1.28	.61	.50	1.58	.96	3.35	2.37	.73	2.81	.01	.38	14.60
1913	.04	.20	1.18	1.82	.24	5.88	.40	.32	4.19	1.53	1.54	2.13	19.47
1914	.15	.10	.29	1.47	4.04	3.86	6.17	5.95	.46	7.12	.35	1.47	31.43
1915	.09	3.00	2.52	6.18	1.52	4.01	1.42	2.96	7.86	1.52	.04	.76	31.88
1916	.17	*	1.15	2.63	.39	1.52	.36	2.45	2.79	2.91	.55	.11	15.03
1917	.35	.05	.21	.58	1.07	.64	1.42	1.16	3.03	.14	.08	*	8.73
1918	.84	.58	.05	.72	1.67	2.95	.53	.79	.79	.51	.69	2.03	12.15
1919	.12	.25	3.39	3.53	2.10	3.52	2.28	2.83	5.70	7.34	.36	.19	31.61
1920	.90	.11	.24	.15	2.91	3.66	2.19	2.64	1.63	1.43	2.21	.09	18.16
1921	.14	.45	1.47	.24	.43	7.71	.84	.92	4.50	.02	*	*	16.72
1922	.34	.20	.55	3.59	3.50	2.43	1.36	.28	.17	.60	1.50	.07	14.59
1923	.24	.76	1.04	3.18	2.77	3.98	1.65	1.59	2.67	6.80	.85	.64	26.17
1924	*	.17	.96	.86	.90	1.79	1.20	1.76	1.25	.47	.03	.06	9.45
1925	.65	.02	*	1.12	2.31	.86	3.38	3.32	9.44	1.33	.11	.21	22.75
1926	.56	.04	1.64	1.81	5.14	1.10	1.03	2.75	4.15	8.40	.67	1.77	29.06
1927	.79	.37	*	.40	*	2.91	2.16	.59	1.16	.40	*	.81	9.59
1928	.31	1.18	*	.09	3.08	1.06	6.78	4.04	.08	2.10	.74	.28	19.74
1929	.43	.34	2.03	.15	6.91	.90	.20	1.68	1.36	3.56	1.00	.07	18.63
1930	.61	.03	.45	1.04	1.71	1.70	.12	1.34	.11	3.91	.94	1.44	13.40
1931	.32	1.98	1.34	1.82	1.32	.95	2.17	2.44	.72	3.47	1.39	1.44	19.36
1932	.93	1.09	.04	1.84	2.37	5.66	1.90	3.15	3.41	1.29	*	2.48	24.16
1933	.37	.95	.02	.06	2.97	.21	1.36	2.19	.71	.42	.99	.06	10.31
1934	.06	.06	1.98	1.08	1.26	.28	.65	1.66	1.86	.28	.55	*	9.72
1935	.12	.60	.89	.04	3.49	2.57	1.25	1.69	3.02	1.22	2.04	.33	17.26
1936	1.08	*	.59	.92	5.86	.92	1.13	.13	13.93	1.52	.74	.21	27.03
1937	.26	.01	1.81	2.01	4.00	3.12	1.32	2.06	3.85	3.22	.07	.52	22.25
1938	.91	1.18	.49	.14	1.99	5.89	4.01	.47	.63	.51	.27	.03	16.52
1939	2.45	.19	.09	.28	1.82	.67	1.73	2.75	.01	.94	.18	.60	11.71
1940	.23	1.97	*	1.84	1.74	2.06	*	1.57	.73	1.07	2.35	.20	13.76
1941	.55	.61	3.56	2.23	12.69	4.13	3.68	1.85	4.47	5.89	.17	.72	40.55
1942	.04	.18	.51	3.25	.35	1.74	2.58	4.97	7.61	3.39	.01	2.70	27.33
1943	.04	.02	.25	.53	2.71	2.37	3.17	*	1.16	.10	.62	1.87	12.84
1944	1.28	1.36	1.09	.84	3.03	1.75	2.93	2.37	3.73	.80	1.72	1.64	22.54
1945	.69	.39	.10	.46	.46	.36	3.08	2.17	2.22	2.26	.27	.32	12.78
1946	1.18	.15	.76	.07	1.49	2.72	.58	3.55	3.49	4.67	.44	1.04	20.14
1947	.73	.02	.69	1.06	6.35	1.56	1.06	.06	.08	.37	1.43	.52	13.93
1948	.14	1.38	.17	.33	2.88	2.31	1.75	.31	1.45	.98	.03	.13	11.86
1949	4.05	.29	.80	1.84	7.80	4.65	1.18	2.07	4.76	1.49	*	.43	29.36
1950	.28	.18	*	.88	3.93	.68	3.12	2.08	3.74	.14	.03	.03	15.10
1951	.32	.66	.78	.58	2.63	4.19	2.04	2.62	.70	.93	.06	.02	15.53
1952	.98	.05	.04	2.30	1.39	1.94	3.24	1.88	.92	.00	.96	.06	13.76
1953	.34	.16	1.07	.62	1.37	.45	1.47	2.57	.04	4.01	.16	.05	12.31
1954	.06	.00	.04	1.91	4.45	.51	.19	2.92	.00	2.82	*	1.09	13.99
1955	.83	.00	.03	.19	2.45	2.30	3.03	.62	2.76	4.53	.10	.00	16.84
1956	.01	1.59	.00	.36	1.80	3.26	.69	1.06	.03	1.73	*	.30	10.86
1957	.08	.73	.98	3.48	6.43	4.96	1.54	.32	.51	4.20	1.27	.06	24.56
1958	1.35	.33	3.23	1.97	2.94	.71	2.65	.21	2.90	.94	.34	.02	17.59
1959	.08	.07	.00	1.28	2.15	7.25	1.30	.72	.89	.98	.02	1.47	16.21
1960	.66	.94	.61	.26	1.16	5.72	5.37	.05	.34	5.83	.00	1.25	22.19
1961	.56	2.51	1.34	.10	2.05	4.03	4.06	1.78	.18	.55	1.31	.35	18.82
1962	.26	.02	.10	1.20	.10	2.56	4.85	1.31	4.17	2.66	.45	.67	18.35
1963	.06	.54	.73	.25	6.79	2.10	.37	2.67	.78	.59	1.13	.20	16.21
1964	.45	.16	.64	.11	1.67	5.00	.82	1.14	2.46	.30	.57	.90	14.22
1965	.08	.35	.22	.41	1.63	1.44	2.14	.62	5.68	1.06	.02	.50	14.15
1966	.52	.06	.13	3.03	.67	2.27	.57	8.85	2.18	.00	.11	.03	18.42
1967	.00	.14	2.09	.95	3.45	7.95	3.29	.71	.98	.45	.11	.52	20.64
1968	.94	.82	2.77	.58	2.01	1.81	3.14	2.72	.67	.81	2.67	.48	19.42
1969	.00	1.13	1.77	1.14	3.88	1.41	2.99	2.59	4.93	7.76	.77	.82	29.19
1970	.00	.11	2.15	.26	4.30	1.36	.00	1.18	1.80	1.34	.05	.08	12.63
1971	.00	.81	.21	1.36	2.44	2.25	.76	4.15	5.22	1.79	.43	.81	20.23
1972	.16	.13	*	.35	3.20	5.37	4.47	5.40	2.95	1.75	.97	.32	25.07
1973	1.44	1.26	1.90	1.40	.43	.32	4.16	.36	.73	.89	*	*	12.89
1974	.08	.01	1.56	.82	1.23	1.11	2.22	5.14	6.62	3.89	.89	.44	24.01
1975	.41	1.53	.04	.45	2.74	1.80	4.32	2.21	2.61	.06	1.18	.34	17.69
1976	*	.03	.24	1.76	1.19	2.46	7.20	1.99	3.28	1.39	.56	.01	20.11
1977	.24	.38	.82	2.90	2.46	2.28	1.13	4.31	.49	1.11	.02	.01	16.15
1978	.59	1.39	.23	.21	3.20	1.93	.15	.34	3.29	1.06	1.11	.17	13.67
1979	.33	.85	2.95	1.17	4.00	3.69	1.84	3.81	.21	.59	.09	1.29	20.82
1980	.54	.38	.19	1.13	3.46	1.78	.20	1.64	3.55	.19	2.29	.51	15.86
Average	.49	.64	.86	1.24	2.70	2.58	2.18	2.05	2.52	2.03	.61	.60	18.50

*Trace

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

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Soil Moisture Deficit Of 2.9 Inches Overall Is Low

By O. H. NEWTON, Consultant to the Texas Agricultural Experiment Station, Lubbock-Halfway, Texas

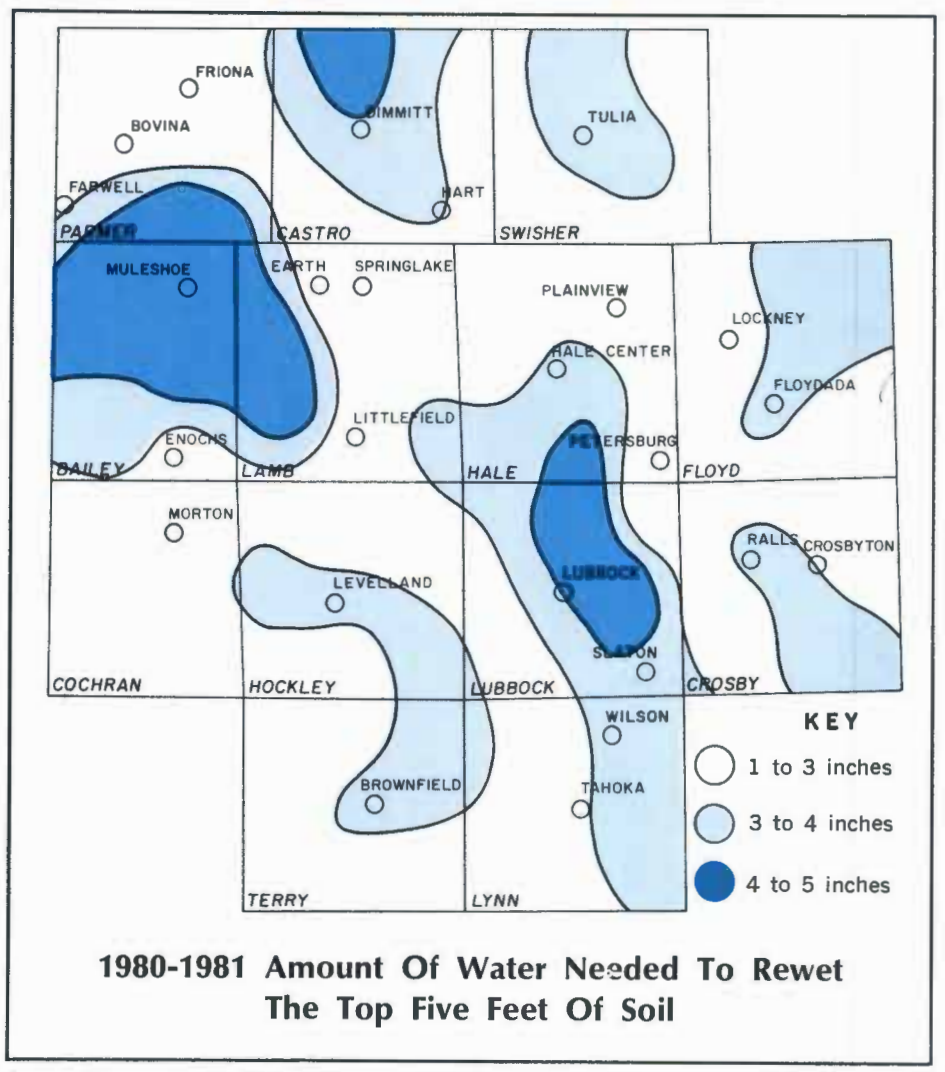
The late fall and winter soil moisture survey for the 1980-81 season was completed in late January. As in past years, this survey covered the same 14-county area of the South Plains of Northwest Texas and was a joint effort of the Texas Agricultural Experiment Station and the High Plains Water District. Danny Meason of TAES and Dan Seale of the district staff made the survey measurements.

The purpose of the survey is to provide soil moisture information which may help farmers in making preplant irrigation decisions and to give an indication of potential dryland production. It is a well-known fact that if the soil is well saturated when crops are planted, it is much easier for rainfall and/or irrigation water to keep up with crop water requirements during the growing season.

Soil moisture measurements were made in the top 5 feet of soil at 87 locations in the 14-county area with a neutron probe measuring system. The locations are distributed over the 14-county area so that the distance between locations varies from 10 to 20 miles. Due to the distance between points, it is possible to establish only a general average of soil moisture conditions.

As might be expected, because of different crops, soil types and cultural practices, the moisture content in the soil often varies from 1 to 2 inches from one location to another, but when all values are plotted a pattern becomes evident. The distribution of varying amounts of soil moisture in the top 5 feet of the soil is shown on the 14-county map that is included. The values

cont'd. pg. 3, col. 2 . . . RAINFALL



1980-1981 Amount Of Water Needed To Rewet The Top Five Feet Of Soil

BOARD OF DIRECTORS: (left) Mack Hicks - Secretary/Treasurer, Webb Gober - member, James Conkwright - member, (seated left) James Mitchell - President, Malvin Jarboe - Vice President.

Board, Committeemen Sworn In

District Board members canvassed the votes of January's election during their regular February Board meeting, and declared the results to be official. James Conkwright of Hereford was re-elected to a second term as Director in Precinct Four which includes Armstrong, Deaf Smith, Potter and Randall Counties. A. W. "Webb" Gober of Farwell was also re-elected and will serve his fifth term as Director in Precinct Three, including Bailey, Castro and Parmer Counties.

Six county committeemen were re-elected to a second four-year term, and eleven new committeemen were seated from within the seven county District voting area. The Board appointed three committeemen in Potter County and one in Parmer County.

W. A. Baldridge and Garnett Holland, both of Dimmitt, appeared before the Board and took the oath of office as Castro County committeemen. They were sworn in by Clifford Thompson of the District staff. Mrs. Dolores Baldridge also attended the meeting and was appointed by the Board as the District's Castro County Secretary to replace Garnett Holland.

The Honorable J. Q. Warnick presided at the District's swearing in ceremonies at noon to formally install James Conkwright and Webb Gober as Directors re-elected to the High Plains Water District Board.

Judge Warnick, of Lubbock's County Court at Law Number Two, administered the oaths of office. James and Webb, accompanied by their wives, each individually affirmed their acceptance of the duties and responsibilities of the office.

The district staff and guests witnessed the solemn occasion after brief and moving remarks by Judge Warnick.

"As you raise your hand to say "I

cont'd. pg. 3, col. 4 . . . ELECTION

READY & WILLING, Garnett Holland, former Castro County secretary, came to Lubbock with Dolores Baldridge, new Castro County secretary, and W. A. Baldridge, to be sworn in as committeemen.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

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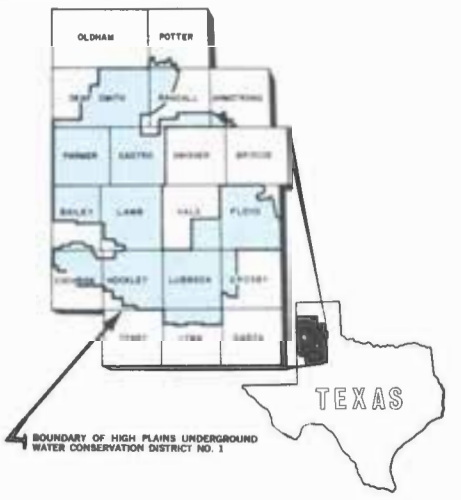

NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Jim Line.

WATER LEVELS DOWN

The High Plains Water District has completed its annual program of measuring the depth to water levels in more than 900 observation wells scattered throughout the fifteen county District area. A total of 856 wells were measured this year.

Since most of the wells measured are operational irrigation wells, the month of January was chosen for the observations in order to allow for a dormant period and for well recovery from the cone of depression developed during the pumping season. Wells were measured to find the depth to "static" water level. After measuring, each well received a red District identification tag for the owner's information.

Data gained from this program is used for decline rate projections, determining the amount of water left in storage in the Ogallala, and very importantly, as a basis for the income-tax depletion allowance claims on landowner's tax returns.

Data on individual wells were available within a few days of completed readings, but a formal tabulation of the data on the entire network is not expected until mid-year.

Average Total Change in Feet For All Water Level Observation Wells Measured In The Following Counties For Time Period Indicated

	*No of Observation Wells in County	1970-1980	1975-1980	1979-1980	1980-1981
Armstrong	9	—10.49	— 5.47	— 1.49	— 1.13
Bailey	74	—12.44	— 6.82	— 0.78	— 2.57
Castro	89	—28.22	—14.48	— 2.82	— 3.06
Cochran	53	— 2.21	+ 0.50	+ 0.87	— 1.09
Crosby	20	—19.80	—10.13	— 0.01	— 3.28
Deaf Smith	89	—24.20	—11.01	— 2.10	— 1.42
Floyd	97	—19.82	— 8.54	+ 0.51	— 3.54
Hale	27	—12.19	— 5.35	+ 1.40	— 3.29
Hockley	90	— 1.80	+ 0.21	+ 1.21	— 1.32
Lamb	94	—21.15	—10.99	— 1.33	— 3.50
Lubbock	119	— 6.18	— 1.18	+ 1.49	— 1.86
Lynn	31	+ 0.21	+ 0.88	— 1.25	— 1.60
Parmer	97	—28.86	—15.85	— 2.55	— 3.49
Potter	6	—11.91	— 7.46	— 1.86	— 1.46
Randall	41	—13.60	— 5.20	— 1.01	— 0.73
District Average		—14.20	— 6.72	— 0.48	— 2.41**

*Records for some wells do not cover the entire period of record(s) indicated. Therefore the water level records for these wells were not used in the averages.

**Average of 856 wells measured in 1981.

River Authority Honors Wells

Walter Wells managed the water resources of the Brazos River Authority, Texas' largest river basin, for 18 years. His death recently in Waco triggered a thunder of recognition and praise from mayors, engineers, business and industrial leaders, columnists and water colleagues, friends and clients whom he served.

They say he made the waters of the Brazos palatable to everyone, and established procedures to protect the water quality on its streams and reservoirs.

Wells is tributed with realizing a dream. Under his general management, the Brazos River Authority developed and now owns and operates three major reservoir projects, conservation storage space in seven other federal reservoirs, two canal systems with pumping facilities, 200 miles of main-line canals, three regional sewerage systems, and a basin-wide program of water quality planning, improvement and maintenance of Brazos Basin water.

Wells achieved a national reputation in his field, and served as the President and Chairman of the Board of the Texas Water Conservation Association, as Director of the National Water Resources Association and of the Interstate Conference on Water Problems, and as a member of the Water Resources Congress. He also served his country well, as a graduate of West Point and an officer in the U.S. Army Corps of Engineers for 23 years prior to his post with the Brazos River Authority.

WALTER WELLS

The Board of Directors of BRA have revered the memory of Walter Wells with a formal proclamation: "Now, therefore be it resolved . . . he be remembered as long as the waters of the Brazos River flow so that those who try to fill his spot in life may do so with his enthusiasm, loyalty, devotion and duty and concern for his fellowman." Members of the High Plains Underground Water Conservation District #1 affirm that resolve.

Plan Ahead, Put Runoff To Work

By OBBIE GOOLSBY

We've had several complaints recently. Folks developing new irrigation wells for production have been pumping their water down the county road bar ditch. This is not only a waste of valuable water and energy, but it is a violation of the rules of the Water District.

Many irrigators who allow their water to escape during the development of a new well most often have not planned how they can conveniently use the water before they begin the drilling of the new well.

An excellent example of groundwater conservation was observed in Parmer County awhile back. During the process of pumping out a new irrigation well, overflow from the slush pit was used to prewater twenty-five rows or about five acres on a farm near Lazbuddie. Said the operator, "I would value that salvaged water at approximately thirty dollars an acre."

Operators planning to develop new wells or rework old ones should plan ahead and put that potential waste water to good use.

Gus Parish Dies

The Water District salutes a longtime friend and colleague, Gus Parish of Earth, Texas, who died February 4th. His memory and contribution to the people of West Texas will live long after him.

Gus was a former Director of the High Plains Water District. He served on the Board from 1954 to 1958. But he is perhaps best remembered as the guy who made a pump that could withstand the demands of a tailwater pit.

Already retired, Gus opened KMP Lake Pump Manufacturing Company of Earth, Texas, in the early 60's, at the persistance of neighbors and friends who knew of his ingenuity and determined nature. And Gus thought he could invent a self-priming pump that could handle large amounts of trash and silts. He produced his first test pump in 1962, and his shop is today making 27 different types of the same high quality pumps.

West Texans will remember Gus as a man of vision and perseverence. He invested his time, his resources, and himself in service to his community and to promoting water conservation.

RAINFALL . . . continued from page 1

shown on the map are the amounts needed to wet the top 5 feet of the soil to its water-holding capacity. Any additional moisture will either run off or move through the soil to deeper layers which cannot be reached by root systems.

The measurements for the 1981 season show an average deficit of 2.9 inches. This deficit may seem low when we consider the general condition of last season's crops and the hot and dry summer, but at the same time we must remember that moderate to heavy rains fell in August and September and heavy snows in November. In some areas crops continued to extract moisture from the soil well into the fall, but in many cases the vegetation was light and cut out early—thus a considerable amount of moisture remained in the deeper layers of the soil. An examination of the survey map shows that about 65 percent of the 14-county area shows a deficit of less than 3 inches. About 20 percent had a deficit of 3 to 4 inches, while about 15 percent was fairly dry with a deficit of 4 to 5 inches or more. The overall deficit of 2.9 inches compares very favorably with past years when crop production proved to be good to excellent.

As a general rule, only small amounts of moisture are received during the winter months in Northwest Texas. During this period fields lose more moisture than is gained in the top foot to 18 inches. A part of this loss occurs during land preparation which is a necessary part of the farming operation. This means that during most planting periods the main concern is a moist seedbed for seed germination and seedling growth. In considering this along with the overall deficit of moisture in the soil, the probability of rain during the spring becomes very important.

Rainfall records at Lubbock have been examined and a 55-year period subjected to computer analysis to determine the rainfall probability from March 21 to May 31.

PERCENT PROBABILITY FOR RAINFALL (equal to or greater than amount stated)

RAINFALL	*TIME INTERVALS*				
(inches)	*3-21/4-20*	*3-21/4-30*	*3-21/5-10*	*3-21/5-20*	*3-21/5-31*
1.0	39	57	77	90	94
1.5	23	40	61	81	87
2.0	14	28	50	69	80
2.5	9	19	40	59	70
3.0	5	14	31	48	62
3.5	3	9	24	39	54
4.0	2	6	19	32	47

In addition to its value as an aid in planning operations based on soil moisture levels such as preplant irrigation, row spacing and plant population, the average deficit over the area has some value in estimating potential production. We must point out that soil moisture levels at the beginning of the season are only one of several factors that determine the final production. It is likely that a serious deficit of, say 6 inches of soil moisture, will set a limit on production. This is due to the fact that spring and summer rains are very unlikely to make up this deficit and add enough additional moisture to produce an average crop. If, on the other hand, the deficit is 3 inches or less, the chances are good that rainfall will wet the soil or even a moderate irrigation will supply the needed moisture. A wet soil profile at planting time is a well-known factor in crop production but this, by no means is the only one. Such factors as cold weather early and late as well as a hot and dry summer can limit production.

Thus, if the deficit is low, the first step toward a good production year has been made. If, on the other hand, the deficit is very high, the probability is high that the total production will drop below average.

In general, the wetting efficiency of rainfall is about 60 percent. This means that if six inches of moisture are needed in the soil, rainfall must total around ten inches. This far exceeds the amount normally expected before crops must be planted. The probability chart is a help in determining the chances for getting from one to four inches of rain this spring. Farmers west and southwest of Lubbock can expect a slightly lower probability and those east and northeast of Lubbock a slightly higher probability.

The key to making this data intelligible for your field is to know how much water is now stored in your soil profile. Soil moisture blocks, tensiometers, neutron probe holes or the feel method of determining soil moisture levels (See *Cross Section*, April, 1980, Volume 26, No. 4) are valuable tools to do the job.

With knowledge of how many inches of water are now stored in the soil's top five feet, the rainfall probability chart will tell you the chances of getting the rest of the moisture needed to fill your soil profile from spring rain.

District Ag Economist Resigns

The District is losing a good man this month. Dwight Adams is leaving to go into private business related to cotton ginning. A graduate of Texas Tech University, Dwight has worked as the District's agricultural economist for the past two years. His assignments have included working the neutron logging operation under a contract to the Texas Department of Water Resources for data on natural recharge and irrigation recirculation.

Dwight earned the name "Digger" from his colleagues during the 24 thousand miles he and Ken Carver traveled on neutron logging trips. Dwight says he shoveled an average of 800 cubic yards of dirt in and out of some 400 holes by digging three days a week for about forty weeks on that project.

"I became very fond of my shovel," he said. "But I'm used to digging with a shovel. I did it all the time while growing up; that's what irrigation farming was all about."

Dwight tracked down equipment to outfit the Field Water Conservation Labs and was one of the staff trained to participate in the irrigation efficiency evaluation program using the labs.

He and Dan Seale ran 240 pump tests this summer, often in searing heat, to evaluate the pumping plant performance of electric and natural gas irrigation wells. Dwight has also written a procedures manual for pump testing, which is one of the specifications of a grant the District has received from the Texas Energy and Natural Resources Advisory Council; and he is contributing to its final report.

DWIGHT ADAMS

"My work helped me gain confidence, says Dwight. But most valuable to me was the experience I got and the exposure to this country. I got to know the geography of the High Plains, and that's educational."

The District staff wish Dwight tremendous success in his future business.

ELECTION . . . continued from page 1

do', it is a public trust. The passing of the reins has taken place to the sound of paper dropping in a box. . . . Your office is a part of that process, and a part of that trust."

Later, during the afternoon Board session, members elected a slate of Board officers. James Mitchell will serve as President for a third year, Malvin Jarboe accepted the position of Vice President, also for a third year, and Mack Hicks was voted Board Secretary-Treasurer.

JAMES AND JANICE CONKWRIGHT

WEBB AND IRENE GOBER

JUDGE J. Q. WARNICK
Lubbock Court-at-Law #2

TOWN'S WATER SEARCH TURNS UP NEW SUPPLY

After more than six months of quiet negotiations, the city of Shallowater has secured groundwater rights to a new supply with enough saturated thickness to keep the town in water for another ten to 15 years. Mayor Joe Cox' reaction, "A big sigh of relief! If we had not secured that water we would have been forced to float a bond issue to go further."

MAYOR JOE COX

Shallowater's new water rights are under a 275 acre tract just southeast of the city limits, in the area of greatest saturated thickness within a five mile radius of the town, and only a few hundred feet from the end of the city's existing main water line. The city's existing supply is pumped from eight wells inside the city limits, producing from 115 to 300 gallons per minute each. But that supply is estimated to begin playing out by 1984. Shallowater residents didn't know that just a few years ago.

Mayor Cox first suggested to the Chamber of Commerce in 1978 that the city needed a water study. The High Plains Water District was asked to make an assessment of groundwater reserves under the city's corporate limits and immediate vicinity, with an evaluation of the adequacy of Shallowater's water reserves to satisfy its future needs.

The results were a jolt. Shallowater had current reserves to last only seven and a half years, or until 1984, based on the then current use patterns and a stable population. The study also stated that its projections "should not be interpreted to imply that there are no solutions to the city's future water supply problems. There are ample groundwater reserves within a radius of two miles of the corporate limits of the city of Shallowater to satisfy the city's short term water needs."

"It created lots of publicity for us," remembers Cox, "because now we were the town with the shortest water supply in Lubbock County. A lot of people felt the study had hurt us because of all that publicity.

"Most of the people who thought we were hurting were land developers and builders. They felt it might have hurt their business. And a lot of their business did fall off, but it fell off every place else at the same time. Apparently it was due to the interest rates. Construction went on here until money dried up.

"But I don't believe the study hurt us any place, because if the district hadn't done the study for us, and given us a lot of help, we probably would have had difficulty realizing we even had a problem."

The Water District assessment was completed in July of 1978. It recommended that Shallowater begin immediately to secure additional groundwater reserves to satisfy its short term water needs for at least ten additional years (a minimum quantity of 2,860 acre feet); and investigate alternatives to secure a long term (50 year) source of water. But as Alderman Leroy Grawunder who arranged the details of the lease contract explained, "It just took a while. We're lucky these people were willing to deal with us. They were very considerate in pricing the water to us; if they'd asked more, I'm sure we'd have paid it. This water is closer, a lot cheaper, and there's more of it."

Shallowater has contracted with the A. C. Wright estate for a minimum, guaranteed 48 million gallons a year for a flat twelve thousand dollars, and 25¢ a thousand gallons for everything over that. The lease runs for as long as there is water.

LEROY GRAWUNDER

The land has supported irrigated farming with three existing wells, but the current operators told Grawunder they plan to go strictly to dryland farming. The city plans to ask the District's help to meter and test the three wells, and will probably put in submersible pumps and drill one additional well.

"This new supply will be our lead water," said Cox. "We have to pay for it anyway."

Shallowater residents will still need to be water conservative. The 1,954 residents use an average of 600 thousand gallons of water a day. And that figure has risen to as much as a million gallons a day during the summer's dry spells. During last summer's drought the city raised its water rates.

"DUNK" WILLIAMSON

"As soon as we raised the rates," says Shallowater's water superintendent of 14 years, W. F. Williamson, "consumption dropped drastically — by about a hundred thousand gallons a day."

Residents now pay five dollars for the first three thousand gallons and a dollar a thousand for everything over that. But nobody expects to have another water rate increase to pay for the new supplies. Says Mayor Cox, "We'll be able to pay for it without raising either water rates or taxes."

For a long term supply, Shallowater is hoping to tie in with Lubbock on the Post/Justiceburg reservoir project. "The city of Lubbock has given us their word we would be part of Justiceburg, if and when," said Grawunder. Mayor Cox further explained that they understand that meant Shallowater would be drinking Bailey County well field water for the cost of their share of the project. The transportation line bringing Bailey County groundwater to Lubbock passes under and within Shallowater's city limits. The line already has a tap on it, and Shallowater already has emergency access to this water supply.

WATER DISTRICT BOARD COMMITS RESEARCH $$$

The High Plains Water District has again committed itself to supporting water conservation research efforts on the Southern High Plains as a priority in calendar year 1981. During their February Board meeting, members approved the funding or partial funding of $41,483 in several water research projects proposed by the Lubbock-Halfway Texas A&M Agricultural Experiment Station. These included an evaluation of the influence of plant growth regulators on the water use relations and yield of cotton on producers' farms; an evaluation of the potential for using beef tallow as an evaporation suppressant to decrease soil and plant water evaporation; and an evaluation of the use of surfactants (a chemical which enhances water's ability to penetrate) to optimize the activity of plant growth regulators on cotton as well as on other crops grown in the District's service area. Work is already being done on each of these areas of research with very promising preliminary results which suggest that plant growth regulators, beef tallow and surfactants have tremendous potential to benefit in the area of water conservation.

In addition the Board approved the appropriation of funds to purchase two neutron probes for 5,600 dollars and to loan them to the Bushland Research Station for their use in water conservation related research.

The Water District is conducting some research projects itself, and considered three cooperative agreements with the Texas Department of Water Resources. Under final negotiation are contracts for approximately 17 thousand dollars for assistance in conducting irrigation application efficiency improvement tests on ten previously checked and repaired systems; for help with conducting a soil moisture survey program to monitor and compare data on moisture conditions in root zones at a minimum of 75 sites; and for assistance with installing soil moisture monitoring equipment in field crops at 15 irrigation sites in the District's service area during the growing season.

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

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THE Cross SECTION

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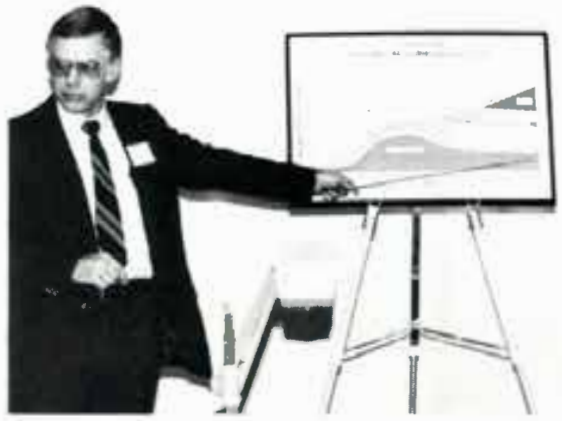
Water Costs, Lifts, Yields Estimated

Dr. Herbert Grubb, Director of Planning for the Texas Department of Water Resources, gave preliminary results of the High Plains Ogallala Study which was authorized by Congress in 1976, at the 14th annual meeting of Water Inc., at Lubbock in February.

Dr. Grubb reported that the Army Corps of Engineers had provided estimated cost and yield data on the four potential importation sources and routes to the High Plains area as shown on the map.

For transfer route A, the Corps has considered a range of 2.1 million to 6.4 million acre feet of water per year. The construction cost plus interest during construction is estimated to range between $5.9 billion and $13.4 billion. Cost per acre of water transferred, including amortization, interest, and pumping cost is estimated to $410 for the 2.1 million acre foot transfer and $360 for the 6.4 million acre foot transfer. A comparison of the estimates for transfer routes B, C, and D were also given.

SUPPLY/DEMAND water curve projected to 2030 by the Texas Dept. of Water Resources are explained by Herb Grubb at 14th annual meeting of Water, Inc. in Lubbock.



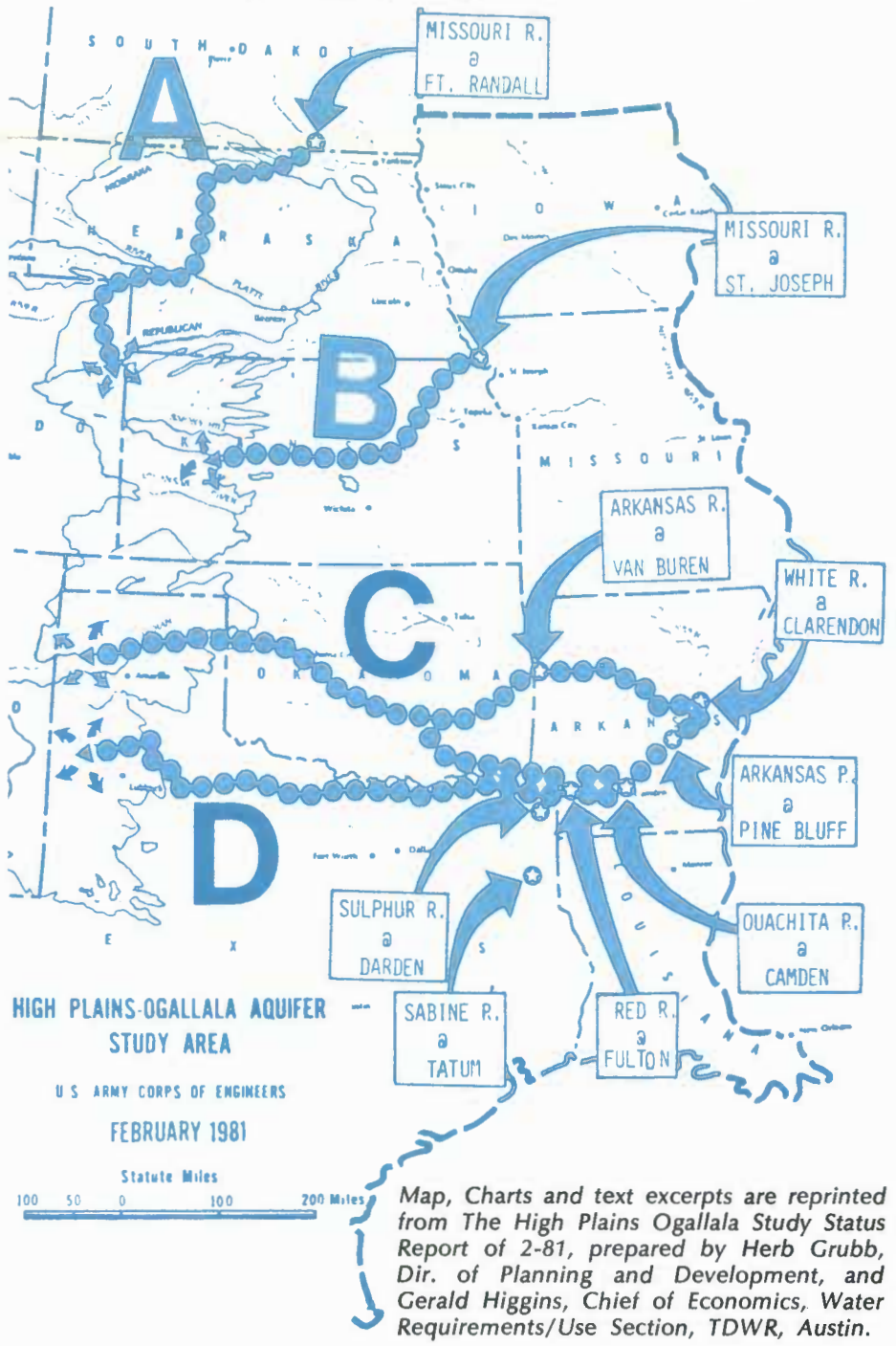
COST ESTIMATES FOR WATER IMPORTATION TRANSFER ROUTES

Route	Quantities of Water Considered for transfer (million Ac. Ft.)	Total Costs; Construction and Interest during Const. ($ Billions)	Avg. Annual Cost Amortization Interest, Pumping Cost ($/acre foot)
A	2.1	5.9	410
	6.4	13.4	360
B	1.0	9.7	880
	6.0	16.1	352
C	2.0	12.8	745
	6.8	20.7	482
D	2.4	16.0	785
	7.2	20.0	695

The transfer cost estimates do not include costs of moving water from the terminal storage points and distributing it to the farms.

The lift, length, and number of pumping plants for each route are:

Route	Lift (feet)	Length (miles)	Number Pumping Plants
A	2,450	620	17
B	1,775	360	15
C	2,380	845	46
D	2,740	713	23



Map, Charts and text excerpts are reprinted from The High Plains Ogallala Study Status Report of 2-81, prepared by Herb Grubb, Dir. of Planning and Development, and Gerald Higgins, Chief of Economics, Water Requirements/Use Section, TDWR, Austin.

Management Now for Water Conservation and Increased Returns

The water resources of the Ogallala are the lowest cost, most valuable water resources the region will ever have available to it. The Corps cost estimates give an indication of the replacement cost of water at the terminal storage points. This, of course, is not the total replacement cost of water at farms, since cost of distribution from terminal storage has not been included. When viewed from the replacement cost vantage point, each farmer of the High Plains must consider whether or not his present water marketing, irrigation operation is paying him enough returns for his water.

There may not be a way to convert the present Ogallala water into dollar values as high as those estimated dollar costs to import replacement water to the area. The reasons for this include the fact that land and water are the claimants of income from irrigation farming that remains after all other farm expenses have been paid. The price of farm commodities, of course, determines the gross income from which expenses can be paid. Thus, the fact is that the short run market for water is through agricultural commodities. The value of the present water supply depends upon farm commodity prices as determined in national and world markets, costs of purchased production inputs (labor, seed, fertilizer, insecticides, herbicides, fuel, machinery, insurance, interest, transportation, and supplies), the weather and the efficiency of water and other inputs used in irrigation.

The High Plains farmer has very little influence on any of these factors except the management of his opera-

cont'd. pg. 2, col. 1 . . . MANAGEMENT

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

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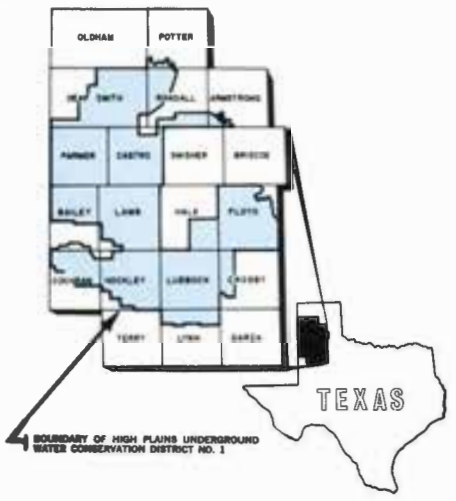

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NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Jim Line.

MANAGEMENT . . . cont'd. from page 1

tion to achieve the most efficient use of his production inputs, including water. That is to say, the High Plains farmer must take every action possible to get the most dollar yield from each acre inch of water he uses. (Remember, the replacement cost of water is more than $500 per acre foot.)

To these ends, both public and private sector research has been directed toward means to increase productivity of water on the one hand, to reduce the quantity of water needed per acre irrigated, and to increase the efficiency of irrigation systems. The information from these research programs is being used today by some High Plains farmers.

The High Plains Study has assembled information about these potential water conservation and water efficiency improving techniques. The Council is recommending that all possible public sector support, encouragement, incentives, and public distribution of this knowledge be given high priority immediately. This course of action won't produce more water, but it will work to save farm businesses from financial ruin, it will make the present water supply last longer, it will increase the value of the existing water supply, and in the end it could work to reduce the quantity of water that would need to be imported. Also, more efficient irrigation methods would raise the value to pay importation costs. The major water conservation practices are:

1. Irrigation scheduling: to meet plant needs in light of soil moisture conditions;
2. Irrigation system improvements: to increase efficiencies of wells, pumps, motors, and distribution systems, to reduce surface water run-off, and to capture and reuse tailwater;
3. Evapotranspiration, evaporation, and run-off reduction: to select the most drought tolerant strains and varieties of crops, use of reduced tillage methods of cultivation, residue management, basin tillage, terracing, and in some cases deep plowing to store and hold moisture;
4. Farm Management—Select economically efficient level of irrigation: to irrigate at a level at which returns to water are maximum as opposed to irrigation for maximum crop yields.

The priority agricultural research and development topics for both public and private sector research efforts, that have been identified are:

1. Genetic improvements to increase drought tolerance;
2. Evaporation suppressants and antitranspirant methods and materials;
3. Engineering improvements in irrigation wells, pump and motor efficiencies, irrigation application systems, and cultivation and harvesting systems for use in water conservation farming systems.

Finally, the public sector needs to increase its efforts at demonstration of water conservation farming methods and distribution of information to farmers. All units of government should adopt tax incentives to encourage investment in water saving equipment, and consideration should be given to low interest loans for such investments. It's in the interest of the entire economy to achieve the maximum economic efficiency from the use of exhaustible resources, such as water from the Ogallala Aquifer.

ONE O'THE BEST IN 14 YEARS

The house was full. Folks lined the walls and crowded up to the head table for breakfast space at Water Inc's Fourteenth Annual Membership Meeting at Lubbock's South Park Inn last month.

The speaker was U.S. Congressman Kent Hance commenting on President Reagan's announced budget cut proposals. Hance said the President favors 'revenue-in' loan repayment water projects consistent with balancing the budget. He said Reagan came from a water short state and appreciates the need for a sound water policy. Noting that Reagan deferred recreational water projects, Hance said Reagan did nothing detrimental to water programs in this area.

Congressman Hance also told the unusually large audience that his status as the first member of the House Ways and Means Committee with an agricultural background was a real advantage for this area. Hance stated there was firm Congressional support for the proposed USDA Plant Stress and Water Conservation Lab locating at Texas Tech University. He also announced that he would propose legislation to allow a double tax deduction on the use of natural gas for agricultural production above regular farm expenses.

The morning line-up of speakers included a keynote address by Texas Water Development Board Chairman, Lewis Beecherl, and comments from Robert Nichols of Freese and Nichols Engineers and Dr. Herb Grubb, TDWR Director of Planning.

After describing the problems of why TDWR has not sold bonds for three years because of a six percent interest ceiling, Beecherl said the Water Development Board is not taking any more applications for water projects until it can find more money. Yet the demand is expected to increase as federal grants stop and EPA regs get tougher, said Beecherl. He added that for all its loans, TWB has a clean record of no bad debts, no bad investments and no defaults.

Dr. Grubb was called on to scope the supply/demand curve. He graphically displayed supply projections in the red by the year 2000, even while holding agricultural water use at its present level and allowing for no growth. Grubb projected an estimated need of $44 billion for urban water development in Texas in the next 25 years, but commented the amount is not much more than we're putting into the program today, from federal and state sources. Today's budget of $800 million, adding ten percent per annum for inflation over the next 25 years is equal to about $44 billion.

Beecherl then examined where the financing might come from, suggesting $11 billion in federal financing, 5 billion by large cities and river authority bonds, and a whopping 29 billion remaining demand (figured in present day dollars) to be secured. He men-

cont'd. page 4, col. 1 . . . WATER, INC.

WHY And HOW To Figure Electric Pump Plant Efficiencies

Contracts for electricity to the rural electric co-ops which serve our area will expire in October 1982. Estimates are that the new contracts will increase the price of electricity from about $2.00 per Kw to about $6.00 per Kw to the co-ops. The new contracts are also expected to contain a ratchet clause which will require the REA to pay 85 percent of the previous peak use month during the year. The cost to the irrigator is expected to increase from the current level of about four cents per Kwh to eight or nine cents by the end of 1982.

The HPWD recommends highly that you get your pumps and motors operating at their maximum efficiency as soon as possible. The district has several brochures which can help you check the energy use efficiency of your wells, with step-by-step "how to" procedures. Tests conducted by district staff to measure pump efficiences, showed the average pump efficiency of electric powered pumps was 41.35 percent with an average lift of 188 feet and average yield of 215 gallons per minute. Results of 168 pump efficiency tests are as follows: (also see *Cross Section*, November 1980.)

SUMMARY OF PUMP EFFICIENCIES ON 168 PUMPS POWERED BY ELECTRIC MOTORS

Pumps		*Performance Level Rating*
1		tested less than 10 percent efficient
11	or	6.9 % ranged between 10 and 20 percent
21	or	13.29% ranged between 20 and 30 percent
45	or	28.48% ranged between 30 and 40 percent
34	or	21.51% ranged between 40 and 50 percent
26	or	16.45% ranged between 50 and 60 percent
18	or	11.39% ranged between 60 and 70 percent
2	or	1.26% ranged between 70 and 80 percent

The average cost to pump an acre foot of water was $24.01 based on an average cost of four cents per kwh. Leon New, Irrigation Specialist with the Texas A&M Agricultural Extension Service illustrates the cost associated with operating an inefficient pump with the following charts:

Current

	Per 100 foot Lift		*Per 250 foot Lift*	
Pump Efficiency In Percent	*Kwh/acre-in. (450 gallons per min.)*	*Hourly Cost At 4.6¢ per Kwh*	*Cost For 1,500 Hrs. Of Operation*	*Cost For 2,400 Hrs. Of Operation*
75%	13	.60	$2,250	$ 3,600
50%	19	.87	$3,263	$ 5,220
25%	39	$1.79	$6,713	$10,740

Projection to end of 1982

	Per 100 foot Lift		*Per 250 foot Lift*	
Pump Efficiency In Percent	*Kwh/acre-in. (450 gallons per min.)*	*Hourly Cost At 8¢ per Kwh*	*Cost For 1,500 Hrs. Of Operation*	*Cost For 2,400 Hrs. Of Operation*
75%	13	$1.04	$ 3,900	$ 6,240
50%	19	$1.52	$ 5,700	$ 9,120
25%	39	$3.12	$11,700	$18,720

Now that we've got your attention, here's what to do to check the current efficiency of your electric powered pumping plant:

The following steps will show you HOW TO:

- **Read your electric meter**
- **Figure the number of kilowatt-hours you use per hour**
- **Determine your pumping plant's water application rate**
- **Find your electricity cost per acre inch of water pumped**

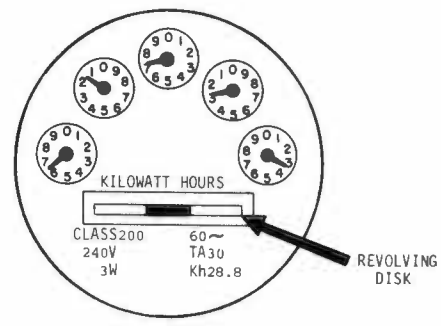
STEP A. FINDING THE NUMBER OF KILOWATTS USED BY AN ELECTRIC POWERED IRRIGATION PUMPING PLANT.

1. If the system is not operating, start the motor and bring the system to NORMAL OPERATING conditions. If the system is a sprinkler or closed system, let it build to NORMAL OPERATING PRESSURE.

2. If pumping from a well which has been shut down for several days, run the system long enough to STABILIZE THE PUMPING WATER LEVEL in the well.

3. If possible, TURN OFF AUXILIARY MOTORS, such as injection pumps, and the center pivot tower motors.

4. READ THE WATT HOUR METER. It features a small revolving disc. The revolutions of the disc per unit of time is in proportion to the amount of current drawn by the electric equipment being used. Find the darkened spot on the edge of the disc to aid in counting its revolutions. Time and write down the number of seconds it takes the disc to make ten (10) revolutions. For accuracy repeat this step several times and take an average of the numbers. Each meter has a Kh factor which is a constant number on the meter face. Read it.



5. Enter the average of seconds and the meter constant (the Kh) from the meter into the following equation:

$$\text{Kilowatts per hour} = \frac{\text{No. of disc revolutions x Kh factor x 3.6*}}{\text{time in seconds}}$$

Operating cost for one hour = kilowatts used x cost per Kwh. (Call the electric supplier if cost per Kwh is unknown.)

*Multiplier to obtain use of kilowatts. This gives the kilowatts of power used each hour.

STEP B. DETERMINING YOUR WATER APPLICATION RATE:

1. Read the pump output in gallons per minute (GPM) with a water meter.

2. Find the amount of water, in inches, pumped on one acre in one hour (this is the acre inches pumped per hour), using this formula:

$$\text{Acre inches per hour} = \frac{\text{GPM}}{450^*}$$

*(450 GPM x 60 minutes = approximately one acre inch.)

STEP C. FINDING THE COST PER ACRE INCH OF WATER:

Divide the cost for one hour of pumping time (Step A) by the acre inches pumped in one hour (Step B).

$$\text{Cost per acre inch} = \frac{\text{cost of operating one hour}}{\text{acre inches pumped in one hour}}$$

STEP D. FINDING FUEL COST PER ACRE

1. Find acre inches pumped per irrigation set by multiplying acre inches pumped in one hour by hours per irrigation set.

$$\text{Acre inches pumped per set} = \text{ac. in. pumped in one hr. x hrs. per set}$$

2. Find acres irrigated per set.

$$\text{Acres} = \frac{\text{width of set in feet x length of rows in feet}}{43{,}560}$$

continued, page 4 . . . WHY AND HOW TO FIGURE

WATER, INC. . . . cont'd. from page 2

tioned a slight increase in the oil and gas severence tax as one proposal which was rejected by Governor Clements because of his commitment to no new taxes; then summarized Texas House Speaker Bill Clayton's water financing Constitutional Amendment.

Chairman Beecherl clearly sees the state's shortage of water funds as a near term problem which, if brought under control, will make it possible to tackle the long term water supply needs of the High Plains.

Bob Nichols brought a report of the Water Task Force of the National Society of Professional Engineers. While he said the report endorsed a concept of keeping control as close to the people as possible, it renigged by outlining more federal control, proposing to expand, restructure and make the National Water Resources Council the virtual authority for coordinating water policy, priorities and financing. "They would be the OMB (office of management and budget) of the water business," said Nichols.

On that sobering note the program moved to a status report of the Six State Ogallala Study Council. Dr. Grubb gave an overview of current and projected reserves of oil and gas, agricultural commodities, and water resources with water importation options. While he noted the projected lifts for water transport on the four proposed Corps of Engineers routes were lower than expected, he stressed that the current estimated 240 million acre feet of water left in the Ogallala is the most valuable and cheapest water we will ever have. Current costs to pump this water is about $24 an acre foot, while replacement pumping costs are projected at $500. an acre foot.

The luncheon speaker was Dr. Sam Curl, Dean of the College of Agricultural Sciences at Texas Tech University. He weighed the decade of the 70's against the decade of the 80's. The 70's delivered high energy, tight money, and rising interest, inflation, production costs and imports, eratic weather and increased government regs and restrictions. The 80's promise more potential for profit, higher credit and energy bills, continued inflation, but greater food and fiber demand. Demand response prices should keep closer to pacing inflation.

Dr. Curl also stressed the farmer must sharpen his management abilities for optimum yields, and learn marketing and money management skills to match the 80's.

WHY AND HOW TO FIGURE . . . continued from page 3

3. Find inches applied per acre by dividing acre inches pumped per set by acres per set.

$$\text{Inches applied per acre} = \frac{\text{ac. in. pumped per set}}{\text{acres per set}}$$

4. Find fuel cost per acre. (Multiply inches applied per acre by the cost per acre inch)

$$\text{Fuel cost per acre} = \text{inches applied per acre} \times \text{cost per ac. in.}$$

FOR EXAMPLE: The watt hour meter has a Kh factor of 28.8. The disc rotates ten times in 18 seconds. The well pumps 540 GPM. The irrigation period is 12 hours on thirty rows, forty inches wide and 1,320 feet long. Electricity cost is 4 cents per kilowatt.

STEP 1 $\text{Kilowatts used per hour} = \frac{28.8 \times 10 \times 3.6}{18} = 57.6$ kilowatts per hour

$\text{Cost per hour} = 57.6 \times 4¢ = \$2.30$ per hour

STEP 2 $\text{Acre inches per hour} = \frac{540}{450} = 1.2$ acre inches per hour

STEP 3 $\text{Cost per acre inch} = \frac{\$2.30}{1.2} = \$1.92$ cost per acre inch

STEP 4 $\text{Acre inches pumped per set} = 1.2 \times 12 \text{ hours} = 14.4$ inches per set

STEP 5 $\text{Acres irrigated per set} = \frac{\frac{40''}{12'' \times 30 \times 1320'}}{43{,}560} = 3.0$ acres per set

STEP 6 $\text{Inches applied per acre} = \frac{14.4}{3} = 4.8$ inches applied per acre

STEP 7 $\text{Fuel cost per acre} = 4.8 \times \$1.92 = \$9.21$ fuel cost per acre

CLAYTON'S WATER FUND BILL IN SUBCOMMITTEE

Texas Speaker Bill Clayton's bill to set up three special trust funds for financing water projects and retiring state bond indebtedness, is now under scrutiny by a subcommittee of the House Committee on Constitutional Amendments. CSHJR 33, a substitute version of Clayton's initial legislation, proposes to dedicate the state's surplus revenue to special funds in the state treasury to be used for retiring state debts and for water development, water conservation, water quality enhancement, flood control, and drainage problems.

Half of the state surplus in the treasury at the end of each biennium would be earmarked for a state water fund to guarantee bonds for water projects. Clayton does not intend that the water fund be spent, but stay put as backing for bonds issued by cities, river authorities and water districts for water projects.

The bill currently proposes an interest limit on guaranteed bonds of 10% per annum.

The other half of treasury surplus would be used to repay existing state bonds. After a ceiling amount of $620 million is reached in this fund, the remaining surplus would be set aside for future emergencies. A two-thirds vote of the Legislature is now proposed to enact the measure as a constitutional amendment which would then go to the voters for approval on November 3, 1981.

The League of Women Voters opposes the bill because it would create a constitutional amendment. The Sierra Club objects to the possibility that the special water fund could help build a West Texas import facility. Clayton denies the fund is chiefly for Ogallala farmers, saying the state's existing water supplies will be insufficient to meet projected water demands in the 1990's. New sources must be tapped and existing reservoir sites developed just to prevent statewide shortages by the year 2005. A "leading water bond expert" was quoted by Associated Press as saying Clayton's proposal would keep the price of water from becoming unbearable.

SHARING THE PODIUM are guest speakers featured at Water Inc.'s annual meeting Sam Curl, Dean, TTU College of Agri.; Robert Nichols, Freese & Nichols; Lewis Beecherl, Chairman, TWDB; and keynote speaker Rep. Kent Hance.

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

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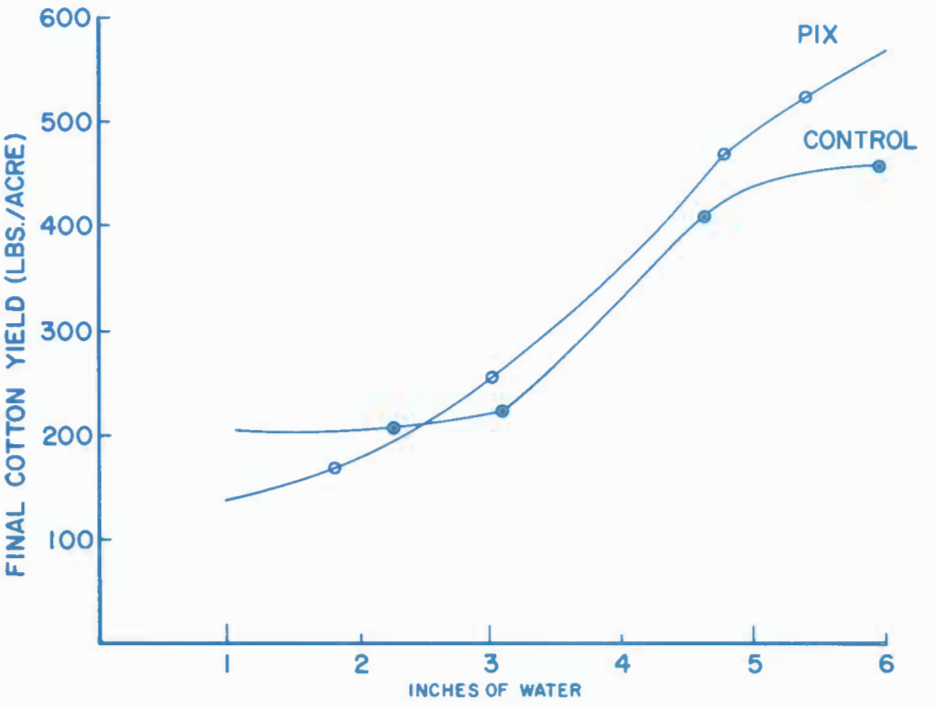
GROWTH REGULATOR AFFECTS YIELD

Studies using PIX as a plant growth regulator for water use efficiency at the Texas Agricultural Experiment Station at Lubbock show PIX decreased plant height and leaf area in cotton and increased yield when it was applied between pinhead square and first bloom stage and adequate water supplies were available.

The timing of the PIX application has proven critical to the studies, as well as the minimum amount of water necessary for beneficial response. Dr. Charles Wendt, who summarized the data of two years research says, at least two and a half inches of water, preferable more, must be available to the cotton from first bloom to peak bloom stage for PIX to show a positive affect on yield.

The PIX research is promising and continues, as do other studies with plant growth regulators at the Experiment Station. However, Dr. Wendt says growth regulators are currently in the same stage of development that herbicides were in during the 1950's. A few compounds are becoming available that can change plant growth and development. However, the exact timing at which they can be applied to change plants to increase yield is still uncertain, just as the time and rate at which to apply herbicides during the 1950's were not known.

Most of the growth regulator work to date has been conducted in the humid or well-irrigated areas of Arizona, Mississippi or Louisiana where water is plentiful. Very little research has been conducted in those areas of low rainfall and short irrigation water such as the Texas High Plains.



AMOUNT OF WATER AVAILABLE IN JULY, 1980 (INCHES) IN RELATION TO FINAL COTTON YIELD

PLANNING STRATEGY for a water conservation landscape design, Jim Vaughn, planner with Texas Tech University's Office of Landscape Architecture, sketches an "environmental chamber". It is one of four water design concepts being proposed for the grounds of the campus to channel runoff, reduce irrigation costs and optimize rainfall use.

After several years of preliminary work and discussion about using growth regulators to increase water use efficiency, Dr. John Abernathy and Dr. Wendt began a preliminary evaluation of this concept with the help of funds from the High Plains Water District. In the study the potential for using PIX to increase the water use efficiency of cotton was evaluated.

It appeared from these studies that PIX improved the value of the cotton crop, primarily by increasing the quality of the crop.

With increased support from the High Plains Underground Water District and the BASF corporation, TAES was able to investigate growth regulators in more detail. All of the cotton was treated with the recommended rate of PIX at the pinhead square or early bloom stage of growth. In a study at the Lubbock station, PIX treatment decreased plant height and leaf area. This resulted in improved plant water status and a higher rate of photosynthesis per unit leaf area, with less evaporation loss through the plant. When three to five inches of water were available for cotton during July of 1980, between first bloom and peak bloom, there was an increase in the yield of the crop of 25 to 61 pounds of lint per acre (see Table 1). Where water was limited during this period (dryland treatment) the yield of the PIX

continued on page 2 . . . PIX

Table 1. Yield of Growth Regulator Treatments at Lubbock Station during 1980.

Treatment	Yield (lbs/acre)	Total Water Use (in.)**
Full Irrigation		
Control	368	15.2
PIX	429	14.8
Limited Irrigation		
Control	200	12.0
PIX	225	12.4
Dryland*		
Control	188	7.4
PIX	151	5.5

*Pre-plant irrigation only.
**Includes 3.5 inches of rainfall.

WYATT IN LINE AS TWCA PRESIDENT

A. Wayne Wyatt, manager of the High Plains Underground Water Conservation District #1, is the President-elect of the Texas Water Conservation Association. Wyatt was elected during the Association's annual General Session and Board of Directors meeting, held this Spring in San Antonio, Texas. Wayne is also a Vice President and Board member and chairman of TWCA's Ground Water panel for 1981.

Fred Pfeiffer of the San Antonio River Authority was elected as President, Bob Parker, Chairman of the Board and Duncan Ellison as Vice-Chairman of the Board.

PALMER INDEX SHOWS

AREA SOIL MOISTURE "NORMAL"

In spite of possible impressions to the contrary brought on by last season's drought, the High Plains is not yet suffering a severe moisture deficit. It is still riding in the mid range of "normalcy" on the Palmer index of climatic soil moisture.

A fifty year span of data relating temperatures, evaporation and precipitation for the High Plains, indicates we have been experiencing near normal climate patterns since the Fall of 1975.

Persistently normal temperatures and precipitation will produce an index near zero on the Palmer scale in all seasons and in all climates. An EXTENDED period of abnormal dryness may, however, produce a negative index to as low as minus six (−6), regardless of the degree of dryness or wetness in the average weather pattern of the region. Extended wet periods may produce a positive index of plus six (+6) or more, as indicated on the numerical scale "Character of Recent Weather."

The Palmer index clearly identifies the extremely wet weather experienced in the early 1940's, and delineates the extended drought of the early and mid 1950's on the graph (on page 4).

PALMER INDEX	*CHARACTER OF RECENT WEATHER*
4.00 or more	Extremely wet
3.00 to 3.99	Severely wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Near normal
.50 to .99	
.49 to −.49	
−.50 to −.99	
−1.00 to −1.99	
−2.00 to −2.99	Moderate drought
−3.00 to −3.99	Severe drought
−4.00 or less	Extreme drought

continued on page 4 . . . INDEX

Our Fair Lady

Norma's leaving, and we're really going to miss her. It wouldn't be so bad if she hadn't been here for eleven years. But as the song goes . . . "we've grown accustomed to her face, her smile, her ways, her style. They're second nature to us now . . ."

Not only that. For the past nine years she's been THE bookkeeper. It's going to be tough to replace her.

Not only does Norma keep track of the monthly debits and credits, the payroll and the budget, she ciphers the monthly cost accounting records of all 15 of the staff. Since the cost accounting system was introduced three years ago, all cash disbursements and salary have been coded by district program. This gives a more accurate and realistic account of the district's time and resource allocation.

NORMA FITE

Norma provides the Board of Directors with a monthly report of the District's financial status. She has responsibility for preparing for the annual audit, and budgeting. She also works with Cliff Thompson to annually audit the records of all 13 county secretaries.

She and Cliff oversee the annual election of County Committeemen and Board members. They verify that candidates and nominations are in order, work with the county offices to deliver supplies and voting boxes, prepare the ballot and legal notice and tabulate the results.

In her spare moments, Norma codes and catalogs all the District's library and reference materials.

Norma's thorough nature and nack for detail is surpassed only by her wonderfully constant sense of humor. For instance, there's the legend of her homemade rum soaked raisin ice cream for the staff. We'll miss that, and her jelly beans, which are the real reason for the regular flow of traffic through her office.

The staff wish her the best. We'll miss her and we think nobody does it better!

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

GROUNDWATER MANAGEMENT DISTRICTS ASSOCIATION officers plan this year's annual meeting for December 2-4, 1981 in Lubbock. The theme will be "Efficiencies in the 80's." Officers are: Tom Bell, Secretary-Treasurer; John Turnbull, President; Don Smith, Vice President.

Table 2. Yield and Quality of Lint for Cotton PIX Study on Producers Farms, 1980.

Farm and Treatment	Planting Date, Plant Population, (plants/acre) and Variety	Lint Yield (lbs/A)	Staple Length (inches)	Irrigation Method	Estimated Water Use (inches)
MITCHELL	5/17, 55,000 Paymaster 266				
PIX		549	1.03	Sprinkler	12.0
Control		517	1.01		12.4
HILBERS	5/16, 77,000 Paymaster 303				
PIX		727	1.08	Furrow—	13.6
Control		766	1.08	every row	14.6
SCHILLING	5/19, 49,000 Paymaster 303				
Dry End —PIX		230	.98	Furrow—	9.1
—Control		172	.97	every 3rd row	9.4
Wet End —PIX		482	1.03		10.9
—Control		539	1.03		10.8
Field Avg.—PIX		356	1.01		10.1
—Control		355	1.00		10.2
BELL	6/2, 47,000 GSA 71				
Dry End —PIX		258	.99	Furrow—	9.9
—Control		276	.97	every other row	9.9
Wet End —PIX		606	1.04		11.9
—Control		575	1.03		12.5
Field Avg.—PIX		432	1.01		10.9
—Control		426	1.00		11.7

treated plots was less than the controls. This does not necessarily mean that PIX will decrease yield. For some reason, the PIX treated plots received less water during pre-irrigation and therefore, had less water to use during the growing season. The lower yield in this case was related to lower soil water availability rather than the growth regulator treatment.

The influence of water availability and the effects of PIX at the Lubbock station are summarized in Figure 1. During July the cotton was in the first bloom through peak bloom stage of growth. The effect of the water and the effects of PIX were more pronounced at this stage of growth than for the water added at later stages of growth.

In another study, the effect of PIX on cotton grown on producers farms was evaluated. Some of the data obtained in the study are summarized in Table 2. The only farm that had consistent positive effects due to the PIX treatment was the Mitchell farm in Wolfforth, which was sprinkler irrigated. On this farm there was an increase in both staple length and yield. There were no positive benefits on the Hilber farm near Idalou due to treatments with PIX even though the farm received more water than the other farms and had the highest yield. It is possible that the cotton had all the water it could use so that there were no benefits from decreasing the leaf area. Another possibility may have been the extremely high plant population. The Hilber farm has 22-30 thousand plants per acre more than the other farms. PIX may not be effective at such high plant populations.

The Schilling farm near Slaton and the Bell farm near Shallowater were sloping and had dry and wet areas. The

continued on page 4, col. 1 . . . PIX

Overall Pump Plant Efficiency: *The Pinch*

Pumping plant efficiency is a comparison of energy used for water pumped. When efficiency goes down, energy requirements go up. Since your energy bills for the pumping plant are a major irrigation expense, inefficiency in your pumping unit will put the pinch on your operation's financial nerve. If your efficiency is low, your unit is wasting fuel or electricity. It is demanding too much power for the water it produces. And you are paying for it . . .

The Tipoff:

Make an armchair efficiency check with your energy bills. Compare each pumping unit for power consumption. Got a runaway? That is the first tip-off.

Here are several clues for spotting an inefficient pumping unit.

1. The water table has declined.
2. Your well's yield has decreased.
3. The well pumps sand, surges, or pumps air bubbles.
4. You are using a squeeze valve or a booster pump.
5. You have changed irrigation distribution systems without modifying your pump.
6. The pump has not been serviced or adjusted in over five years.
7. You have connected several wells to one line.

The Setup:

While no pumping plant is 100 percent efficient because of energy losses in the motor or engine and between the drive shaft and pump, performance standards for irrigation pumping units have been established.

STANDARDS FOR OVERALL PUMPING PLANT EFFICIENCIES OF SEVERAL ENERGY SOURCES

Power Unit	Attainable Efficiency
Electric	66.0%
Natural Gas	17.0%
Gasoline	17.0%
Diesel	20.0%
Propane	19.0%

If you suspect your efficiencies do not compare favorably, it would probably pay you to set up your own PUMPING PLANT EFFICIENCY TEST. It is not too difficult and it will help you calculate how much energy or fuel your pump is wasting and whether you will benefit by recovering the cost of improvements, repairs, or replacements in a reasonable period of time.

An Efficiency Test Will Pinpoint:

1. Your pump's output in gallons per minute (GPM),
2. The feet below land surface from which your pump must lift the water to the surface (pumping lift),
3. Artificial lift created by water pressure in the system,
   Water pressure (psi) at the pump × 2.31 = artificial lift in feet
   Total Head in feet = pumping lift in feet + artificial lift in feet,
4. The amount of power used in thousands of cubic feet (mcf) or kilowatts per hour (Kwh), and
5. The overall pumping plant efficiency expressed as a percentage.

The overall efficiency of an irrigation pumping plant indicates what percentage of the energy being consumed is performing useful work by pumping water. It is a measure of energy used to water pumped.

The Hook:

You can figure your own pumping plant efficiency with some basic arithmetic and a few formulas, when you can accurately determine:

GPM

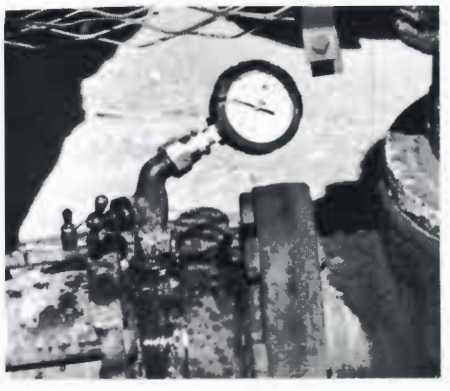
GALLONS PER MINUTE (GPM) of water pumped are found with a meter. Use a flow meter for an open discharge or underground line system and/or a velocity gauge for closed systems.

Flow Meter

Velocity Gauge

WATER PRESSURE

WATER PRESSURE (PSI) is found by installing a pressure gauge on your discharge pipe (pressure is a measure of additional lift—one psi = 2.31 feet.)



Pressure Gauge

PUMPING LIFT

PUMPING LIFT is found with a drawdown gauge such as an E-line.

ENERGY USED

ENERGY USE is measured by reading your fuel meter.

E-line

How To Read An Electric Watt Hour Meter To Calculate Input Horsepower

Count the disc revolutions (R) on your watt hour meter for a given time (t) in seconds. Read the Kh factor listed on the face of the meter. Plug these three figures into the formula to obtain input horsepower.

Watt Hour Meter

INPUT HORSEPOWER for electric motor =

$$\frac{R}{t} \times \text{Kh factor} \times 4.8^{*1}$$

How To Read A Natural Gas Meter To Calculate Input Horsepower

Some natural gas meters use a pressure multiplier to correct for elevated pressure. Before you begin, check with your local gas supplier to find out if your meter compensates for elevated pressure, or if you need to use a multiplier number to correctly figure your actual gas consumption.

Always begin by reading the highest value dial on the meter and read each dial stopping with the 1,000 dial or the 100 dial if the meter has one. If the hand is between numbers, use the lowest number. Read the meter again in one hour. Subtract the first series of numbers from the second. The difference is cubic feet of gas (CFG) per hour.

$$\text{mcf/hr} = \frac{\text{CFG/hr}}{1{,}000}$$

**1 4.8 is a constant to convert Kwh to horsepower*
**2 BTU's per mcf*
**3 Conversion of BTU's to horsepower hours*

Natural Gas Meter

INPUT HORSEPOWER for natural gas =

$$\frac{\text{mcf/hr} \times 1{,}000{,}000^{*2}}{2545^{*3}}$$

WATER HORSEPOWER (Theoretical Energy Demand) =

$$\frac{\text{GPM} \times \text{Total Head in feet}}{3960}$$

Now you have all the factors to figure your overall pumping plant efficiency with this formula:

OVERALL EFFICIENCY =

$$\frac{\text{Water Horsepower}}{\text{Input Horsepower}} \times 100$$

The Payoff:

Now that you know your pumping unit's efficiency, can you afford it? Compare your efficiency against the standard listed in the box for your type of power unit. Now find out what it is actually costing you to run at your efficiency.

Divide the standard by your overall pumping plant efficiency. Now divide your monthly pumping plant fuel bill by this number. The answer is WHAT IT SHOULD COST YOU to run your pumping plant.

The difference between this figure and your bill is the PAYOFF in potential energy or fuel savings; and it is also the amount of capital you could spend on repairs or improvements with an almost guaranteed return on the investment.

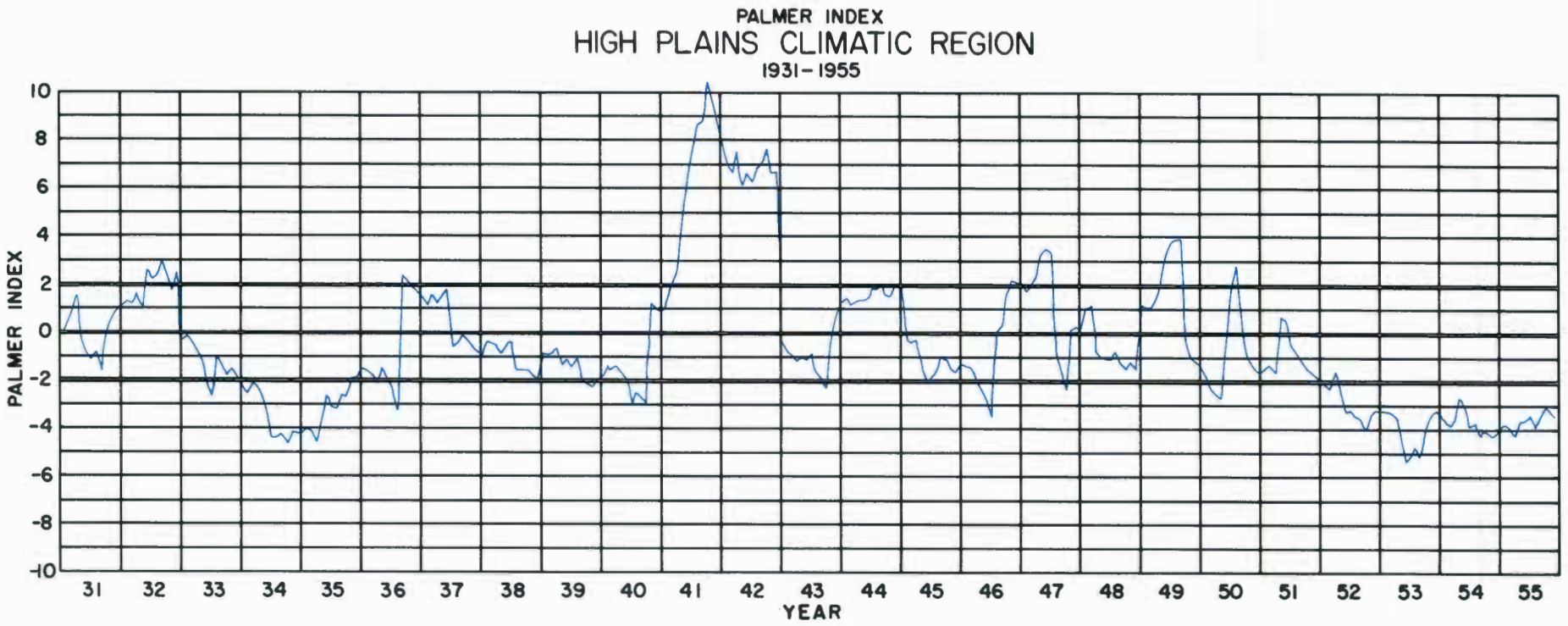
For example: Assume for a natural gas pumping plant that you found an overall efficiency of 10.8%. Standard is 17%. This month's fuel bill was $983.70.

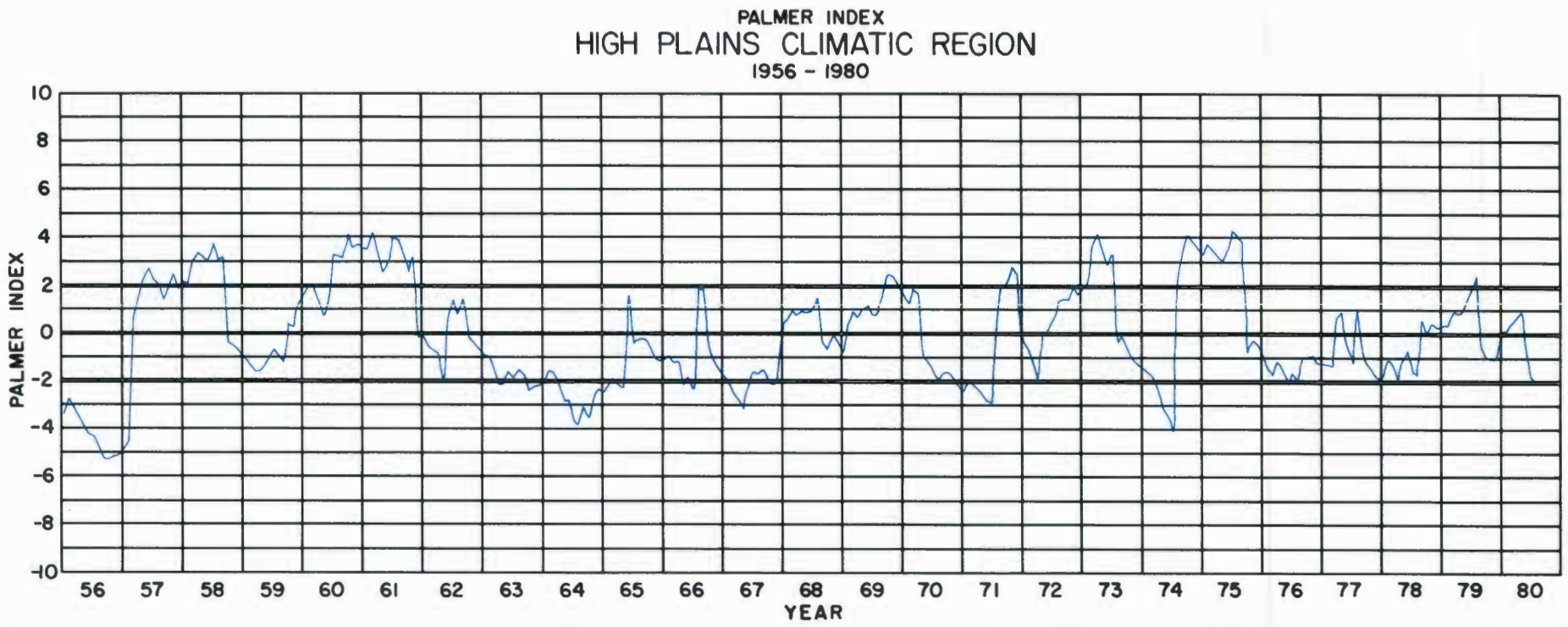
$$\frac{17.0\%}{10.8\%} = 1.57$$

and

$$\frac{\$983.70}{1.57} = \$624.94$$

Last month's bill was:	**$983.70**
You should have paid:	**$624.94**
YOU COULD BE SAVING:	**$358.76**





PIX . . . continued from page 2

influence of the dry areas on staple length is very pronounced. On both farms the staple length was significantly shorter. The yields of the dry areas were almost one half of that in the wet areas. PIX increased the yields of the dry areas on the Schilling farm and the wet area on the Bell farm. The farms differed in variety, planting date and irrigation method. Not enough information was obtained to determine if any of these caused the inconsistency in yield response.

From the 1980 studies, it appears that it is important to have a uniform irrigation and plant populations of 55 thousand or less to get consistent results from PIX. Field variability can explain why farms have problems with their cotton grades. These studies are being continued in 1981 to better define the conditions under which PIX can be expected to work.

Another growth regulator study at Lubbock involved the use of an experimental growth regulator on grain sorghum grown at three different moisture levels. No benefits were obtained from the use of the growth regulator. There was a feeling that the growth regulator never got into the plant. Studies for the 1981 season are planned to determine if the growth regulator is getting into the plant using the growth regulator in a radioactive form. Similar studies are being planned with PIX using different surfactants to determine if it can be applied at later stages of growth.

The information obtained to date indicate it will be necessary to define very precisely the climate and water regimes under which growth regulators can be expected to work. This will require time and effort but will be valuable due to the great potential to increase water use efficiency.

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

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HOUSE JOINT RESOLUTION 33

Trust Fund Proposed For Future Resource Needs

House Joint Resolution Number 33 (H.J.R. No. 33) by Texas Speaker of the House, Bill Clayton, is a proposal to enable the financing of water supply development, water conservation, water quality protection, and flood protection for Texas. In addition, H.J.R. 33 raises the interest rate ceiling on authorized but unissued State bonds from six percent to 10 percent or a higher rate if such rate is approved by two-thirds of the members of each house. The Resolution incorporates existing constitutional provisions to protect basins of origin of surface water to the foreseeable 50-year future.

In recent years, the Texas State Tax system has been generating more tax revenue than has been needed to pay the costs of State Government. The surplus is defined by H. J. R. 33 to be the difference between the total amount of revenue in the State Treasury eligible for legislative appropriation for a particular biennium, and the amount appropriated for the biennium. As soon as possible after the close of each biennium, the Comptroller of Public Accounts shall determine the amount of the surplus and make deposits to the funds created by H.J.R. 33. The surplus as defined in H.J.R. 33 was on the order of $300 million dollars for the 1978-1979 biennium.

At the present time, there is a constitutional limit on interest rates on bonds guaranteed by the full faith and credit of the State of 10 percent maximum in some cases, and in the case of Water Development and Water Quality Enhancement Bonds, the limit is 6 percent. Thus, in today's bond market, no Water Development or Water Quality Protection Bonds can be sold and other bonds can only be sold on short maturities. H.J.R. 33 would amend the Texas Constitution to increase interest rate ceilings to 10 percent or to a higher rate if a rate higher than 10 percent is approved by law enacted by an affirmative record vote of two-thirds of the members of each house.

Under conditions when the total amount of revenue collected and deposited in the State Treasury over a biennium exceeds the total amount appropriated for the biennium the surplus is dedicated to two special funds created by the constitutional amendment as follows:

(1) One-half of the surplus shall be deposited in a special fund or funds in the State Treasury dedicated for use for or in aid of water development, water conservation, water quality enhancement purposes, and flood protection and drainage. The legislature shall prescribe by law the fund or funds in which the deposits are to be made and the manner in which the deposits are to be used. The legislature may, to the extent that current obligations of the fund are not impaired, by law enacted by an affirmative record vote of two-thirds of the members of each house use moneys from this fund for other purposes.

(2) The other one-half of the surplus is to be deposited and accumulated in a special reserve fund in the State

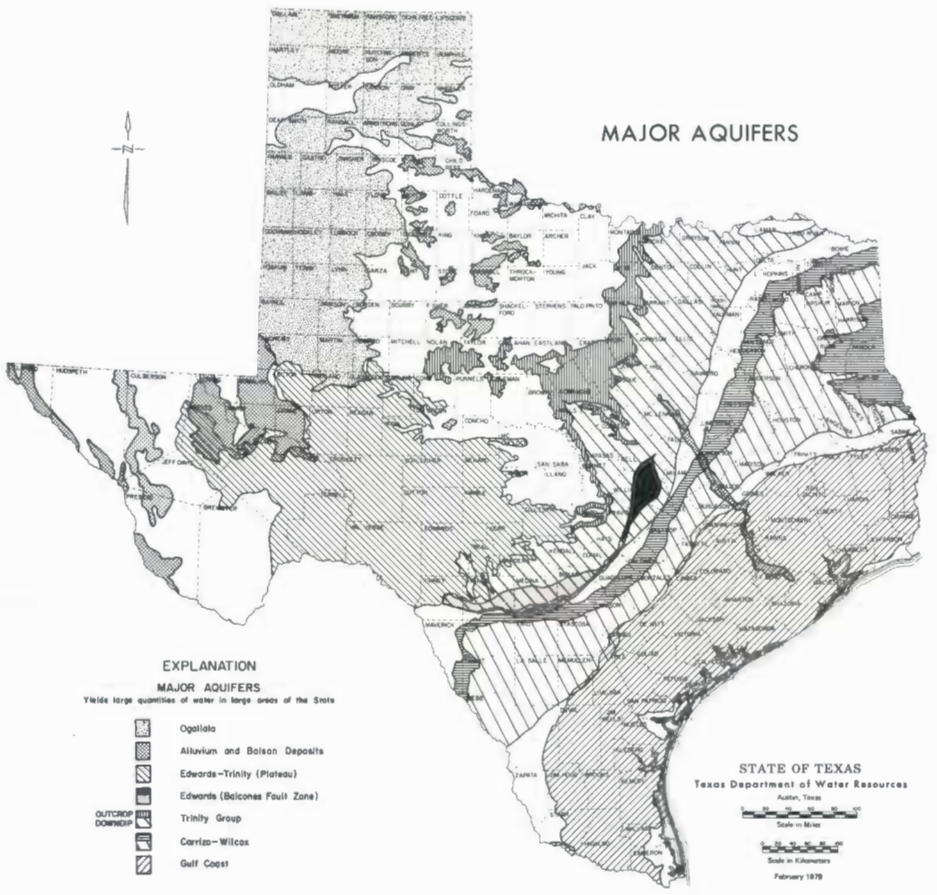
continued page 4 col. 1 . . . HJR 33

Simple Adjustments Reduce Pump Costs

After Bob Veretto converted his well to electric this spring he got Raymond Benham and Monty Gearner, Levelland SCS, to help test his well efficiency. Bob increased his well yield from 160 to 400 gpm by making several adjustments. He tightened the belts, changed the gear head pulley and adjusted his impellers. He improved his overall pump plant efficiency by 87% and reduced the fuel cost per acre inch of water pumped from $3.33 to $1.85 for a 44% reduction in fuel costs.

Have you checked your well's efficiency?

MEASURING DRAWDOWN, Raymond Benham tested Bob's well three times.



Texas Has 286 Million Acre Feet Of Groundwater Resources

Texas is blessed with substantial supplies of ground water, though more of it is being used than is being replenished, Tommy Knowles told those present in San Antonio on Feb. 26 for the Texas Water Conservation Association's annual convention. Knowles is chief of the Data Collection and Evaluation Section in the Texas Department of Water Resources.

There are few areas in the State where ground water of good quality cannot be obtained in quantities sufficient for domestic purposes. In many areas, ground water producing formations, called aquifers, yield large quantities of water to wells which supply water to municipalities, industries, and irrigated agriculture.

Texas aquifers, he explained, are composed of many rock types, ranging from those laid down by the sea, including limestones, sands, and sandstones, to the intermontane deposits of far West Texas. The State has been bent and cracked by major fault movements, resulting in significant changes in the aquifers. For example, there is the extensive faulting in the Balcones Fault Zone which extends from Brackettville to San Antonio to north of Austin, resulting in the highly productive Edward aquifer with its major springs which include Comal in New Braunfels, San Marcos, San Antonio and San Pedro in San Antonio, and Barton in Austin.

Under 50 Percent Of State

The aquifers in Texas are divided into major and minor categories, and more than 50 percent of Texas is underlain by one or the other. A major aquifer is one which yields large quantities of water in a compartively large area of the State and seven have been so designated. Among them is the Ogallala aquifer which yields moderate to large amounts of fresh to slightly saline water on the High Plains. Thickness of the formation ranges up to 900 feet with the saturated thickness approaching 525 feet.

continued page 3 . . . AQUIFERS

MOLLY SMITH

SHE'S A WINNER

Molly Smith is our new receptionist/secretary. She's a New Mexico girl with a natural interest in agriculture. Her dad is an extension agent in Portales where Molly and her four older brothers and sisters grew up. She joined 4-H at 8 years of age and showed many a sheep and took home many a blue ribbon before winning first place in the New Mexico State Fair "Lady's Lead" Division in 1976.

Molly would like to work with youngsters in 4-H again, and has studied to be a home economist. She worked to help support herself through a year of college in New Mexico and spent a short time working at Texas Tech University in Lubbock before coming to the High Plains Water District. Molly says she finds the land and weather and especially the people of Lubbock "just like home."

She handles the district's water depletion tax information program, working with accountants and the farmers and providing secretarial support for the field staff. "I'm learning a great deal about another side of agriculture," says Molly, "and I like it." So do we.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

Wyatt Named To Head WT Chamber Water Committee

Mr. Burvin Hines, President of the West Texas Chamber of Commerce recently announced the appointment of A. Wayne Wyatt, HPWD manager, as Chairman of the Chamber's Water Development Committee. Wayne accepted the position reluctantly from Arthur Duggan, a long time state water resources leader and the 1980 water committee chair. Arthur is resigning for reasons of health. Under his leadership the West Texas Chamber of Commerce took an early lead role in helping West Texas cities look at their water futures. Arthur's water Committee gave program priority to examining municipal water issues in its Fall Pre-Legislative Conference.

WAYNE WYATT received honors and the 1980-1981 Professional Man Award from both the County and Regional Soil and Water Conservation District Boards. He was recognized at the Region 1 Annual Texas Conservation Awards Program.

Says Permit Chief

"I'm A Stickler For Details..."

"I'm a stickler for details! I believe in abiding by rules, laws, and regulations."

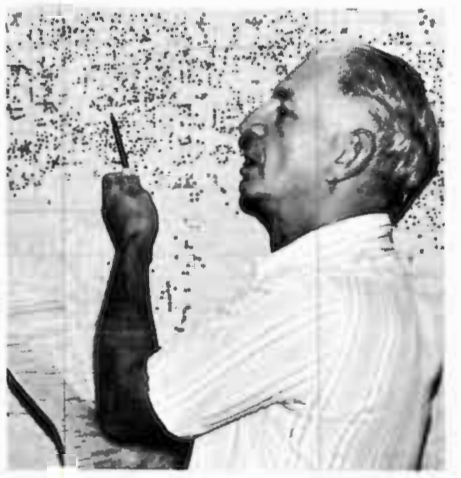
Clifford Thompson got that way over 35 years of being a "ref." He says he umpired baseball and basketball for some 22 years, and claims 1981 begins his 35th year of officiating football. (He says he started at age 4.)

All that makes Clifford the best man for the job of handling the district's water well permit application program. He has been chief of the Permit Division for twelve years. And 13,503 plus permits later, he's still hard at work.

Clifford, or "Coach" as some of us like to call him, handles every permit that the District's Board finally approves—and then some. He receives applications from the County Secretaries for each of the 15 counties in the District's service area, and himself serves as County Secretary for Lubbock, Lynn and Crosby counties.

When Cliff took over the job, he initiated a comprehensive cross-referenced indexing, record keeping and filing system for permits and abandoned wells, the likes of which would envy a librarian. Each application must be checked to be sure it conforms with the rules of the District; logs must be matched; deposits held and returned; and occasionally field investigations, reminder letters or extension permits are needed.

As for one of the most common bottlenecks in the permiting process, Clifford says, "Tell'em, if they don't furnish a well log, they have an illegal well which violates the rules of the District and can be shut down."



CLIFFORD THOMPSON

But Clifford's job doesn't begin or end with paperwork. He also handles a brisk traffic in irrigators and landowners coming to the Lubbock office for permitting information, forms, details or just a good conversation.

Clifford takes complaints related to the District's tailwater abatement and open hole programs. He corresponds with violators and checks up on any number of cases which are in actual or apparent irregularity with the rules of the District.

"Everybody's gonna make mistakes," says Clifford. "We try to correct them and we give a man every opportunity to take care of problems."

The permit chief meets monthly with county committeemen and secretaries in the different counties, and makes a yearly audit of county secretarys' records. As election time rolls around yearly, he contacts potential new office holders, election judges and serving committeemen to apprise them of the election rules. He oversees the election proceedings, and sees that officers are duly sworn in.

"Coach" speculates that his sixteen years in the selling business as well as his officiating career have influenced how he handles his work.

"You learn to control your temper and don't let the rhubarb get you. And you have to have a real good knowledge of the rules but use common sense in applying them."

240 Million Acre Feet Of Ground Water In Ogallala

(continued from page 1)

The Edwards-Trinity (Plateau) aquifer yields small to large amounts of fresh to slightly saline water. Over its eastern portion, the aquifer yields more water than is used, and aquifer thickness ranges up to 800 feet.

The Edwards (Balcones Fault Zone) aquifer yields moderate to large amounts of fresh to slightly saline water. Some of the limestone beds which comprise this aquifer are highly cavernous resulting in wells with extremely large yield, some in excess of 10,000 gallons per minute with very little water level decline in the aquifer.

Area Overdeveloped

The Trinity Group yields small to large amounts of fresh to slightly saline water. Much of the area has been overdeveloped, especially in the Fort Worth-Dallas area. Thickness ranges up to 1,200 feet and some Trinity Group public supply wells are more than 3,300 feet deep, yielding water as hot as 135 degrees Fahrenheit.

The Carrizo-Wilcox aquifer yields moderate to large amounts of fresh to slightly saline water. Southwest of the Guadalupe River, the Wilcox portion is poorly developed and the Carrizo Sand is the major producing unit. The aquifer is as much as 3,000 feet thick.

The Gulf Coast aquifer comprised of alternating beds of sands, clays and gravels, yields moderate to large amounts of fresh to slightly saline water with the eastern portion being the most productive, approaching 3,200 feet in thickness.

Alluvium and Bolson deposits are classified as a major aquifer with formations composed of unconsolidated or partially consolidated sand, clay and gravel. Bolsons are the principal aquifers in the upper Rio Grande basin, supplying small to large quantities of fresh to moderately saline water. Elsewhere, alluvium yields vary from low to high.

Seventeen Minors

By contrast, a minor aquifer is defined as one which yields large quantities of water in small areas or relatively small quantities of water in large areas of the State, and 17 have been so designated in Texas. Among the more significant are the Woodbine in North Texas, the Blossom Sand and Nacatoch Sand in Northeast Texas, the Queen City and Sparta in East Texas, the Hickory Sandstone in Central Texas, and the Bone Springs-Victoria Peak, Rustler, and Santa Rosa aquifers in West Texas.

However, Knowles told his audience that water that has been stored in the aquifers throughout geologic time is now being used, and the reduction in the amount of water in storage results in ground water depletion, or mining.

Currently, Texans use about 19.2 million acre-feet of water annually, and about 13.1 million acre-feet come from ground water sources. Of that 13.1 million acre-feet, 12.9 percent is used by municipalities, 4.2 percent for manufacturing, 0.9 percent for steam electric power generation, 1.5 percent for mining, 1.0 percent for livestock watering, and 79.5 percent, or 10.4 million acre-feet, is used for irrigation.

Ground water is used for municipal purposes in all areas of Texas and in almost every county, with about 50 percent of municipal water coming from ground water sources. However, in many areas, the long term use of well fields is lowering the water tables to an extent that major water supply problems are occurring or are projected in the near future.

Recharge vs. Reserve

All of the aquifers, major and minor, have a total average annual effective recharge (the amount of water entering an aquifer and available for development) of about 5.1 million acre-feet and a total recoverable reserve storage of about 286 million acre-feet, of which 240 million acre-feet are in the Ogallala aquifer in the High Plains. Recoverable storage is that portion of the underground reservoir capacity estimated as capable of being economically and physically withdrawn from an aquifer.

Annual availability is the effective recharge plus that amount of water which can be recovered from storage over a specified period of time without causing irreversible harm such as land subsidence or water quality deterioration. The average annual availability is estimated to drop from 10.2 million acre-feet in the 1980's to 7.6 million acre-feet by 2030. Most of the change is due to depletion of the Ogallala aquifer. Availability of water from that aquifer is expected to decrease by 50 percent over the next 50 years.

Mining Is Major Problem

So, the difference between present ground water use, 13.1 million acre-feet per year, and average effective recharge, 5.1 million acre-feet per year, or 8.0 million acre-feet per year, is the amount of ground water that is being removed from storage. This depletion, or ground water mining, is one of the major problems facing Texans. Mining occurs across the State and is not limited to one geographic area.

The aquifer which has received the most publicity concerning ground water mining is the Ogallala. In 1975, pumpage from the Ogallala was estimated to be 8 million acre-feet, and the long term yields has been estimated to be on the order of 300,000 acre-feet per year. Near the center of the southern part of the aquifer, in the area of long-term development, water levels have declined approximately 104 feet during the past 60 years.

Other Areas

Another area that has undergone severe ground water mining is the Harris-Galveston County area. Over the past 50 years, water levels in that area have declined in excess of 200 feet, though in areas where pumpage has been reduced in recent years, water levels have recovered substantially.

The Winter Garden area of South Texas has experienced water-level declines in excess of 240 feet in the past 40 years, and water levels in the Trinity Group aquifer in the Dallas-Fort Worth area have declined more than 400 feet during the past 25 years.

Around El Paso, water levels have shown a marked decline as the Cities of El Paso and Ciudad Juarez, Mexico, have pumped more water than is recharged to the Hueco Bolson. It is simply a matter of time until the aquifer is either depleted or is invaded by the underlying salt water.

Mining of ground water in the Houston-Galveston area has been reduced through use of additional surface water supplies, and in the Waco area, where levels continue to fall, the rate has slowed with the development and use of surface water supplies. Irrigators on the High Plains are using water conserving practices to reduce mining. In the El Paso area, the city is increasing the amount of usable ground water by blending water of good and poor quality, and in the Pecos Valley area, water level declines have decreased with the rapid increase in the cost of energy, since the cost of pumping the water exceeded the benefits of pumping. Cessation of pumpage, in fact, has actually allowed water levels in some areas to rise.

Measuring And Monitoring

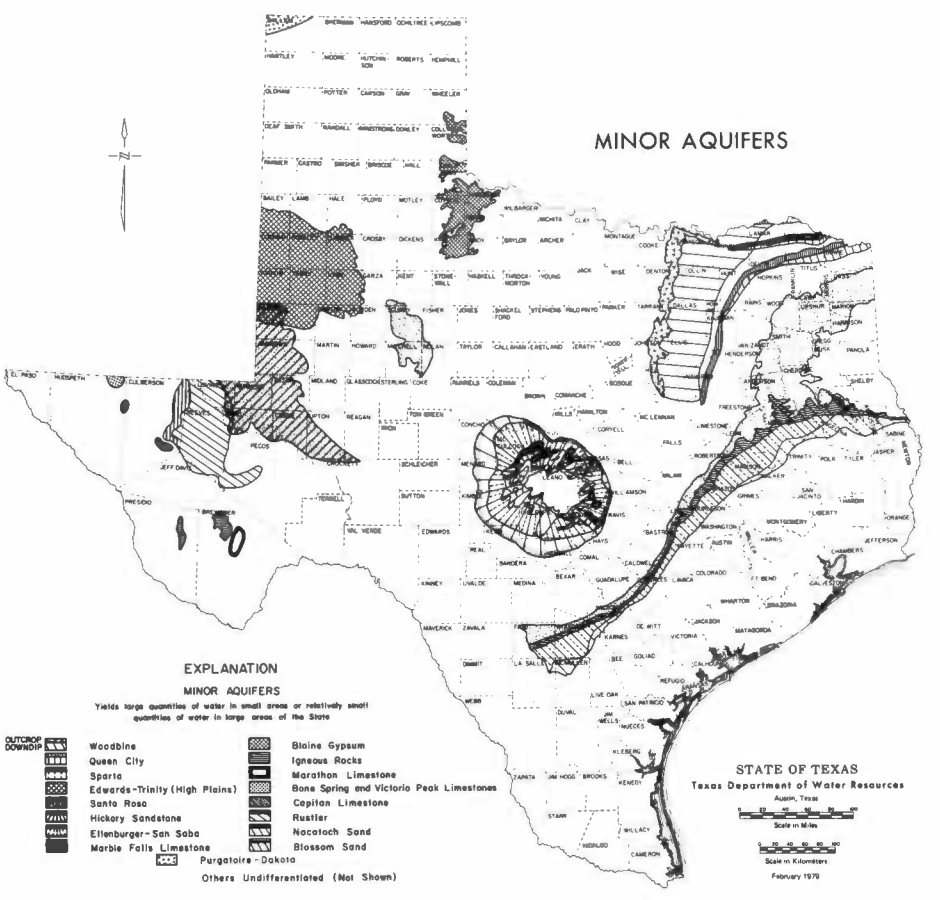
Of almost 8,900 water-level observation wells in Texas, 6,100 wells are measured regularly by TDWR staff people, 1,000 by federal agencies, and 1,800 by water districts. TDWR also maintains a statewide network of water quality observation wells with water samples collected annually from 1,100 wells. Analyses of the samples are used to determine the quality of ground water and to indicate areas where quality is changing. Data from both networks are available from the Texas Natural Resources Information System (TNRIS), and periodically the data are distributed in Departmental reports.

This year TDWR began a project to publish a series of reports that describe ground water conditions in the State, with a different area being covered each year, and a goal of covering the entire State in five years. The first report will cover Central Texas, to be followed by reports covering the Central and Lower Gulf Coast areas.

Ground water studies are in progress in a number of areas of the State, being conducted by various local, State and federal groups. "Scheduling of future studies will likely be governed largely by the most demonstrable, urgent needs in local areas," Knowles said. "The Department is no longer able to plan investigations calculated to meet all anticipated future needs. As water problems become more widespread, severe, and complicated, TDWR study capacity will indeed be spread thinly to attempt to identify solutions to the many problems.

"We must continue to utilize available resources to appraise our ground water supplies and make every effort to reduce ground water mining while maintaining economic growth and prosperity. Implementation of water conservation practices and development of renewable surface water supplies to agument our declining ground water resources may offer some hope of accomplishing this goal."

(Reprinted from TEXAS WATER, March 1981, by the Texas Department of Water Resources.)



BEFORE COMMITTEE, Ken Carver (upper center) testified along side Dr. Sam Curl (left) and Cleve Littlepage (right) to the House Agriculture Committee at field hearings in Lubbock on the 1981 Farm Bill. Committee members were (from lower right) Congressmen Stenholm, Hance, Hightower, and Stangeland.

HJR 33 . . . continued from page 1

Treasury. The legislature, from time to time, by law enacted by an affirmative record vote of two-thirds of the members of each house, may transfer all or any part of the special reserve fund to any other fund or funds in the State Treasury.

During the biennium in which a surplus accrues, the legislature, by law enacted by an affirmative record vote of two-thirds of the members of each house, may suspend all or part of any one or both of the deposits of the surplus that are required by the provisions of the amendment which creates these funds. The amounts of deposits suspended would be a part of available cash for legislative appropriation for the biennium. If the legislature so chooses, funds could be used from the special fund to reduce or pay off state debt.

The water resources fund shall be administered and invested by the Water Development Board. The special fund created by this amendment shall be administered and invested as provided by law. The investment earnings of water resources funds mentioned above become a part of the fund from which the earnings are realized.

Money on deposit in the water development fund cannot be used to aid or finance any project which contemplates or results in the removal from the basin of origin of any water necessary to supply the foreseeable water requirements of the basin of origin for the ensuing 50-year period.

The legislature may transfer money from the general revenue fund to the funds created in this amendment.

This proposed constitutional amendment shall be submitted to the voters at an election to be held on November 3, 1981. The ballot shall be printed to provide for voting for or against the proposition: "The constitutional amendment authorizing the use of surplus funds to retire state debt, to create a reserve fund for future public needs, and to provide assistance for water resource development and conservation, water quality enhancement, and flood control purposes."

In summary, H.J.R. 33 would

(A) Increase the interest rate ceiling on presently authorized bonding authority of the State to 10 percent, or a higher rate if approved by a two-thirds record vote of the Legislature.

(B) Divide the State surplus into two major parts:

(1) One-half to be used to aid in water development, water conservation, water quality protection, and flood protection and drainage as loan guarantees for local units of government engaged in water resources actions (though leverage of 10 to 1 which lowers the interest rates the local unit of government has to pay). (The anticipated primary user of this fund will be municipalities for water supplies.)

with the remaining one-half of the surplus to be used to:

(2) Establish a special reserve fund which upon a two-thirds vote of the members of each house may be transferred to any other state fund.

Explained by Charles Nemir, Assistant Executive Director, Texas Department of Water Resources, and Dr. Herb Grubb, Director of Planning, Texas Department of Water Resources.

A PRESENTATION TO THE
U. S. HOUSE OF REPRESENTATIVES AGRICULTURAL COMMITTEE
Lubbock Memorial Civic Center, Lubbock, Texas
April 21, 1981

By: Ken Carver, Chief, Agriculture Division
High Plains Underground Water
Conservation District No. 1

Mr. Chairman and Members of the Committee:

We appreciate very much your coming to Lubbock to learn about the special problems associated with our area's agricultural production and economy.

One of the most serious problems associated with irrigated agriculture on the High Plains of Texas is the ever increasing price of energy used in pumping water for irrigation. The Rural Electric Co-op Associations which supply the electricity for the irrigation wells in this area have told us that their present contracts with the wholesale generator will expire in the fall of 1982. These rural electric co-ops are currently purchasing power for $1.94 per Kw and expect their new contracts to be in excess of $5.00 per Kw. They have been charging the irrigator about four cents per Kwh. Under the new contracts, the co-ops will have to increase their price to the irrigator to eight or nine cents per Kwh. Additionally, the power generator has indicated the new contracts will contain a ratchet clause which is likely to result in an additional increase in the fuel price of perhaps as much as two cents per Kwh.

The principal natural gas supplier to the area has been increasing its price by two cents per thousand cubic feet (MCF) per month and this price increase trend is expected to continue until natural gas is deregulated. At that time they expect the price will increase to five or six dollars per MCF. The current price of natural gas is approximately $2.45 per MCF.

We have approximately 70,000 irrigation wells in the High Plains of Texas and the number of these wells is split fairly evenly between natural gas and electricity.

The Water District conducted about 250 pump plant energy efficiency tests during calendar year 1980 and from these tests found the average fuel cost to pump irrigation water was about $25.00 per acre foot with an average pumping lift of about 250 feet. With the increase in energy costs, we believe that it will cost the irrigators about $50 to pump an acre foot of water by the end of 1982. With your help, we believe that the irrigator can reduce his energy needs and perhaps afford to continue to produce the food and fiber needed by our nation.

In our testing program, we found the average energy use efficiency of 91 pumps powered by internal combustion engines fueled by natural gas was 46 percent and that 158 pumps powered by electrical motors had an average energy use efficiency of 41 percent. Pump efficiencies should range between 60 and 80 percent. In a nut shell, what this means is that at least 50 percent of the irrigation pumping plants tested are consuming twice the amount of fuel required by an efficient unit to pump one acre foot of irrigation water.

The cost to repair these pumps to bring them up to maximum efficiency will vary with size and depth of setting. We estimate that the cost per pump will range from $2,000 to $5,000. The BTU's of energy saved by reducing by one-half the energy used by 35,000 irrigation wells would equal about 25 percent of the current energy used for pumping irrigation water here in the High Plains of Texas.

We respectfully request that the House Agricultural Committee sponsor legislation which would provide tax relief for irrigation farmers similar to the tax credit being given to homeowners for installing insulation in their homes to conserve energy. A $2,500 per pump tax credit would make it possible for most irrigators to upgrade pumping plants to increase their energy use efficiency, conserve energy for other or future use, make our nation less dependent upon foreign countries for energy and help our nation with its trade deficit. Even more important, it might make the difference as to whether or not our irrigators can stay in business to produce the food and fiber needed by our nation's citizens.

Thank you very much for your time and consideration of this proposal.

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Saturated Thickness Of Region Mapped

Inside this issue is a four color map illustrating the 1980 saturated thickness of the Ogallala Formation in the High Plains area which covers all or part of eight states, including Colorado, Kansas, New Mexico, Oklahoma, South Dakota, Texas and Wyoming. This regional map was compiled by John B. Weeks and Edwin D. Gutentag with the Department of Interior, United States Geological Survey in Denver. The High Plains Water District contributed to this work under a sub contract with the Texas Department of Water Resources by providing data and maps of the saturated thickness of the area of the Ogallala Aquifer underlying the Texas High Plains served by the Water District.

This mapping activity was an integral part of a five year study of the High Plains regional aquifer system. The full USGS study provides hydrologic information needed to evaluate the effects of continued groundwater development of the aquifer, and computer models to predict aquifer response to changes in groundwater development.

There are several components in the atlas packet, including a Bedrock Geology and Altitude of Aquifer Base map and a Geohydrologic Cross Section through the Aquifer with explanatory texts.

Introduction

The High Plains aquifer underlies 177,000 square miles in eight States. Within this area, the aquifer is the principal source of water for irrigation as well as providing water for industrial, municipal, and domestic use. The economy of the High Plains is dependent upon irrigated farming. In recent years declining water levels, decreasing water supplies, and increasing energy costs have caused the economics of irrigated agriculture to become marginal and, in some places, unprofitable. A thorough understanding of the geohydrology of the High Plains aquifer will be necessary to manage the remaining water resources in the most beneficial manner.

Saturated Thickness

A saturated thickness map of the High Plains aquifer was prepared by superimposing 1980 water-table contours over the altitude of the base map and constructing lines of equal saturated thickness. The resulting map shows the 1980 areal distribution of saturated thickness. Each thickness interval on the saturated thickness map shows the range in that area.

The volume of water in the saturated material in the aquifer is summarized in the table. Saturated thickness ranges from zero where the deposits comprising the High Plains aquifer are unsaturated, to more than a thousand feet in west-central Nebraska.

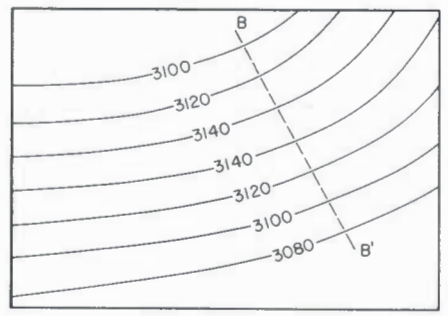
State	*Area of High Plains aquifer within State (square miles)*	*Total volume of water in storage in aquifer (millions of acre feet)*
Colorado	14,870[1]	112.5
Kansas	31,050[2]	300.0
Nebraska	64,400	2,100.0
New Mexico	9,710[3]	48.0
Oklahoma	7,350	91.0
South Dakota	5,290	105.0
Texas	36,080	375.0
Wyoming	8,190	138.0
TOTAL	176,940[4]	3,270.0

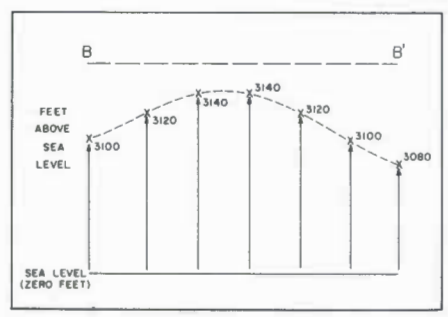
[1] 1,200*
[2] 3,200*
[3] 2,600*
[4] 7,000*

*Square miles with little or no saturated thickness included.

Because of the map scale, it is not possible to show small areas within each thickness interval where saturated thickness may be more or less than that indicated. This map was designed for a general understanding and use to study the water resources of the aquifer. However, more detailed and complete mapping information is available. The High Plains Water District is preparing contour interval maps describing the saturated thickness of the Ogallala aquifer by counties within the 15 county areas or their portions served by the District (see story this page).

Copies of the complete USGS atlas are available for $1.75 each from the Branch of Distribution US Geological Survey,, 1200 South Eads Street, Arlington, Va. 22202 or from the Branch of Distribution, USGS, Box 25286, Federal Center, Denver, Colorado 80225. Ask for Hydrologic Investigations Atlas HA-648.





HOW TO read and understand contour lines is visually explained in the text of each county hydrologic atlas. These lines translate data onto 4 maps to describe land surface, water table, base of aquifer and its saturated thickness.

Special Session May Save HJR 33

Time ran out on HJR 33. Texas House Speaker Bill Clayton's bill to create a water trust fund by using surplus state revenues to guarantee bonds issued by local governments for water treatment, wastewater and flood control construction projects, died on the floor of the Senate on a point of order.

The measure passed the House weeks ago. It also managed to survive parliamentary maneuvering to stop it in the Senate Finance Committee. Just out of committee the bill was killed for want of unanimous consent of a rule suspension that would have allowed HJR 33 to be heard on the Senate floor in the late hours of the session.

While Clayton expressed disappointment, he is not calling it quits. Governor Clements, who sets the agenda for special legislative sessions, has called for a special session of the Texas lawmakers for July 13. Consideration of the special water fund will be one of five issues on the agenda.

Hydrologic Atlases For 15 Local Counties Of HPUWC Being Prepared

They're hot off the press. Hydrologic atlases are ready for six of the fifteen counties or portions of counties served by the High Plains Underground Water Conservation District. The county atlases published so far are for Armstrong, Castro, Deaf Smith, Parmer, Potter and Randall.

The atlas for each county consists of a packet containing a text specific to the county area and a set of four maps. The maps were developed using twenty feet contour intervals. They illustrate (1) the elevation of the land surface; (2) the elevation of the water table in the Ogallala Formation in 1980; the elevation of the base of the Ogallala Formation; and (4) the saturated thickness of the Ogallala in 1980.

The data for each map describing this information is printed on a county highway base map at a scale of two miles per inch. Legal descriptions are also illustrated on the maps to assist landowners in proper identification of their property. A tremendous amount of data was used in constructing the maps and they should reflect a very accurate picture of the hydrologic conditions as of 1980 for the areas served by the water district within each county.

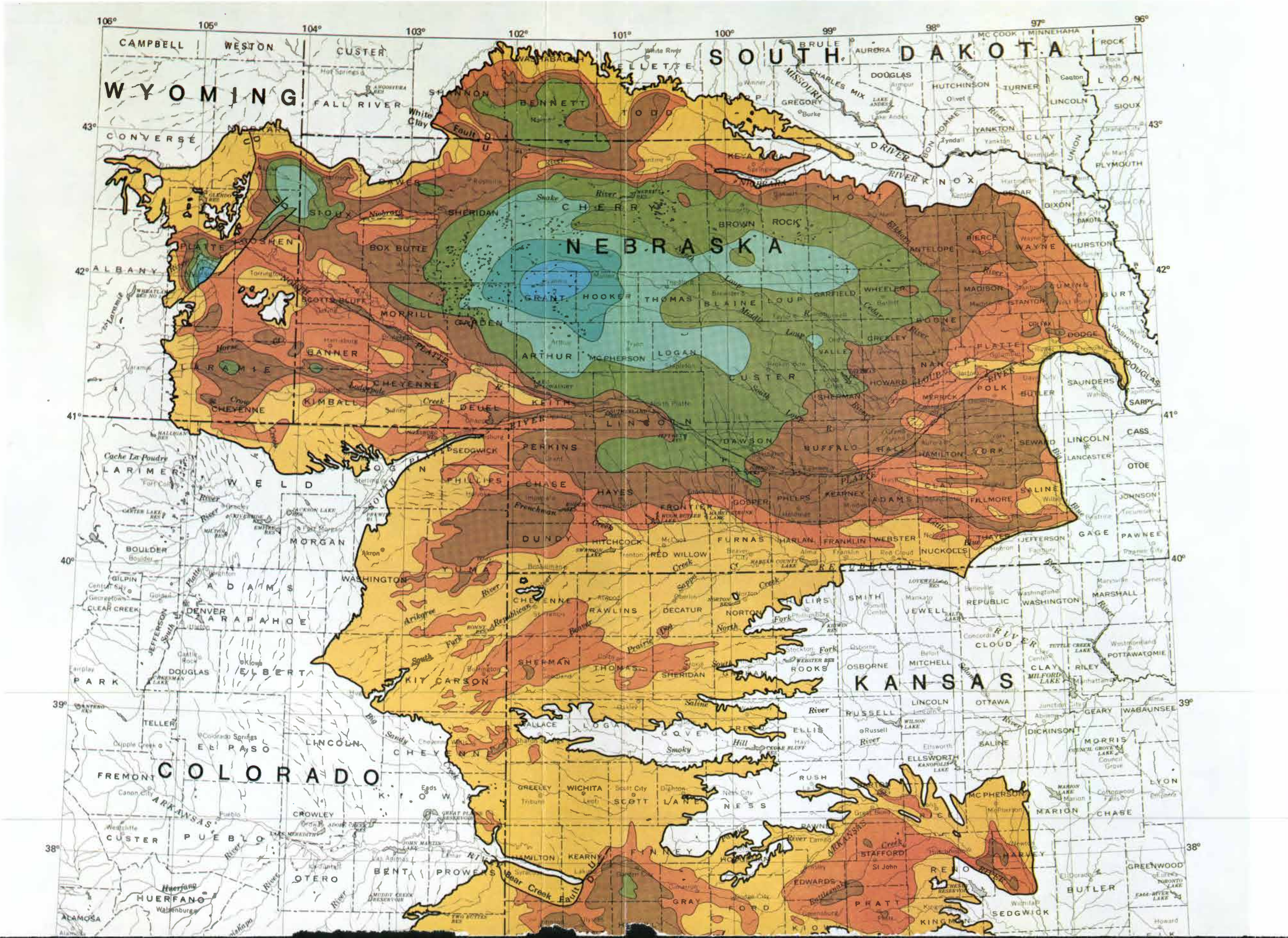
The text is short, concise, illustrated, and includes an explanation of how to read and interpret contour lines. Points discussed in the text include the Older Geological Formation in relation to the Ogallala, the composition of the Ogallala, its volume of water in storage, chemical quality, recharge, movement and water-level changes.

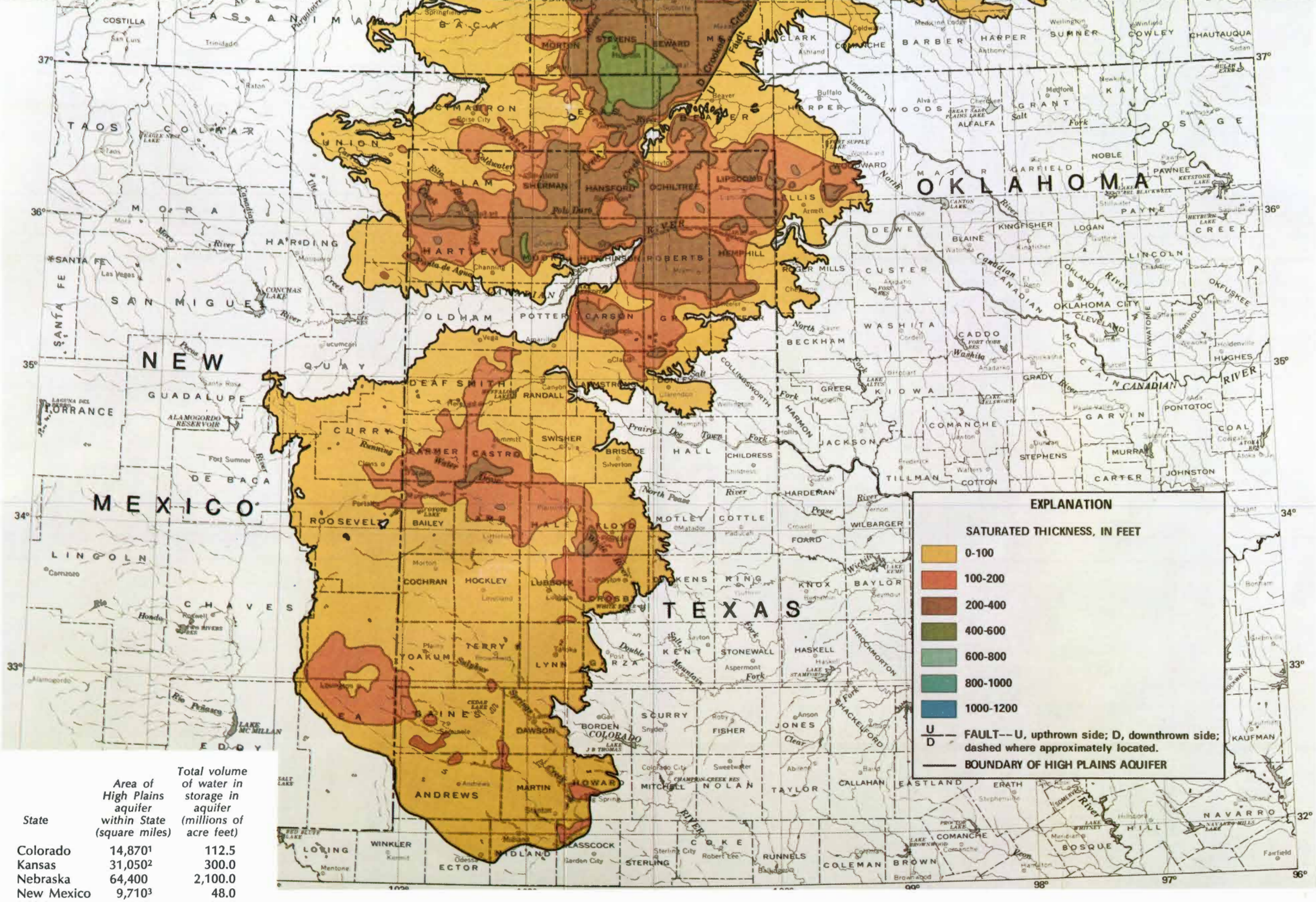
The construction and drafting of these maps was made possible with support from the Texas Department of Water Resources. Production has required over six man years of effort by the water district staff geologists and draftsmen. The atlases are the most detailed and complete groundwater mapping investigation ever completed in this area.

These atlases are being prepared to help local landowners and operators and other county residents to better understand the fresh water resource available under their towns, cities, farms and industries. They should be a valuable planning tool to confirm available water resources and for locating future irrigation well sites. The maps are intended for use primarily in providing general information to the public served by the district and are not warranted for use in real estate transactions or other legal matters.

con't pg. 4, col. 3 . . . COUNTY ATLASES

HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1





State	Area of High Plains aquifer within State (square miles)	Total volume of water in storage in aquifer (millions of acre feet)
Colorado	14,870[1]	112.5
Kansas	31,050[2]	300.0
Nebraska	64,400	2,100.0
New Mexico	9,710[3]	48.0
Oklahoma	7,350	91.0
South Dakota	5,290	105.0
Texas	36,080	375.0
Wyoming	8,190	138.0
TOTAL	176,940[4]	3,270.0

[1] 1,200*
[2] 3,200*
[3] 2,600*
[4] 7,000*

*Square miles with little or no saturated thickness included.

Saturated Thickness Of High Plains Aquifer–1980

by John B. Weeks and Edwin D. Gutentag

United States Geological Survey, 1200 South Eads Street, Arlington, VA 22202

Hydrologic Investigations Atlas HA-648

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 762-0181

YANKS TAKIN' POT SHOTS AT THE WATERIN' HOLE

It is NOT a problem of crisis proportion. As this paper 'goes to bed' the June issue of *Science '81* is the most current publication to feature western water woes as "a problem of crisis proportion."

The eastern and national press have been eying the Ogallala region and sending out scouts to survey western water holes for over a year now; indications are that it will continue. All the notoriety aside, it sure has been a tough job teachin' those Yanks to shoot straight.

So far the Water District has heard from Fortune, Newsweek, the Wall Street Journal, National Geographic, and the Reader's Digest, each looking for interviews and leads to confirm their notions that the High Plains had dried up and is blowing away. This week both ABC and NBC pulled into town believing they were hot on the trail of a water crisis story.

Well, they didn't find one. They came looking for a "typical" farmer who's farm business had shriveled up at the other end of an abandoned water well. What they found were some of the most progressive irrigators and some of the most efficient water application techniques, distribution systems and management practices on either side of the Mississippi.

Typically, they expected to see a delapidated old homestead, settling in under sand, tumbleweed and rusted out farm implements, with the landowner settin' on the front porch swing waiting on the mail wagon to bring the food stamps for next months rations. They wanted to interview the fella tellin' how the good ol' days when prosperity flowed like the water, had dried up and forced the farmer to abandon his operation to the mercy of the government.

That's no tall tale, but it took a heap of facts to convince those pen slingers that "this ain't no crisis."

FACT: We're NOT drying up and blowing away.

The Ogallala in Texas has some 375 million acre feet of water still in storage.

FACT: This is NOT a desert area, it is a semi-arid region.

The High Plains of West Texas receive 18 to 20 inches of annual rainfall, 60 percent of which falls normally just prior to and during the growing season.

CLINGING to a center pivot over corn in Lamb County, the cameraman, audioman, and reporter, Roger Peterson of ABC news go for the rainbow shot.

FACT: This is NOT a totally irrigated area.

Of the 35 thousand square miles of the High Plains, about 13 million acres are farmed. Only six million acres have ample water beneath to support irrigation. In 1978 irrigation accounted for 56 percent of production acres while dryland crops accounted for 44 percent.

FACT: The farmers are NOT being run off the land.

They have put in 2½ million acres of furrow dikes and 35 thousand miles of terraces to hold precipitation on the land, they are using the most advanced low pressure, low evaporation distribution techniques for supplemental irrigation, efficiency testing programs, cropping patterns for optimum yields, and plant varieties continually improved for drought tolerance. The soil is rich and highly fertile, supporting 34 percent of the cropland in Texas in cotton, wheat, feed grains and other crops.

MR. CHARLIE DIES

Water District friends and staff express their deep sorrow at the death of Charles A. Whitfield. Mr. Charlie, as he was affectionately known, died in Lubbock on May 8. He was 89. Mr. Charlie was respected for his wealth of 50 years experience and knowledge of West Texas soils and land values. He was associated with the water district for many years as a land appraiser, private consultant, mentor and friend. We will long honor his memory.

COUNTY ATLASES . . . cont'd from page 1

Hydrologic atlases are also being prepared for the remaining nine counties in the District's service area, including Bailey, Cochran, Crosby, Floyd, Hale, Hockley, Lamb, Lubbock and Lynn. These maps and texts should be printed and available for distribution during the next six months.

HONORED by the Lubbock chapter of Women in Communications, Inc., Cross Section editor, Patricia Bruno, was named 1981 Outstanding Communicator.

LAYMAN'S REPORT ON WATER WELL DESIGN

A report discussing "The Design, Construction and Development of Efficient Water Wells" is now available from the High Plains Water District. It is written for the layman to provide the irrigator or landowner with a better understanding of what he should expect from a water well driller, and to give him a step by step explanation of the procedures for constructing efficient wells.

Report 81-02 covers test hole drilling, screen and casing requirements, drilling techniques, and the development and completion stages of well construction. It concludes with an analysis of the economics of water well efficiency.

At current energy costs and average pump efficiency, the added fuel cost for one foot of lift over a 20 year life of the well is roughly a thousand dollars. Since available drawdown is limited by the aquifer, improving well efficiencies can offer increased yield or decrease the drawdown, and offer a substantial saving to the operator.

BILL WOULD PROTECT PLAYAS FROM REGULATION

Once again Texas Senator John Tower has introduced legislation to keep federal agencies from taking regulatory control over the playa basins. He and Senator Bentsen are co-sponsoring SB 777 this session which is designed to narrow the definition of navigable waters as used in Section 404 of the Clean Water Act, and to restrict the government's management of so-called "wetlands." The bill would restrict the federal permit program to channels of navigation, prohibit any other federal regulation of dredge and fill activities in non-navigable waters, and reserve to the states the regulatory authority over dredge and fill in other waters.

Since a high percentage of the playa lakes are equipped for irrigation and furnish some 20 percent of crop irrigation in a water short area; since the playas are only an intermittant source of water storage due to high evaporation rates on the High Plains; since the landowner's are using this water to produce food and fiber for the benefit of this nation beyond any benefit the regulation of the High Plains 17 thousand playas might offer to migratory waterfowl; and since no farmer we know believes the playas should be defined as wetlands; we urged you to make known your support for SB 777 and its companion House bill HR 3083 sponsored by Congressman Sam Hall.

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

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Evaporation Demand High

By DR. CHARLES WENDT
Soil Scientist, Texas Agricultural Experiment Station, Lubbock

EDITOR'S NOTE: The message behind this analysis of the May-June evaporative demand curve is straightforward: If you haven't had at least an inch of rain or begun irrigating cotton, crank 'em up. Unless July turns out to be a wet one, anticipated crop moisture needs are already getting ahead of available daily reserves at the root zone due to high evaporative demand. A delay in watering now will be costly later when the plants begin to stress.

Cotton has been subjected to a heavy evaporative demand that resulted in above average use of soil moisture in May and June (Figure 1). The evaporative demand is calculated from temperature, relative humidity, light intensity and wind, and represents the amount of soil water that will evaporate from a wet soil or well developed crop.

The evaporative demand was above average in mid May and late June due primarily to the amount of wind received during this period of time. Almost 400 miles of wind was measured some days. Other conditions were also severe. Temperatures reached 105 degrees, humidity ranges

contd. page 3 col. 3 . . . DEMAND

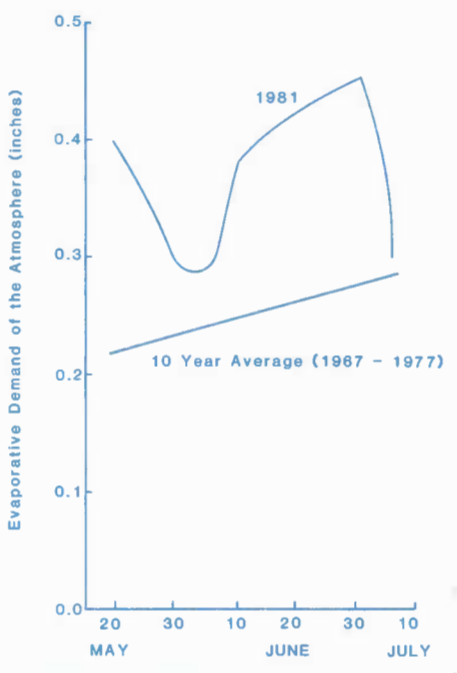
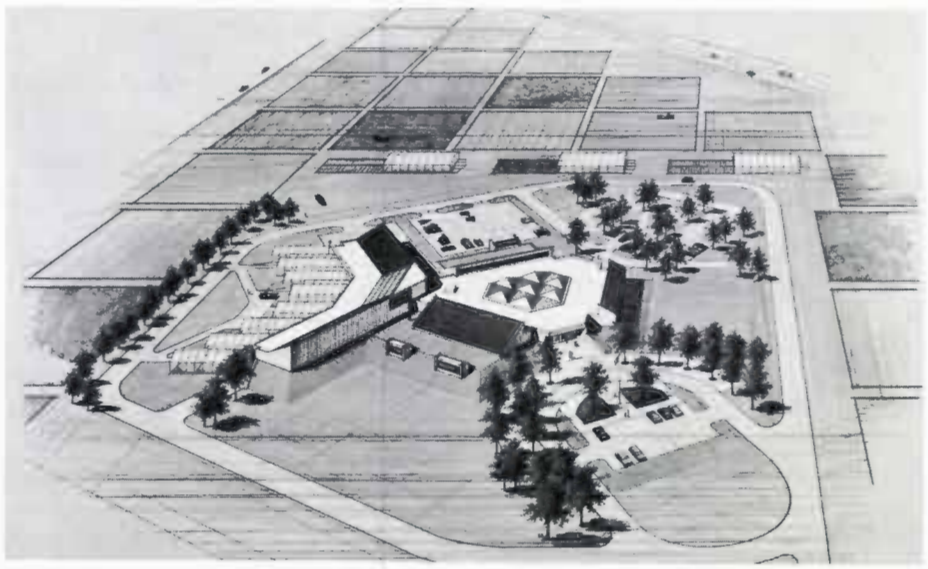


FIGURE 1. Evaporative demand in 1981 compared to a 10 year average during May through July 10.



AN ARCHITECTURAL rendering of the proposed laboratory. The facility contains space for twenty-two scientists, with accompanying greenhouses, headhouses, growth chambers and storage units.

TEXAS TECH TO HOUSE

NATIONAL CENTER FOR PLANT STRESS STUDIES

Nothing takes a greater toll on crops in the High Plains than drought stress. The problem is aggravated when current irrigation water resources can't quite reach far enough fast enough. But scientists believe one solution to the problem lies in encouraging the "survival of the fittest."

At Texas Tech University the idea of a plant stress laboratory has been germinating since as early as 1959. Now studies are underway to develop genetically - improved crop varieties with greater stress tolerance and improved water use mechanisms. The program has been alive for just three years. It is only beginning to establish roots as a major national center for plant stress and water conservation research.

Texas Tech University has taken the lead to work to develop a cooperative research program with the U.S. Department of Agriculture's Science and Education Administration (USDA-SEA), the Texas Agricultural Experiment Station, agricultural colleges and universities throughout the region, farmers, ranchers, the agribusiness industry and private research organizations. Texas Tech's contribution to the cooperative research effort is coordinated through the interdisciplinary Institute for Plant Stress Research, now housed in the College of Agricultural Sciences. Tech hopes to establish a major USDA research facility, and is working to secure funds for construction of the laboratory on campus at Lubbock.

Cooperative research is already underway among USDA, Texas Tech and Texas Agricultural Experiment Station scientists, with a $300,000 grant from USDA, but the work is necessarily limited in scope. What is needed are additional scientific facilities, equipment and disciplinary specialists. The current level of research activity can be expanded to some extent using limited space and resources now provided by TTU and the Experiment Station. No major effort can be launched, however, without a substantial increase in research funding and the availability of the highly specialized facilities planned for the proposed laboratory. But funding is in the works. Texas Senator Lloyd Bentson recently gave an encouraging word to program administrators over the prospects of a million dollar Congressional appropriation this year for ongoing research. Funds for the lab construction are not expected this year.

When the construction of the Plant Stress and Water Conservation Laboratory is funded by Congress, it will serve as the major national focal point for the development of drought-resistant plants and cultural practices to maximize water use efficiency in crop production. The modern, energy-efficient lab will house a powerful team of fed-

contd. page 3, col. 1 . . . PLANT STRESS

Water Trust Fund Bill On Agenda

Gov. Bill Clements has reaffirmed his support for creation of a Texas Water Trust Fund, an item he has placed on the agenda for the special session.

Warning Texans that "we are in a water crisis right now," Clements remarked to a meeting of the Texas Energy and Natural Resources Advisory Council early this month, "I would say that I know of no issue in this state that, long-term, is as important as the water issue, and I have said that on many occasions . . . Because of the lead time involved in solving these problems, the crisis is now."

We can't wait until the year 2000 to solve the problems or to seek the solutions. It has to be now, and if there is one issue that requires very definitive and in-depth the best available talents' long-range planning, it's in our water problem. So I totally support the concept of the Water Trust Fund and I know of no issue before the people of Texas that is as important as this issue."

contd. page 3, col. 1 . . . HJR-33

UNCOVERED WELLS . . .

Death Traps

All rescue attempts finally failed. Only a high powered microphone captured the last small whimpers of six-year-old Alfredo Rampi before his death. The boy had stumbled and slithered more than 200 feet down a 16 inch abandoned well hole near his grandparent's home in Frascati, Italy. His body wedged into the well's narrowing mud wall, then slipped another 80 feet beyond the grasp of desperate rescue operations. He died perhaps only hours later while rescuers and the entire nation kept vigil and hoped for a miracle.

Earlier this year the body of 22-month-old Chris Brents was also found at the bottom of a 40 foot open hole with a ten inch casing. It was just a few yards from his Louisiana home.

These tragic losses might have been prevented if those open holes had been adequately covered. Such grim

contd. page 4, col. 1 . . . OPEN HOLES

THE CROSS SECTION (USPS 564-920)

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2930 Avenue Q, Lubbock, Texas 79405
Telephone 762-0181

PATRICIA BRUNO, Editor

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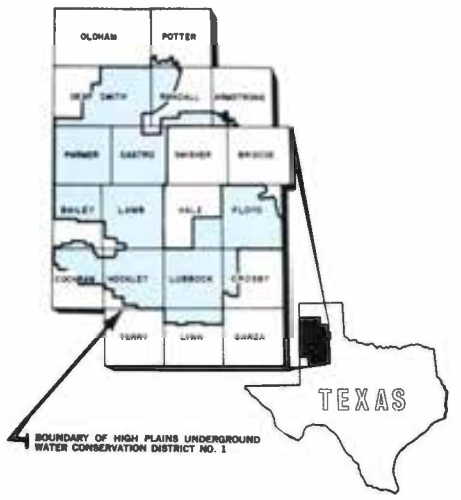


NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Jim Line.

PERMITS PROTECT WELLS

Texas law gives the landowner absolute ownership of the groundwater beneath his land and the right to use it for beneficial purposes. It also gives him a local option to create underground water conservation districts with the authority to "promote and enforce rules . . . to provide for conserving . . . and preventing waste of underground water."

Within the 15 county areas where folks have elected to be managed by the High Plains Water District, the district has enacted rules to require permits for drilling water wells, and enforced sizing and spacing requirements. These rules protect a man's water from the increasing competition for well sites, and from reduced efficiency and pumpage where wells are spaced too closely.

A local survey has shown that an overwhelming majority of the area's residents favor local management of groundwater resources; yet the district recognizes that it treads a narrow path between private ownership rights and its responsibility for protecting and preserving this resource. The Water District has the authority to limit production of wells. For the most part, it has chosen to accomplish such limitations by restricting the spacing of wells according to their gallons per minute capacity.

Size of Well	Spacing Requirements
69.4 to 265 gpm (four-nch pump, or smaller)	200 yards
265 to 390 gpm (five-inch pump)	250 yards
390 to 560 gpm (six-inch pump)	300 yards
560 to 1,000 gpm (eight-inch pump)	400 yards
More than 1,000 gpm (ten-inch pump, or larger)	440 yards

Through 1980 the High Plains Water District has issued upward of 44,982 applications for well permits at no cost to the operator. The district does require a fifty dollar deposit which is refunded when a completed registration and well log or a cancellation of the application is received. A permit is required for drilling any well capable of supplying more than a hundred thousand gallons of water a day, or 69.4 gpm; and the permitted well must be spaced in accordance with its capacity.

There are more than 50 thousand irrigation, municipal and industrial wells within the Water District's boundaries. Yearly records reflect the number of permits issued, new wells completed, and after 1970, wells abandoned. Many of the wells which are abandoned were drilled in the early 50's and were not drilled to the base of the aquifer, or they had mechanical failures. Most of these wells were replaced by new wells which are then reflected in the 'new wells completed' tabulations.

The figures suggest a steady decline in all three categories over the past few years. A major reason for this decline is the skyrocketing cost of equipment, operation and energy for pumping irrigation wells.

Year	Permits Received	New Wells Completed	Wells Abandoned
1953	2794	1494	—
1954	6771	2933	—
1955	4051	3998	—
1956	2617	2170	—
1957	2377	2137	—
1958	1141	710	—
1959	1849	1225	—
1960	1118	872	—
1961	1049	709	—
1962	1875	1160	—
1963	2208	1458	—
1964	2544	1984	—
1965	2410	2080	—
1966	1484	1255	—
1967	1500	1265	—
1968	1087	873	—
1969	848	710	—
1970	825	618	—
1971	1354	1116	220
1972	823	660	202
1973	1136	719	169
1974	1416	1171	261
1975	836	677	225
1976	1155	835	285
1977	828	731	242
1978	603	494	184
1979	541	527	160
1980	551	387	173

Clifford Thompson, permit division chief, sees a correlation between the permitting activity and the seasonal rainfall.

"A dry year will cause more operators to take out permits the following year," says Clifford, "because they see how much difference the lost water makes.

"I've had 'em tell me they sure needed that well last year. It makes them realize the costs."

Rainfall data seems to confirm his observations. (See *Cross Section*, January 1981, Volume 27, No. 1, page 4.) Amarillo area farmers got 23 inches in 1971 and 1974, while Lubbock area irrigators got 20 and 25 inches in 1971 and 1972. Well permit applications and completions dropped off substantially in 1972 and 1975 and then jumped up again after a dry spell in 1973 when Amarillo got 18 inches of rain and Lubbock only 12 inches.

Since last summer's drought, the district is seeing more permit applications come in this year. We've received 413 applications through April of this year compared with 190 permit applications through April of 1980. There appears to be a great deal of well drilling activity in Floyd, Lamb, Lubbock and Parmer counties this year. These same counties are returning a higher number of abandoned well forms this year with more reports of dry wells.

According to District manager, Wayne Wyatt, last summer was one of the toughest. "We've had heavier pumping in past years because we've had more water, and energy costs were less. But I don't believe we'll ever pump any more water again than we pumped this last year," he said.

PLANT STRESS RESEARCH ONGOING

(continued from page 1)

eral, state, and private scientists working in one of the most important and innovative agricultural research projects in the nation and world.

Key Events In The Development Of The Program To Date

1975 - 1976 Preliminary discussions with officials of the U. S. Department of Agriculture and members of the Congress.

1977 - 1978 Congress appropriated $100,000 for a feasibility study. The study team concluded that there was indeed an urgent need for a plant stress and water conservation research program and that Lubbock, Texas, was the ideal location for a laboratory facility. A later decision to locate the facility on the campus of Texas Tech University, in conjunction with the College of Agricultural Sciences, finalized the first major step in the development of the program.

1978 - 1979 Congress appropriated $800,000 for the preparation of a research program plan and architectural and engineering plans for the appropriate laboratory in which to carry out the proposed research. These plans are nearing completion. The Science and Education Administration in August, 1979, transferred a USDA scientist (plant physiologist) to Lubbock, Texas, to serve as a cooperative scientist working with Texas Tech faculty on environmental stress mechanisms in grain sorghum and cotton. Texas Tech is providing office and laboratory space for the USDA/SEA scientist who, together with Texas Tech scientists, has initiated the research program. In addition, the University provides use of the library, computer and other University facilities as well as extending full faculty privilages to the USDA/SEA scientist.

1979 - 1980 Congress appropriated $200,000 for cooperative research in plant stress and water conservation.

1980 - 1981 Congress appropriated $300,000 to continue and expand the cooperative research program in plant stress and water conservation.

Program Objectives

A. The objectives of the cooperative research funded to date are as follows:

1. To increase water use efficiency by managing our water resources more effectively.

   Individual studies are designed to minimize evaporation and thus increase the effectiveness of rainfall and irrigation water. Other studies are designed to increase irrigation well efficiency and application efficiency, thus conserving valuable resources of both water and energy required for pumping.

2. To develop an understanding of the relative sensitivity of various developmental and physiological processes controlling plant growth and yield to water stress intensity and duration.

   This research has been underway for seven years. Major emphasis has been placed upon the photosynthetic process and the search for an understanding of the effects of stress on the various components of carbon assimilation and utilization. An area of major attention at present is the function of the root system in extracting soil water more efficiently from greater depths of the soil. Most crop root systems are fairly shallow and do not extract large quantities of water from below one meter of depth.

3. To develop an improved understanding of the degree of genetic variability in each growth-limiting development and/or physiological process.

   If sufficient genetic variability exists, progress can be made through plant breeding procedures for each sensitive trait. The environment in which the plant is expected to perform has a major influence on the response of each physiological and/or developmental response to stress. By defining the genotype by environment interaction very thoroughly in terms of developmental and physiological responses to stress, more rapid progress can be made in developing higher yielding stress-tolerant genotypes.

B. Three primary research thrusts have been outlined for the Plant Stress and Water Conservation Laboratory with specific objectives defined for each thrust. These are as follows:

1. Characterize the dynamics of the soil-plant-atmosphere continuum.
   - Develop unifying concepts involving root development, water movement, and soil water availability (atmospheric demand).
   - Develop relationships which readily describe root systems and their extrapolation to various genotypes and environments.
   - Develop an understanding of the dynamics of the transport of water and nutrients through the soil-plant-atmosphere continuum.
   - Determine the adaptive nature of the transport system in response to plant stress.
   - Determine genotypic-environment interaction in the transport system.
   - Develop, test, and validate comprehensive models of water uptake to link with models of plant growth, development and yield.
   - Develop concepts in plant development that permit predictive capability in various environments.
2. Define environmental stress impact on growth, development and yield, and identify mechanisms which aid plants in tolerating or avoiding environmental stress.
   - Assess crop sensitivity to heat and drought, and define the genetic diversity for this sensitivity.
   - Determine the tolerance and avoidance mechanisms that inhibit yield under dry conditions and temperature extremes.
   - Develop screening techniques for characteristics contributing to the tolerance and avoidance of drought, heat, and cold.
   - Create genetic lines that differ selectively in these traits.
   - Develop growth regulator techniques for maintaining yield under dry conditions and temperature extremes.
3. Define genetic control of stress mechanisms.
   - Define the approximate limits of genetic variability for specific stress mechanisms by crop species.
   - Identify available sources of domestic and foreign germplasm with specific stress characteristics.
   - Determine the inheritance and breeding behavior of these mechanisms.

HJR-33 NEEDED . . . contd. from page 1

Railroad Commissioner Mack Wallace joined with Clements, commenting that in the 1950s, the Railroad Commission was warning the country of what would happen to the production of oil and gas. "We're going to have exactly the same situation in water as we have in oil and gas," Wallace warned, "and it's sheer folly."

Wallace commented that "as a practical matter, you can live without oil and gas, but you can't live without water . . . You've got to have water if this state is going to survive."

The Texas Water Development Board also supports the Water Trust Fund measure. Chairman Louis Beecherl, Jr., told TENRAC that because of federal pull backs on water grants, "we're going to have to go it alone more than we have in the past." Beecherl predicted that we would need to import water from out of the state or restrict water use and curtail growth.

Beecherl told TENRAC that "we've built all the easy reservoirs." He estimated that the state will need to impound an additional six million acre feet of water by 1990. The cost estimate is $11 billion in current dollars or a possible $28 to $30 billion in future dollars.

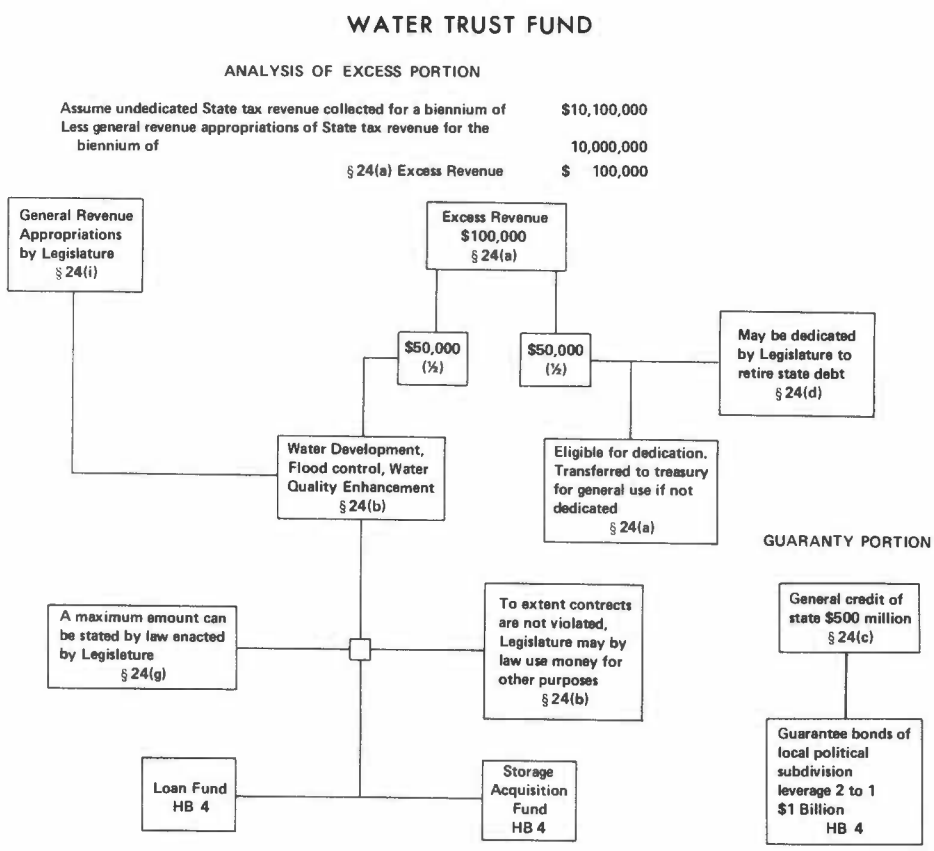
Clements is leaving the details of the Water Trust Fund to the special session of the Legislature. Speaker Bill Clayton is lead sponsor for the proposal. The bill calls for a constitutional amendment to create a fund to finance $500 million in water revenues. If passed it would go to voters in November, 1981. *(Texas Water Report)*

DEMAND . . . continued from page 1

dipped to 10 to 17 percent and plants received maximum light intensity during this time.

The amount of water cotton will use in relation to the evaporative demand depends on the leaf area index (LAI). The LAI is the amount of leaf surface a crop has in relation to the land surface it occupies. In late June the cotton crop had an LAI of 0.1 to 0.2 which means that the crop had approximately 4,000 to 9,000 square feet of leaf surface per acre. With this surface, the crop had been using less than 0.05 of an inch of water per day. However, the leaf area was expanding rapidly and tensiometers show that the crop was beginning to use water at the two feet soil depth level.

When fully developed, a cotton crop in this area will have an LAI of 2-3 or approximately 87,000 to 130,000 square feet of leaf surface per acre. Although the wind slowed down in early July, resulting in a lower evaporative demand (0.3 inch per day), farmers with wells (and especially those with weak wells) should consider watering now in order to get over their crop. This is especially true if the crop has one third to one half grown squares. An irrigation now could help prevent stress when the crop begins to get a boll load in late July and thus result in a better yield.



Open Holes Still A Hazard

(continued from page 1)

reminders underscore the importance of the High Plains Water District's program to locate and cap abandoned wells within our 15 county service area.

District rules and state law require landowners or operators to properly cover any well, cistern or hole that is more than ten inches and less than six feet in diameter. The covering must be permanent and withstand a 400 pound weight. The law also requires that any abandoned well or hole ten or more feet deep be completely filled or capped at the ten foot depth with a permanent plug and filled from the plug to the surface.

In the water district service area in excess of 11 hundred abandoned or uncovered wells have been closed since 1951. Over half that number were discovered and closed since 1978. District engineer technician, Obbie Goolsby, was recently commended by the Board of Directors for his lead responsibility and diligence in locating and in getting covered more than 550 open wells in the past three years.

The search intensified in 1970 when the district completed a survey of Parmer County to locate all existing and abandoned wells. It took nine years for district staff to completely drive out the service area of each of the 15 counties to identify abandoned well sites, or to locate them in conjunction with other programs of the district.

The table below lists a record of open hole investigations for each county since 1970. It indicates vigilence is still needed to remind landowners of their responsibility to protect human and animal life. Pollution of the aquifer is also a serious potential threat which can occur through these abandoned well holes.

The staff will continue its surveillence with the help of topographic maps, replacement well permit records and visual clues. They will monitor those remaining identified and uncapped wells, and keep an eye out for new ones.

"We've learned to spot the tell-tale signs of an abandoned well site," says Obbie. "They generally tell you a farmer's got something he can't plow. A good example is a heavy clump of weeds in a field, particularly if they're thriving at a high point on the land. That usually means an abandoned well. Another landmark which stands, left over from the good ol' days of plentiful water, is the big old tree which farmers planted near their wells. It generally still stands and is the last testament to an abandoned well."

Considering the density of irrigation wells in the High Plains area and the tremendous number of abandoned well holes already located, the district is proud of the fact that no one has fallen into a well and no deaths in the area have resulted from an uncovered or unused well.

A FIT: District Field Technician Eldon Lancaster wedged into a 16" well casing to illustrate that an adult can fall into an open hole. Below, an improperly covered well hole.

TABLE: Open Holes Covered as a Result of Investigation by Water District Personnel Since February 1970.

County	Wells Covered	Wells Found Open—Still Uncovered
Armstrong	3	0
Bailey	34	1
Cochran	84	15
Castro	6	1
Crosby	8	0
Deaf Smith	84	0
Floyd	59	0
Hale	107	7
Hockley	100	3
Lamb	98	2
Lubbock	245	4
Lynn	5	0
Parmer	47	14
Potter	0	0
Randall	34	6
	914	82

MINI-LABS FILMED

A film crew from John Deere & Company scaled the tower of a center pivot in Hale County last month to capture a Soil Conservation Service sprinkler evaluation team in action. The crew came to follow an irrigation water management evaluation from the time the field water mini-lab rolled onto the farmer's field, right through the line, out the end of the sprinkler and into the ground.

Deere is presenting the mobile Field Water Conservation mini-Laboratory in a public service film featuring different mobile lab programs from all across the nation. John Deere's national headquarters in Moline, Illinois, annually produces short, non-product informational films to show to local and area farmers during the implement manufacturer's winter exposition.

Next spring the film will be released and be available at no charge to local dealers and anyone interested in a showing. The water district and Soil Conservation Service will receive complimentary copies of the film.

ON CAMERA, the Hale County SCS irrigation evaluation team read a velocity meter over a center pivot on the Luke Miller farm near Plainview. Centron Films captured the story for Deere & Co.

. . . WHAT'S ITS NAME

Interior Secretary James Watt has announced that the Bureau of Reclamation, which underwent a poorly-received name change in November 1979 to become the Water and Power Resources Service, will regain "its historic title at a saving to the taxpayers of nearly $1.5 million in printing and sign cost—changes that will not have to be made."

"This restoration of the historic title is effective immediately," Secretary Watt said. "The name Bureau of Reclamation is one of historical significance as well as a symbol of excellence. Changing the name to Water and Power Resources Service was a mistake. The public we serve did not like it, nor did the employees who loyally worked for it. The name proved to be awkward, difficult to use in speech and writing, and lacked a logical and convincing short form as a ready reference."

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

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Boy Rescued From Open Hole

It was the first case in the Water District's history of a child falling down an abandoned irrigation well. Ironically, the abandoned well was in the process of being permanently filled and sealed. Four year old Jared Artho was riding a front end loader to the sand pile and racing back to the well hole where his uncle was dumping fill sand when the boy ran too close and slipped feet first down the shaft. He fell a total of 260 feet before firemen could lower a loop harnessed rope, oxygen tube and flashlight down the hole. Rescuers say Jared was a tough little youngster. They hadn't counted on that. But they don't know what they would have done if he hadn't grabbed that rope. Jared fell off the rope after being pulled only 20 feet during the first attempt to haul him out. Then for another tense 45 minutes there was no apparent sound or movement until Jared shined his flashlight to the surface indicating he was again ready to be pulled out. Two hours after the ordeal began, Jared's frightened face emerged from the shaft. He was clutching a one inch diameter rope for dear life. He suffered only a few scratches. He was a very fortunate little boy.

Photo by Kathaleen Curtiss, Globe News Photographer ©

Texans To Vote On Water Amendment

Texas voters will have the final say on HJR 6 this November 3rd. The constitutional amendment they must approve or reject is a "proposition to authorize use of a portion of the excess revenues of the State for water development, water conservation, water quality enhancement and flood control purposes."

In addition, the proposition would authorize the Water Development Board to use $500 million of the credit of the State to guarantee water development and water quality enhancement bonds of local units of government.

The third part of the proposition would increase the interest ceiling on already authorized but unissued bonds, including bonds for the Veteran's land board, bonds for the College and University Coordinating Board from which student loans are made, bonds for state parks, bonds for farm securities purposes, and bonds for water development and water quality enhancement.

Support of House Speaker Bill Clayton's water assistance fund concept gained momentum during the special legislative session. With support from Governor Clements, the West Texas Chamber of Commerce, the Texas Water Conservation Association, the Texas Municipal League, and all but a handful of legislators, both HJR 6 and HB 8, the enabling legislation, made it through. The House approved it early, then the water assistance fund legislation successfully assimilated minor changes and technical amendments in the Senate and won the two-thirds Senate majority needed to go to the people in November.

The House quickly concurred with the Senate's amendments to HB 8.

What The Legislation Will Do:

- ★ The enabling legislation will provide some immediate cash relief to the Texas Water Development Board by providing $40 million in money to fund the water assistance fund.
- ★ The constitutional amendment puts a ceiling on the amount of the State's full faith and credit of $500 million for guaranteeing the water resources bonds of local units of government.

contd. pg. 4, col. 4 . . . AMENDMENT

Compare Benefits

According to the most recent cost estimates, Washington, D.C.'s Metrorail system is costing more to build than has been spent in the nearly 80 years of the Bureau of Reclamation. The total estimated cost for the subway system in the nation's capitol is now more than $10 billion, but in the nearly 80 years of the BuRec's history, the federal government has spent less than that—about $9 billion—on water projects.

Western water projects repay significant portions of their costs and generate substantial economic benefits for the nation. According to a recent report, the western water projects generated $25.6 billion in federal tax revenues between 1940 and 1978—nearly three times the total investment to date. In 1978 alone, water projects accounted for $8.5 billion in personal income.

(From July, '81 Nebraska Water Letter)

FIELD DAY SET

The Texas Agricultural Experiment Station at the Lubbock location will host the field day on Tuesday, September 8, 1981 beginning at 1:00 p.m. Other agencies located at the Lubbock-Halfway Center and cooperating in the event are the USDA-ARS, Texas Forest Service, Agricultural Extension Service and the High Plains Research Foundation.

THE CROSS SECTION (USPS 564-920)

NOTICE: Information regarding times and places of the monthly County Committee meeting 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, except for Potter County; in this county contact Jim Line.

EVOLUTION OF IRRIGATIO

Irrigation systems have come a long way in the span of less than two decades. The changing profile of irrigation systems is the story of an evolution. The irrigation boom of the late 40's and 50's had a major influence on the development of sprinklers. The invention of the deep well turbine pump and the coming of the thousand gallon a minute well made irrigating a standard practice. It was now production insurance rather than a last resort against crop failure. The rapid growth in irrigation in the fifties saw irrigated acreage in the High Plains of Texas expand from 1.86 million in 1951 to 3.5 million by 1954. But new water distribution techniques were needed to spread all that water farther, faster.

Enter the labor intensive, hand move system of aluminum pipe sections. Donald Green describes it in his book *Land of the Underground Rain.*

The hand move sprinkler system was one of the first widely used systems.

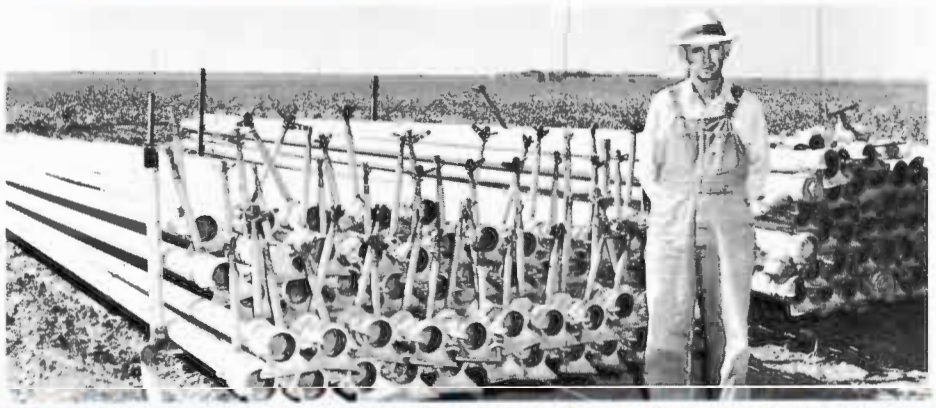
The towable hand move sprinkler system used skids under it to allow towing by a tractor.

"Early sprinkler units required a great deal of labor. The farmer or his employee had to carry each segment of aluminum pipe, some thirty or forty feet in length, for sixty or eighty feet and lock the end of it into another joint of pipe before making a 'set'. With two 'sets' per day, two to four hours of labor or more were required."

It didn't take long for the farmer to rig up a method for towing the hand move pipe system. He spaced skids under the pipe and its joints, hooked the line to a tractor, and dragged the system down the field for another 'set'. It still took a lot of pipe and a lot of labor.

The next improvement made in the system was to get the pipe off the ground and above the crop. Early side roll systems were put on wheels and motorized. The motor was attached to a sprocket and chain, and straddled a pair of center wheels which turned and pulled the rest of the line by tension. This innovation was still labor intensive. It required a man to haul and joint all that pipe and to crank up the engine each time a new set was ready to be made.

Later these motorized side roll systems began appearing with a series of drag lines attached. Each trailing line supported a series of evenly spaced sprinkler heads. The additional sprinkler lines trailed off the main line and covered a large expanse of ground. These adapted systems required lots of water to feed all that line, but they could be moved much less often. To move the lines, the water was turned off, the motor cranked up, and the system moved down the field a few hundred feet.



A stack of hand move sprinkler pipe gives an indication of the amount of labor required.

By the 60's farm laborers were in short supply and expensive, and sprinkler irrigation was still in its infancy. The advent of the center pivot was to change all that.

The grandfather of the first center pivot was a tinkerer. Frank Zybach, a dryland tenant farmer in Colorado, had observed hired hands mucking through mud to disassemble and reconnect the then popular hand move system of pipe sections, and he had gone home to design an automatic, self-propelled sprinkle irrigation system. He built the first proto-type in 1948, a small two-tower, water driven center pivot system. By 1952 he was granted a patent for the "Zybach Self Propelled Irrigation Apparatus." That same year he built a five tower center pivot to irrigate 40 acres. By 1954 he had manufactured ten center pivot systems. He had also raised the main pipeline to about ten feet above ground for water-

...N SPRINKLER SYSTEMS ON TEXAS' HIGH PLAINS

On a side roll system the large wheels raised the main line and sprinkler nozzles above the crop. A motor moves the system to the next set.

ing taller crops. Zybach tells his story to Les Sheffield in the January 1981 issue of *Irrigation Age*.

Zybach recalled he had "one heck of a time trying to sell the concept of center pivot irrigation . . . and even if he could get the farmers interested in buying one, the next problem was getting banks and agricultural lenders to agree to lend money for it. Zybach said one irrigation expert called his center pivot a "Rube Goldberg contraption" and told him the concept and system weren't practical."

In spite of their tremendous potential, labor-saving advantages and the fact that they were well suited to irrigate sandy soils and uneven terrain, and that they offered advantages to farmers with weakening wells; acceptance was slow until the mid-Sixties.

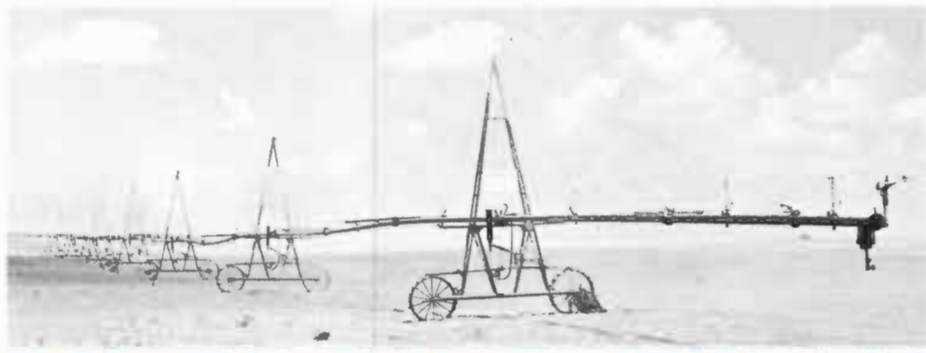
However, in the sandy soils of the Texas High Plains, 96 percent of the 505,000 acres being irrigated in 1962 were under sprinklers. These were located in the ten county area of Bailey, Lamb, Cochran, Hockley, Yoakum, Terry, Lynn, Gaines, Dawson, and Martin Counties. And there was a growing advocacy for their use in medium textured soils where water supplies were declining.

The termination of the "Bracero Program" in the early Sixties added incentive for use of sprinklers and improvements began appearing.

Green reports that a Deaf Smith County farmer with early awareness of his declining water had "designed a system using a long boom with sprinkler heads set on a four-wheel rig. It moved itself through a field while straddling an irrigation ditch. A pump on the rig sucked water from the ditch and applied it to some forty rows in one half of a round. The automated rig needed human hands only when it reached the end of the rows and had to be turned around and started back down forty more rows . . . That farmer estimated he got the same production using one fourth the amount of water he had previously employed using furrow-flood."

"His experience and that of other irrigators prompted the publisher of *Irrigation Age* in 1970 to suggest in strong terms that local bankers had an obligation to do their share for water conservation and the economy by promoting and financing more sprinkler than flood irrigation in your area."

"Various units now appeared on the market; automatic wonders powered by hydraulic cylinders or water pressure which propelled themselves at a snail's pace in great circles or in straight lines."



In the early stages of development, the center pivot was powered by hydraulic fluid or water. It provided the method to irrigate the very sandy soils.

A 1971 Texas A&M Experiment Station report by William Hughes credits one sprinkler equipment dealer with claiming there were 84 different models of sprinkler equipment available in 1969. New systems and improvements in older systems: from the flexible, relatively low cost, slip-joint portable system with high labor requirements, through various types of sideroll laterals to the sophisticated self-propelled center pivots. A common sight was the Valley system identified by its tall towers standing above each of its sets of tandem wheels. Guy wires from the towers supported the pipe in the same way that cables support bridges.

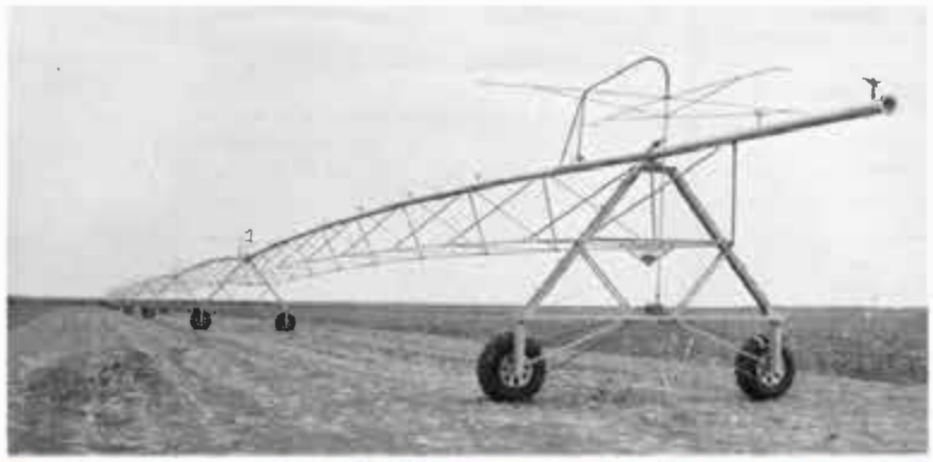
By the 1970's sprinkler irrigation was one of the most significant innovations in irrigation. Major design improvements began to appear. Flotation or balloon tires, electric drives and variable speed drives that applied different amounts of water per revolution, end guns with automatic shut-off capability and safety switches that shut down the system in case of pressure loss or misalignment of the towers.

Hughes reports that the center pivot system required slightly more than four times the investment per irrigated acre than the slip-joint hand moved systems, but its labor requirements were only one fourth as great.

In 1971 there were 885 center pivots in operation, by 1977 the Texas High Plains had a total of 3,645 units running. 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. Distribution of water was almost even over the field, eliminating the problem in furrow watering of deep percolation at the start of the furrow and insufficient penetration at the end of the row. However, these 60 to 90 psi pressure systems required extra energy costs because each pound per square inch of pressure is equal to about 2.3 feet of lift.

The side roll system with drag lines will water more acreage in one set, but requires enough water to support the additional sprinklers.

High pressure nozzles had a trajectory of about 27 degrees. Later these impact sprinklers were improved and lowered to a 6 degree angle. The problems of high evaporation losses and high pumping costs prompted further nozzling improvements; they also prompted the design of low pressure systems. Nozzle sizes increased and they were mounted under drop lines which could supply larger water droplets under lower pressures of 20 to 30 psi. The low pressure center pivot irrigation systems offered the potential of efficiently applying irrigation water with significant energy savings, however they also created problems of runoff and soil erosion, with uniformity of water application and operation.



The electric drive center pivot with high pressure impact nozzles were very popular in the 60's and 70's.

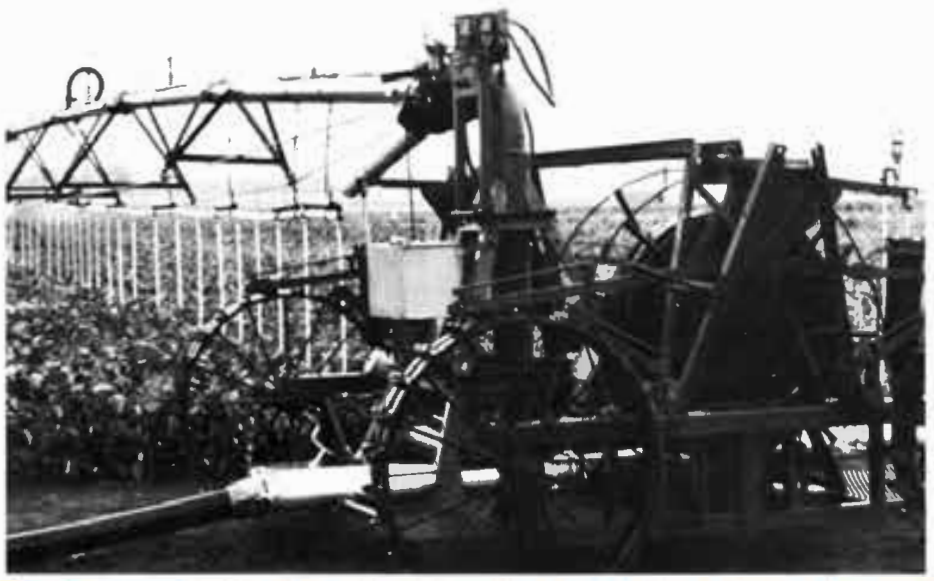
Sprinkler System of Future:

The most efficient water conservation and energy efficient system to be developed to date is the design by Dr. Bill Lyle, called the LEPA system or Low Energy Precision Application system. It now appears that the sprinkler design of the future will be a modification of Dr. Lyle's work. LEPA distributes water directly to the furrow at very low pressure through drop tubes and orfice controlled emitters. Dr. Lyle's system moves continually and laterally and is used in conjunction with furrow dikes to eliminate runoff and optimize rainfall catchment. Dr. Bill Lyle is an engineer with the Texas A&M Experiment Station at Lubbock-Halfway.

Another variation, the mobile drip irrigation method of dragging long hoses punctured with spaced orfices that drip water into the soil behind a main pressure line, has been limited to low capacity wells and low growing crops and had had limited success to date.

In 1980, two variations of the LEPA system were developed by Anton, Texas, irrigator Carl Butler. He modified one of his low pressure center pivot systems and a lateral system with adjustable swiveling tube extensions attached to his re-spaced drop lines.

Low pressure systems were developed to cut energy and evaporation losses.



The low Energy Precision Application System; bringing the drops closer to the ground to further reduce evaporation and requiring only 10 psi or lower at the head to reduce fuel cost.

The LEPA is used with furrow dikes to prevent run-off from the drops and in capturing and holding rainfall.

The drop lines were capped and punctured with varying sized holes to allow progressively higher volumes of water to be released as it moved down the pipe away from the center pivot. A canvas sock or sleeve was slipped over the tube and extended down into the furrow to gently diffuse the water between the rows. To adapt his center pivot to this drop line method it was necessary to plow his furrows in a circle. That was another real innovation of the system. Butler's system is achieving near hundred percent irrigation distribution efficiency ratings, and a uniform application pattern. Additional variations of the LEPA system are being designed by the manufacturers.

Nozzle improvements have come a long way from the original impact sprinkler to these low pressure modifications, including the wobbler and the vari-directional spray nozzle. A very promising discharge tool used with the drop line system is the "bubbler." It allows large quantities of water to be applied at pressures as low as 10 psi, applied very close to the ground without gouging the furrow. These nozzles are suspended from adjustable drop lines, and come in variable sizes to adjust for uniform application.

One of the most recently installed experimental design low pressure center pivot systems is on the James Mitchell farm near Wolfforth, Texas. It uses a series of adjustable booms, droplines, tubes and bubblers or sox to lay water gently into his round bedded rows blocked with furrow dikes. A series of pressure regulating float can-

Carl Butler stands under his modified LEPA system. The drops have socks attached to let the water out on the surface.

isters ride atop the booms to regulate pressure and improve distribution uniformity. (Look for more about Mitchell's system in a future issue of the *Cross Section.)*

And still more innovations are coming to the market, including improvements in end gun systems for watering corners, automated coupling hardware systems for linear move sprinklers using buried main lines, and for center pivots using corner sprinklers. This month's *Irrigation Age* also reports manufacturers are even looking for ways to use traveling sprinklers for light tillage and planting.

A very promising discharge tool used with drop lines is the "bubbler" nozzle.

James Mitchell stands under his modified drop line rig with adjustable booms and pressure regulators.

Manufacturers will continue to line up in the newest race, this one to design sprinkler systems to operate with even less water volumes, at even lower pressures, for an absolute minimum of evaporation loss and uniform distribution patterns. The winners will be the irrigators who will reap bigger energy and labor savings and more dependable, trouble free systems.

AMENDMENT . . . .

(continued from page 1)

- ★ Local units of government would sell their own water bonds on the open market with loan guarantees from the Texas Water Development Board. Local governments would thus be able to sell bonds at the credit rating of the State which is currently a triple-A rating.
- ★ The companion enabling legislation provides that the loan guarantee rate shall be one dollar of credit by the State to guarantee two dollars of bond issue by a local unit of government. Since many Texas cities don't have a triple-A bond rating, this guarantee feature would result in reduced interest cost to each city using it and lower cost of water and waste water treatment to customers.
- ★ The constitutional amendment would raise the ceiling on interest rates the State may pay to sell bonds from six to 12 percent. This will immediately create a market for some $218 million in state water development and water quality enhancement bonds already authorized but stymied under current low interest rate limits.
- ★ A key provision of the amendment is that one half of any state revenue surplus at the end of a biennium is dedicated to the water assistance fund for financing water projects.
- ★ However, a simple majority vote of the legislature could allow revenues to be pulled back out of the water assistance fund.

Although this particular legislation does NOT provide for importing water to West Texas, it does provide financial assistance to all of the cities of Texas, including those in West Texas, for loan guarantees and front end financing of water sewage treatment plants, pipelines and well fields, some reservoirs that can be built in the area and flood protection. The amendment would "prohibit use of these funds to finance any project to remove from any state surface water basin, the water necessary to supply reasonable, foreseeable future water requirements for the next 50 years, except temporarily."

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CAPILLARY WATER RESEARCH FUNDED

The High Plains Water District has entered into a $250,000 contract with the Texas Department of Water Resources to study the feasibility of secondary recovery of capillary water from the unsaturated portion of the Ogallala Formation.

Capillary water is that water held around the clay, sand and gravel particles in areas already exhausted of their "free water" supply by gravity drainage. Water District hydrologists have speculated that as much as 200 million acre feet of water may still remain in storage in the dewatered areas of the Ogallala. If so, that amount would equal the quantity of water already pumped from storage.

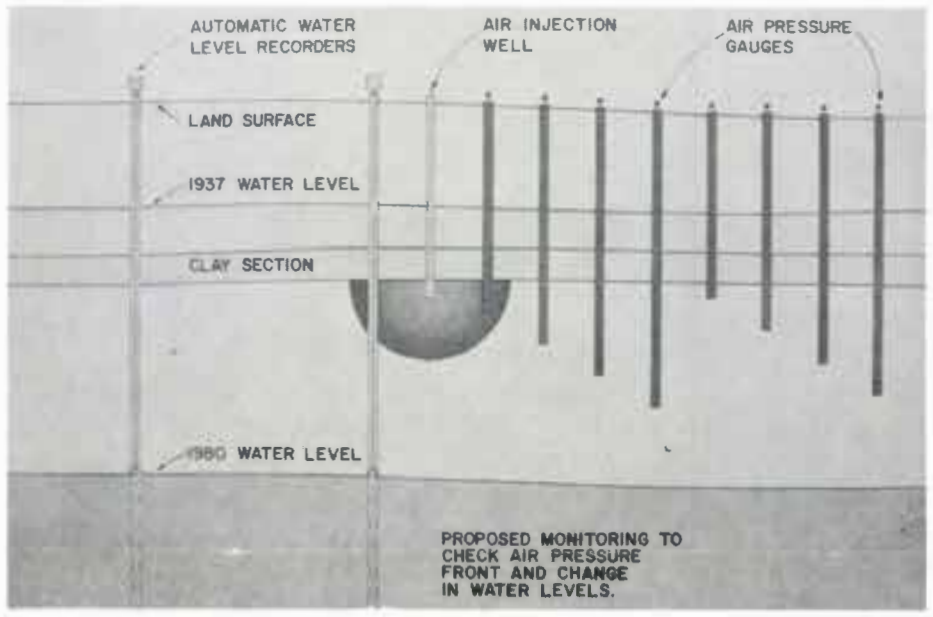
One of the methods of recovery now being investigated involves injecting compressed air through wells to break surface tension and release the water to gravity so it can reach the water table.

The total anticipated cost of this study is $356,579. That figure includes the quarter of a million dollars from the TDWR contract which was appropriated in a "rider" to the general appropriations bill passed this legislative session. TDWR will provide general assistance and supervision for the project and will construct eight test holes to be cored from land surface to the water table. The cores will be tested for moisture content at sites selected on the basis of soil type, precipitation, geology, topography, and historical land use.

The High Plains Water District will subcontract some of the investigative work to Texas Tech University's Water Resources Center. The North Plains and Panhandle Water Districts have also indicated willingness to cooperate in the project.

The full investigation will include determining the amount of water in capillary storage, and identifying technologies for recovery of capillary water from consultations with leading authorities in the field and a computer search of abstracts of scientific articles. It will also involve determining technologies which are economically feasible by using laboratory experiments and computer simulations. Investigators will develop plans for and test in-situ pilot installations, and evaluate data derived from the work.

The Texas Department of Water Resources will monitor the investigations and will submit a report on the work to the Texas Legislature by November 30, 1982.



Conceptual test site model for monitoring air injection/recovery of capillary water.

FEDS SCOUT AREA ENERGY-WATER NEEDS

The General Accounting Office in Washington D.C. has taken a special interest in energy and agricultural conservation on the High Plains. GAO research reporter Bob Huston was recently on the Plains looking for opportunities to reduce energy consumption in agriculture and irrigation. He was covering territory in Texas and California, while another GAO reporter covered the Midwest area.

Huston spent several days in the Lubbock area, at the Water District and speaking with a sample of farmers. He wanted to learn what they are doing in the way of conservation, what they're not, and why. GAO also interviewed members of federal agencies in Texas, the USDA, the Soil Conservation Service and the ASCS offices; and he talked with state agencies including the Texas Departments of Agriculture, Water Resources and the Texas Energy and Natural Resources Advisory Council.

"Although some folks say farmers are farmers, they have very individual problems," said Huston. "Our six month investigation has met with interest from the Congressional Subcommittee on Food and Energy who will review the first draft, after being refined by the USDA and other affected agencies." The report, with possible recommendations, may merit Congressional hearings in the future.

SHIFT IN IRRIGATED ACREAGE SEEN

Preliminary results of the economic analysis of the farming portion of the High Plains Ogallala Aquifer study being made by the Texas Department of Water Resources indicates that a significant shift in the number of acres planted to the various crops for irrigation in the High Plains of Texas is expected to occur during the 43-year study period (1977 - 2020).

For major crops, irrigated acres planted to corn and wheat are expected to drop sharply (1.4 million acres to 0.07 million for wheat), while cotton is expected to rise markedly (1.7 million acres in 1977 to 3.0 million in 2020), and grain sorghum plantings are expected to remain nearly constant (1.2 million acres in 1977 to 1.4 million in 2020).

To contrast those estimates with relative sizes, 6.1 million irrigated acres were planted to all crops in 1977 compared with the 4.9 million acres that are estimated to be planted in 2020. Thus, the relative share of corn and wheat declines sharply, cotton's share rises sharply, and the share in grain sorghum rises slightly.

From a financial perspective, agriculture in Texas, both irrigated and dryland, can be maintained on a profitable level, showing a positive return to land and management. The total value of production, irrigated and dryland combined, is expected to increase from $1.7 billion in 1977 to $2.84 billion in 2020 (in 1977 dollars). Of those totals, irrigated production accounts for about 74 percent, or $1.26 and $2.10 billion in 1977 and 2020 respectively.

Returns (in 1977 dollars) to land, water, and management for irrigated production, on a per acre basis, are $13 in 1977 and $108 in 2020, according to the analysis. Returns to land and management for dryland production on a per acre basis are $13 in 1977 and $35 in 2020.

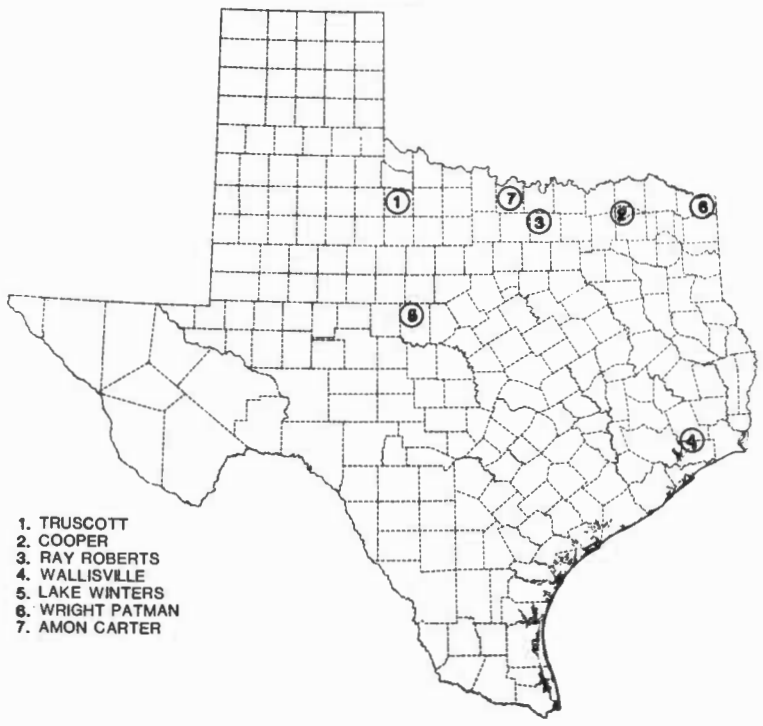
In the Baseline case, it was estimated that technology and management would reduce the average quantity of water use per acre from 1.38 acre-feet in 1977 to 0.68 acre-feet in 1990, and 0.65 acre-feet in 2020. The specific data for Texas about water conservation technologies, crop yield trends, and expected improvements in plant breedings were obtained from agricultural scientists and leading farmers in the area. The rate of adoption of technology to achieve this level of efficiency will depend upon prices for farm commodities, costs of production, and capital availability to finance the investments.

contd. pg. 4, col. 4 . . . SHIFT

TEXAS WATER PROJECTS

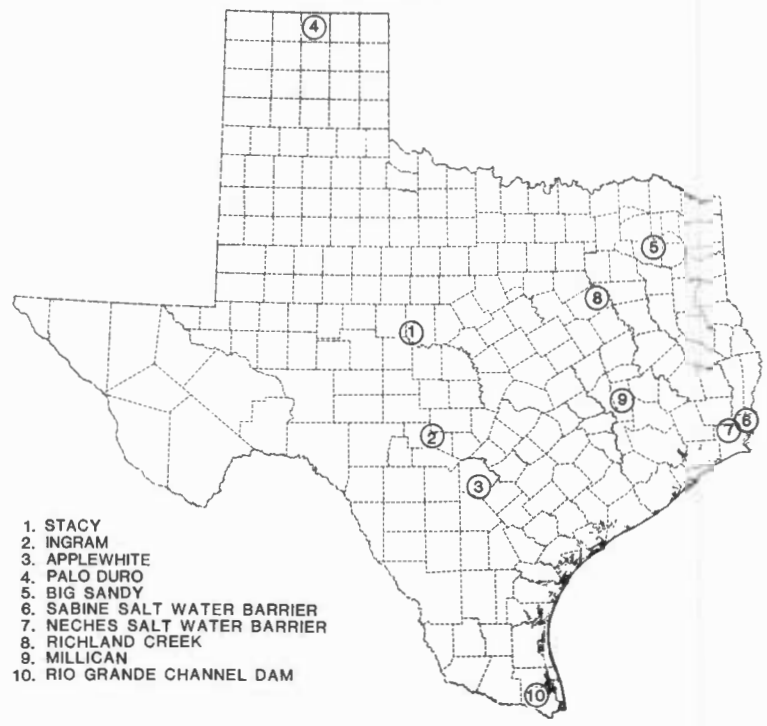
Texas voters will have the opportunity to cast a ballot on November 3rd to approve or disapprove the Water Assistance Fund. The intent of this proposed constitutional amendment is to guarantee financing for Texas water projects. Major water projects identified by the Texas Department of Water Resources that need to be completed in Texas from 1980 to the year 2004, are illustrated on the maps on pages 2, 3 and 4 of this issue of the Cross Section. For more details on the Water Assistance Fund see the August 1981 issue of the Cross Section.

FUTURE RESERVOIRS NEEDED
1980–1984



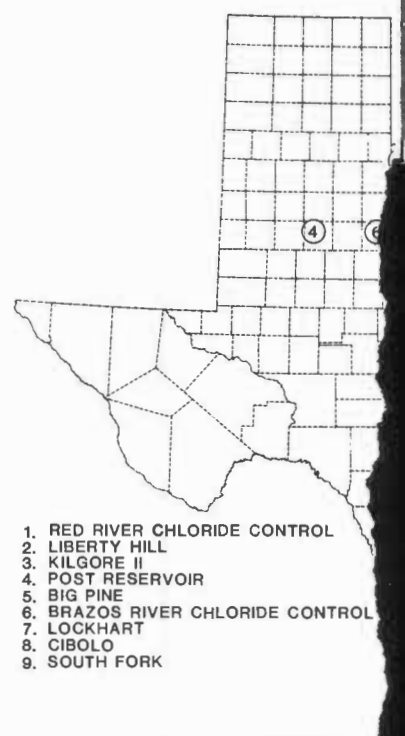
1. TRUSCOTT
2. COOPER
3. RAY ROBERTS
4. WALLISVILLE
5. LAKE WINTERS
6. WRIGHT PATMAN
7. AMON CARTER

FUTURE RESERVOIRS NEEDED
1985–1989



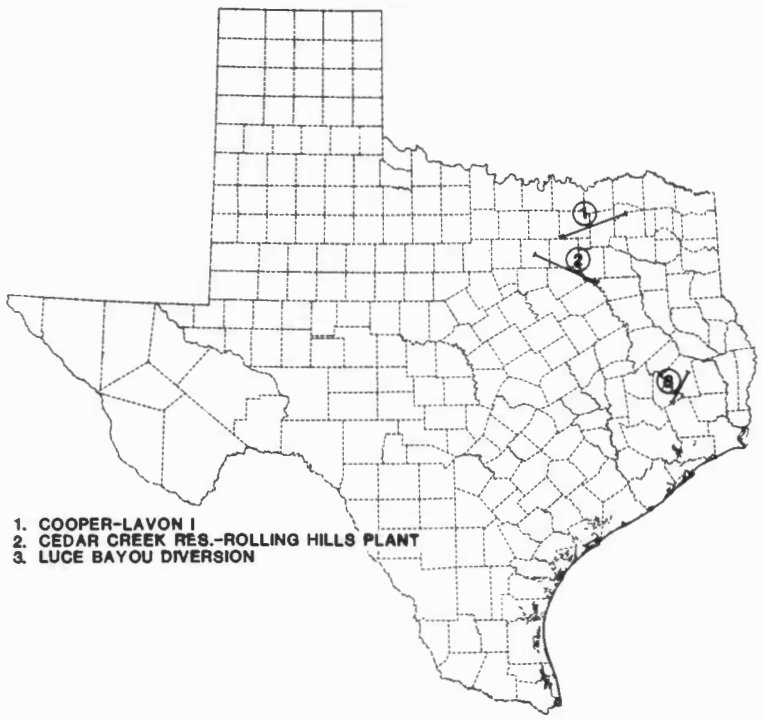
1. STACY
2. INGRAM
3. APPLEWHITE
4. PALO DURO
5. BIG SANDY
6. SABINE SALT WATER BARRIER
7. NECHES SALT WATER BARRIER
8. RICHLAND CREEK
9. MILLICAN
10. RIO GRANDE CHANNEL DAM

FUTURE RESERV
1990–1



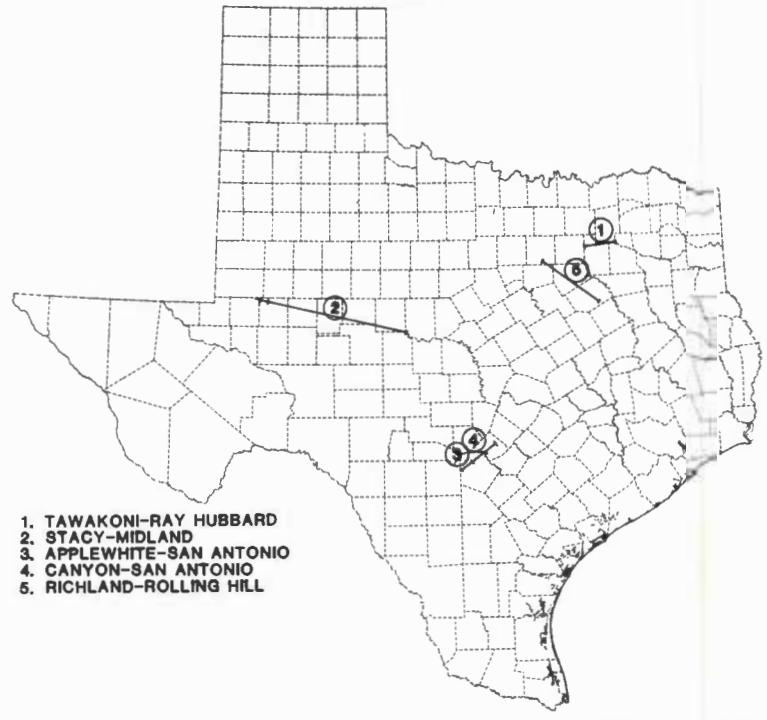
1. RED RIVER CHLORIDE CONTROL
2. LIBERTY HILL
3. KILGORE II
4. POST RESERVOIR
5. BIG PINE
6. BRAZOS RIVER CHLORIDE CONTROL
7. LOCKHART
8. CIBOLO
9. SOUTH FORK

FUTURE WATER CONVEYANCE SYSTEMS NEEDED
1980–1984



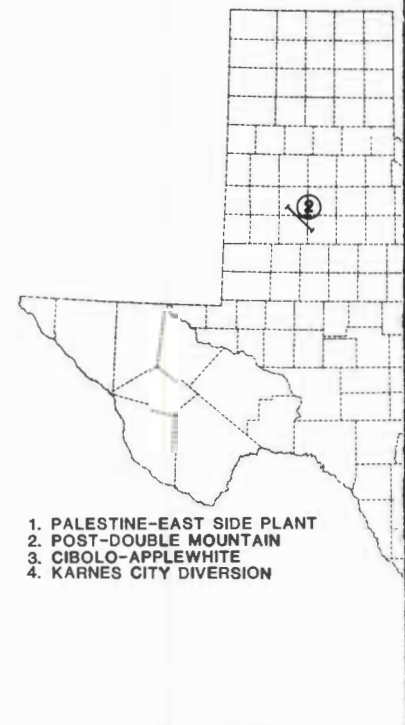
1. COOPER-LAVON I
2. CEDAR CREEK RES.-ROLLING HILLS PLANT
3. LUCE BAYOU DIVERSION

FUTURE WATER CONVEYANCE SYSTEMS NEEDED
1985–1989



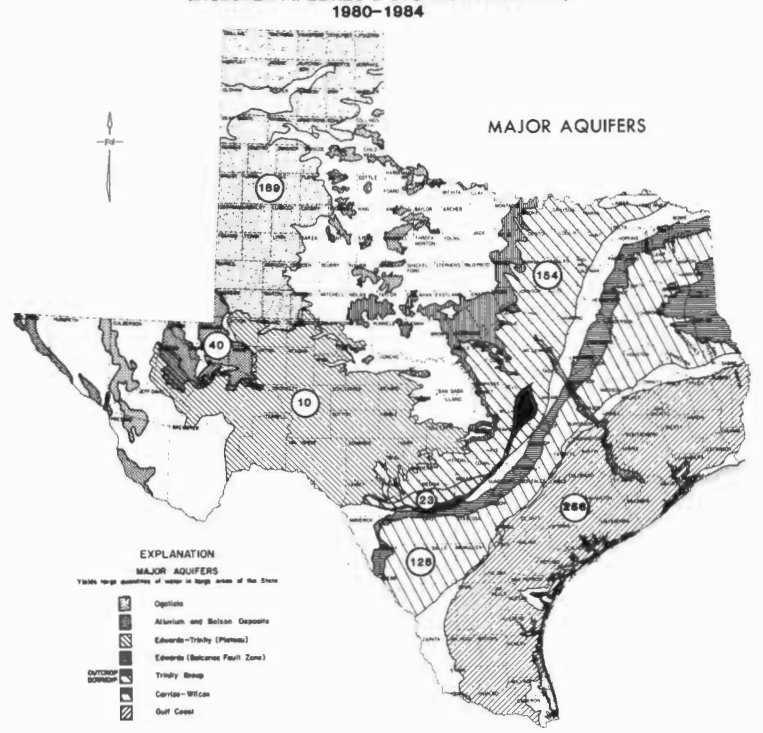
1. TAWAKONI-RAY HUBBARD
2. STACY-MIDLAND
3. APPLEWHITE-SAN ANTONIO
4. CANYON-SAN ANTONIO
5. RICHLAND-ROLLING HILL

FUTURE WATER CONVEYA
1990–1

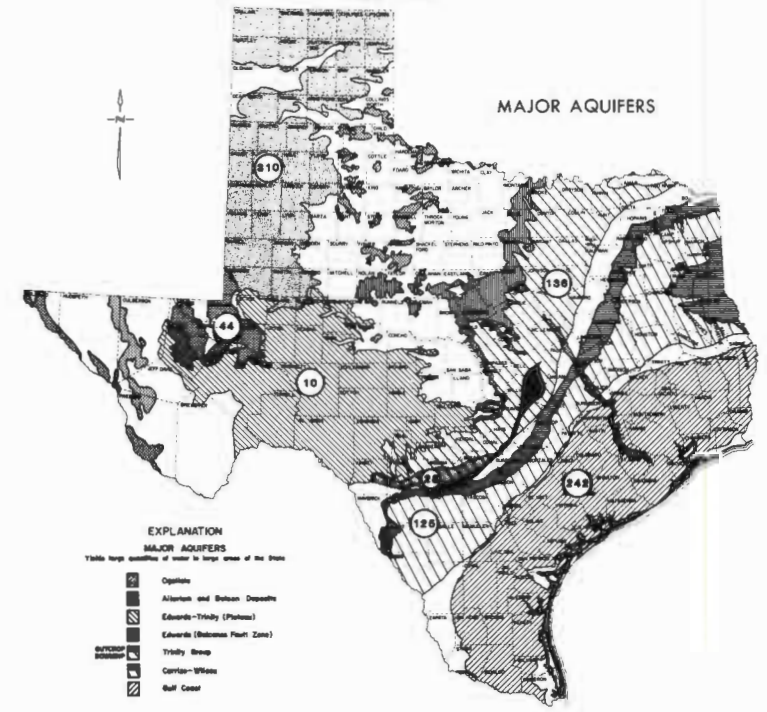


1. PALESTINE-EAST SIDE PLANT
2. POST-DOUBLE MOUNTAIN
3. CIBOLO-APPLEWHITE
4. KARNES CITY DIVERSION

NUMBER OF FUTURE MUNICIPAL WELLS NEEDED
(INCLUDES PIPELINES & STORAGE FACILITIES)
1980–1984



NUMBER OF FUTURE MUNICIPAL WELLS NEEDED
(INCLUDES PIPELINES & STORAGE FACILITIES)
1985–1989



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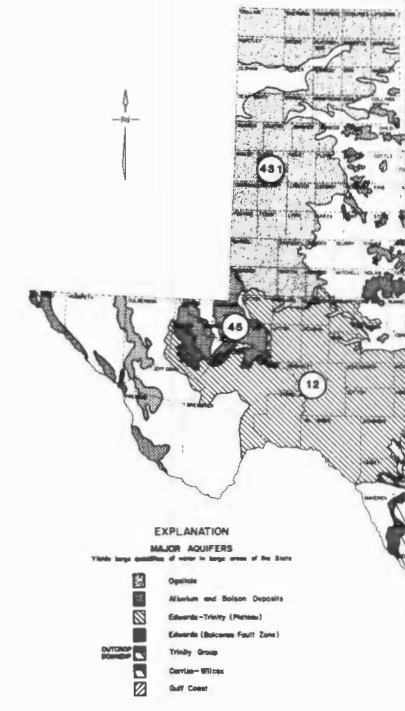
1990–1



OIRS NEEDED
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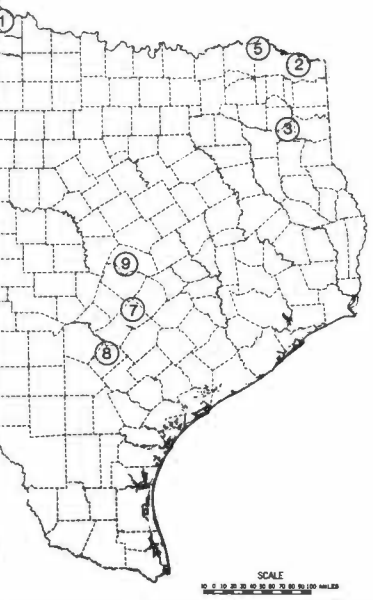
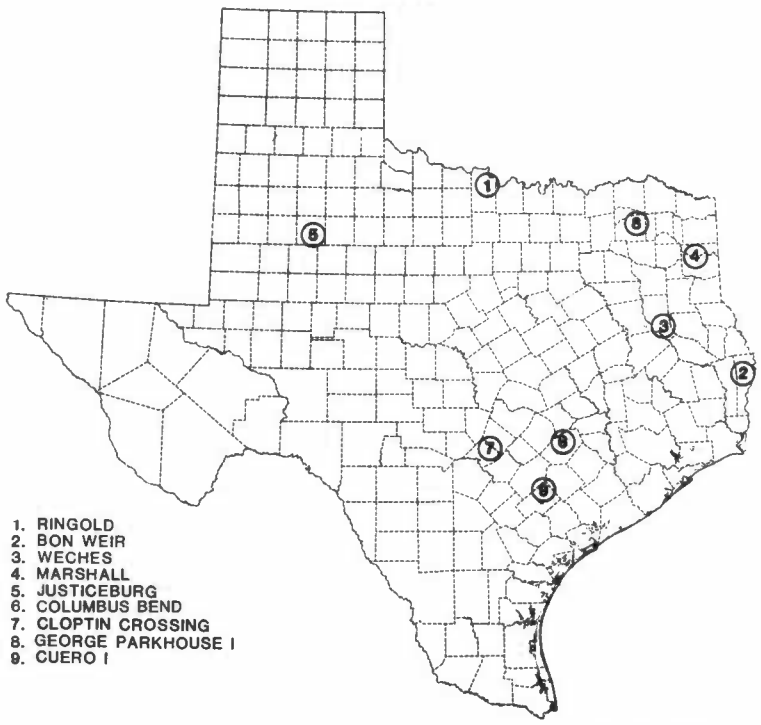
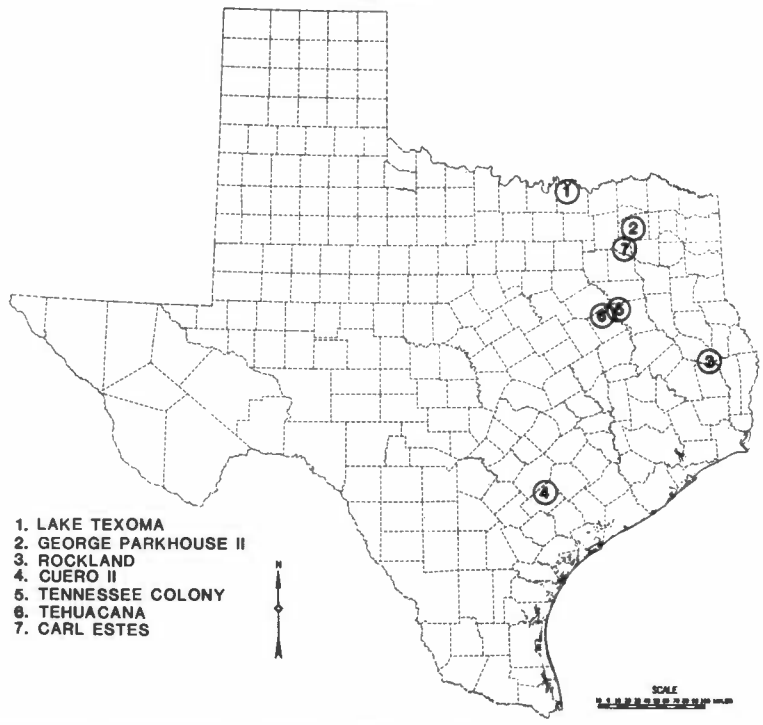


FUTURE RESERVOIRS NEEDED
1995-1999



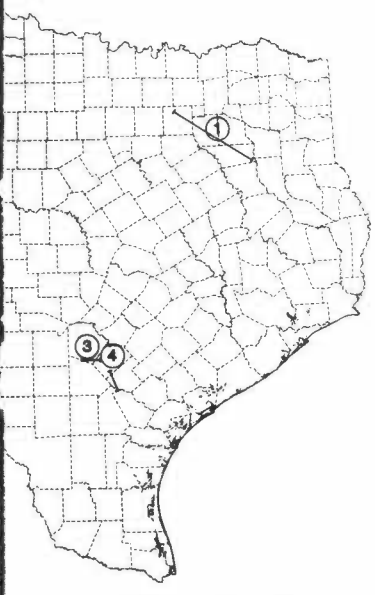
1. RINGOLD
2. BON WEIR
3. WECHES
4. MARSHALL
5. JUSTICEBURG
6. COLUMBUS BEND
7. CLOPTIN CROSSING
8. GEORGE PARKHOUSE I
9. CUERO I

FUTURE RESERVOIRS NEEDED
2000-2004

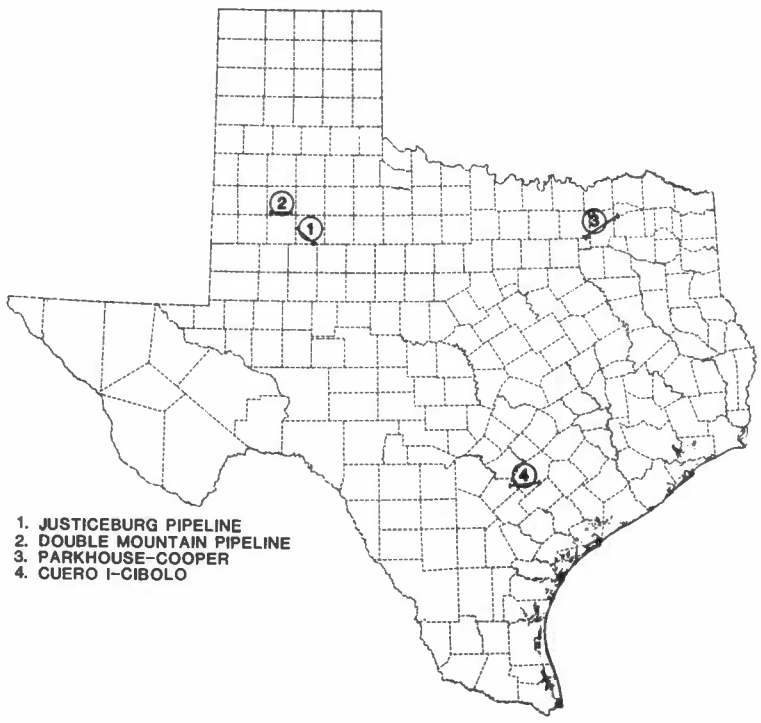


1. LAKE TEXOMA
2. GEORGE PARKHOUSE II
3. ROCKLAND
4. CUERO II
5. TENNESSEE COLONY
6. TEHUACANA
7. CARL ESTES

NCE SYSTEMS NEEDED
994

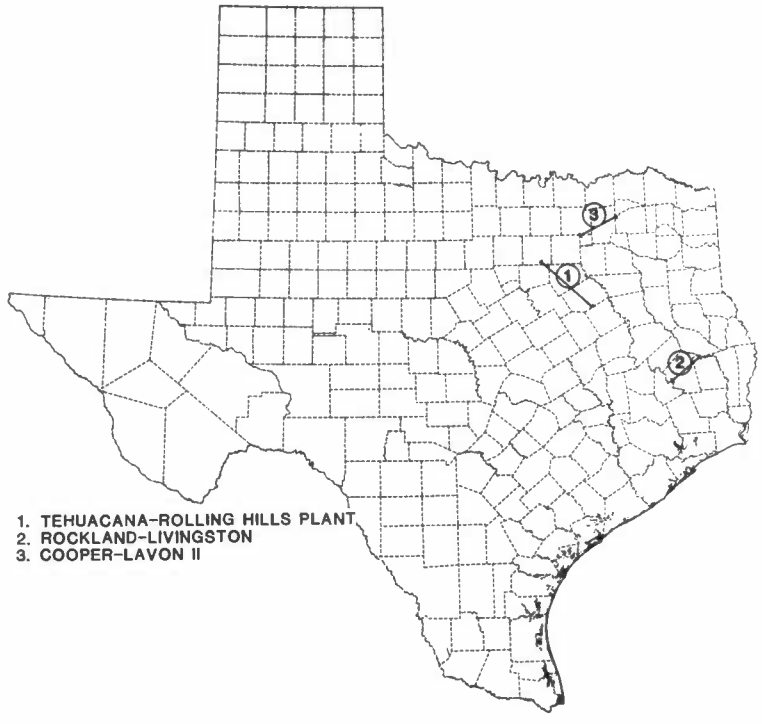


FUTURE WATER CONVEYANCE SYSTEMS NEEDED
1995-1999



1. JUSTICEBURG PIPELINE
2. DOUBLE MOUNTAIN PIPELINE
3. PARKHOUSE-COOPER
4. CUERO I-CIBOLO

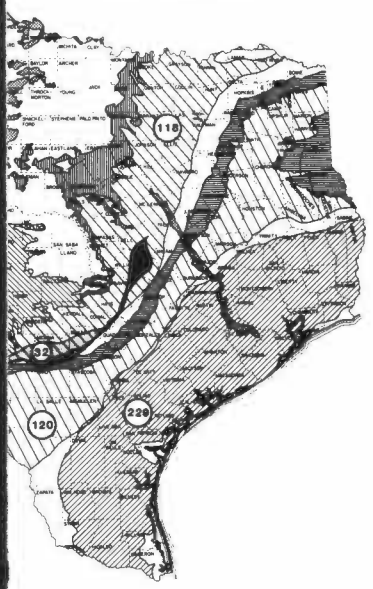
FUTURE WATER CONVEYANCE SYSTEMS NEEDED
2000-2004



1. TEHUACANA-ROLLING HILLS PLANT
2. ROCKLAND-LIVINGSTON
3. COOPER-LAVON II

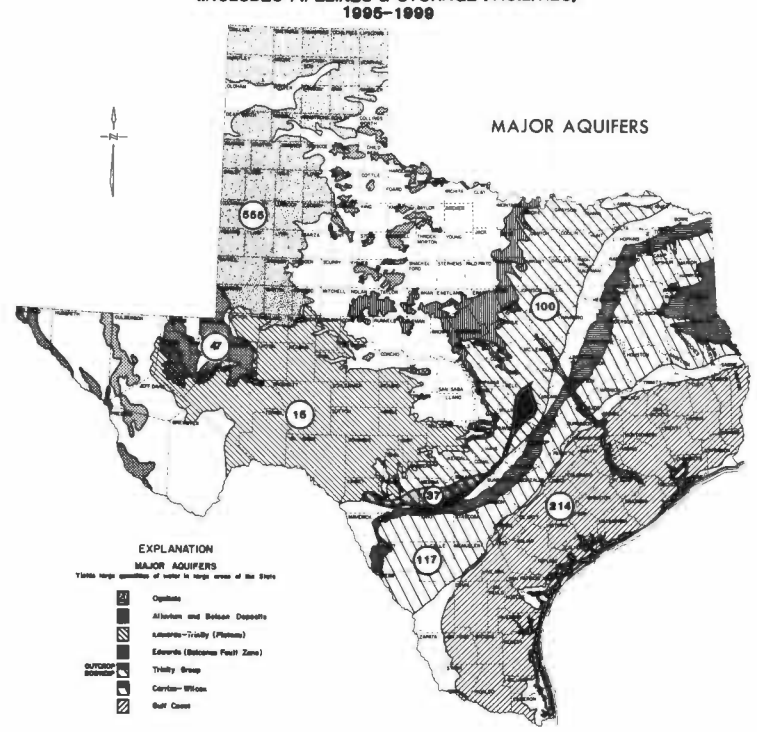
ICIPAL WELLS NEEDED
STORAGE FACILITIES)
994

MAJOR AQUIFERS



NUMBER OF FUTURE MUNICIPAL WELLS NEEDED
(INCLUDES PIPELINES & STORAGE FACILITIES)
1995-1999

MAJOR AQUIFERS



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2000-2004

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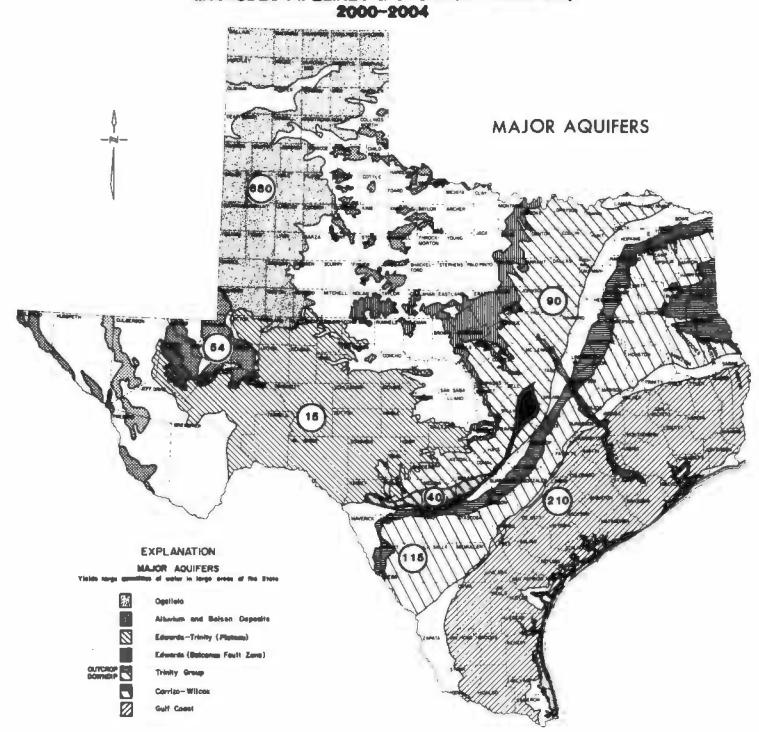

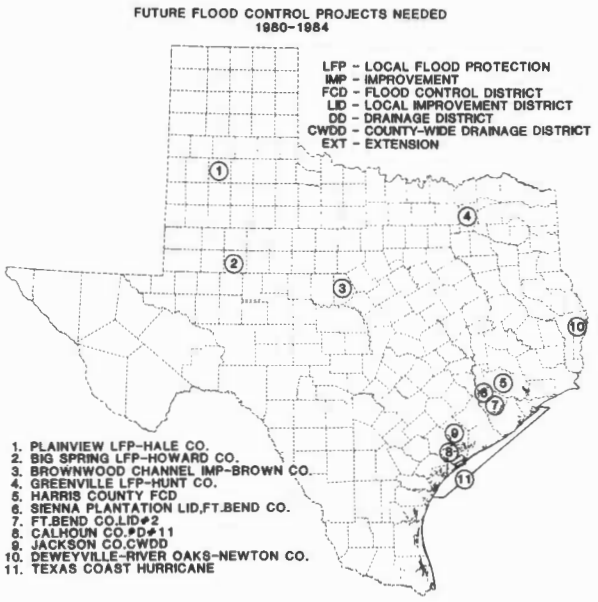

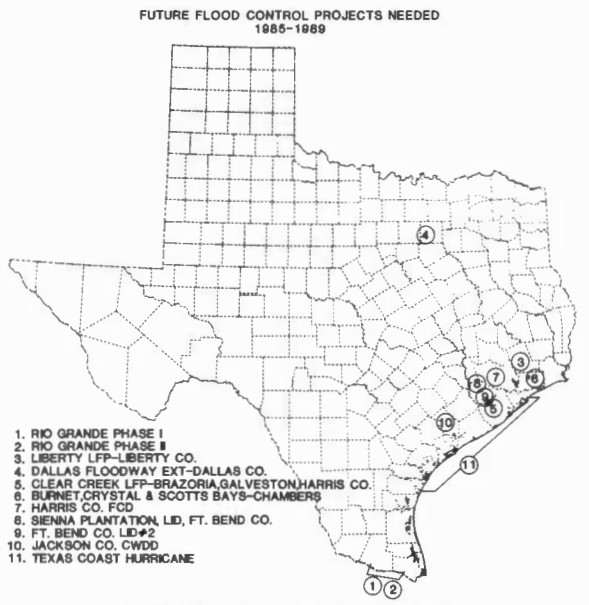

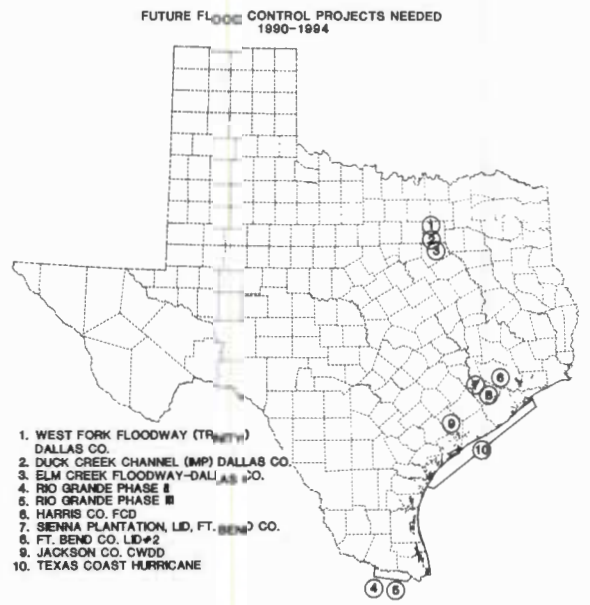

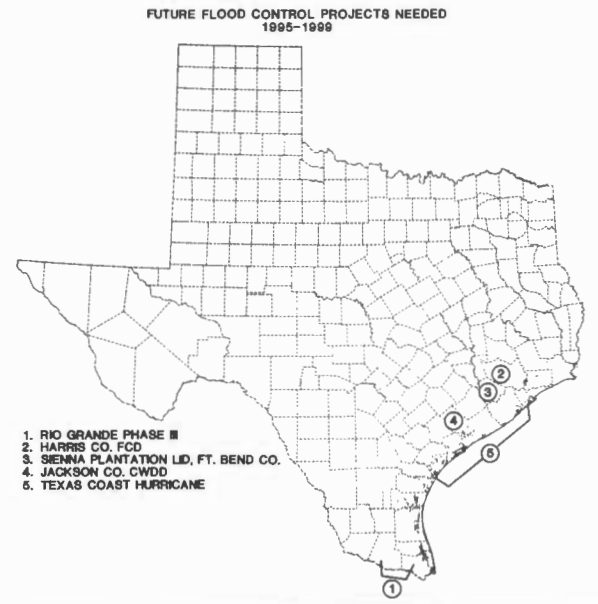

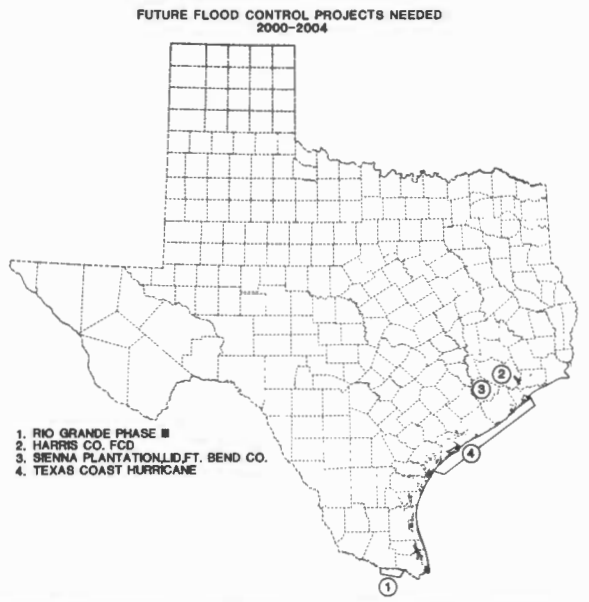

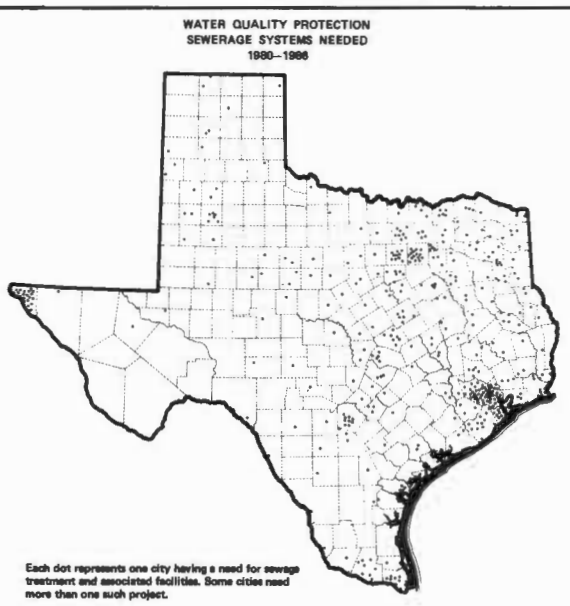

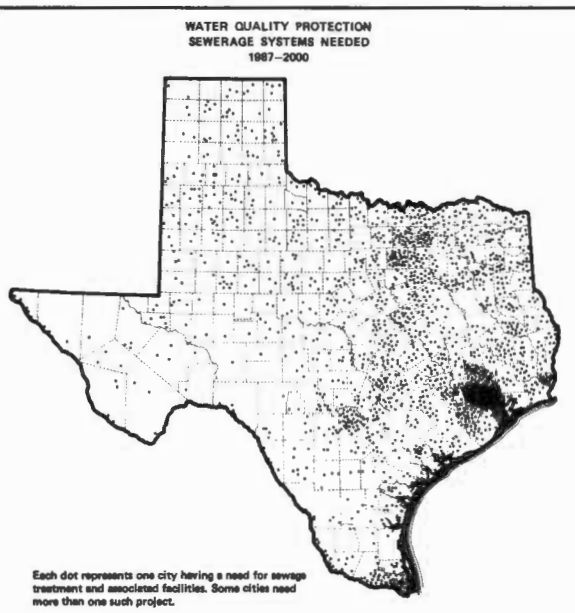

SHIFT IN ACRES . . . .

(continued from page 1)

An alternative analysis has been done based on the assumption that the adoption rate of technology and management to improve water use efficiency would be only one-half as effective, in terms of average reductions in the quantity of water used per acre, as that of the Baseline case. In other words, the average quantity of water used per acre would be reduced from 1.38 acre-feet in 1977 to 1.03 acre-feet in 2000, and 1.01 acre-feet in 2020. Under this assumption of a less efficient technology of water use, annual irrigated acreage in the Texas High Plains would decline from 6.1 million acres in 1977 to 5.2 million in 2000 and 1.9 million in 2020. Under the more efficient water use technology of the Baseline case, other things being equal, irrigated acreage would decline from its annual level of 6.1 million acres in 1977 to 5.5 million in 2000 and 4.9 million in 2020.

When the Six-State Study is completed, it will cover, in addition to the farm level impact analyses, sections on economic impacts and on energy, and several sections concerning work done by the general contractor, including interbasin transfer assessment, national and regional impact assessment, agriculture and water assessment, environmental impact, unconventional water supply assessment, institutional assessment, crop prices, energy prices and technology, dryland farming, nonagricultural development and potential, and alternative development strategy assessments.

(HPSC Bulletin, August, 1981)

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

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PLAYA WATER UNRELIABLE AS RESOURCE

By B. R. CRITENDON, P. E.

The many playa lakes that dot the High Plains of Texas have long been discussed as a potential source of water to supplement the dwindling supply in the Ogallala Formation. When one flies over the High Plains after a recent rain, he is impressed by the reflection from the vast number of playas in the area. It leaves the observer with the thought that a large volume of water lies untapped below him. In reality, neither the quantity of water available nor its frequency of occurrence has yet been totally substantiated.

In an effort to evaluate all possible alternatives for providing water to the High Plains, the U.S. Bureau of Reclamation initiated the Llano Estacado Total Water Management Study. The Bureau contacted the Texas Department of Water Resources to determine the agency's interest in the portion of the study in which the potential of the playas was to be considered. The Department's interest in the potential of the playa lakes has existed for a long time, dating back to 1965 when predecessors of the Department worked on several projects aimed at inventorying the playa lakes. Additional expertise obtained by the Department through the Texas Natural Resources Information System in regard to the development of an operational remote sensing technique for the detection and mapping of surface water bodies showed promise for mapping the surface area of playa lakes. The continued interest of the U.S. Bureau of Reclamation, the Texas Department of Water Resources, and the Texas Natural Resources Information System resulted in a cooperative project to develop a methodology for inventorying and determining the availability of water in the playas.

The study was formulated based on the Texas Natural Resources Information System and the Texas Department of Water Resources being able to accomplish the following work:

WATERING HOLES dot the High Plains after a rainfall, as runoff collects in natural depressions. Evaporative water loss is high.

- Develop a procedure to analyze data from LANDSAT satellites, each of which is equipped with an onboard multispectral scanner for recording images of the earth. The procedure was to make use of a computer system called Detection and Mapping (DAM), identify and map each playa, and provide a means to store the data. It was to also update files of previously stored data and provide a tabulation of each playa by county and a summary tabulation of the playas.
- Evaluate results of the procedure developed by comparing LANDSAT data with aerial photos of the same area taken at approximately the same time. Develop a method for computing playa volume from surface area, and a procedure to estimate the quantity and availability of playa water in the High Plains. Prepare cost of LANDSAT mapping techniques.
- Evaluate results and make recommendations regarding the feasibility of continuing the study.

In the past, efforts to inventory the playas relied, for the most part, on ground-based surveys. Due to the vast area of the High Plains, aerial photography has always been considered too expensive.

LANDSET, in orbiting the earth at an altitude of 560 miles, images the entire High Plains area of Texas in nine frames. This sequence is repeated every nine days and offers the potential to support the need for monitoring playa lake water availability. For these reasons, LANDSAT was considered as the most efficient and cost-effective data source available for total and repetitive coverage of the High Plains.

continued pg. 4, col. 1 . . . PLAYAS

IRRIGATION HAS IMPACT

The conclusion of an input-output study on the impact of High Plains irrigation suggests that all sectors of the High Plains economy, not just agriculture, will be affected by declining water availability and production. However, the good news is, "we do not have to have a decline in the total economy, if we continue to increase the efficiency of the water we use in agriculture, and if we use our current economic base to attract industries which are less dependent on irrigated agriculture," according to Texas Tech University agricultural economist Arthur L. Stoecker.

The 50 percent of the region's million cultivated acres now under irrigation produces two-thirds of the value of High Plains crop production. As water availability decreases and that production declines, all sectors of the High Plains economy, not just agriculture, will be adversely affected.

"Each dollar of output from irrigated agricultural production results in three dollars of total output in the High Plains economy," Stoecker said. "The total output includes further processing of the products, plus the output generated in fertilizer sales and credit services."

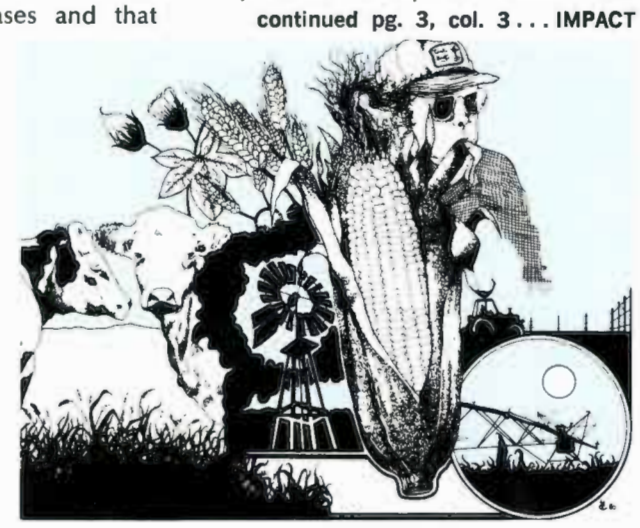
A decline in production from irrigated cropland results in a decline in the total output of economy, Stoecker said.

"The impact would be most directly felt by households, processors of agricultural chemicals, producers of agricultural chemicals, utilities companies, and banking and credit institutions," the agricultural economist explained.

Stoecker holds a joint appointment with Texas Tech University and the Texas Agricultural Experiment Station in Lubbock.

Using 1977 as the base year, he has constructed a model of the High Plains economy, based on a survey of area business firms. Information on the economic output of these firms was compared with expenditures for raw

continued pg. 3, col. 3 . . . IMPACT



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THE CROSS SECTION (USPS 564-920)

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2930 Avenue Q, Lubbock, Texas 79405
Telephone 762-0181

PATRICIA BRUNO, Editor

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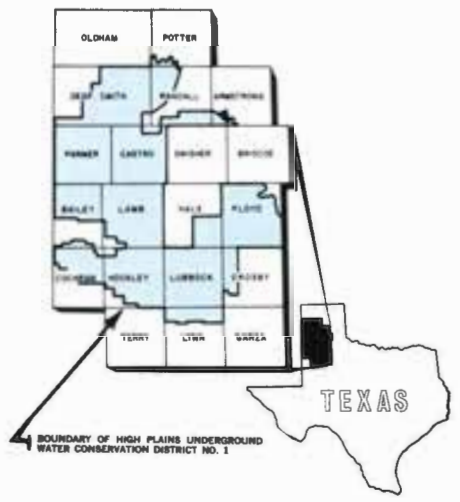


NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Jim Line.

LETTERS---

The race is on:

Dear Editor:

I commend you on your article "Evolution of Irrigation Sprinkler Systems on Texas' High Plains." You brought home the often overlooked and underestimated impact that technology has on solving our present and future problems. Your coverage of Dr. Lyle's research and its practical application by farmers like Carl Butler and James Mitchell will give the doomsdayers and defeatists something to think about as American ingenuity and tenacity go forward to solve our problems.

As President of Lindsay Manufacturing Co., I can guarantee you that the irrigation equipment manufacturers are on to the water conservation challenge. We are indeed lining up in a race "to design sprinkler systems to operate with even less water volumes, at even lower pressures, for an absolute minimum of evaporation loss and uniform distribution patterns."

Keep up the good coverage and send me a hundred more copies of Volume 27—8.

Sincerely,
Gerald L. Abts, President,
Lindsay Manufacturing Co.,
Lincoln, Nebraska

Give 'em a plug:

Dear Editor:

Our compliments to photographer, Kathaleen Curtis, and to you on the article, "Boy Rescued From Open Hole," in the most recent publication of Cross Section (August). Both are excellent to emphasize the importance of plugging and sealing abandoned wells.

If available, we would appreciate receiving 60 additional copies of this issue for distribution in this Commission's district.

Very truly yours.
Ellen B. Osborne
Administrative Assistant
Capital-Area Groundwater Conservation Commission
Baton Rouge, Louisiana

TASK FORCE APPOINTED

Governor William P. Clements, Jr., named a Water Task Force in June, charging the group with responsibilities having to do with evaluating future water resources in both urban and rural areas in the state. The Task Force held its first meeting in August on July 7 with Chairman Louis A. Beecherl, Jr., of Dallas presiding.

The Governor's Executive Order which created the study group is as follows:

WHEREAS, the continued prosperity and well being of the citizens of Texas are dependent upon the preservation and development of the State's water resources; and

WHEREAS, there is a critical need both at the present time and in the future for an adequate supply of water; and

WHEREAS, the State of Texas is already a water short state in that more water is being used than is being replaced by nature; and

WHEREAS, anticipated population growth coupled with the needs of industry and agriculture will place ever greater demands upon this basic resource; and

WHEREAS, in the immediate future of certain urban areas would suffer greatly curtailed water supplies in the event of a severe drought; and

WHEREAS, the need to anticipate and meet these additional demands is a statewide challenge, not limited to any single region or locality; and

WHEREAS, there is no existing mechanism which effectively coordinates the activities of the responsible state agencies planning for our present and future water needs; and

WHEREAS, the Governor of Texas has the authority to create an interagency planning council to coordinate the planning efforts of the several governmental agencies in the area of water resources under Article 4413 (32a) V.A.C.S.

THEREFORE, in order to meet my responsibilities as chief executive officer of this State and to provide coordination and cooperation among state and local water agencies and to avoid a critical water resource shortfall, I am creating the Governor's Task Force on Water Resource Use and Conservation, hereinafter referred to as Task Force.

The Task Force will be charged with the following responsibilities:

(a) to provide a forum which will facilitate the exchange of ideas and information among the various state water authorities;

(b) to advise the Governor and the Texas Water Development Board on matters which impact the water development and conservation policies of this state;

(c) to study, evaluate, and investigate future water development in agriculture, industry, recreation, and domestic use in all geographic portions of the State as well as both rural and urban areas;

(d) to assist the Water Development Board in maintaining and updating the State Water Plan and to make such interim reports to me as necessary; and

(e) to assist, support, and coordinate with the Texas 2000 Commission.

Principal staff support for the Task Force will be provided by the Texas Department of Water Resources.

Mini-Benches are

Cheap To Build, Hold Rainfall, Increase Yields

BUSHLAND, Texas—Increasing yields of dryland sorghum 98 percent in the Southern Great Plains is a good trick. Reggie Jones, Soil Scientist at the USDA Research Laboratory at Bushland accomplished this with "mini-benches" that held all of the rainfall for use by the crop. Conventional graded furrows produced 1071 pounds per acre of grain, while mini-benches in the same field produced 2125 pounds per acre. Mini-benches can be constructed on nearly flat Pullman soil with less than two percent slope for about $50 per acre. "An economic analysis showed that over 10 years, mini-benches would increase returns a total of $303 per acre," Jones said.

JIM BARROWS, research technician at USDA Conservation and Production Laboratory, Bushland, Texas, stands in dryland sorghum growing on a level mini-bench terrace.

Jones conducted his research from 1975 through 1979. He compared graded furrows, conventional contour furrows, wide furrows, conservation mini-benches and mini-benches. All plots were 450 feet long land, except for graded furrows, were diked on each end. Graded furrows on 40-inch centers with 0.25 percent slope allowed an average of 2.6 inches of runoff annually. Conventional contour furrows were made on 40-inch centers. Wide furrows were formed on the contour with 40-inch beds and 40-inch furrows. Orthman tri-level equipment was used to make the beds, and two rows of sorghums were seeded 40 inches apart in each furrow. These wide beds and furrows could hold twice as much water as conventional contour furrows.

Conservation mini-benches consisted of eight 40-inch rows. The top four were planted flat on the slope and contributed runoff to the lower four rows on an area of leveled soil. A motor grader was used to level the area and a border disk was used to build a dike at the lower side of the leveled area. Level mini-benches were built with a motor grader and border disk and were four rows wide.

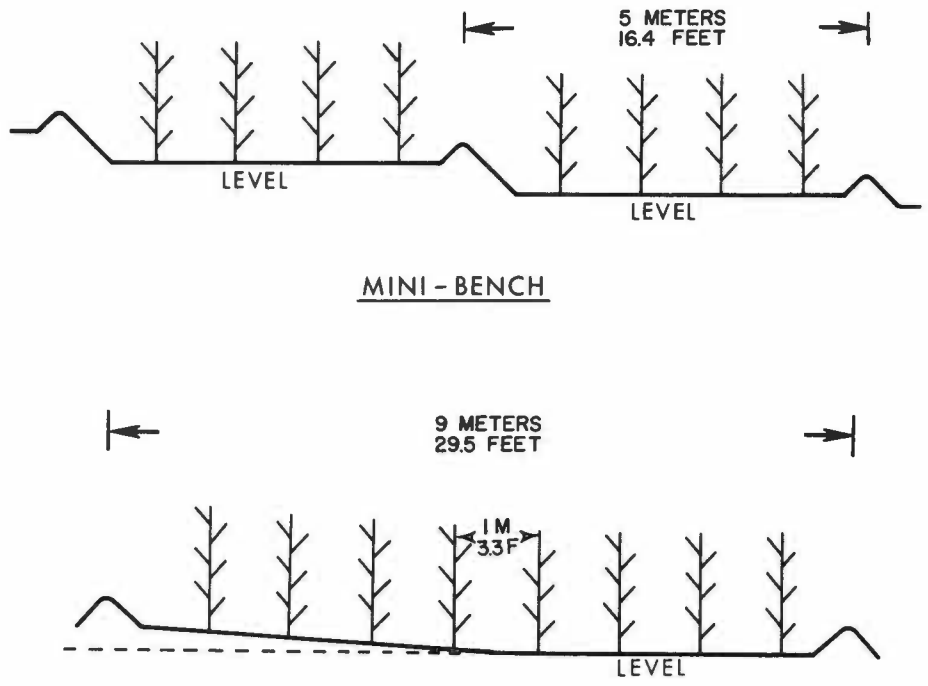
Jones said all plots were tandem disked in early April to bury residue and allow volunteer sorghum to sprout. Furrows were made, and leveled areas were sweep tilled in early May to control weeds and volunteer sorghum. Sorghum was planted on all treatments in mid-June. All plots and dikes were treated with propazine at 1.2 pounds per acre active ingredient immediately after planting to eliminate cultivation.

Runoff control and erosion prevention were severely tested during 1978 when 5.2 inches of rain fell in less than 24 hours; 4.8 of which fell in 7 hours. The USDA researcher said that a storm this severe occurs only once in 75 years.

All treatments except graded furrow and contour furrows prevented runoff. Jones said the wide furrow, mini-bench and conservation mini-bench had enough capacity to hold all of the water.

"Conserving rainfall and preventing all runoff increased sorghum yields from 51 to 98 percent," Jones said. Average yield was 2130 pounds per acre on mini-benches. Conventionally, graded furrows produced 1071 pounds per acre or about average for dryland sorghum on the Southern Great Plains. Sorghum on conservation mini-benches, wide furrow and contour furrows produced 1830, 1620, and 1630 pounds per acre, respectively. Jones said, "High yields on mini-benches proved that using water where it falls is the best way to produce high sorghum yields on dryland." He studied soil moisture and found that water evaporated from the soil when beds were built in the contour and wide furrow systems.

Jones pointed out that constructing mini-benches is much cheaper than building larger conservation systems. On a 2 percent slope, 594 cubic yards of soil per acre would have to be moved to build a 42-foot wide bench terrace. Only 118 cubic yards or 20 percent as much must be moved to construct mini-benches. Cost of the large benches at 1975 prices was $250 per acre. The cheaper mini-benches cost only $50 per acre.



CROSS SECTIONAL schematic of narrow terrace systems used in Bushland research.

The researcher calculated economic returns for the mini-benches and conservation mini-benches. He assumed a 10-year life for each terrace system, sorghum price $6 per hundred and interest at 15 percent. "Mini-benches proved best," Jones said, "if farmers want to maximize profits on dryland, mini-benches can increase returns up to $31 per acre annually over returns from graded furrows." Increased return in 10 years over graded furrows was $313 per acre for mini-benches and $227 per acre for conservation mini-benches.

IMPACT ON TOTAL ECONOMY PREDICTED

(continued from page 1)

materials and unfinished goods to determine interrelationships with the farm sector and other segments of the economy.

The results of Stoecker's 1977 economic model study will be used by the Texas Department of Water Resources to make regional projections of the economic impact caused by changes in irrigation and in petroleum and natural gas production. Those projections, in turn, will be given to the High Plains Study Council and to the Economic Development Administration of the U.S. Department of Commerce, which is assessing the impact of changes in agricultural and petroleum production for the six-state area sharing the Ogallala Aquifer. Affected states are Texas, New Mexico, Oklahoma, Kansas, Nebraska and Colorado.

"Land, groundwater and petroleum are the three basic natural resources of the area," Stoecker said.

The 54-county area that Stoecker and research associates Joe L. Lovell, Eluned Jones, David R. Booth and David A. Pyles studied extends from the Texas-Oklahoma line southward to Pecos and Reeves counties and includes a million residents. The area's largest cities are Lubbock, Amarillo, Midland and Odessa. Of the region's total work force, 11 percent is directly employed in agriculture and 19 percent is involved in the production of inputs for agriculture or the processing and trading of agricultural products, Stoecker said.

Approximately 30 percent of the area's manufacturing is related to processing of agricultural products, including textiles, meat, food and grain.

The Texas Tech researcher pointed out that although the 54-county region lost 34,000 people between 1960 and 1970, the '70s saw an increase of 50,000 residents.

"A major source of growth in the last 10 years was the development of the irrigated feed grains-feedlot-meat processing complex within a triangle running from Lubbock to Muleshoe to Amarillo," Stoecker said. "Of the region's 65,000 new jobs created in 1967-77, more were created in meat processing than in any other industry."

He traced the construction of new feedlots and meat packing plants to the availability of fed grains in that area.

"The seven or eight top Texas counties in agricultural receipts are in this triangle, and they produce a very significant part of total agricultural production in Texas," Stoecker said.

"Previous projections have shown that, under current practices, by the year 2000 irrigation will have decreased in this area by 50 percent, which means a decline in crop production of $300 million in 1977 dollars. This is a total decline in the economy of $900 million."

A decline of 50 percent in irrigated agricultural production would result in a direct loss of 7000 jobs and a total loss of about 18,000 jobs, he said.

"This is how the economy will go if we do not alter our production techniques and compensate by growing in another direction," Stoecker predicted.

PLAYAS . . . .

(continued from page 1)

The study area selected for the project was Lubbock County. This area was contained in a single LANDSAT scene, and two earlier frames of the area were available. After examining historical rainfall data for the study area, TNRIS and TDWR staff selected two high quality, cloud-free LANDSAT scenes representing dry and wet season conditions. The dry season scene was imaged on February 25, 1974, and the wet season scene on July 26, 1976. A scene imaged August 16, 1972, was also analyzed to check the accuracy of the LANDSAT data compared to aerial photography.

Generally, the study shows that LANDSAT data can be used to inventory playa lakes located on the High Plains. While the correlations made for the study show encouraging results, additional work is needed to evaluate a greater number of scenes as well as scenes from other areas of the High Plains.

The results of the study do establish several points. Earlier studies have focused on the number of depressions in the High Plains and not specifically on the number of depressions that contain water. While it is estimated that 19,250 depressions exist in the High Plains of Texas, there is wide variation in the number that contain water. In Texas Water Development Board Report 10, it was estimated that 1,500 of the 19,250 depressions in the High Plains are located in Lubbock County. The current study showed that on July 26, 1976, only 296 of the depressions in Lubbock County actually contained water even though this was an above normal rainfall period for the County. The 296 playas were estimated to contain a total of 10,251 acre-feet of water. Individual playa volumes ranged from a minimum of 1.35 acre-feet to a maximum of 455.58 acre-feet with the average being 34.63 acre-feet per playa.

Using relationships developed by this study concerning the volume of water that could be collected in the playas from various rainfall emounts and the precipitation frequency curve, a playa lake storage frequency curve was developed for Lubbock County. The result showed that the playas in Lubbock County would contain 4,500 acre-feet of water 5 percent of the time, 3,280 acre-feet 10 percent of the time, 2,620 acre-feet 15 percent of the time, 2,190 acre-feet 20 percent of the time, and 690 acre-feet 50 percent of the time. While the economics of utilizing this water resource were beyond the scope of this study, it does appear that the cost for collection and distribution of these waters would be prohibitive.

The cost of expanding the study to the entire High Plains of Texas also appears to be prohibitive at this time. A full-scale playa lake data collection project for the High Plains could cost in excess of $230,000 for the initial effort and about $120,000 for successive years. Such a commitment is probably too expensive for the expected results.

The study did provide some beneficial and interesting information on playa lakes. For the most part, previous inventories of the playas were based on ground surveys which take a long time to conduct. With the vast number of depressions in the High Plains and the short duration of time that they may contain water, no dependable means has heretofore been available to physically observe all the playas at the same time. LANDSAT on the other hand can, within a period of four days, provide images of the entire High Plains.

The study indicated that the playa lakes in Lubbock County are not a dependable water supply because fifty percent of the time only 690 acre-feet or less of water are available for use. The uneven distribution of those playas in the county that contain water makes the playas even less of a potential water supply. For the most part, property owners are probably utilizing the playas to the maximum extent possible at this time.

Another factor against relying on the playas as a dependable source of water is that evaporation rates in the High Plains are excessive. Rainfall exceeds evaporation only a small portion of the time. Therefore, water that is captured in a playa remains in storage only for a very short period of time before it evaporates. In order to utilize a major portion of the playa waters, they must either be placed below ground as recharge to the underground reservoir or otherwise stored where evaporation can be minimized.

HYDROLOGIC ATLASES READY

Hydrologic atlases are now ready for distribution for each of the fifteen counties or portions of counties served by the High Plains Underground Water Conservation District No. 1.

The atlas for each county consists of a packet containing a text specific to the county area and a set of four maps. The maps were developed using twenty feet contour intervals. They illustrate (1) the elevation of the land surface; (2) the elevation of the water table in the Ogallala Formation in 1980; (3) the elevation of the base of the Ogallala Formation; and (4) the saturated thickness of the Ogallala in 1980.

The data for each map describing this information is printed on a county highway base map at a scale of two miles per inch. Legal descriptions are also illustrated on the maps to assist landowners in proper identification of their property. A tremendous amount of data was used in constructing the maps and they should reflect a very accurate picture of the hydrologic conditions as of 1980 for the areas served by the Water District within each county.

The text is short, concise, illustrated, and includes an explanation of how to read and interpret contour lines. Points discussed in the test include the Older Geological Formation in relation to the Ogallala, the composition of the Ogallala, its volume of water in storage, chemical quality, recharge, movement and water-level changes.

The construction and drafting of these maps was made possible with support from the Texas Department of Water Resources. Production has required over six-man years of effort by the Water District staff geologists and draftsmen. The atlases are the most detailed and complete ground water mapping investigation ever completed in this area.

These atlases have been prepared to help local landowners and operators and other county residents to better understand the fresh water resource available under their towns, cities, farms and industries. They should be a valuable planning tool to confirm available water resources and for locating future irrigation well sites. The maps are intended for use primarily in providing general information to the public served by the District and are not warranted for use in real estate transactions or other legal matters.

Individual copies of the atlases for any of the counties served by the Water District may be obtained by contacting the High Plains Underground Water Conservation District No. 1 at 2930 Avenue Q, Lubbock, Texas 79405, 806-762-0181.

Introducing:

We've got ourselves a crackerjack bookkeeper. Meet Kay Hughes. Bookkeeper, accountant, businesswoman and mother. Kay is a native of Lubbock. She worked for Litton Industries for three years before moving to Houston in 1969. It was there she was seasoned to her career as a bookkeeper. For seven years she was supervisor of bookkeepers for a chain of thirty grocery stores.

On coming back to Lubbock in 1978 with her two sons, now 16 and 19, she took to the challenge of owning a small retail business for more than a year. Kay emphatically remembers it was a great educational experience, but preferring a service profession, she sold her partnership interest in favor of more schooling.

Kay, determined to learn accounting, enrolled in Lubbock's American Commercial College. A year later she graduated with a diploma in executive accounting with over 200 hours of coursework and the equivalent of four years of college accounting classes.

Coming to the Water District, Kay said, "I feel fortunate that I was hired; I think it's really a terrific place to work."

She got an unexpected bonus with her new job. The District has just installed a 23-Datamaster computer to handle our growing needs. Kay has been learning her way around computer language and says it's very exciting.

"While it didn't look easy, it's a challenge, and I really love the change. I'm eager to take full advantage and make it work for the District."

Welcome, Kay, from all the District staff, Board and Committeemen.

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

INDUSTRIAL AGRICULTURAL MUNICIPAL

Published monthly by High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405

Volume 27—No. 11 Publication number USPS 564-920, Second Class Postage paid at Lubbock, Texas *November, 1981*

CASTRO COUNTY FARM OWNER Dale Winders, Board Chairman of the Running Water Conservation District, shows SCS Chief Norm Berg the controls on his sprinkler irrigation system. Local District Conservationist Barney Lee keeps an eye on the equipment during a demonstration efficiency evaluation.

SCS CHIEF IMPRESSED BY AREA PRACTICES

Norm Berg, Chief of the USDA Soil Conservation Service, toured the High Plains area recently and observed the newest soil and water conservation practices of local farmers. Berg was in Amarillo to address the 41st annual Texas Soil and Water Conservation District Directors meeting.

The Chief got a first hand look at local irrigation efficiency research and projects in Randall, Deaf Smith and Castro Counties. He also had the opportunity to discuss local problems with several area farmers.

Soil Conservation Service personnel at the Hereford field office ran a pump plant efficiency evaluation on the Bill Wimberly farm, explaining to Berg the benefits of the test. The SCS Chief also visited with Wimberly about area water conditions and the economic situation of local farmers.

James Conkwright, a Hereford rancher and member of the High Plains Water District Board of Directors, hosted a luncheon at the Hereford Country Club where Berg exchanged ideas with the luncheon group on water conservation needs in the High Plains area. Later Berg toured the Dale Winders farm in Castro County where SCS staff from the Dimmitt field office demonstrated a center pivot sprinkler evaluation and explained its importance in a good water management program for fine-tuning irrigation system efficiencies. Berg also stopped at an SCS soil moisture study site on the Monte Ballard farm near Dimmitt.

Observers say Berg listened more than he talked and was extremely pleased to be able to visit with local farmers and see the new ideas and practices for conservation and efficiency being tested in the area.

Berg pledged to support work by the SCS on the High Plains. He believes our problems are not unique, but we are certainly facing them ahead of most of the nation.

Chief Berg commented that USDA policy will stress soil erosion and flood damage control as priorities vital to assure future productivity of American agriculture. He predicted an emphasis on local and state conservation programs and hinted at possible conservation tax incentives or agricultural tax credits.

EDUCATORS CRITIQUE WATER SERIES

A very select group of educators in Amarillo, Friona, Levelland, and Muleshoe are on special assignment for the High Plains Water District and the Texas Department of Water Resources. Their job is to review and evaluate a unique set of water education material created by Water & Man, Inc., a nonprofit educational corporation formed in Salt Lake City, Utah. And a great deal is resting on the outcome.

The teachers were hand picked by their superintendents and administrators in each of these four school districts and invited to attend a dinner meeting where they were introduced to a newly created interdisciplinary water education series for grades K-12. The materials are more than another layer of water information for youngsters. They provide a comprehensive framework as an educator's guide to the goals, concepts and general objectives behind a water curriculum. The conceptual framework booklet of water education goals and objectives is key coded to three sets of teachers' water education activity guides for grades K-4, 5-8, and 9-12. Additional activities are provided in a packet of tear sheet lesson plans. These are accompanied by a Water Jargon glossary of water related terms and a Comprehensive Water Education Bibliography and Directory of current water resources nationwide.

The High Plains Water District was selected for a unique pilot program to evaluate the Water & Man materials because of our track record of providing good quality water education materials to area teachers who were already motivated by a water awareness and concern about local area water needs. These educators were no exception.

At each of the four workshops, teachers and administrators were captured by a hands-on approach to introducing the materials. They listened and participated with enthusiasm. The teacher's teacher was Don Daugs, a contributing designer to some of the Water and Man materials, an educational consultant, and a professor of science education at Utah State University.

WATER & MAN consultant, Don Daugs, spent four days in four school districts on the High Plains, introducing water materials to some 90 teachers and administrators.

The Water District hosted the workshops, introduced Don and presented District Manager, Wayne Wyatt, as a guest dinner speaker. Wayne gave an

continued page 4, col. 2 . . . MATERIALS

"EFFICIENCY IN THE 80's"

The squeeze is on. Improving efficiency of water and energy use is critical to agriculture, industry and municipal water users. A program offering some answers will be the thrust of this years Eighth Annual Conference of the Groundwater Management Districts Association. "Efficiency in the 80's" is the thread that will run through the conference opening at the Lubbock Memorial Civic Center and Hilton Inn on December 2 through the 4th.

The conference is open to anyone interested in such topics as using computers to improve water district or farm management, using chemicals for water conservation, or improving irrigation efficiencies.

Researchers and scientists from the Texas Agricultural Experiment Station, Texas Tech University, the Texas Department of Water Resources, the Soil Conservation Service, the Bureau of Reclamation, the USGS and the USDA-ARS Southwestern Great Plains Research Center will participate in discussions on efficiencies, technologies, and educational opportunities. Don't miss it. Registration begins at 6 p.m. December 2nd at the Civic Center.

See GMDA Conference Program On Page 3 . . .

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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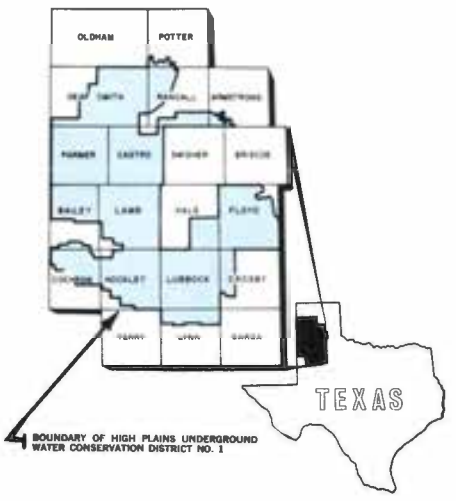

WTCC Water Task Force Reports To Texas 2000

Governor Clements by executive order created the Texas 2000 Project in April 1980. Texas 2000 is designed to ensure that difficult public policy questions are addressed by state government. It provides for early problem identification so that legislative and public opinion can be gathered for necessary action. And it provides for action recommendations from a common information base. The Texas 2000 Commission charge is to describe the long term consequences of current actions, to provide for necessary public services as needs change, and to increase productivity and promote better use of state funds.

The Texas 2000 Commission, appointed by the Governor, is providing both a public forum for the discussion of issues critical to the future of Texas and a means to determine the actions needed to resolve these issues. The project is guided by a Steering Committee headed by the Governor, Lieutenant Governor and Speaker of the House. The Committee requested the three regional Chambers of Commerce in the state to provide information on the various subjects the Texas 2000 Committee is to address for their respective service areas.

The West Texas Chamber of Commerce Task Force on Water recently submitted its report to the Texas 2000 Commission. The following is the first of a two part presentation of the Task Force report with recommendations as delivered by A. Wayne Wyatt, Chairman of the Water Task Force.

The West Texas water problems have been blown out of proportion by news media looking for a crisis. In the West Texas Chamber of Commerce's service area, the water needs of its citizens have been met in the past and will continue to be met in the foreseeable future from the water supplies available in the area. West Texans are the most resourceful people in the world and are willing and able to meet any challenge that presents itself.

Water has never been in surplus supply in the area and is not today. We have in the past and are currently excelling as leaders in water management and we believe that we will continue this tradition.

The Water Committee of the West Texas Chamber of Commerce does not wish the Texas 2000 Commission to view our area as an area of the state which will decline in economic productivity between now and the year 2000 as a result of our declining water supplies. We believe that we can improve or increase our productivity, expand our population, and continue to contribute to the state's economy during the interim period.

We appreciate very much the interest of the Commission and we certainly can use your assistance in reaching our goals. The Texas Department of Water Resources and its predecessor agencies have a reasonably accurate data base on the surface and ground water supplies available throughout the state. The surface water supplies which are available for harvest in the streams and rivers which pass through our area are not yet fully developed; therefore, we can and will develop these supplies for additional growth in the area. The ground-water aquifers in most of the area are being mined. The rate of depletion in most of these aquifers will be reduced substantially during the period between now and the year 2000 due to new technology being introduced for maximum efficiency in the use of these water supplies.

Municipal Water Survey

The Water Committee of the West Texas Chamber of Commerce conducted a municipal water survey in 1980. The purpose of the survey was to identify short, intermediate, and long-range local water needs, as well as possible solutions to these needs, and to obtain a base of water data for future planning of West Texas Chamber of Commerce policy.

The West Texas Chamber of Commerce received responses from 51 towns and cities which is about 33 percent of the communities in the West Texas area.

Cities responding represent the entire range in size, with twelve percent of the responses coming from cities over 85,000 population, 20 percent coming from cities between 12,000 and 85,000, and the remaining 68 percent coming from cities under 12,000 in population.

Water Supply Sources

Over half of the cities and towns responding to the survey (52 percent) relied on ground water for their municipal needs in 1980. Sixteen percent of the cities used surface water sources, and the remaining 33 percent relied on a combination of wells and surface water.

Future Water Supplies

Most of the cities responding to the survey classified themselves in "good shape" for the next 50 years provided they can develop the projects they have presently in the planning stages. Generally, the larger cities appear to be in the best position to meet future demands for water at projected growth rates, while a few small towns and several rural areas indicated immediate supply problems or shortages within the coming 20 years. Of the cities estimating their ground-water reserves in years, the average life expectancy of their ground-water reserves was 44 years.

However, cities planning to construct reservoirs number only twelve percent of those responding. Seventy-eight percent indicated that no reservoirs are under consideration in their areas, with at least half of these towns indicating no need for a reservoir or that reservoir construction was not feasible.

Emergency Contingencies

Thirty-eight percent of the cities answering the survey have an emergency rationing plan for their residents which could be put into effect should the municipal supplies reach a dangerously low level. However, only 16 percent of the cities indicate the existence of an emergency plan by which they can secure water from an additional outside source.

In answer to the question, "Do you think your city would be willing to join a regional water supply project to obtain a long-term source of water?" sixty-eight percent answered yes, 26 percent replied no, and six percent did not answer.

Industrial Water Use

Over 50 percent of those responding have identified industrial water users of some kind in their cities, while the remaining cities indicate that they do not have any heavy industrial customers.

Eighty-nine industries are named by responding cities with water requirements ranging from one million gallons to 785 million gallons of water annually. City officials and chamber officials completing the surveys were asked to estimate what these industries would do if confronted with water shortages, and the responses are eye-opening.

Fully one-fourth of the industries, it is estimated, would move to another city

with an adequate water supply. Another nine percent would close and abandon their operations. Thirty-seven percent would try to obtain their own water supply from a private source, and twenty-two percent could not or would not estimate what the industries might do if confronted with such a dilemma.

Common Problems and Needs

The most common local problem listed by West Texas cities dealt with water treatment and sewage systems.

The survey showed an awareness among West Texas cities of a need to pursue programs that will result in developing additional long-term water supplies; a goal which the West Texas Chamber of Commerce has been working toward since 1918.

Municipal Water Supply Management

Research and development should include the examination of the management procedures necessary for conjunctive use of water for municipal supplies in West Texas. Conjunctive use meaning the use of both surface and ground water to satisfy local needs.

Surface water should be developed as the base municipal water supply and ground water should be used as a supplement where surface water occurs in large enough quantities to serve as the base supply. Ground water should be used only when it is available on a reliable basis, but use should be limited to an amount which will not result in depletion of the supply source. At times when surface water exceeds the current demands, the surplus surface water should be recharged into the ground-water aquifers and stored until such time as this water is needed to supplement the surface water supply.

The feasibility of and technology for storage of surface water in ground-water aquifers for future municipal use very definitely needs a great deal of research. This should be a high priority of the Commission to obtain maximum use of the water resources of the state.

The Water Committee of the West Texas Chamber of Commerce believes that much can be done to reduce the water demand by the urban residents and has prepared a summary of some of these ideas with recommendations as to assistance the Commission might provide.

Urban Water Use

Urban water use in the West Texas Chamber of Commerce's service area is approximately 165 gallons per day per capita. Of this quantity of water, about 65 percent is used inside the home and about 35 percent is used outside the home for lawn watering. Research and development is needed in both areas, particularly in the water use outside the home.

The Texas Agricultural Experiment Station at Lubbock in cooperation with the High Plains Water District, the Texas Department of Water Resources and the City of Muleshoe, conducted studies related to the efficiency of lawn sprinklers during the summer of 1981. This preliminary study revealed that in some instances more than 50 percent of the water being applied through conventional lawn sprinklers is lost through evaporation. Much work needs to be done to identify water application methods which will reduce this tremendous loss and waste in the urban community.

Additionally, work was initiated on the use of plant growth regulators to inhibit the growth of grass and its water use. Five chemicals were identified which showed promise in achieving this objective, however, additional research needs to be pursued before these can be recommended for use in the community. The use of native vegetation for landscaping purposes needs to be further researched. The potential for minimizing water use outside the home in the urban environment is great and education to show the community the potentials needs to be addressed. Current lawn water use can be reduced by one-half with proper research, development and education of the public. Also, the potential to utilize precipitation for lawn watering is tremendous; however, certain federal rules and regulations must be changed such as the FHA and VA's building code regulations requiring that lawns be graded away from houses to the street which virtually eliminates the use of this valuable resource in our cities. Urban runoff or flood flows should no longer be viewed as a problem, but as a resource that needs to be harvested and utilized.

Additionally, large quantities of water can be conserved inside the home. A great deal of research has already been done to identify ways that this can be achieved, such as the installation of flow restrictors for showers and in sinks. Also, some of the major plumbing fixtures manufactured have water conservation devices. An education program needs to be initiated in each city in the State of Texas to inform its citizens as to how much water is being used in each of the routine activities and suggestions need to be made as to how water can be conserved in these activities.

Research, development and education also need to be pursued in the area of the use of "grey water." Grey water herein is defined as that water from the dish washer, the clothes washer and the sink and its potential use as lawn water or for recirculation back through the house for waste disposal in toilets. Admittedly, research has been done on the possibilities of this second use of water within the urban environment; however, very few promotional and public educational efforts have been made in this area.

Use of Water by Public Entities Such as Towns and Schools

Water use by public entities can probably be improved throughout Texas. Research, development and education of public officials and water utility directors are needed to provide them with alternatives as to how they can best utilize the water resources in their communities. Not only to conserve water, but they should

continued page 4, col. 1 . . . TEXAS

Eighth Annual GMDA Conference Program and Events

WEDNESDAY, DECEMBER 2, 1981

3:00 p.m. Board of Director's Meeting (Hilton Governor's Room)

6:00 p.m. Registration Desk Opens (Civic Center Mallway)

6:00 until 9:00 p.m. "Hospitality Night" - Meet and Greet, Exhibits and Films, Drinks and Snacks (Civic Center Mallway and Rooms 111 and 112)

THURSDAY, DECEMBER 3, 1981

8:00 a.m. Registration Desk Opens (Civic Center Mallway)

9:00 a.m. **General Session** (1/3 Banquet Hall)
Presiding: John Turnbull
Welcome
"Welcome to Texas" - Senator E.L. Short, Texas 28th District
"Welcome to Lubbock" - Mayor Bill McAlister, City of Lubbock

9:30 a.m. **Keynote Address**

10:00 a.m. "Plant Stress Laboratories" - Dr. Sam Curl, Dean, College of Agricultural Sciences, Texas Tech University
Testing and Breeding

10:30 a.m. Coffee Break

10:50 a.m. "Precipitation Management Techniques - New and Old" - Jack Musick, USDA-ARS, Southwestern Great Plains Research Center
The Basics

11:20 a.m. "Future Use of Chemicals for Water Conservation, Plant Growth Regulators, Etc." - Dr. Charles Wendt, Texas Agricultural Experiment Station
Hope for the Future

11:50 a.m. Announcements

12:00 noon **Luncheon**
(2/3 Banquet Hall)

1:30 p.m. **Afternoon Workshops**
(Concurrent Sessions)

A. "Water Districts Education Programs" - Chairman, A. Wayne Wyatt, High Plains Water District (1/3 Banquet Hall)
Teaching and Learning

B. "Irrigation Application Efficiency" Chairman, Myron Namken, USDA-SCS (Room 108-109)
Splattering vs. Splashing

2:50 p.m. Coffee Break

3:00 p.m. **Afternoon Workshops Continue**

C. "Computer Applications for District Management/Farm Management" -Dr. Tommy Knowles, Texas Dept. of Water Resources (Room 108-109)
Relief for the Filing Cabinets

D. "Pump Plant Energy Use Efficiency" Co-Chairmen - Leon New, Texas Agricultural Extension Service and Ken Carver, High Plains Water District (1/3 Banquet Hall)
EPA Ratings - MPG

4:20 p.m. Break - Return to Hilton Inn

4:30 p.m. State Caucuses and Refreshments

5:30 p.m. Board of Directors Meeting (Hilton Governor's Room)

7:00 p.m. "Relax and Enjoy" - Cash Bar and Sumptuous Banquet - Mr. Kenneth Hobbs, Esq., will "tickle your funny bone" as our evening speaker (Civic Center 2/3 Banquet Hall)

FRIDAY, DECEMBER 4, 1981

8:45 a.m. "Board of Directors Report to Membership" - John Turnbull, President (1/3 Banquet Hall)

9:15 a.m. "USGS High Plains Regional Aquifer Study - Status Report" -Jack Weeks, USGS
The Numbers

9:45 a.m. "Economic Development Administration - Ogallala Aquifer Study - Status Report" Jean O. Williams, Camp, Dresser and McKee
Crystal Balling

10:15 a.m. "Playa Lakes Study" Bureau of Reclamation - Nick Palacios -Bureau of Reclamation
The Great Illusion

10:45 a.m. Coffee Break

11:00 a.m. "Power Load Management for REA's - LaVerne Stetson, USDA-ARS
The Generators' Revenge

11:30 a.m. "Alternative Energy for the Future - Sources and Use" - Dr. Marion O. Hagler, Center for Energy Research, Texas Tech University
Where Are We Headed

12:00 noon **Adjourn**

1:30 p.m. **Optional Field Tour** "Modified Center - Pivot Sprinkler With In-Furrow Delivery of Water and Modern Cotton Gin"
Putting the Package Together

Water Amendment Defeated Statewide

The Water Amendment went down the drain on November 3, but not for want of West Texas support. The High Plains bucked the statewide trend and overwhelmingly approved Proposition 4. The Water Trust Fund amendment carried by nearly 90 percent all over the West Texas region. Voting patterns were spotty, but the total number of voters here was considered good for a constitutional amendment election. Just not good enough. Voter turnout was only around 20 percent. That wasn't enough to out vote opponents of the measure statewide, particularly in Houston where a heavily contested mayors race brought voters to the polls where they voted against the water proposal four to one. Statewide the measure went down 57 percent against, 43 percent for.

Supporters are convinced a water bill will rise again. Bill Clayton, writer and chief sponsor of Proposition 4, promised the defeated amendment will return in some simpler form for the next legislative session. Clayton attributes the defeat to misunderstanding. He believes "it was a little too complicated for some folks to understand." The measure had three provisions, a bond guarantee, a loan fund, and a higher ceiling on interest rates. Clayton felt people in this area understood the amendment would be helpful and voted for it anyway, and he was pleased with the overall support statewide.

Others saw the trust fund aspect of the amendment as the most complicated and vulnerable.

"It's hard to sell the idea of a trust fund," said Alan Henry, President of the Texas Municipal League. "The mechanics of the financing plan of diverting state budget surpluses into a water trust fund got the most objections," said Henry.

He expects the 1983 Legislature to continue working on a plan to address the long term problems of flood control, sewage treatment and water supply needs for Texas. The need for comprehensive water resource planning still remains. In the months ahead supporters will be designing a revised proposal to present to the next Legislature. Those who opposed the Water Trust Fund Amendment are encouraged to submit their ideas to Governor Clements on how the issue should be addressed in the future.

A MEETING OF MINDS—Participants in this conference at the Water District's board room, agreed to pool their data for a cooperative publication. The report will be a summary of results from hundreds of irrigation application efficiency and pump plant efficiency tests performed and/or supported on the High Plains by the three local water conservation districts, the SCS area offices in Amarillo, Big Spring, Lubbock and Pampa, the Agricultural Extension Service, the State Soil and Water Conservation Board, the Texas Dept. of Water Resources, and local REA's. The report is expected next Spring.

TEXAS 2000 REPORT . . .

(continued from page 3)

be the example in the community for residents to follow.

For example, most cities in the High Plains have at least one or more playa basins located within the city. The area of the playa and around the playa is considered flood plain; therefore, building is prohibited in this area. Consequently, these areas usually have been designated as park areas. Flood waters from the streets are normally discharged into these basins. Most of these basins could be modified to create a holding pond (modification to reduce evaporation and restrict the water to a small area). Water can then be pumped from these basins to irrigate the landscape in the park area rather than using water from the cities principal water supply source. Many schools provide large landscaped areas as play grounds and these schools could use wells on their grounds for irrigation.

Effluent waters from most of the towns in West Texas are being utilized for irrigation and/or other uses such as in cooling towers in power generation and other industrial uses. However, in those towns where a secondary use is not now being made, they should be made aware of the possibilities of reuse of this water hopefully to replace some water which is now being provided by the principal water supply. There are exceptions. Where existing water rights for downstream water users depend on sewage effluent as a return flow to meet their water supply needs, this secondary use of effluent waters would not be feasible.

Landscape design by cities and schools and other public entities should include water conservation in the concept not only to eliminate as much waste of water as possible, but to harvest precipitation.

To be continued . . . next month: Agricultural water problems, water law, importation, and more.

Materials Evaluated For Possible Statewide Adoption

(continued from page 1)

overview of the area's water resources, and discussed some positive steps being taken to address our municipal and agricultural water needs.

The response was tremendous. Every teacher accepted our invitation to participate in the evaluation pilot project. They agreed to carry the materials back to their classrooms, to become familiar with the lesson plans, and activities, and the conceptual framework, to incorporate some of the activities into their existing curriculum as time and demands allowed, and to complete a formal evaluation form summarizing their impressions before the end of this school semester.

The evaluations will be analyzed by Jim Barufaldi, Director of the Science Education Center at the University of Austin, and by select master teachers throughout the State.

The Water & Man evaluation program is being sponsored by the Texas Department of Water Resources which hopes to consider these evaluations in a decision to recommend possible statewide distribution of the Water & Man materials through the Texas Education Agency.

AMARILLO TEACHERS AND ADMINISTRATORS listened to Don Daugs explain Water & Man's story and recommend local background reading in the District's own water text being used by Amarillo's earth science classes.

THIS PLUME IS MIGHTY n the hands of Asst. School Superintendent Elizabeth Watson. The Muleshoe workshop was given a water color assignment to dramatize ways of applying the conceptual framework of the water series to classroom activities.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
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SECOND CLASS PERMIT

THE Cross SECTION

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TEXAS WATER PLAN TO BE REVISED

Louis Beecherl, Chairman of the Texas Water Development Board, announced recently the Water Development Board has authorized its staff to undertake a new effort to review and revise the Texas Water Plan and to develop recommendations to be made to the Governor and to the Legislature relating to long-range solutions to Texas' water needs.

The Board and the Texas Department of Water Resources will be aided and advised by Governor Bill Clements' Task Force on Water Resource Use and Conservation.

Our goal is to revise and update the Texas Water Plan in time to present results and recommendations to the next session of the Texas Legislature when it convenes in January of 1983.

The task is an extremely complex one. It involves a very large number of factors including recognition of existing water rights, along with the views and interests of the 1,050 existing water authorities and districts, 786 municipal water systems, approximately 2,500 water supply corporations, nearly 4,000 major industrial water users, tens of thousands of irrigation farmers, several federal and state agencies, public and private research and special interest organizations, and of course the general public.

Specific attention must be given to an extensive list of water-related concerns:

- Water supply
- Water quality protection
- Flood protection
- Water resources research
- Water conservation
- Better use of flood storage in existing and potential reservoirs.
- Improved coordination between water districts, river authorities, federal agencies and conservation districts in construction and operation of projects.
- Inter-basin transfers of water
- Modifications to Texas water law that may be needed for more efficient management of water resources.
- The state's role in financing water projects.
- Environmental elements of water resources programs.

Cities and towns throughout Texas are struggling with urgent water-related problems which threaten to erupt into a statewide crisis which could threaten our health and prosperity if not addressed on an orderly basis. Data available to the Department shows that the water supply, water treatment, sewage treatment and flood control needs facing us over the next 25 years have a staggering price tag in excess of $50 billion, most of which will have to be paid for by the local utility customers and taxpayers. For example, Texas must develop 36 new reservoirs before the year 2005—just 24 years from now—to meet the state's projected surface water requirements. Even sooner, by 1986, 500 sewage systems need to be built, and between 1987 and the turn of the century an additional 2200 sewage treatment facilities need to be built all at a cost of $11.5 billion.

Federal funding available in the past will not be available in the future. Thus, it will be necessary for the people of Texas to assume more of the financial responsibility for water, sewer, and flood protection projects.

One of the difficult problems of Texas water planning for the future centers around projections, assumptions, and desires about population and economic growth. Rapid growth in recent years and expected future growth are placing severe strains upon municipal water supply and sewer systems. Growth in population and in the associated business, service, and manufacturing sectors has been and is expected to continue to be fundamental to a strong Texas economy that can provide jobs at all skill levels, opportunity for upward mobility of all groups, and a broad and dependable tax base from which education, and public services can be financed through the public sector. A satisfactory supply of suitable quality water is essential to maintain existing levels of the economy and to meet the needs of growth in the future.

Many local and state officials and private sector leaders fully understand these principles of our economy and

contd. on page 4, col. 3 . . . WATER PLAN

SENATOR E. L. SHORT

Short Seeks Public Input

Texas Senator E. L. Short of Tahoka, Chairman of the Senate Water Subcommittee, recently announced in Lubbock his plan to let the public "design their own destiny to resolve long and short term water solutions." His statement comes in the wake of a defeat for the Texas Water Amendment by Texas voters last month. Senator Short stated in part:

"Instead of the Legislature designing a plan they think is in the best interest of Texas, we will take the opposite approach by receiving public input from all areas of the state . . . This will serve a two-fold purpose: first, an informed public makes for the best government possible, and second, more than likely, public acceptance will prevail because I intend to see that the public helps to decide and write the legislation.

"Many newspapers throughout the State, as well as citizen groups, have said that the water amendment failed because of its complex design. They have said the issue needed to be divided. I will divide the defeated constitutional amendment into two parts, and neither is likely to cost the people of the State one red cent.

"We will explore legislation to introduce in the next legislative session. It will be in the form of two constitutional amendments: 1) to allow the

contd. on page 3, col. 1 . . . PLAN

Voters To Elect Slate Of Officers

Voters in the High Plains Underground Water Conservation District will go to the polls on January 16, 1982, for the annual election of a slate of District Directors and County Committeemen. The ballot will carry positions for sixteen County Committeemen and three District Directors in 1982. The election will be held only in those counties (or portions thereof) comprising District Director Precincts One, Two and Five. The eight counties affected are Cochran, Crosby, Floyd, Hale, Hockley, Lamb, Lubbock and Lynn.

Positions to be filled include places for eleven County Committeemen who have completed two consecutive four year terms of service and are not eligible for re-election under the district's by-laws. A total of sixteen county committee places, or two for each of the eight counties, will be filled.

District Director Malvin Jarboe of Floydada, who has served in Precinct Five for six years, is retiring this year, leaving that position open to a new Director. James Mitchell will seek re-election as District Director in Precinct One, and Mack Hicks will seek his second term as Director in Precinct Two.

Directors serve on the Board for two year terms with no restrictions on the number of terms they may serve, while committeemen are elected for four year terms and may not serve more than two consecutive terms.

The District is currently accepting affidavits of candidates eligible to serve, and will publish legal notice of the election and candidates, as well as publish details of the judges and polling places in local newspapers of the affected counties.

Absentee voting begins December 28. Voters must have a valid voter registration certificate, reside within the boundaries of the District and within the county where balloting is conducted. They should cast a ballot only for the candidate eligible to serve in the specific precinct boundaries within the water district's service area where the voter lives. Maps are being provided to each election judge which further define the overall District Directors precincts and county committeemen or county commissioners boundaries. For more information on the election, contact Clifford Thompson at the District headquarters at 2930 Avenue Q in Lubbock, 762-0181.

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PATRICIA BRUNO, Editor

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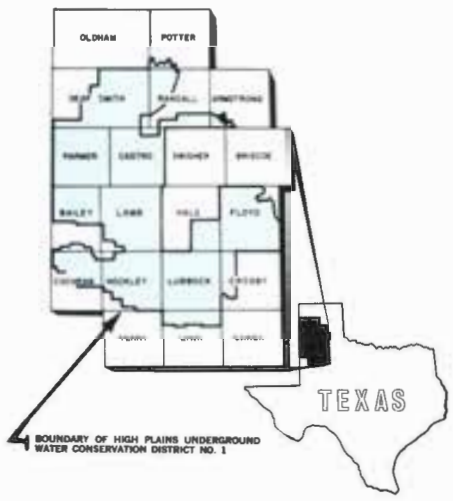

NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Jim Line.

WTCC Water Task Force Reports To Texas 2000

NOTE: The West Texas Chamber of Commerce Task Force on Water recently submitted its report to the Texas 2000 Commission. The following is the conclusion of a two part presentation of that report in the Cross Section (see October, 1981) with recommendations, as delivered by Wayne Wyatt, Task Force Chairman.

Problems: Agricultural Water Users

The number one problem of all farmers (irrigated and dryland) in the West Texas Chamber of Commerce's service area is the nation's "cheap" food and fiber policy. The inability of the farmer to make a profit on his production magnifies those items in his production costs which have increased significantly in recent years such as energy and interest rates.

The nation's cheap food and fiber policy is hampering water conservation activities in the agricultural community. Profits are necessary to improve irrigation equipment and to construct recommended soil and water conservation practices such as terracing, bench levelling, pipelines, and sprinkler systems. Depleting aquifers and available water supplies are of concern to most irrigators, but most will tell you that if farm prices do not improve and soon, they will run out of money and credit before they run out of water.

The probability of little or no profits from farming, either dryland or irrigated, is creating another problem which will also have long-term detrimental effects on agriculture production in West Texas. The problem I am speaking of is the loss of our young people from the farm. Most of today's successful farmers learned the trade on the farm under the guidance and direction of their fathers. Many have degrees from colleges which have helped to improve their skills, but most spent the summers while earning their degrees on the farm. Most of these young people, if forced to seek off-farm occupations will never return to the farm once they are settled in new trades or skills in the city.

The continued production of large quantities of food and fiber from the West Texas Chamber of Commerce's service area is important to Texas and the nation; therefore, the Water Committee of the West Texas Chamber of Commerce recommends that the Texas 2000 Commission work for a national farm program which will allow reasonable profits with prudent management in the farming sector.

Agricultural Water Use

Agricultural water use in the West Texas Chamber of Commerce's service area probably exceeds 90 percent of the total water utilized. The irrigators in the area have worked very hard and even though much progress has been made in the utilization of water in agriculture to eliminate waste, a tremendous amount of work still needs to be done in this area. Maximum utilization of precipitation should be encouraged. The Texas 2000 Commission is encouraged to support proper funding of soil and water conservation programs to achieve this objective, such as the funding of the Great Plains Conservation Program and the ACP cost share programs.

Additionally, research and development needs to pursue precipitation utilization as one of its principal objectives. One example of what can be done is best illustrated by the reintroduction of the furrow diker machine which had been invented in the 1930's. The furrow diker builds miniature dams in the furrow at a close spacing and holds precipitation in place until it has time to infiltrate into the soil. In 1979 approximately 850,000 acres were furrow diked in the High Plains of Texas. In 1980, about two and one-half million acres and in 1981, 3.2 million acres were furrow diked. Precipitation, when held in place, can provide more than one-half of the total water requirements of most of the field crops grown in the irrigated portion of West Texas and can be utilized to increase yields by an average of approximately 25 percent annually in those areas of West Texas which are farmed under dryland conditions.

Chemicals can be utilized to improve water use efficiency of field crops as has been demonstrated by research during the past two years at the Texas Agricultural Experiment Station at Lubbock. Growth regulators have been applied to cotton which reduces the square inches of leaf area, shortens stems, shortens the growing season and has shown to improve the quality and quantity of production by as much as 50 pounds of lint per acre. Thus far, growth regulators have only been identified for a few of the crops grown in the West Texas Chamber of Commerce's service area and this committee recommends that additional work be done on research and development.

A different type of chemical needs to be researched which will reduce the evapotranspiration rates from plants and from the soil surface. The Texas Agricultural Experiment Station at Lubbock has used beef tallow with success in reducing evapotranspiration rates; however, to date the use of beef tallow for this purpose has not advanced to the point of on-farm application. The West Texas Chamber of Commerce's service area has a large beef industry and beef tallow is a by-product with very little market. If beef tallow can be perfected as an antitranspirant, this would strengthen two segments of the agricultural industry as well as conserve water.

Water use efficiency is another area which is being addressed but needs additional support from federal and state levels. In 1978, the Water Districts in the High Plains initiated a program which involved mobile field water conservation labs and technicians trained to conduct on-farm irrigation application efficiency testing at the request of irrigators. To date, several hundred irrigation systems have been evaluated and recommendations have been made to upgrade the efficiency of these systems where inefficiencies were detected. The equipment available and trained manpower available is limited and it is anticipated that it will take ten years to evaluate all of the systems currently in place. Water conservation research and development needs to be accelerated in water use on the farm for irrigation.

Additionally, plants need to be identified which are water use efficient. Federal tax credits for upgrading irrigation and industrial equipment for maximum water use efficiency need to be secured to promote and encourage more efficient use of water. Funding of water conservation research by state agencies such as the Texas Department of Water Resources, Texas A & M University Experiment Station, and Texas Tech University can further identify water conservation techniques to extend the life of the water supply in the area. Therefore, we encourage increased funding in these areas.

Desalinization

In the West Texas Chamber of Commerce's service area, large quantities of salt water are available which in their natural state are presently unsuitable for municipal, industrial or agricultural uses. These occur both as ground water and surface water. It is possible that desalinization of these waters might be more cost effective than the importation of fresh water from outside the area for future use. Therefore, the Water Committee recommends that the Texas Department of Water Resources maintain a staff to quantify available sources and to monitor desalinization technology and costs.

Additionally, the committee recommends that state and federal agencies continue their current efforts to improve the chemical quality of surface water supplies which are being contaminated by inflows of saline water. In the West Texas Chamber of Commerce's service area some cities have elected to extend the usage of their ground water supplies to improve the palatability of the surface water supplies they receive which in turn speeds up the process of mining the underground water supply resulting in earlier depletion. Therefore, the committee encourages the continuation of efforts to eliminate or reduce inflows of saline water which inhibit the usability of water supplies in the West Texas area.

Weather Modification (Rainfall Enhancement)

Federal funds for weather modification studies are becoming extinct. Some weather modification activities in the Upper Colorado River Basin have been ongoing for the past ten years. It appears from the work which has been done that weather can be modified to increase precipitation about ten to fifteen percent. The effects of this increased precipitation is best illustrated in increased crop yields in those counties where the weather modification project has been tested. Average crop yields in these counties have increased about twenty percent during this time period and the farmers in the area indicated a wide acceptance of the program. The Water Committee, therefore, recommends that the Texas 2000 Commission support the Texas Department of Water Resources in their ongoing weather modification research and development and further that they recommend to the legislature that funds be appropriated for continued research in this area.

Water Education in Public Schools

The management of the water resources in the State of Texas can best be achieved by a public which understands the limits of these resources and the methods by which they can be utilized to their maximum efficiency. The Texas school system does not have an adequate water education program in use; however, this can be achieved in a short time by adoption of water education information available which can be incorporated in existing education programs. The Water Committee recommends that the Commission investigate those materials currently available and if deemed inadequate, direct the Texas Education Agency to work with the Texas Department of Water Resources and other appropriate agencies to develop suitable materials for use in the public school systems throughout the state.

Environmental Issues

Surface water development in the West Texas Chamber of Commerce's service area has been hampered and delayed which resulted in increased costs to local taxpayers due to environmental constraints in existing laws. Prevailing attitudes during the 60's and 70's seemed to be that it was alright to construct a reservoir, treatment plant, and necessary conveyance facilities provided no part of the environment was disturbed. Benefits provided to humans as a result of such projects were placed at a be of more concern. State and national low level and concerns for the pup fish, snail darter and blind minnows seemed to laws need to be reviewed and environmental issues put in their proper perspective as to the weight of benefits provided by project development.

Water Laws

The water laws of the State of Texas should be administered to provide proper development to support maximum utilization of the state's water resources while giving full recognition to existing water rights. The water laws of the State of Texas need to be reviewed and those laws which are currently active need to be updated, amended or repealed that prohibit the effective use of the state's waters and restricts the beneficial use of water within the state. Additionally, the state should take a strong position on federal laws and federal agencies' regulations that hamstring the overall development and use of water such as Section 404 of the Clean Water Act.

Water Importation

Water importation to the area served by the West Texas Chamber of Commerce would be highly desirable to support the water needs of the area, particularly if it is to develop and grow to its maximum potential. Supplemental water would also support the needs resulting from declining water supplies from the aquifers located in the area. At the present time importation of water from areas of surplus such as portions of the Mississippi river system is not considered economically feasible under current federal procedures for evaluating water projects. Economic feasibility is further degraded by present high costs of energy and prohibitive interest rates. The committee realizes, however, that importation of water to the area will ultimately emerge as a national issue and recommends that the Governor and the Texas 2000 Commission support importation of water to the area.

Irregardless as to the future time of construction of an import project, water use technologies to maximize the use of the water resources must be improved to optimize the use of water resources available in the area both now and in the future. Application of research and development recommended for maximum efficient water use will dictate the quantities of water needed to be imported into the area.

In Conclusion

I began this set of remarks by saying the water problems in West Texas have been blown out of proportion by the news media. Let me now close the loop by returning to that remark. In no significant sense do I mean to dump off our water problems upon the news media; nor do I mean to imply that they have created a problem where none exists. The issue of providing a continuous supply of water is of such a long-term nature that it exceeds the attention span of almost everyone, including those operating in the political domain. There just is not much enduring glory and recognition inherent in a water project that takes years of continuous dedication to complete. In effect, water problems are never solved in the sense of being resolved once and for all, but are managed continuously through time by trying to keep available supply one step ahead of essential demand. Issues of this sort do not make very exciting campaign material. They are gloomy and they exhaust peoples' patience and interest. True statesmen are necessary to endure the test of time to complete and manage water projects.

If this Commission issues a concluding paper that blossoms with concensus agreement that indeed the problem is serious and indeed it is deserving of widespread attention and support, the report likely will collect dust on the shelves of the libraries throughout the state with little being accomplished. In my view, this Task Force can provide a valuable and, most importantly, an enduring public service by putting in place a mechanism that causes attention, effort, and resources to be concentrated continuously upon this long-term problem of water supply development and management. We need an executive and legislative mandate upon the appropriate public agencies to get a planning process in place. This must be a genuine planning process, not merely a studying process. With such a mandate in place, productive effort can be concentrated upon producing solutions to this continuing water supply problem.

Thank you very much. The members of the West Texas Chamber of Commerce's Task Force on Water are:

Mr. A. Wayne Wyatt, Chairman
Manager, High Plains Water District

Mr. Owen Ivie, Vice-Chairman
Manager, Colorado Municipal Water District

Mr. John Williams, Manager
Canadian River Municipal Water Authority

Mr. Orval Allen, Manager
North Plains Water District

Mr. Richard Bowers, Manager
Panhandle Water District

Mr. Al O'Brien, Manager
White River Municipal District

Mr. Carson Hoge, General Manager
Brazos River Authority

Mr. Russell Bean, Past President
Board of Directors, High Plains Water District

Mr. Fred Parkey, General Manager
Red River Authority of Texas

Mr. Duncan Ellison, Executive Director
Water Incorporated

Mr. Martin Clevellan, Manager
West Central Texas Municipal Water District

Mr. Ralph McLaughlin

Mr. M. L. Wiggins

Mr. Gary Hanner

Mr. Sam Phelps

PLAN IN REVISION . . .

(continued from page 1)

State to guarantee local water bonds, and 2) to permit the State to pay up to 12% interest on the bonds sold. . .

"We will be gathering information to draft a plan by exploring the needs to year 2020 and beyond for the urban areas, cities, and small towns. . .

"We will try to establish food and fiber needs for Texas, the nation, and the world. We must establish the economic impact to this State for years to come, in industry, agriculture, and energy, with projected shortages and decline of water resources.

"Education is a big factor toward getting public acceptance of a water plan. We might be doing the State and ourselves a favor by putting on a first class public relations campaign in Houston, Dallas, and San Antonio, telling them our farmers are the best in the world. They are grassroot conservationists and are using soil and water management in the best ways known to man. We need the rest of the State's population to be proud and knowledgeable of West Texas' productivity and contribution to the very survival of the urban masses and the economy of Texas.

"When the Legislature and the people discuss water needs for Texas, they should not consider this a rural vs. urban issue. Texas needs a plan, written by Texans and approved by Texans. We cannot expect federal assistance until we solidify our efforts as a State. Personality conflicts, area-to-area conflicts, partisian political differences all should be cast aside . . .

"The information and the attitudes of the people of Texas will finally be reflected in a report that should be a valuable document for the Legislature, Congress, and the Nation."

Texans Lose Bill Waddle

The District deeply regrets the untimely death of Bill Waddle on November 27. Bill, only 45 years old, was general manager of the Texas Water Conservation Association in Austin for thirteen years.

He is remembered fondly by the Water District staff as a former staff member and as *Cross Section* editor from 1964 to 1968. He was an Agricultural Education graduate of Texas Tech University. Bill's experience included three years as a county agricultural agent with the Texas Agricultural Experiment Station, College Station, and three years with the Lubbock Chamber of Commerce as assistant manager for Agriculture.

Bill received an Outstanding Civic Service medal and certificate only last year from the Department of the Army

for his service to the Southwest Division of the Army Corps of Engineers. He was cited as a "prime mover in the field of water-related legislation at both the State and federal level." Bill Waddle will be truly remembered for his many and major contributions to the development of Texas' water future.

Edwards Introduces Mini-Text

The Edwards Underground Water District is going into the education business in a big way. They have just published 40 thousand copies of their own mini-water textbook for public schools titled *Water, Water Conservation and the Edwards Aquifer.*

Prepared by the EUWD and Southwest Texas State University's Edwards Aquifer Research and Data Center in San Marcos, the textbook is being distributed to middle school through senior high students and teachers in the District's five counties of Bexar, Comal, Hays, Medina and Uvalde.

Tom Fox, Manager and mover behind the water book idea for Edwards, says the text may be used most effectively with eighth and ninth grade Earth Science classes, but is not necessarily restricted to this class level or curriculum. The mini-text is meant to be a supplement to current school textbooks, and not to replace existing materials.

Teachers also receive a guide to the text offering water experiments, classroom and field activities, field trip suggestions and text questions. Fox hopes the children will take their Edwards Aquifer water books home for their parents to study and learn more about how the aquifer functions.

The High Plains Water District's Board of Directors and staff congratulate the Edwards Water District and the Research and Data Center for their attractive and very informative publication. We hope demand for the booklets mightily exceeds the supply.

Members of the Secondary Recovery Study Advisory Board met for the second time recently at the Water District office in Lubbock. A substantial amount of material was presented for their review and consideration. Advisory Board members include: Chairman, Dr. Charles Wendt, Soil Physicist, Texas Agricultural Experiment Station, Lubbock; Dr. R. M. Brimhall, Petroleum Engineer, PE Department, Texas A & M University, College Station; Dr. Ron Lacewell, Agricultural Economist, Department of Agricultural Economics, Texas A & M University, College Station; Dr. Warren Wood, Ground Water Hydrologist, USGS, Reston, Virginia; and Don Rauschuber, Engineer, Rauschuber & Associates, Inc., Austin.

The Board expressed their approval and confidence that the study is progressing satisfactorily.

WATER PLAN UNDER STUDY

(continued from page 1)

are working to find solutions to water and other problems of the public and private sectors. However, there are mixed voices regarding policies and programs of water resources development. On the one hand, the Texas Department of Water Resources is urged to adopt and pursue policies to develop water supplies to meet the needs of the future, including growth. On the other hand, the Department is urged to pursue objectives of limited growth, increased conservation (meaning to reduce per capita use of water by people and reduced quantities of water for industry and agriculture), and increased regulation of water use.

In Texas, state water resources agencies historically have been limited in authority to water rights and water quality protection administration, statewide comprehensive water quality and water development planning, and the administration of a water development loan program for hardship cases. The implementation and operation of water supply and sewage treatment systems is the responsibility of local and regional units of government. Thus, Texans must realize that the Texas water resources program is fragmented and is the subject of heated discussion by many voices holding varied opinions reflecting widely differing objectives. Most Texans know, however, that our state both enjoys and suffers from a very wide diversity of climate—ranging from among the highest annual rainfall in the nation on our eastern border to arid conditions at El Paso, and from a subtropical, although semiarid climate in the Lower Rio Grande Valley, to the Panhandle where winters are cold and frozen, and precipitation is light. Obviously, any meaningful state water plan must recognize these realities.

Our population and economy are growing. Without a plan for the future, we cannot avoid a water crisis. The Department has a long-range water planning program in which data and planning methods have been developed to advanced stages. However, the Department does not have all the answers needed to solve the state's long-range water problems. Certainly some of the most important of those missing are the answers to three key questions:

(1) What do the people of Texas want in the way of a water plan?

(2) What are they willing to pay?

(3) How will the cost be financed?

In the months ahead, the Board will schedule both public information/discussion meetings and formal public hearings to address these and other questions of relevance to solving our future water problems as we proceed with our efforts to revise the Texas Water Plan. We welcome the ideas and suggestions of all Texans.

GMDA Elects Officers

Congratulations to Don Smith, assistant manager of the High Plains Water District, who was named President of the Groundwater Management Districts Associations at their 8th Annual Meeting in December.

Don is the 8th president of GMDA. He accepted his post from John Turnbull, Manager of the Upper Big Blue Natural Resources District in Nebraska. Other officers elected are Tom Bell, Manager of the Equus Beds GMD, Kansas, as Vice President, and Craig Pope, Manager of the Groundwater Section of the Little Blue Natural Resources District, Nebraska, as Secretary-Treasurer.

This year's conference was hosted in Lubbock by the High Plains Water District, and featured a program emphasizing the conference theme of "Efficiency in the 80's."

A LINE UP of several past presidents of GMDA joined Don Smith (right) for the business at hand during the annual GMDA conference. Grinning from left are John Turnbull, Wayne Bossert, Northwest Kansas GMD No. 4, Colby, Kansas, and Ron Neighbors, Harris-Galveston Coastal Subsidence District, Houston.

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