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FOREWORD

Legislative Bill 1106, adopted by the Eighty-Eighth Legislature, Second Session (1984) states in paragraph 37 in part: Prior to January 1, 1986, each district shall prepare a groundwater management plan based upon the best available information and submit such plan to the director for review and approval.

The Plan shall include, but not be limited to, the identification to the extent possible of:

(1) Proposed geographic and stratigraphic boundaries of the management area;
(2) Groundwater supplies within the area including transmissivity, saturated thickness maps, and other groundwater reservoir information, if available;
(3) Local recharge characteristics and rates from any sources, if available;
(4) Average annual precipitation and the variations within the area;
(5) Crop water needs within the area;
(6) Current groundwater data collection programs;
(7) Past, present, and potential groundwater use within the area;
(8) Groundwater quality concerns within the area;
(9) Proposed water conservation and supply augmentation programs for the area;
(10) The availability of supplemental water supplies, including the opportunity for groundwater recharge;
(11) The opportunity to integrate and coordinate the use of water from different sources of supply;
(12) Groundwater management objectives, including a proposed groundwater reservoir life goal for the area;
(13) The controls enumerated in Section 46-673.08 to 46-673.12 proposed to achieve the groundwater reservoir life goal, and the impact of such controls on the goal;
(14) Existing subirrigation uses within the area; and
(15) The relative economic value of different uses of groundwater proposed or existing within the area.

In 1991, the Nebraska Legislature enacted Legislative Bill 51 which requires that "prior to July 1, 1993, each district shall amend its groundwater management plan to identify to the extent possible the levels and sources of groundwater contamination within the area, groundwater quality goals, long- term solutions necessary to prevent the levels of groundwater contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards, and practices recommended to stabilize, reduce, and prevent the occurrence, increase, or spread of groundwater contamination."

Due to the fact that this district has already formed a groundwater quality management area that was authorized and approved without amendments to our original groundwater management plan, the district has chosen to present the amendment as a separate section to the plan. The amount of material that the district has accumulated to verify the need for the management area warrants this decision.

Water quantity management has not changed in the NRD since 1986. Water levels are still above those set as the triggering point for any type of quantity control. These levels will be monitored and the plan will be followed if the need arises.

Water quality is a different matter. A continued rise in groundwater nitrate-nitrogen contamination from 1980 levels caused a triggering action in the groundwater management plan. Public hearings were held and the support for a groundwater quality management area was greater than anyone

could anticipate. The Tri-Basin NRD Groundwater Quality Management Area (GQMA) was initiated November 15, 1989, with controls going into effect for the 1990 crop year.

The groundwater quality section of this plan is primarily a compilation of the facts and figures that were used to verify the necessity for the GQMA along with the rules and regulations adopted for administration of the program.

PART I
GROUNDWATER QUANTITY

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INTRODUCTION

The Tri-Basin Natural Resources District is made up of Kearney, Phelps and Gosper Counties in south central Nebraska. Its boundary is the same as for the three counties. It has an area of 1520 square miles. Population of the district, according to the 1990 census, is 18,272. Nearly half of the people live in Holdrege and Minden, the remainder either are rural or live in towns of approximately 700 population or less.

Topography varies from the hill and canyon country of southern Gosper and Phelps Counties to the level valley of the Platte River and the gently rolling plains found throughout the three-county area. Soils for the most part are deep and fertile. The Holdrege soils are predominant although there is a sandhill area along the south side of the Platte Valley in Phelps and Kearney Counties. Soils in the Platte Valley vary greatly but are generally very productive.

The cropland is especially suited to irrigation. There are now nearly 4200 irrigation wells in the district supplying water for an estimated 400,000 acres. The Central Nebraska Public Power and Irrigation District (CNPPID or Central) supplies water to over 105,000 acres of cropland in that area of the NRD that is in the Platte Watershed. Groundwater supplies vary greatly in the district. Generally that area of the NRD in or adjacent to the Central Nebraska Public Power and Irrigation District has experienced a rise in groundwater levels since the district began operation. Other areas of the NRD, especially the southwest corner and along the southern border of Phelps and Kearney Counties have experienced declines in the groundwater level.

Over 95% of the groundwater use is for irrigation with the remainder used for municipal, industrial and domestic purposes. Groundwater is the only source of all drinking water in the district, except for bottled water.

The Tri-Basin Natural Resources District (NRD) has recognized the importance of groundwater since its inception in 1972. Although most of the NRD is in an area of a steady to rising water table due to the influence of the Central Nebraska Public Power and Irrigation District's surface water irrigation project, small areas with a declining water table became apparent in the mid-seventies. A groundwater monitoring program was started in 1977 and expanded in 1978 so that now the NRD monitors 90 irrigation wells in that area of the district not served by CNPPID. Central has their own well monitoring systems and duplication of their efforts would be unnecessary. This monitoring system has been in operation long enough now to give an indication of how the water table is responding to the ever-increasing demand.

Several studies have been initiated by the Tri-Basin Natural Resources District to monitor the groundwater system. In 1980, the NRD entered into a cooperative agreement with the Conservation and Survey Division - University of Nebraska, to establish a chemical baseline for groundwater quality in our three county area. The results of this study will be explained more fully in the groundwater quality section of this plan.

Tri-Basin NRD contacted the Nebraska Department of Environmental Quality December 30, 1988, and requested a Special Protection Area study around the town of Wilcox in southwestern Kearney County. The reason for this study request was that Wilcox's public water supply had exceeded the Maximum Contaminant Level (MCL) in nitrates since 1983. The results of this study tended to verify the validity of the formation of the Groundwater Quality Management Area as the Department of Environmental Quality recommended an addition of 41 square miles to the Phase II area of the management area rather than formation of a Special Protection Area. This plan will also be more fully explained in the groundwater quality section of this plan.

In 1983, the engineering firm of Henningson, Durham and Richardson, Inc. (HDR) was selected to conduct a groundwater recharge study of the NRD. The first phase of this study was completed along with a preliminary investigation of diverting drainage water from the lower reaches of Central District's Phelps Canal system near Minden into Sand Creek to be used for groundwater recharge. Selection of ten possible reservoir sites along Sand Creek was included in the study. Opposition to any diversion of water to Sand Creek by local landowners and the unfavorable cost-benefit ratio of reservoir construction costs to recharge benefits made the board decide to stop the program for now.

After LB 375 was passed by the Legislature in 1982 allowing Natural Resources Districts to write groundwater plans and establish groundwater management areas, the Law was explained to different farm groups in the NRD in an attempt to get some feeling as to how the district should proceed. The acceptance of the idea of a groundwater management plan and possibly a designated management area fell on deaf ears. No one opposed the Law as a management tool for someone who needed to use it but thought it was unnecessary in this area at this time. Consequently, no further action was taken by the Tri-Basin NRD toward groundwater management planning until after LB 1006 was passed, making it mandatory.

Another study which has been a valuable tool in formulating this amended Groundwater Management Plan is the U.S. Geological Survey Water Resources Investigations Report 87-4176, a joint venture of the U.S. Geological Survey, the Nebraska Natural Resources Commission and the Lower Republican NRD. The study was devised to gather the information necessary to resolve future water resource problems brought on by extensive irrigation development in that part of the Platte-Republican watershed which includes Dawson, Franklin, Furnas, Gosper, Harlan, Kearney, Phelps and part of Webster Counties. This study was to fill the gap between studies already underway in Lincoln and Frontier Counties on the west and the Big and Little Blue River Basins on the east.

The report was completed in 1987. Many of the maps used in this plan are taken from this report. Although this report deals primarily with water quantity, the information on hydrogeologic characteristics is applicable to water quality as well.

I. TECHNICAL REQUIREMENTS

A. Proposed Geographic and Stratigraphic Boundaries

1. The geographic boundaries for the groundwater management plan will be the same as those of the Tri-Basin Natural Resources District as certified by the Secretary of State of Nebraska when Natural Resources Districts were formed. This area includes all of Gosper, Phelps and Kearney Counties. See Map #1 in Section II - Maps and Graphs.

2. The stratigraphic boundaries of the groundwater management plan are from the ground surface down to the base of the underlying layers of water bearing sands and gravels which make up the groundwater reservoir of the entire district. The major sources of groundwater are the undifferentiated Pleistocene deposits and the Pliocene Ogallala formation. Most of the wells in the Tri-Basin area draw water from the Pleistocene formation although many of the newer wells are drilled deeper into the Ogallala formation.

B. Goundwater Supplies Within the District

1. Quantity: Generally speaking, groundwater supplies within the Tri- Basin Natural Resources District are very good. Map #2 shows groundwater in storage by townships in acre feet. The total for the NRD is 50,104,000 acre feet, based on 1980 figures compiled by the Nebraska Natural Resources Commission for our groundwater recharge study in 1983. Based on water level variations in the NRD groundwater monitoring system from 1980 to 1992, it is safe to assume that this amount of water is still in storage.

2. Saturated Thickness - the layers of sand and gravels that make up the groundwater reservoir lay generally from 40 to 200 feet below the land surface and vary in thickness from 0 to 400 feet across the NRD. One test hole drilled in northwest Gosper County by the Conservation and Survey Division, University of Nebraska in 1981, had over 500 feet of water-bearing sand and gravel. The layers are thicker in the north and taper off to the south to where there is not enough thickness for a high capacity (500 gpm or more) irrigation well in some areas along the south boundary of the NRD. Maps #4 to #10 (in the map and graph section) show north-south geologic cross-sections across the district from west to east. Maps #4 and #5 are from the Geological Survey Water Supply Paper Number 779 dated 1938. They are very general in nature but give you an indication of the pre-development water table. Maps #6 through #10 are from CNPPID's application for a permit for incidental underground water storage and recovery for Gosper, Phelps and Kearney Counties, submitted to the State of Nebraska, Department of Water Resources, in October 1984. Some of these cross-sections were extended to shale to give an indication of the thickness of the aquifer. Also note that the maps show both the pre-development (1952) and 1983 groundwater elevations. Map #11 is a configuration of the base of the aquifer taken from USGS Water Resources Investigations Report 87-4176. Map #12, also from the same source, shows the thickness of the principal aquifer.

3. Transmissivity is the rate which quantifies the ability of an aquifer to transmit water and is expressed in thousands of gallons per day per foot of saturated thickness. Transmissivity can limit the pumping rate of a well and in many instances is more of a factor in irrigation development than the groundwater in storage. The distribution of transmissivity for 1940 and 1981 is shown in figure 3 and figure 3A. Transmissivity values increased from 1940 to 1981 in the northern part of the district. The transmissivity of the aquifer is a good indicator of potential well yield at a given location. In areas where transmissivity values are large, wells are favorable for developing high yields. Groundwater flows in the direction of decreasing head which usually follows water table contours. Flow pattern will be toward discharge areas and away from recharge areas. The

rate of movement of pollutants in the aquifer is also partially regulated as a result of discharge and recharge.

4. Groundwater Level Contour Maps: Maps #13 and #14 are contour maps of the water table expressed in feet above sea level and show the difference in the water table from pre-development to the present time, respectively. These maps are taken from CNPPID's water right application for underground water storage and recovery and would be the most up-to-date of any maps of the area. Note the groundwater mound shown on Map #14. As the water migrates out from this ridge of high water levels it recharges a large area of the district. The area believed to receive some benefit from this migration is outlined on Map #15.

5. Depth to Groundwater: The distance from ground level to the static water level varies across the NRD from less than 10 feet to over 200 feet. The wells in the well monitoring network varied from 7.66 in northern Kearney County near the Platte River to 228.79 in southern Phelps County in 1992. Maps #6 through #10 show an approximate groundwater depth. Note the extreme variations on Maps #6 and #7.

C. Recharge Characteristics and Rates

The following paragraph is from the Groundwater Recharge Program Phase I status report prepared for the district by HDR as explained in the introduction:

> "The most suitable surface and soil conditions for recharge projects are concentrated along the northern border of the District across the eastern half, and at a few other scattered locations along the southern border of the District in the western half. The Sand Creek area rates quite high from a surface soil suitability standpoint. Some of the better soil conditions for recharge also occur in the southwest corner of Gosper County where a current and projected decline area exists. Soils everywhere in the district are generally very permeable, and have not limited the amount of recharge that has occurred from canals and surface application in the area."

These same characteristics hold true for the movement of contaminants through the vadose zone and into the aquifer.

Recharge from the CNPPID system which has gone on now for over 40 years is estimated at 6.5 to 7.0 million acre-feet. From this it can be concluded that if (or when) a recharge program is initiated soil conditions will not be a limiting factor. The rate of recharge is difficult to assess. Factors such as soil type, amount and concentration of rainfall influence it. Estimates of natural recharge from precipitation vary from 1.0 to 6.0 inches per year across the district according to the groundwater recharge study by HDR (See Map #16). The largest amount of recharge was in those townships with very sandy soils and shallow groundwater levels. This rate of natural recharge equals 163,800 acre feet per year for the entire NRD. The 42,000 irrigation wells in the Tri-Basin NRD could pump this amount of water in less than 10 days.

D. Average Annual Precipitation and Variations

The Tri-Basin NRD has a semi-humid climate. The variable weather in the region is typical of the interior of a large land mass in the temperate zone.

The area lies between the rain shadow of the Rocky Mountains and the more humid regions to the east, so the amount of precipitation varies considerably from year to year in response to small changes in the prevailing winds. Nearly all moisture is carried by warm winds from the

Gulf of Mexico and the Caribbean. When these currents maintain a more easterly direction, drought conditions can develop.

Average annual precipitation in the Tri-Basin area varies from 24 inches in the east to less than 22 inches in the west (see map #17). But averages are misleading - the average precipitation during the 10 wettest years on record is more than 2 times that received during the 10 driest years on record. Generally, more than three-fourths of annual precipitation falls during April through September. However, because of the extreme variations in frequency and amounts of rainfall from month to month and year to year, current crop production without irrigation is next to impossible.

E. Crop Water Needs

Corn, sorghum, alfalfa and soybeans are the crops irrigated in the area with corn being the main one. Soybeans have probably edged out alfalfa as the second most irrigated crop as they have gained in popularity the last few years. Sorghum, primarily milo, is grown under irrigation in areas with a limited water supply as it can withstand moisture deficiency conditions longer than corn without a reduction in yield. Much of the alfalfa is irrigated with "off-season" irrigation water. Very little wheat is irrigated in this area.

The water supply to meet a crop's consumptive use demand is partially met by precipitation during the growing season plus any moisture in the root zone carried over from the previous fall and spring. This will vary from year to year but will usually average from 10-14 inches. The following table shows the probable water needs for the main production crops in the area, assuming 12 inches of water is supplied by precipitation.

CROP	TOTAL NEEDED	TOTAL IRRIGATION REQUIREMENT
Corn	26 - 28"	14 - 16"
Sorghum	22 - 24"	10 - 12"
Soybeans	22 - 24"	10 - 12"
Alfalfa	30 - 36"	18 - 24"

Assuming a 70% irrigation efficiency rate, which can be obtained with proper management, 16" to 18" of irrigation water should meet average crop needs within the NRD. This would vary from year to year depending on amounts and timing of precipitation.

Current Groundwater Data Collection Programs

The Tri-Basin Natural Resources District began its groundwater level monitoring program in the spring of 1977 at which time 43 wells were chosen for measurement. Forty-one wells were added to the program in the fall of 1978 to give a more representative overview of groundwater fluctuations in the district. Five wells in Kearney County, formerly measured by the United States Geological Survey, were added to the network in 1982. The well network was planned to avoid duplication of wells already monitored by the Conservation and Survey Division, UNL, and the CNPPID throughout its surface water delivery area.

The monitoring program consists of spring and fall measurement of water levels in the selected wells. The measurement is taken by lowering a chalked steel tape down the well and recording the static (non-pumping) water level in the well. These recordings are sent to the cooperating well owners for their information and also to the United States Geological Survey, where the readings become part of a state-wide program coordinated by the Nebraska Conservation and Survey Division and including many other natural resources districts.

The location of these observation wells is shown on Map #18. The wells within the shaded areas are wells that have shown a decline in the static water level from the spring of 1983 to the spring of 1993. These declines range from 0.02' to 2.42'.

Graph #19 shows a rising groundwater level in that part of the district monitored by the NRD even though there are five years of decline in the last ten years. This graph shows the overall trend and individual wells may vary significantly from this trend. On the average, the water level in that area of the NRD was 1.99 feet higher in 1992 than in 1983.

G. Groundwater Use

1. Past: The first irrigation wells were drilled in this area in 1934 or 1935 and there was no significant increase in well numbers until the mid 1950's. Well installation from 1957 to 1983 is shown in Graph #20. Graph #20-A shows the increase from 1983 to 1992.

2. Present: Well registrations have not increased as fast since 1983. Map #21 shows the location of the irrigation, commercial and industrial wells in the NRD. The following table shows the present number of wells registered December 31, 1992.

COUNTY	IRRIGATION	MUNICIPAL	INDUSTRIAL	OTHER
Gosper	608	5	3	1
Phelps	1822	22	2	15
Kearney	1758	11	1	3
	---	---	---	---
Totals	4188	38	6	19

Many of the wells registered over the past two years have been wells that were drilled previously and are just now being registered. An increasing number of replacement wells are also being drilled, replacing those originally drilled in the 1950's and 1960's. This trend is expected to continue as many of the wells have been in service over 30 years.

3. Future: Irrigation development is expected to continue, but at a rate below anything anticipated in the groundwater recharge study completed in 1983. In this study it was assumed that future well development would occur at a rate one-half of that experienced from 1970 to 1980. Present economic conditions and increased energy costs are the primary factors in keeping this development rate down.

H. Groundwater Quality (See Groundwater Quality Section)

I. Availability of Supplemental Water Supplies

Supplemental water is supplied to the Tri-Basin NRD area by CNPPID from Platte River natural flow and storage water in Lake McConaughy near Ogallala. The Diversion Dam is located just below the confluence of the North Platte River and the South Platte River approximately 50 miles downstream from Kingsley Dam. The Diversion Dam diverts the natural stream flow of the North Platte River and the South Platte River and storage water releases from Lake McConaughy into the headgates of a 75.5 mile long Supply Canal.

The Supply Canal has a capacity of 2250 cfs and extends from the Diversion Dam to the Johnson Return, located south and east of Lexington. There are 27 impoundments ranging in size from less than one surface acre to 2,500 surface acres of water along the Supply Canal. The Supply Canal diverts water on a year around basis and furnishes water for three hydroelectric power plants and the cooling water for the Canaday Steam Plant. The Jeffrey Reservoir and Johnson Reservoir serve as regulating reservoirs for the Jeffrey and Johnson No. 1 Power Plants. The Johnson No. 2 Power Plant is located on the Supply Canal about six miles below the Johnson No. 1 Power Plant. The Supply Canal also serves as the water supply for three district irrigation systems and water pumped or siphoned from the canal irrigated approximately 7500 acres during 1992 in Lincoln, Dawson and Gosper Counties.

The major portion of the irrigation systems of CNPPID consists of three separate feeder canals; Lateral E65, Lateral E67 and the Phelps County Canal. They have a combined length of 120 miles of main canals with approximately 480 miles of distribution laterals and buried pipelines. These are used to irrigate land (105,355 acres in 1992) in the three county area of Gosper, Phelps and Kearney Counties.

The E65 System headgate on the Supply Canal is located north of Elwood just before the Supply Canal enters Johnson Reservoir and the system consists of 54.7 miles of main canal and 188 miles of distribution laterals and pipelines which provide water to land (42,359 acres in 1992) in Gosper and Phelps Counties. The Elwood Reservoir is located just south of Johnson Reservoir and is filled during the non-irrigation season by the Carl T. Curtis pumping station. Elwood Reservoir has an active capacity of 24,715 acre feet and the water is released during the peak irrigation season to supplement the E65 Diversion from the Supply Canal. Nine deep wells supplying a total of 31 cfs were installed in 1954 and are also used during peak irrigation to supplement the canal flows in the area northeast of Loomis.

The E67 System diversion is made from the Supply Canal just east of Johnson Reservoir. It is 9.3 miles in length and has 16 miles of distribution laterals which provide water to land (5,678 acres in 1992) in northern Gosper County.

The Phelps County Canal is the District's largest irrigation canal. It begins at the Johnson Return to the river and consists of 56.7 miles of main canal and 276 miles of distribution laterals and buried pipelines. It provides water to land (57,318 acres in 1992) in Gosper, Phelps and Kearney Counties.

The distribution system of the three irrigation canals (E65, E67 and Phelps System) consists of earth lateral sections and approximately 80 miles of buried pipeline. The majority of the laterals have been rehabilitated by compaction and reshaping to meet the peak irrigation demands.

This supplemental water benefits the groundwater supply of the area in two ways. First, it supplies surface water to over 105,000 acres of irrigable land most of which would probably be developed for pump irrigation if it was not for the surface water. And second, seepage of water from the Supply Canals and laterals along with deep percolation of irrigation water has actually caused the groundwater level to rise under much of the NRD (see maps #13-#15). According to CNPPID's figures from 1984 through 1992, an average of 221,251 acre feet of water was diverted into the irrigation systems from the main Supply Canal and an average of 108,784 acre feet was actually delivered to water users. Much of this loss entered the groundwater reservoir.

The Catherland Project would have been another supplemental water supply for one area of the Tri-Basin NRD with a declining water table. This project proposed to divert 125,000 acre feet of water annually from the Johnson Power wasteway return in northeast Gosper County,

transport it through the CNPPID Phelps County Canal to near Axtell, Nebraska, then run it through their own canal and down the Little Blue River to a reservoir near Campbell. The project was designed to irrigate 66,500 acres in Kearney, Adams, Webster and Nuckolls Counties. Seven-thousand of these acres were in southeast Kearney County. The Catherland Reclamation District, formed to sponsor the project, includes two townships in southeast Kearney County where groundwater recharge is anticipated from the supply canal and Campbell Reservoir as well as from the surface irrigation. Unfortunately, this project has been turned down by the Department of Water Resources after years of litigation and controversy because it was not in the best interest of the State of Nebraska.

J. Opportunity to Integrate and Coordinate the Use of Water From Different Sources

An opportunity exists to develop a recharge project on Sand Creek south and east of Minden in Kearney County using drainage water from a large area along the lower end of the Phelps County Canal. Through the years, due to land improvement in the Axtell to Minden area, CNPPID has accepted several thousand acres of drainage into their Phelps Canal system. Under the present rehabilitation plan for this system, this water could be diverted to Sand Creek and used for recharge purposes. As mentioned in the Introduction, under present conditions this does not seem feasible because of the lack of support of landowners on Sand Creek and the unfavorable cost-benefit ratio of reservoir construction cost to recharge benefits. Flood control benefits on Sand Creek are low as are recreation benefits on a reservoir of the size that would be designed here.

This project is something to consider in the future. Recharge in the possible reservoir areas along Sand Creek may then be more important to local landowners.

K. Existing Subirrigated Uses

Historically, the only subirrigation in the Tri-Basin NRD would have been along the Platte River and some fields of native grasses which are cut for hay still benefit from this condition. The acreage is small compared to total irrigated cropland acreage of the District.

It has been said and often proven that the difference between subirrigation and seepage is a six inch rise in the water table. There are areas where the Central District groundwater mound is the correct distance from the land surface for beneficial subirrigation uses. However, when this condition does exist, it is usually just a prelude to seepage problems unless proper drainage is installed. There is undoubtedly a potential benefit to properly managing the high groundwater levels in the northern part of the NRD for subirrigation, but no effort to do that has been brought to the attention of the NRD. The usual practice where drainage is installed is to lower the water table enough for row crops to be grown and then irrigated.

L. Relative Economis Value of Different Proposed or Existing Uses of Groundwater

Irrigation is and probably always will be the primary use of groundwater in the Tri-Basin NRD. Municipal, industrial and domestic uses now account for less than 5% of the groundwater consumed and will probably never exceed that amount. All of the municipal and industrial wells, except for Wilcox and Atlanta, are within Central's recharge area and have not experienced any decline. Therefore, competition for the use of groundwater is insignificant and the comparison of their relative economic value is unnecessary.

III. POLICY REQUIREMENTS

A. Groundwater Management Goal

The goal for the surface and groundwater supply and management developed for the Tri-Basin NRD's Master Plan in August 1979 and amended in 1989 is as follows:

> "Goal: All water supplies within the Tri-Basin NRD, whether their origin be groundwater or surface water, will be used in a beneficial manner, efficiently managed and properly utilized to preserve the present quality and quantity of this vital resource."

Add to this statement the reservoir life desired and it is a valid goal for the quantity section of this groundwater management plan.

B. Reservoir Life Goal

In an attempt to arrive at a reservoir life goal agreeable to the people in the NRD, public opinion was solicited twice. In February 1985, the NRD page in all the newspapers in the district was devoted to an explanation of the requirements of a groundwater management plan and the need for a reservoir life goal. A questionnaire was also printed which readers were supposed to answer, clip out and return to the ASCS, SCS or NRD office. Response to this was very low (only three) and all thought the major problem was a rising water table and that groundwater should last forever. In June 1985, a letter and questionnaire along with a stamped, self-addressed envelope were sent to 195 residents living in those townships where there had been a decline in the water levels since the start of the NRD well monitoring program in 1978 (See Appendix A). Seventy-one of these questionnaires were returned (36%) with 54 persons feeling that there was or soon will be a groundwater problem in their area. Twelve of the 54 thought that only water quality was or would be a problem, 23 gave only water quantity as a problem and 19 considered both quantity and quality as a problem.

Fifty-seven respondents to the questionnaire answered the question on what they would like for a reservoir life goal. Thirty-five chose an infinite goal, ten said the reservoir life goal should be 100 years while eight and four said 50 and 75 years, respectively.

With this information in mind, the Tri-Basin NRD board has set an infinite reservoir life goal. They feel this is an attainable goal at the present time, recognizing that some areas may have to eventually be designated management areas to achieve this goal. These management areas would be established as required by Sections 46-673.03 to 46- 673.12, Reissue Revised Statutes of Nebraska, 1943.

C. Controls Proposed to Achieve Groundwater Reservoir Life Goal

Methods of control required to meet the reservoir life goal were also solicited in the questionnaire. Five different control measures were listed and ranked in order of preference. Voluntary water conservation through irrigation scheduling, better water management, etc. was the control most desired with 18 respondents selecting it for their number one priority. Fifteen respondents said that water allocation was their first priority even though it ranked third overall. Several of them stated in the comments that they felt voluntary controls would not work. Spacing of wells greater than 600 feet seemed to be the second choice of the majority of people while pumping rotation and a well drilling moratorium were the number four and five priorities.

Voluntary controls have actually already been enacted by the Tri-Basin NRD through their goals and objectives for water management as stated in the Master Plan. These include the

encouragement of irrigation scheduling to conserve groundwater and the promotion of tailwater recovery systems as a means to control runoff and increase efficiency. The NRD has stressed water use efficiency through its sponsorship and financial support of an Automated Weather Data Network (AWDN) station south of Holdrege. Crop water use figures from all AWDN stations are calculated by the Extension Service and are broadcast over radio stations for statewide use. Much of the Nebraska Soil and Water Conservation fund allocations for this NRD have gone for constructing tailwater recovery pits and water conservation is constantly stressed through enforcement of the Groundwater Management and Protection Act groundwater runoff rules and regulations.

Well spacing of greater than the present 600 feet between irrigation wells and water allocation controls would be put into effect at the same time if and when they are needed. Distances needed to limit new wells to one well per 80 acres or quarter section could be used without any great hardship on anyone. Variations to this well spacing would need to be granted so that no landowners would be denied the opportunity to irrigate. Allocations would be for three or five years to allow irrigators more flexibility in how they irrigated and the crops they grew. For example, this could allow an irrigator to grow a high water use crop such as corn two years out of three and then a less demanding crop the other year and still stay within his allocation.

Allocation would require water meters on all wells in the management area and irrigators would need time to get them installed. Any control measures should allow time for irrigators to get ready without an undue hardship.

Pumping wells on a rotation basis was not well accepted by respondents to the groundwater survey but could have a place in water management. At the present time there are problems developing with well competition in certain areas of the NRD where well yield drops significantly in late August after long periods of pumping. This can be true even in areas where static water levels are constant. If this trend continues, some form of rotational pumping in these areas may be beneficial. This would require establishing a management area.

A moratorium on well drilling would require a change in state law to be used in a management area, yet 12% of the questionnaires returned were marked with that as the first choice for controls if water management is required. It is an indication that if controls in a management area were not enough to protect the reservoir life goal then the NRD should ask that a control area be designated so a moratorium could be imposed.

D. Factors Determining When to Impost Controls

Probably the most difficult part of establishing a groundwater management area is determining when to impose the necessary controls to protect the reservoir life goal established. Choices could include imposing controls when the spring static water level drops three years in a row in any given area or when the spring static water level drops a certain number of feet below what it was in 1984 or some other base year. Well monitoring would be increased in prospective management areas so that it would be easier to determine management area boundaries. No less than a township (36 square miles) should be considered for a management area.

Water allocations should be set for three or five years and should be subject to change at least that often. The allocations could go into effect only after adequate time is allowed for installation of water meters. Well spacing restrictions could be imposed immediately after a management area was formed.

E. Water Quality - (See Water Quality Section)

SPECIFY POLICY REQUIREMENTS

A. Goal – Including Reservior Life Goal

All groundwater supplies within the Tri-Basin NRD will be used in a beneficial manner, efficiently managed and properly utilized to preserve the present quantity of this vital resource forever.

B. Actions to Take at the Present Time to Help Insure Infinite Reservoir Life Goal:

QUANTITY:

1. Continue groundwater monitoring program initiated in 1978.
2. Encourage installation of tailwater recovery systems and their proper use after installation.
3. Continue sponsoring the AWDN to facilitate irrigation scheduling. Encourage local irrigators to use this management tool through cooperation with Extension Service and Soil Conservation Service in news releases, educational meetings and demonstrations.
4. Encourage water saving irrigation systems such as cablegation and surge irrigation where practical. Cooperate with the SCS and CES to demonstrate the benefits of these systems and others that may be developed.

QUALITY: (See Water Quality Section)

C. Procedure to Follow When Establishing a Groundwater Management Area if Necessary to Realize Reservoir Life Goal:

QUANTITY:

Random wells are being monitored twice a year throughout the area to determine the static water levels. Spring readings will be used to determine declines. Any well which shows a net decline from the spring of 1983 levels over a three-year period will initiate measurement of surrounding wells in adjoining sections to establish the areas of decline. If these measurements show a ten percent (10%) decline in the saturated thickness of the groundwater reservoir as determined from the South Central Hydrogeology Study, or a 25 foot decline in the static water level, whichever is less, over a 72 square mile area for a period of three (3) consecutive years, a groundwater quantity management area will be created. Township lines will be followed if at all possible.

There is nothing in this procedure which would preclude landowners in an area from taking action sooner to address a developing problem.

QUALITY: (See Water Quality Section)

D. Controls Proposed to Achieve Reservoir Life Goal

QUANTITY:

The severity of the decline in relation to the saturated thickness of the aquifer would be considered in the necessary controls and would be addressed in public hearings as required by law. The first control imposed would be to increase the spacing of new wells to 1320 feet from the present 600 feet. Irrigators would be allowed three years to install meters on all irrigation wells before allocation would be required. The first allocation would be for 15 inches of water

per acre per year for a total of 45 inches over a three year period. The allocation could be adjusted after the initial three year period if water levels warranted a change.

QUALITY: (See Water Quality Section)

E. Endangered Species

The Tri-Basin NRD recognizes that the general protection of groundwater quantity and quality has many benefits including protecting the habitats of threatened and endangered species and that groundwater management activities proposed in a plan may have some impact, positive or negative, on these species.

The district is not aware of any threatened or endangered plants growing in the district at the present time; however, the district is aware of potential for the prairie fringed orchid to grow in high quality wet meadows and that this species may be affected by groundwater levels. If this protected plant or any other endangered species is found in the district the Nebraska Game and Parks Commission will be notified immediately. The NRD will cooperate with their Heritage Botanist as a plan is developed to protect the species.

Should specific adverse effects on threatened species from groundwater management activities listed in the plan be identified, the NRD acknowledges the potential need to modify the groundwater management plan in the future. Such modifications should include actions within control or management areas consistent with the Nebraska Groundwater Management and Protection Act that could be taken by the NRD to reduce adverse effects on species by maintaining a groundwater level that will help sustain these species.

REFERENCES

1. Application for a Permit for Incidental Underground Water Storage and Recovery for Gosper, Phelps, and Kearney Counties; Central Nebraska Public Power and Irrigation District; October 1984.

2. Areal Groundwater Quality in the Tri-Basin Natural Resources District, 1978-1980: Mary E. Spalding; An open file report prepared in fulfillment of a cooperative agreement between the Tri-Basin NRD and the Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln; September 1981.

3. Aspects of Groundwater quality; Proceedings of the 1985 Water Resources Seminar Series; Nebraska Water Resources Center; May 1985.

4. Geology and Groundwater Resources of South-Central Nebraska; Geological and Survey Water Supply Paper 779; 1938.

5. Groundwater Reservoir Management: a policy issue study for the State Water Planning and Review Process; Nebraska Natural Resources Commission; March 1982.

6. Handbook for the Preparation of Groundwater Management Plan; a Contract report for the Nebraska Association of Resources Districts by the Conservation and Survey Division, University of Nebraska, Lincoln; November, 1984.

7. Long-Range Implementation Plan and Supplements; Tri-Basin Natural Resources District; October, 1979-1984.

8. Master Plan; Tri-Basin Natural Resources District; August 1979. Revised 1989.

9. Tri-Basin Natural Resources District Groundwater Recharge Program Phase I Status Report; Henningson, Durham and Richardson, Inc., Omaha; November 1983.

10. Tri-Basin NRD Public Water Supply Data 1979 through 1983; Nebraska Water Use Data Program, Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln.