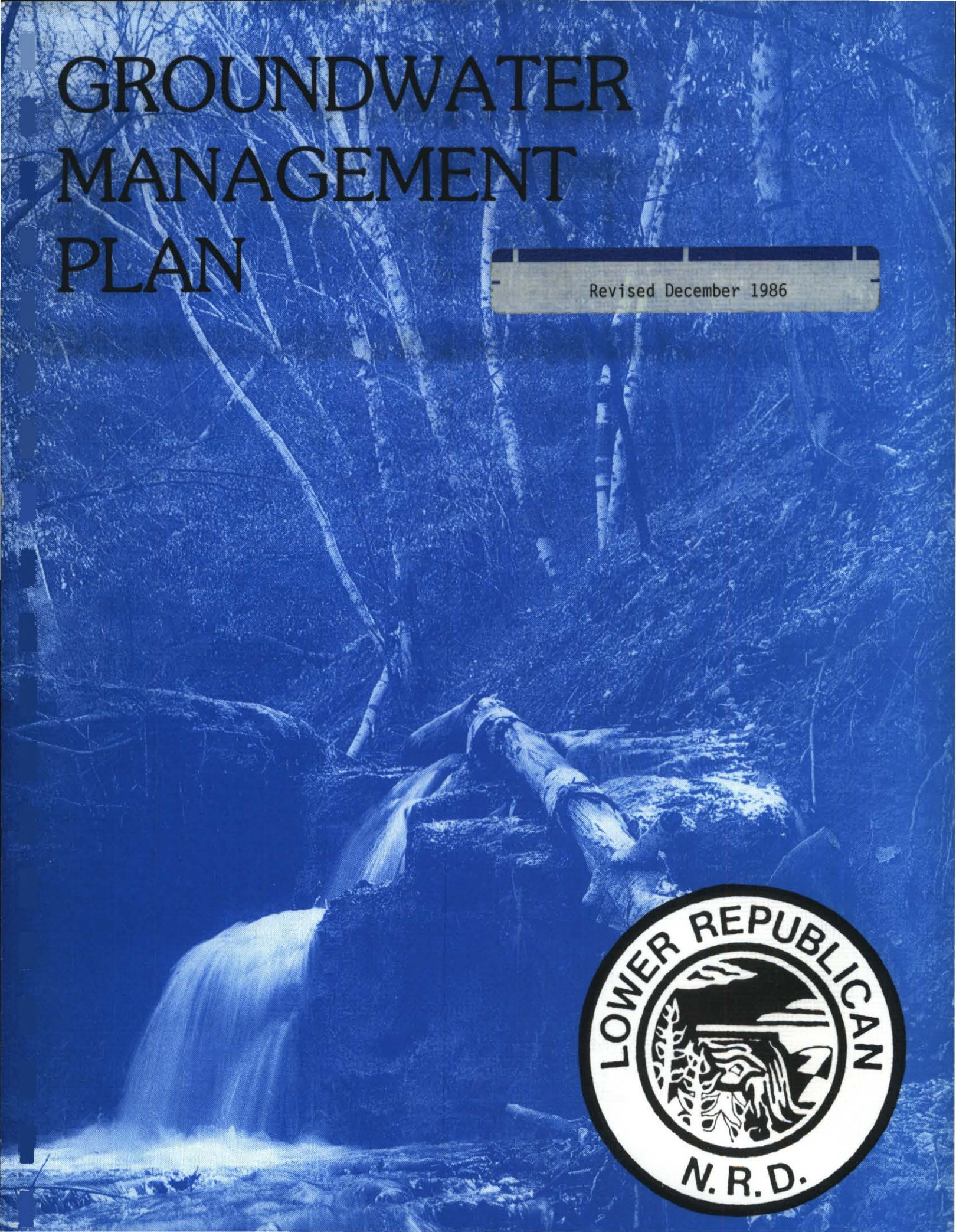
GROUNDWATER MANAGEMENT PLAN

Revised December 1986



LOWER REPUBLICAN N.R.D.

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The Plan's cover was reproduced from a photo found in the March 1985 issue of the NEBRASKAland magazine. The Lower Republican NRD thanks the Nebraska Game & Parks Commission for use of this photo which helps to depict the scenic as well as useful aspects of clean, abundant water.

ACKNOWLEDGEMENTS

The Lower Republican NRD would like to acknowledge the work of two individuals who spent a considerable amount of time in helping to re-work this revised copy of the LRNRD Groundwater Management Plan. These individuals are Angela Maruhn, who was involved in a large share of the initial re-drafting process and Jo Bantam who provided many hours of typing the various plan drafts throughout the complete revision process.

Our District would also like to thank the staff of the Natural Resources Commission, Department of Environmental Control, Department of Health, and Conservation & Survey Division who provided specific suggestions to our NRD in this revision process. These suggestions and comments to the quality and quantity policy and implementation sections proved to be most helpful.

Board of Directors
Lower Republican NRD

LOWER REPUBLICAN NATURAL RESOURCES DISTRICT

SCHEDULE OF BOARD OF DIRECTORS

Directors		Nebraska	Term
Paul Schroeder		Arapahoe	1986
Jay Ziegler	Secretary	Riverton	1988
Gene Hayes		Naponee	1986
Dean Artz	Treasurer	Alma	1986
John Burkholder		Holdrege	1988
Terry Woollen	Chairman	Alma	1986
Gerald Disney		Holbrook	1988
Elmer Meyer		Superior	1986
James Moore		Bloomington	1988
Richard Nelson	Vice-Chairman	Superior	1988
Lloyd Wulf		Red Cloud	1986

ASSOCIATION MEMBER FOR THE DISTRICT:

John Burkholder	Holdrege
Dean Artz (alternate)	Alma

Office Location:	Court House, Box 618, Alma, Nebraska 68920
Telephone:	(308) 928-2182
Manager:	Ronald L. Wunibald
Assistant Manager:	Bryan Lubeck
Administrative Secretary:	Jan Wilson
Assistant Administrative Secretary:	Jolene Bantam

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WHY PLAN?

Basically, this Groundwater Management Plan was developed for two reasons: 1) to fulfill a legislative requirement for Natural Resources Districts to prepare a plan by January 1, 1986, and 2) to better identify and address the quantity and quality concerns relating to our groundwater resource now and in the future.

Overview of Planning Effort

The Lower Republican Natural Resources District officially started operation on July 1, 1972. Each of the 24 Natural Resources Districts in Nebraska has certain legislative given responsibilities in attempting to manage our natural resources in a wise manner. One of these responsibilities was to wisely manage our water resources - surface and groundwater. When the State Legislature passed LB 1106, in the 1983 Session, a further emphasis was placed on the importance of Districts drafting a Plan which would put into writing how that NRD planned to manage their groundwater resource - for quantity and quality purposes (now and in the future).

Within LB 1106, certain technical requirements were identified to be part of the NRD's groundwater planning effort. The LRNRD attempts to address these requirements in this Plan, with best known present resource information (and public opinion on perceived current and future groundwater concerns) available.

To obtain our groundwater goal we will be including the Lower Republican Natural Resources District Policy and Implementation Mechanism for Reaching the Reservoir Life Goal sections, one of which will deal with groundwater quality issues and the other which will deal with groundwater quantity issues.

The policy of the Lower Republican NRD for dealing with groundwater issues at this time is that Four Levels of Management (increasingly stringent) will be established by the District. All areas within the District will be designated to be in one of these Levels of Management based on the status (the quality and quantity) of groundwater.

Communication and cooperation with three NRDs - Middle Republican NRD, Tri-Basin NRD, and Little Blue NRD - surrounding our District will be essential. This will be especially true with the Tri-Basin NRD regarding our "declining water table" concern, and the Little Blue NRD within our "groundwater quality" concern. Since ground water and surface water interrelate so much in the Republican River Basin, we will also be working closely with the Bostwick and Frenchman-Cambridge Irrigation Districts, the Corps of Engineers, the Bureau of Reclamation, Catherland Reclamation District, and the Nebraska Game and Parks Commission on monitoring and managing our concerns which deal with supplemental water concerns and instream flow concerns. Two agencies which will be called upon to assist in our groundwater management efforts, on a local basis, will be the Extension Service and the Soil Conservation Service. These two agencies will be requested to help in educational and informational efforts, and planning of water conservation practices with landowners. They will also act as advisors to the Lower Republican NRD in our management efforts.

Cooperation between Federal, State, and local agencies and governmental entities will be essential in managing our important groundwater resource.

The general format selected for this Plan will be:

1) Explain why Plan Developed
2) Overview of Plan
3) Public Involvement in Planning
4) Technical Requirements of Plan - not covered specifically in other portion of Plan
5) Groundwater Quality and Quantity Goal
6) Policy and Implementation Mechanism for Reaching Groundwater Quality Goal
7) Policy and Implementation Mechanism for Reaching Groundwater Quantity Goal

The Lower Republican NRD chose to combine the 15 technical planning requirements for a Natural Resources District to follow in preparation of their Groundwater Management Plan into seven - with portions of some of the requirements found in the section of our Plan which addresses specific "concern" areas in our NRD. This grouping of the technical requirements can be found by looking at their titles in the "Technical Requirements" portion of the table of contents.

PUBLIC INPUT

Groundwater Management Plan Committee

With the establishment of the Groundwater Management Plan Committee (consisting of one LRNRD Director for each of the five District political sub-districts), the Board began a part of the public input process of the Plan.

This Committee, representing the public throughout the LRNRD, formed the core of this planning effort. Their monthly committee meetings were held to 1) keep updated on the progress of the planning effort assigned to the LRNRD staff, 2) make independent decisions on methods used in drafting and presenting the materials in the Plan, and 3) make recommendations to the entire Board on such things as policy issues, public involvement, and methods of obtaining the Board's input into the implementation of the Plan's Management Options.

Methods Used in Planning for Direct Public Involvement

The LRNRD chose the following process to obtain direct public input into our Plan:

Early in Planning Effort - Our NRD decided early in our planning process (March - April 1985) to identify what our public perceived as our groundwater concerns for now and into the future - relating to both water quality and quantity. We decided against holding public meetings (throughout our District) to obtain early public response, fearing a poor turnout as is commonly experienced with this method. Instead we chose to use the questionnaire approach. The results of this questionnaire, in which over 165 responses were received throughout our District, are shown as supplemental information # 1 on page 4 of the Plan.

The questionnaire responses proved helpful in giving our District direction in planning, and prompted our NRD to expand our nitrate testing program considerably to address this concern in our Plan.

Public Response to 1st Draft Management Procedures - Chart 1 on page 5 shows the many considerations to be addressed when establishing policies which deal with the management of a groundwater reservoir. Certainly all management attempts key on "cooperation". Cooperation from Federal, State, and local governments and agencies is important, but of greater importance

Groundwater Management Plan
QUESTIONAIRE

PLEASE ANSWER AND RETURN TO:

Lower Republican NRD
Box 618
Alma, NE. 68920

1. Do you believe there is a groundwater problem or there may be one in the near future?

   ☐ Yes

   ☐ No

2. If you answered yes, what is the problem?
   ☐ declining water table ☐ rising water table
   ☐ water quality degradation ☐ other _____

3. If you answered water quality is a concern, check category below;
   ☐ Existing groundwater quality problem (such as nitrates, coliform, etc.)
   What is source of problem? _____

   ☐ Potential groundwater quality problem (such as nitrates, coliform, etc.)
   What is source of problem? _____

4. Groundwater Management Plans must include a groundwater reservoir life goal. What do you think that goal should be?
   ☐ 50 years ☐ 75 years ☐ 100 years ☐ infinite

5. If controls are necessary to achieve a groundwater reservoir life goal, which would you prefer? Rank each by number. One (1) being the

1	35%	2	23%	3	15%	4	14%	5	13%	well spacing on new wells greater than 600 feet
1	26%	2	17%	3	18%	4	14%	5	25%	allocation of water pumped (requiring water meters)
1	22%	2	28%	3	20%	4	17%	5	13%	voluntary water conservation through irrigation scheduling
1	8%	2	14%	3	26%	4	37%	5	15%	rotation of pumping, so not all wells pump at once
1	37%	2	18%	3	13%	4	10%	5	22%	moratorium on new well drilling

6. Other comments not covered above; _____

_____

_____

_____

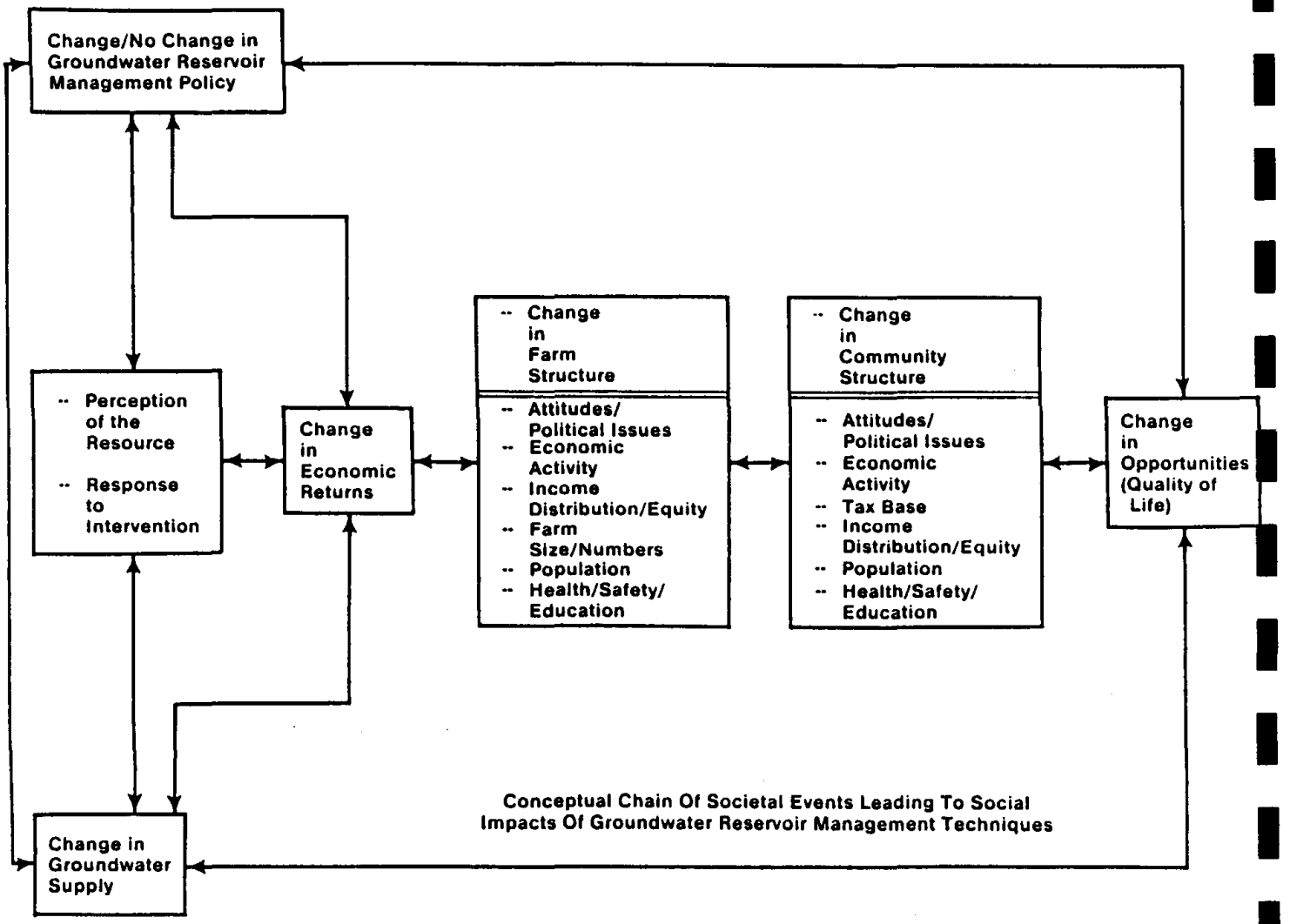
NAME _____

ADDRESS _____

_____

Location of area of concern _____

Chart #1



Conceptual Chain Of Societal Events Leading To Social Impacts Of Groundwater Reservoir Management Techniques

Source: Appendix to the Policy Issue Study on "Groundwater Reservoir Management" -- State Water Planning and Review Process Nebraska Natural Resources Commission

Date: March 1982

is our local people's cooperation. They will be the ones who will be directly affected by the management procedures selected by the NRD.

With this in mind, our District made a second attempt at public involvement in our Plan at the conclusion of our 1st draft phase. The method chosen this time was a series of four meetings held throughout our NRD (September 17, 1985, at Red Cloud, September 18, 1985, at Franklin, September 25, 1985, at Alma, and September 26, 1985, at Holbrook) on the management procedures proposed in our 1st draft for both the "district-in-general" and "specific concern" areas identified in our Plan. Comments from the public obtained from these meetings can be found on pages 7-8 of this section of the Plan.

Public Input into Final Draft - The Lower Republican NRD believes that the most effective time for public involvement in any planning activity is early in the effort. Considering this idea, the Lower Republican NRD chose to have one public meeting on the final draft prior to our December Board Meeting for input into this draft of the Plan. This public involvement is to be accomplished prior to sending it to the Department of Water Resources for consideration.

The Lower Republican NRD Groundwater Management Plan Committee spent much of their time in the preparation of this Plan. The membership of this committee is as follows:

Paul Schroeder - Sub-district #1
Arapahoe, Nebraska 68922

John Burkholder - Sub-district #2
R R #2 - Box #42
Holdrege, Nebraska 68949

Gene Hayes - Sub-district #3
Naponee, Nebraska 68960

Lloyd Wulf - Sub-district #4
Red Cloud, Nebraska 68970

Elmer Meyer - Sub-district #5
RFD 2
Superior, Nebraska 68978

COMMENTS AND QUESTIONS RECEIVED AT FOUR PUBLIC INFORMATION MEETINGS HELD IN SEPTEMBER 1985 ON PLAN'S MANAGEMENT PROCEDURES

Questions Received

-- What does table showing average annual decline in Lower Republican NRD's water table indicate?

-- On Instream Flows for Wildlife and Other Beneficial Uses, what effect would establishment of base flows on Republican River have on existing water rights?

-- Regarding control area option, how are control areas established and how are controls utilized in the Upper Republican control area?

-- Does NRD check for phosphorous levels in groundwater?

-- What is the white area on concern map?

-- What are present laws relating to the use of chemicals in irrigation systems?

-- Will NRD address other contaminants, other than nitrates, in groundwater planning?

-- What type of wells monitored for nitrates - irrigation or domestic?

-- Is there a mechanism incorporated into the Plan that will allow it to be adjusted to new problems? In other words is it flexible?

-- What is the difference in nitrate concentrations for District's deep wells versus shallow wells?

-- Can well drillers introduce bacteria into the groundwater from unclean drilling equipment?

Comments Received

-- In addressing highwater table areas in plan may want to include an area of 800 to 1,000 acres located in Nuckolls County Township 1 (2 miles east of Webster-Nuckolls County line and 1 mile north of Kansas-Nebraska State line). There should not be controls placed on pumping in this area.

-- Problem of groundwater to supply irrigation needs around Hildreth - always has been problem.

-- In discussing recharge attempts to supplement groundwater declines a person was opposed to charging a fee for recharge benefits - used Tri-County Irrigation District as example.

-- Quite a number of irrigators in Campbell, Nebraska area using chemigation with pivots - questioned if wells were properly equipped or hooked up right for this activity.

Comments Received (continued)

-- Concern over problem of bacteria being introduced into newly drilled wells in Upland area - maybe this could be transmitted by well drillers.

-- Concern over runoff from chemigation pivots and impact to cattle drinking this water.

-- With current economics of farming, maybe water need will be less in the future - change of cropping.

-- Water needs to be cleaned up whether we like it or not.

-- Person questioned the effectiveness of using surface water to inject it into the groundwater reservoir as a management tool.

-- Restrictions should be placed on the type of land that can be irrigated - based on erosion problems. Need some type of legislation to control this type of development.

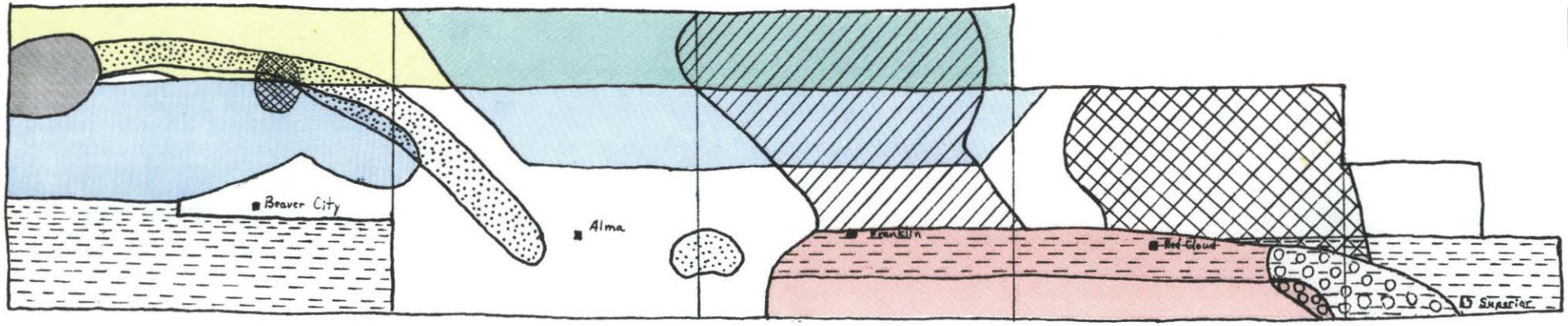
-- Concern that in certain parts of the Lower Republican NRD, irrigation wells are taking water from domestic water sources rendering those wells useless.

-- Maybe District should show a water quantity problem along the Kansas-Nebraska line along with the quality problem.

Map # 1 on page 10 shows specific areas of current or anticipated future groundwater concerns throughout the Lower Republican NRD as expressed by the Directors and general public during public input meetings in 1985. The Lower Republican NRD has received other information since those 1985 meetings which indicate that some of the anticipated future concerns would cause this map to look slightly different. However, it does give the reader of this Plan, an indication as to what the public perceives the groundwater concerns to be and where they are located.

Specific Areas of LRNRD Groundwater Concern

- High Groundwater Table
- Declining Water Table
- Depth of Water - Economic Concern
- Lack of Groundwater - Problem for Domestic Use - Also Quality Problems
- Declining Water Table and Depth of Water - Economic Concern
- Potential Water Quality in Groundwater
- Instream Flows for Wildlife and Other Beneficial Uses
- Water Quality From Irrigation Affecting Surface Water
- Water Quality
- Flooding-Sedimentation Problem From Irrigated Lands



Map #1

GENERAL STATEMENT CONCERNING TECHNICAL REQUIREMENTS

The technical requirements of this plan contain tables, charts, maps, graphs, quotes from publications, and other information which helped the Lower Republican Natural Resources District formulate management decisions to address our groundwater concerns - today and for the future. Where possible the information contained in this segment of the Plan has been condensed to pertain specifically to the LRNRD. Some references to the technical information found in this section will be noted within context; however since most of the reference material used is compiled by agencies supported by the public - we will treat it as public information and thus list as a reference in the "List of References" portion of our Plan.

Geologic Information about Groundwater Reservoir

What is a groundwater reservoir? - A groundwater reservoir should be considered as an aquifer (or combination of aquifers) that can be used as a source of water. It is necessary that groundwater reservoirs be described geographically to define the extent of surface area covering a reservoir and stratigraphically to give a vertical indication of thickness and composition of the reservoir.

Description of General Geology found within LRNRD - To describe the general geology found within the LRNRD, map 2, page 12, shows the location of the four geologic formations found within our NRD; 1) Ogallala, 2) Pierre, 3) Niobrara, and 4) Carlile.

A series of five geologic cross sections across our NRD is illustrated with maps in this section of the Plan. These cross sections were sketched to show the geology at the following points in the LRNRD (from west to east across our District): 1) north-south profile west of Arapahoe to the Kansas-Nebraska border, illustrated with map 3, page 13, 2) north-south profile from Elm Creek, Nebraska, to Alma, Nebraska, illustrated on map 4, page 14, 3) north-south profile from Gibbon, Nebraska, to Riverton, Nebraska, illustrated on map 5, page 15, 4) north-south profile from the corner of where four counties (Adams-Kearney-Franklin-Webster) converge, then south to the Republican River illustrated on map 6, page 16, and 5) north-south profile from the corner of where four counties (Adams-Clay-Webster-Nuckolls) converge, then south to the Republican River, illustrated on map 7, page 17 .

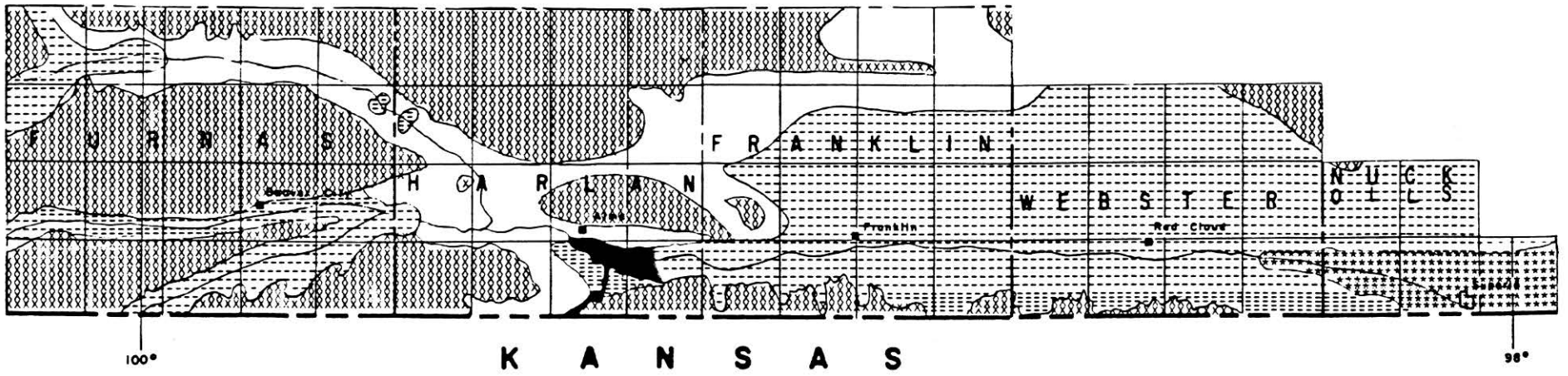
BEDROCK GEOLOGY

FORMATION: OGALLALA

PIERRE

NIOBRARA

CARLILE



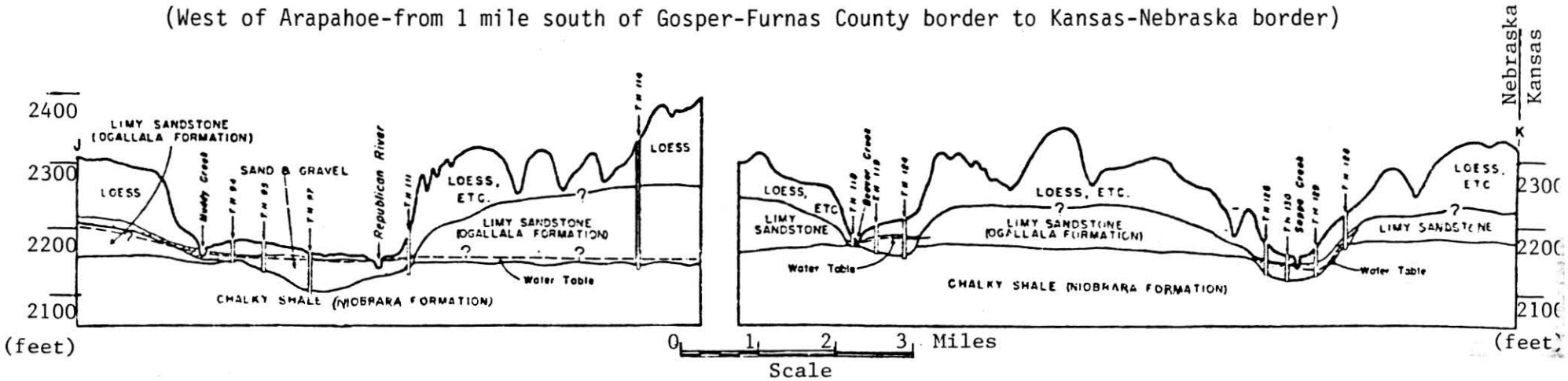
Map #2

Source: Conservation & Survey Division (map constructed from information received from Conservation & Survey Division)

Date: March 1985

GEOLOGIC CROSS SECTION IN FURNAS COUNTY

(West of Arapahoe-from 1 mile south of Gosper-Furnas County border to Kansas-Nebraska border)



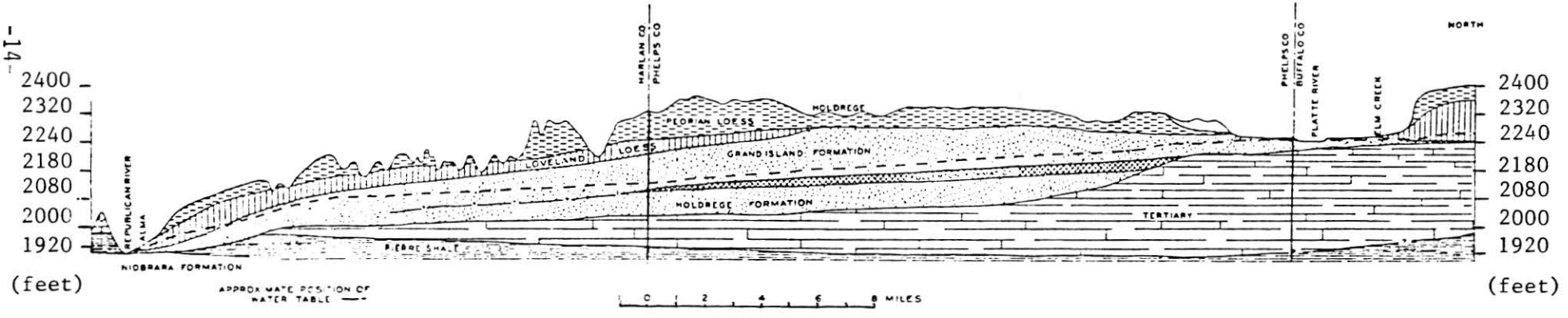
This section is located at the west edge of Arapahoe and extends in a north-south direction from a point 1 mile south of the Gosper County-Furnas County line (J) to the Nebraska-Kansas state line (K). A break in the profile section representing a distance of about 5 miles occurs near the middle of the inter-stream divide between the Republican Valley and the Beaver Creek Valley. Note the thin deposit of sand and gravel overlying the Ogallala formation north of the Republican Valley; the relatively good infiltration area immediately north and south of the Republican River in the vicinity of test holes 94, 95, 97, and 111 as well as the smaller areas in the Beaver Creek Valleys in the vicinity of test holes 118, 119, and 124 and in the Sappa Creek Valley in the vicinity of test holes 126, 128, 129, and 130; the relatively high shale bedrock (Niobrara formation) south of the Republican Valley between the Republican River and the state line, overlain by limy sandstone and silt of the Ogallala formation (Tertiary age); and the relatively thick mantle of loess capping the upland areas and intermediate slopes both north and south of the Republican Valley. The dashed line representing the water table indicates that the water table slopes southward to the Republican Valley in the region north of the Valley. The position of the water table beneath the inter-stream divides both north and south of Beaver Creek and Sappa Creek Valleys has not been shown because of insufficient control. The chalky shale is part of the Niobrara formation of Cretaceous age. In general, the Niobrara formation is relatively impervious and does not represent a source of water for this area.

Source: Conservation & Survey Division (map constructed from information received from Conservation & Survey Division)

Date: March 1985

Map #3

NORTH-SOUTH GEOLOGIC PROFILE SECTION FROM ELM CREEK TO ALMA, NEBRASKA

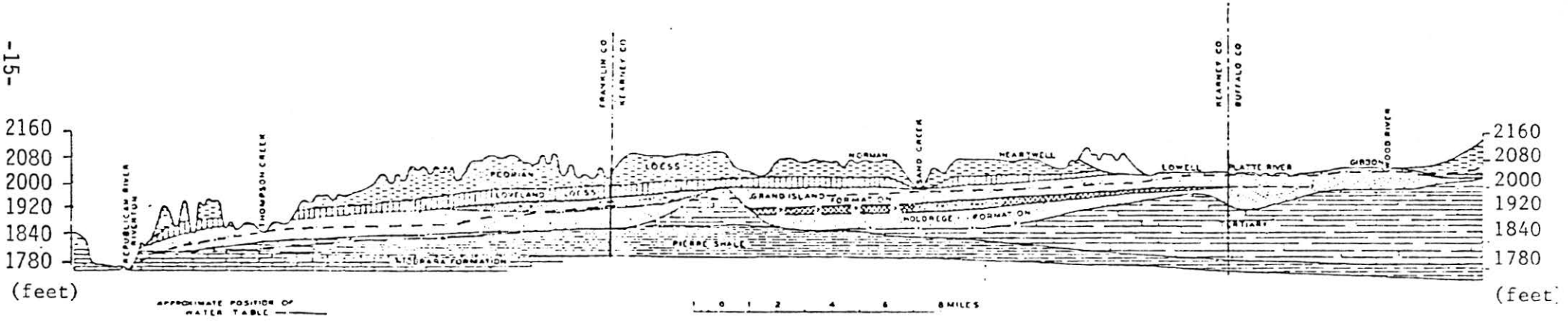


Source: Supplied from Conservation & Survey Division

Date: April 1985

Map # 4

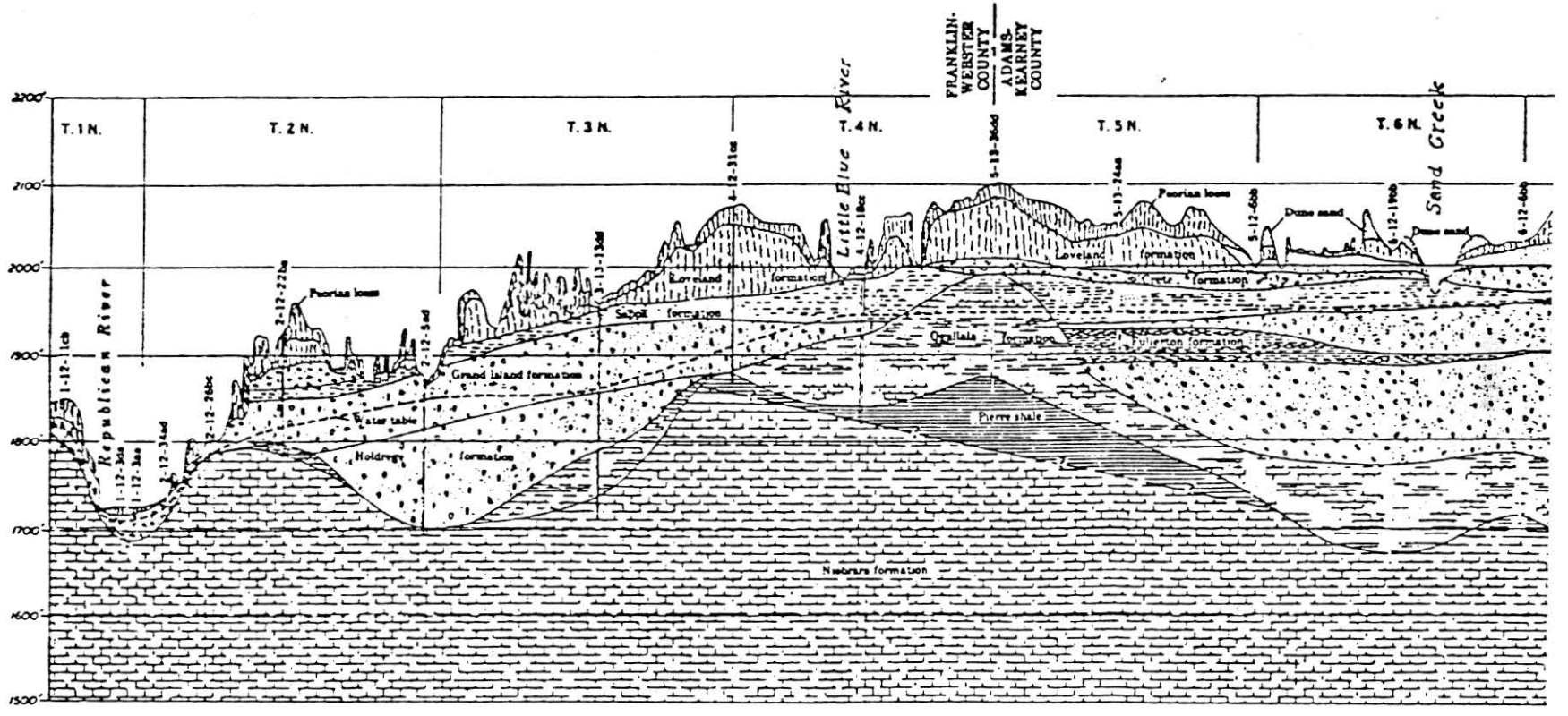
NORTH-SOUTH GEOLOGIC PROFILE SECTION FROM GIBBON TO RIVERTON, NEBRASKA



Source: Supplied from Conservation & Survey Division

Date: April 1985

Map #5



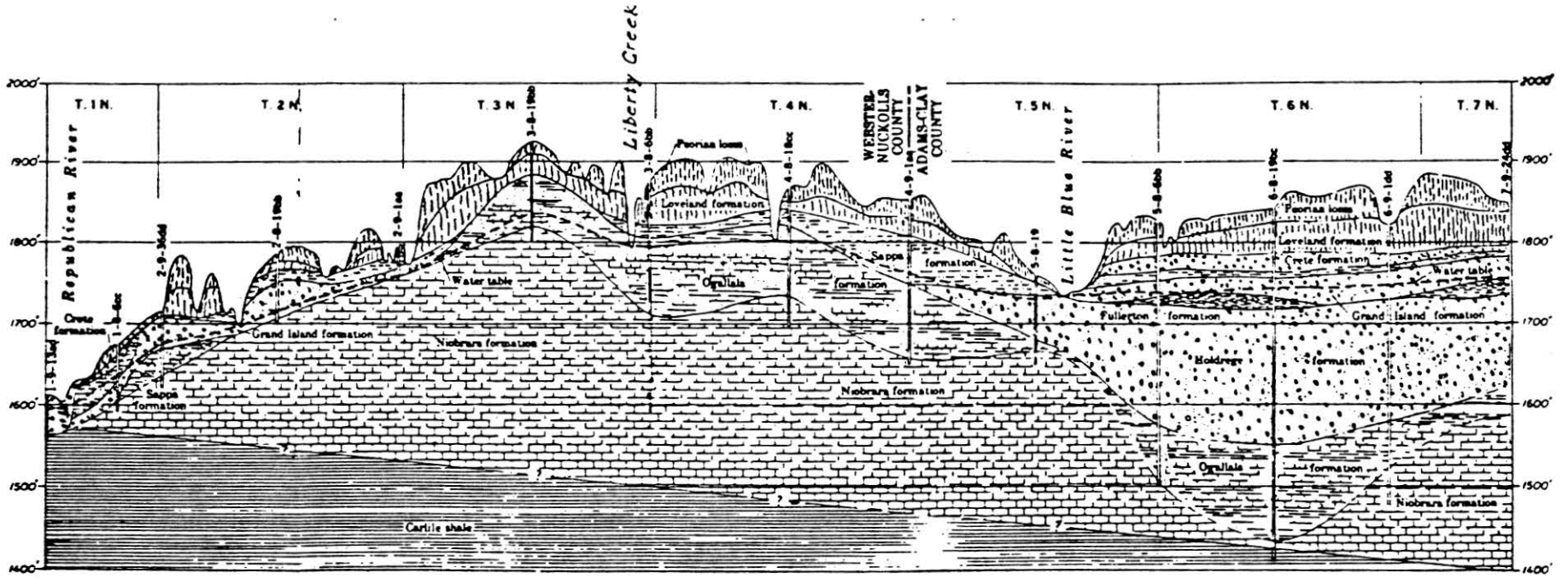
(feet)

NORTH-SOUTH SECTION ALONG ADAMS-KEARNY & FRANKLIN-WEBSTER COUNTY LINES

Map #6

Source: US Geological Survey, Water Supply Paper 1489 (This map reproduced from "Prefeasibility Engineering and Economic Report", Boyle Engineering Corporation)

Date: September 1976



(feet)

NORTH-SOUTH SECTION ALONG PORTION OF ADAMS-CLAY & WEBSTER-NUCKOLLS COUNTY LINES

Generalized after geologic sections prepared by E. C. Reed and V. H. Dreeszen and based on cooperative test drilling investigations by the Conservation and Survey Division of the University of Nebraska and the U. S. Geological Survey

Map #7

Source: US Geological Survey, Water Supply Paper 1489 (This map reproduced from "Prefeasibility Engineering and Economic Report", Boyle Engineering Corporation)

Date: September 1976

A more detailed description of the geologic formations found in our NRD has been reproduced from a Bureau of Reclamation Study on the Republican River Basin. Since our District is divided into what the Bureau of Reclamation terms "upper" and "lower" Republican River Basin, we felt their description would be helpful in this portion of our Plan.

A general description of the "upper portion" of the Republican River Basin would be from the source of the river basin (in Kansas and Colorado) to the Harlan County Reservoir in Nebraska. The "lower portion" of the basin then would include all of the drainage to the Republican River downstream from the Harlan County Reservoir to Milford Lake in Kansas.

Upper Republican Basin

The major geologic formations are the Ogallala Formation, alluvium, and eolian deposits that make up the aquifer system. The base for the aquifer system is comprised of the Niobrara Formation, Pierre Shale, and White River Group.

The Niobrara Formation and the Pierre Shale of late Cretaceous age, and the White River Group of Tertiary age are relatively impermeable consolidated deposits, which restrict the downward movement of water from the overlying aquifer system. The Niobrara Formation and Pierre Shale are of marine origin. The Niobrara Formation (the aquifer base in the eastern part of the upper basin) consists of massive chalk beds, chalky shales and limestones, and thin beds of bentonite. The Niobrara Formation has a thickness of approximately 650 feet in Phillips County, Kansas (located directly south of Harlan County in the Lower Republican NRD). The Pierre Shale (the aquifer base in the western part of the upper basin) lies conformably on the Niobrara Formation. It is a thinly bedded shale with thin beds of bentonite and numerous concretionary zones. The Pierre Shale in the Frenchman Creek area is more than 2,000 feet thick. The Niobrara Formation and Pierre Shale slope to the east with an average gradient of 14.7 feet/mile. The White River Group (Brule and Chadron Formations) of Oligocene age, lies unconformably on the Pierre Shale in the northwestern portion of the upper basin. It appears to be of fluviatile origin and consists of siltstone, clay, and localized channel deposits of sand and gravel that may or may not be cemented. Although the deposit is considered impermeable, minor amounts of water could be obtained from unconsolidated sand and gravel deposits within the formation. It has a maximum thickness of $\pm$ 450 feet.

The semiconsolidated Ogallala Formation of Pliocene age is the major source of ground water due to its areal extent, accessibility, and extent of saturation. The formation is present throughout the upper basin, except where major streams have eroded through it to the bedrock. The Ogallala is believed to have been formed by eastward flowing streams whose sediment filled pre-existing valleys in the bedrock. Eventually, lateral constraints were eliminated, and the streams coalesced to form a broad alluvial plain. The formation consists of a poorly sorted mixture of clay, silt, sand, and gravel that is loosely cemented; the material becomes coarser or less cemented in the lower part (McGovern and Coffin, 1963). Also present are beds of soft limestone, bentonite, and volcanic ash. The top of the formation consists of a few feet of a dense, sandy limestone known as the "Algal limestone". Maximum thickness is about 500 feet in the northern Medicine Creek subbasin in Nebraska. Depth to the top of the formation varies from 0 to 200 feet, averaging less than 100 feet. The surface of the Ogallala slopes to the east with an average gradient of 12 feet/mile.

Pleistocene loess deposits (wind deposited silt and clay) are present throughout the upland areas and valley walls. These deposits, varying in thickness from 0 to 200 feet, lie above the water table and yield little water.

Sand deposited by the wind during the Pleistocene and Holocene epochs is present in the northwest section of the upper basin with a maximum thickness of 170 feet. These deposits are an important element of the aquifer system because of their high permeability, which allows rapid recharge to the underlying Ogallala Formation.

The next most important sources of ground water are alluvium and terrace deposits of Holocene age. They are found in the valleys and under the flood plains of the larger streams and are comprised of varying mixtures of clay, silt, sand and gravel. Thickness of these deposits varies from 0 to 90 feet.

Lower Republican Basin

The principal aquifer system in the lower basin is comprised of alluvium and terrace deposits and the Ogallala, Grand Island, and Dakota Formations. The base of the aquifer system consists of Pierre Shale, the Niobrara and Wellington Formations, and the Chase Group.

The alluvium and terrace deposits of recent and Pleistocene age are

a major source of municipal and irrigation water. They are made up of unconsolidated clay, silt, sand, and gravel that have been deposited in the valleys and flood plains of the major streams. The deposits generally become more coarse with depth. Thickness of the alluvium ranges up to 130 feet. The terrace deposit thickness ranges up to 125 feet.

Covering the uplands of the lower basin are undifferentiated deposits, consisting of loess, volcanic ash, and gravels formed locally by weathering or stream action. Where saturated, these deposits will provide small to moderate amounts of water for domestic and stock wells. Thickness ranges up to 100 feet.

The Ogallala Formation occurs in the Nebraska portion of the lower basin. It is comprised of sandstone and siltstone interbedded with sand, gravel, and clay and has various degrees of cementation by calcium carbonate and silica. Thickness ranges over 100 feet and thins in an easterly direction. The base of the formation slopes to the southeast with an average gradient of 7 feet/mile.

Underlying the Ogallala and forming a relatively impermeable base are the Pierre Shale and Niobrara Formation. These formations were deposited in a marine environment during the late Cretaceous age. The Pierre is a dark-gray fissile shale, and the Niobrara consists of chalky shale and limestone. The Niobrara has a thickness of about 400 feet in Harlan County, Nebraska, and thins in an easterly direction.

GROUNDWATER SUPPLIES WITHIN THE LOWER REPUBLICAN NRD INCLUDING TRANSMISSIVITY, SATURATED THICKNESS MAPS, AND OTHER GROUNDWATER INFORMATION

To illustrate the impact of the different geologic formations within the Lower Republican NRD, refer to Map # 8 on page 22, which shows the Transmissivity of Principal Aquifer. Transmissivity is considered to be the rate at which water is able to move through the aquifer. It indicates the availability of water to wells. This map shows the rate of transmissivity to range from 20,000 to 150,000 gallons per day per foot throughout the Lower Republican NRD.

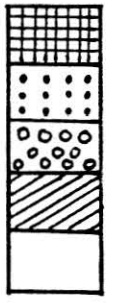
It illustrates that the majority of our water bearing material generally lies in the northern part of our District, which is north of the Republican River.

The Map # 9 on page 23 shows the Configuration of Base of Principal Aquifer. This map points out areas of where our District's principal aquifer is either absent or very thin, making the potential for future groundwater use either impossible or very unlikely. Recharge considerations in these areas would prove useless.

The Bureau of Reclamation, in their "Special Report (February 1985) for the Republican River Basin", notes in Table # 1 on page 24, a projection for an annual increase of groundwater development for the River's subbasin included in the Lower Republican NRD. The projected increase of approximately 5.5 thousand acres, below the Harlan County Reservoir to the Kansas-Nebraska border, indicates to the Lower Republican NRD that the Bureau of Reclamation feels that the potential for increased development in land not suited for irrigation might occur. Since the water provided for this additional groundwater development is located north of the Republican River within Franklin and Webster counties, the District's Management Options consider the increased potential for erosion to occur. The District addresses this concern accordingly.

Two other maps, Map # 10 on page 25 and Map # 11 on page 27, relate to the location of the water table in the Lower Republican NRD. Map # 10 shows the "Configuration of the Water Table" for the year 1979. Additional water table information will be provided, in the next section of this Technical Requirement, from the District's Static Water Table Monitoring Program.

TRANSMISSIVITY OF PRINCIPAL AQUIFER



150,000 +

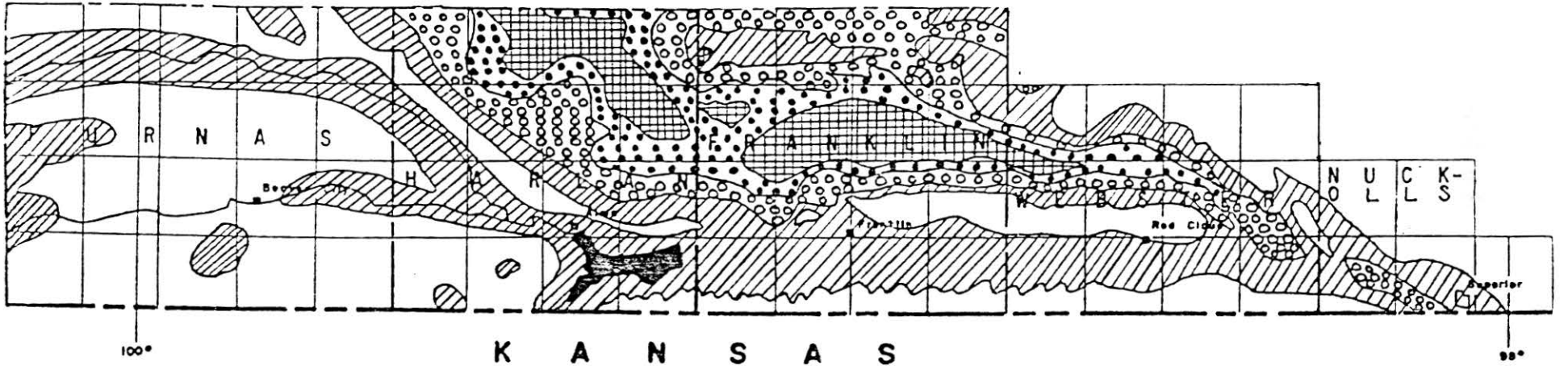
150,000

100,000

50,000

20,000

(thousands of gallons/day/square foot)



scale: 1" = 12 miles

Source: Reproduced from slides furnished by Conservation & Survey Division

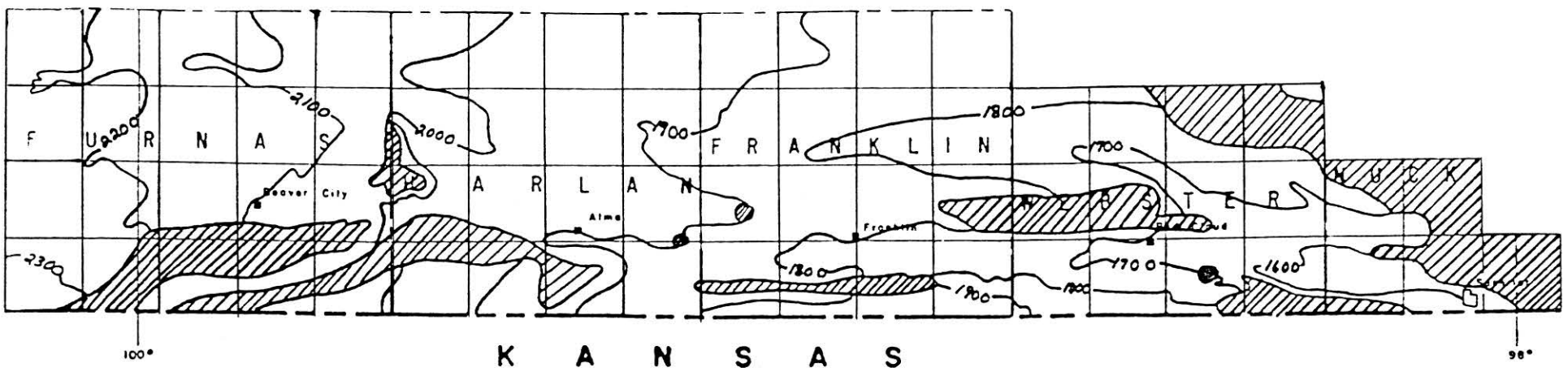
Date: 1985

Map #8

CONFIGURATION OF BASE OF PRINCIPAL AQUIFER

PRINCIPAL AQUIFER ABSENT OR VERY THIN

(base of principal aquifer measured in feet above mean sea level)



K A N S A S

Scale: 1" = 12 miles

Source: Reproduced from slides furnished by Conservation & Survey Division

Date: 1985

Map #9

Table # 1

Projected Annual Increase of Ground-water Development Per Subbasin for 1979 -- 2020

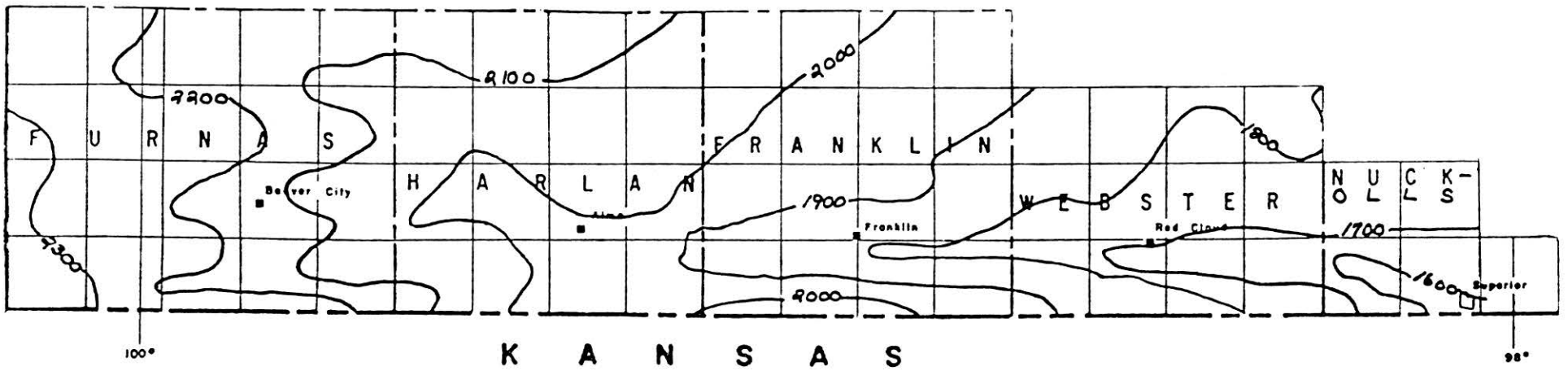
Subbasin	Net Pumpage (acre feet)	Irrigated Acres
* Beaver and Sappa	2,064	1,795
* Prairie Dog	290	252
* Main Stem Republican above Harlan County Dam	12,589	10,947
* Republican below Harlan County Dam to Nebraska-Kansas State Line	6,119	5,665

* Partially or wholly within boundaries of Lower Republican NRD

Reference: "Special Report - Republican River Basin Water Management Study" - February 1985 - Department of Interior-Bureau of Reclamation

CONFIGURATION OF WATER TABLE - SPRING - 1979

(configuration of water table measured in feet above mean sea level)



Scale: 1" = 12 miles

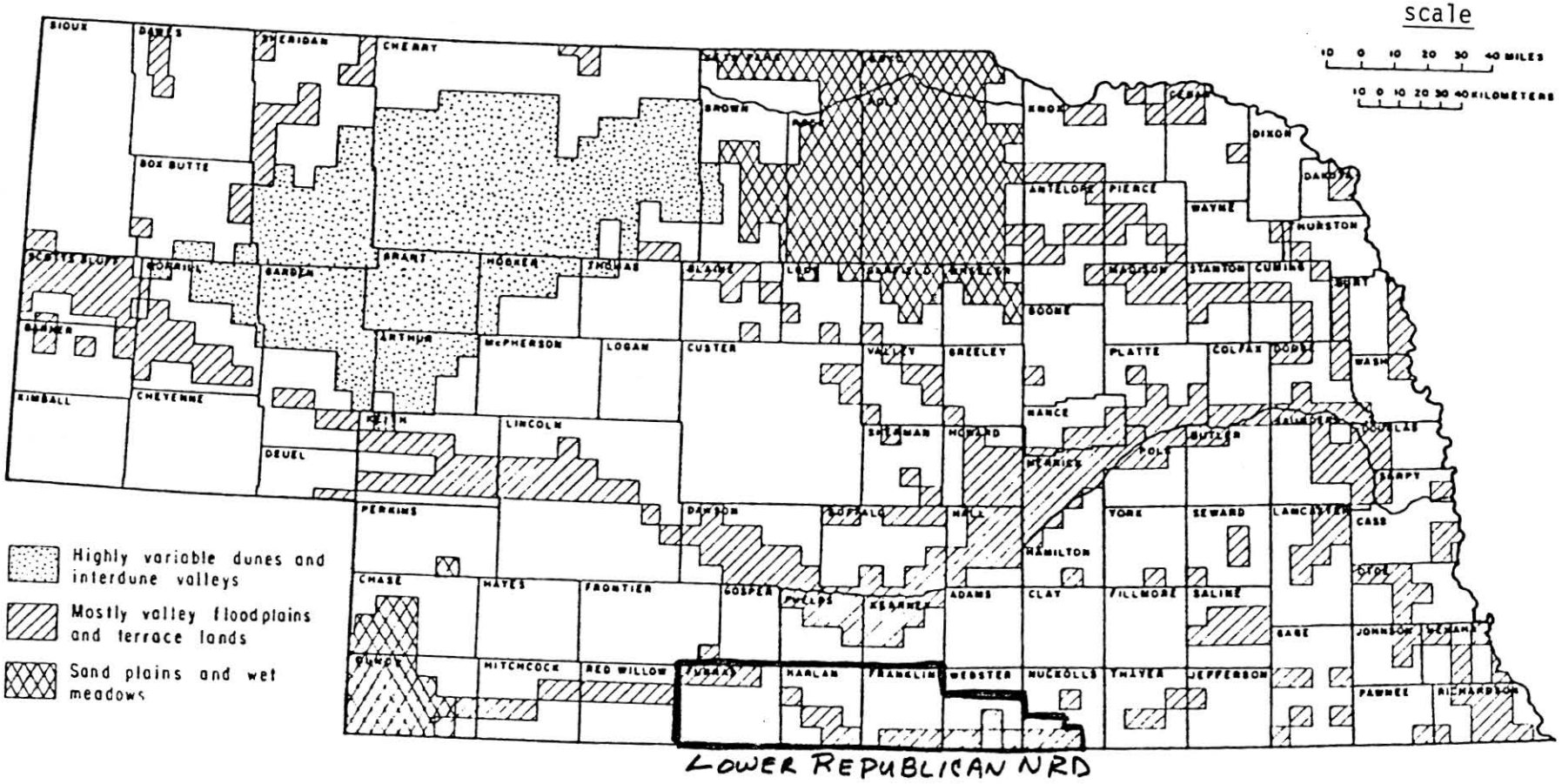
Source: Reproduced from slides furnished by Conservation & Survey Division

Date: 1985

Map #10

The Map # 11 on page 27 shows the townships throughout the State which exhibit areas where the depth to water is less than 50 feet. The Lower Republican NRD is outlined on this map and indicates that most of these areas within the District are located along the Republican River.

Two maps, Map # 12 on page 28 (Saturated Thickness Map-1981) and Map # 13 on page 29 (Static Water Levels-1981) will be used by the Lower Republican NRD as guides to help make management decisions regarding both quality and quantity concerns. Both maps were constructed from data obtained by the Lower Republican NRD from the Natural Resources Commission and the U.S. Geological Survey. This information represents data obtained from the South Central Nebraska Hydrogeologic Study. The District has selected the year 1981 to base decisions regarding quantity management on since the Study data represents the most extensive accurate information available to the Lower Republican NRD to base management decisions -- especially regarding groundwater quantity.

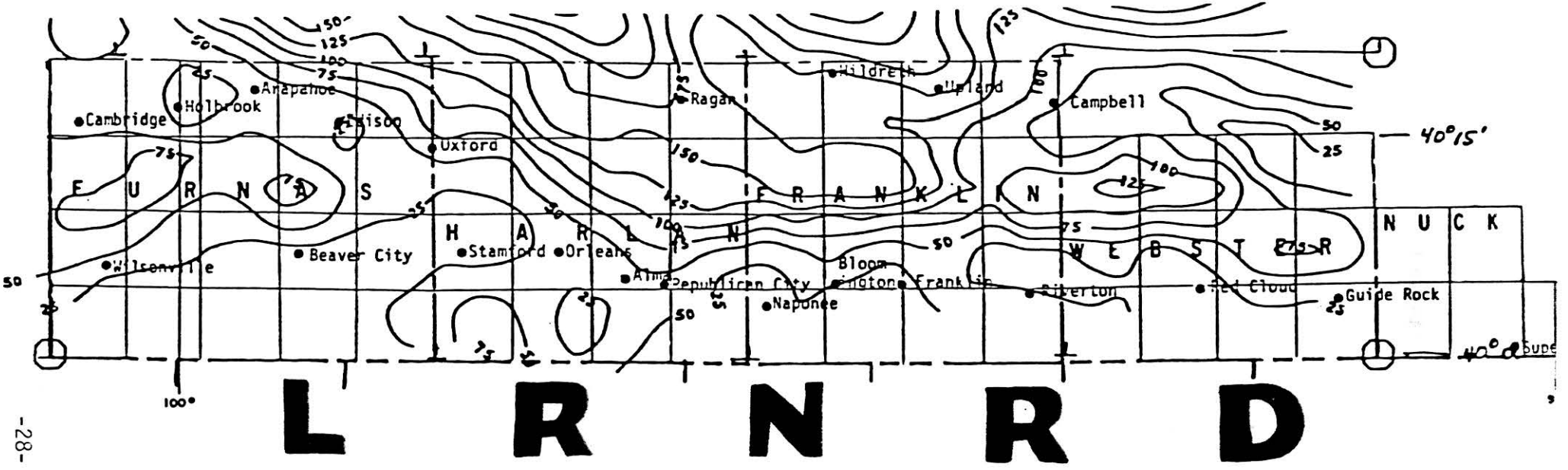


Map #11

Townships containing areas of depth to water less than 50 feet

Source: Groundwater Reservoir Management Policy Issue Study, Nebraska Natural Resources Commission

Date: March 1982

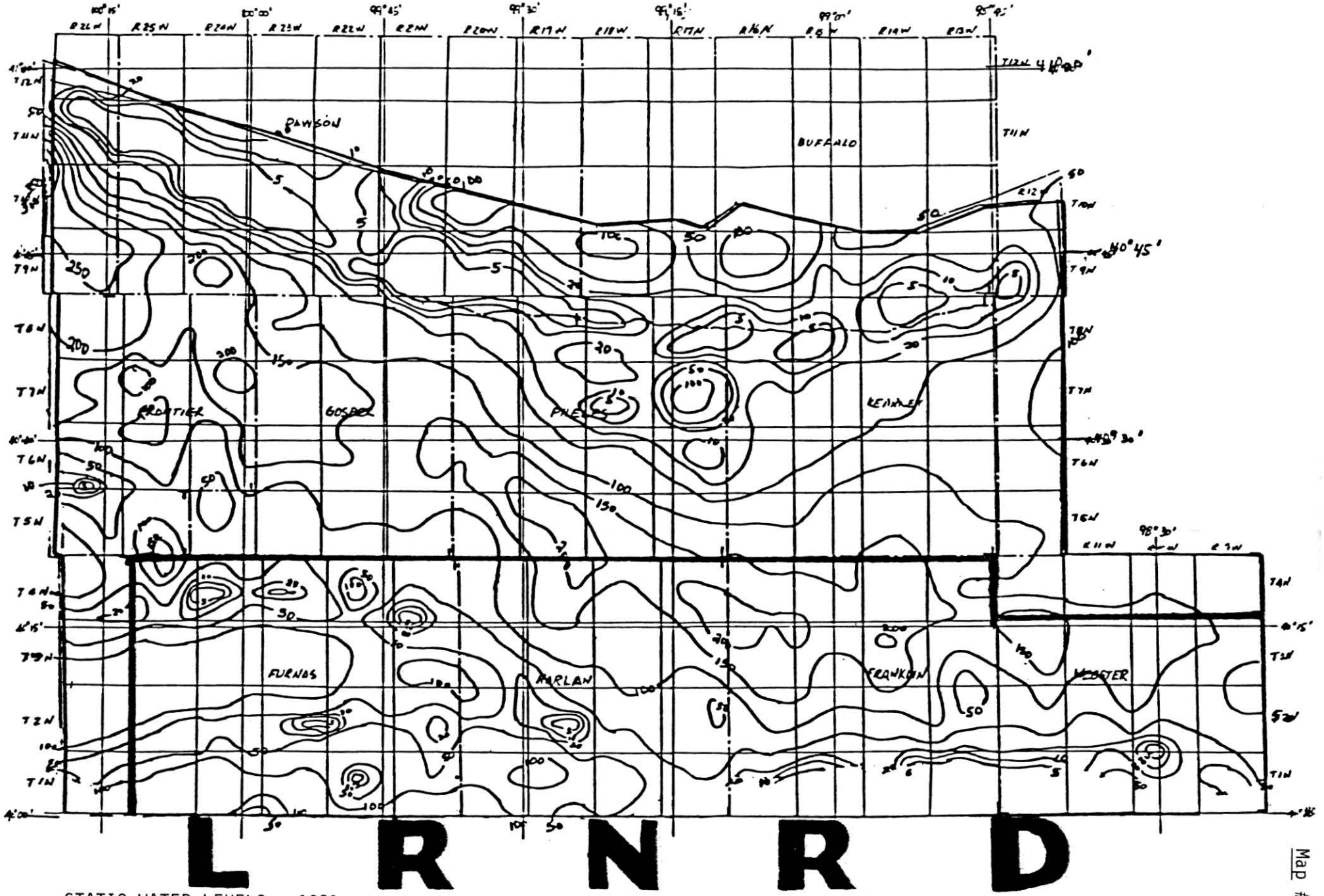


SATURATED THICKNESS - 1981

Source: Reproduced from information compiled from USGS - NRC South Central Hydrogeologic Study (Map excludes portion of Nuckolls County in the LRNRD - not in study area.)

Date: October 1986

Map #12



STATIC WATER LEVELS - 1981

Map #13

Reproduced from information compiled for USGS-NRC South Central Hydrogeologic Study, 1986. (Map excludes portion of Nuckolls County in LRNRD--not in study area.) October 1986

CURRENT GROUNDWATER DATA COLLECTION PROGRAMS

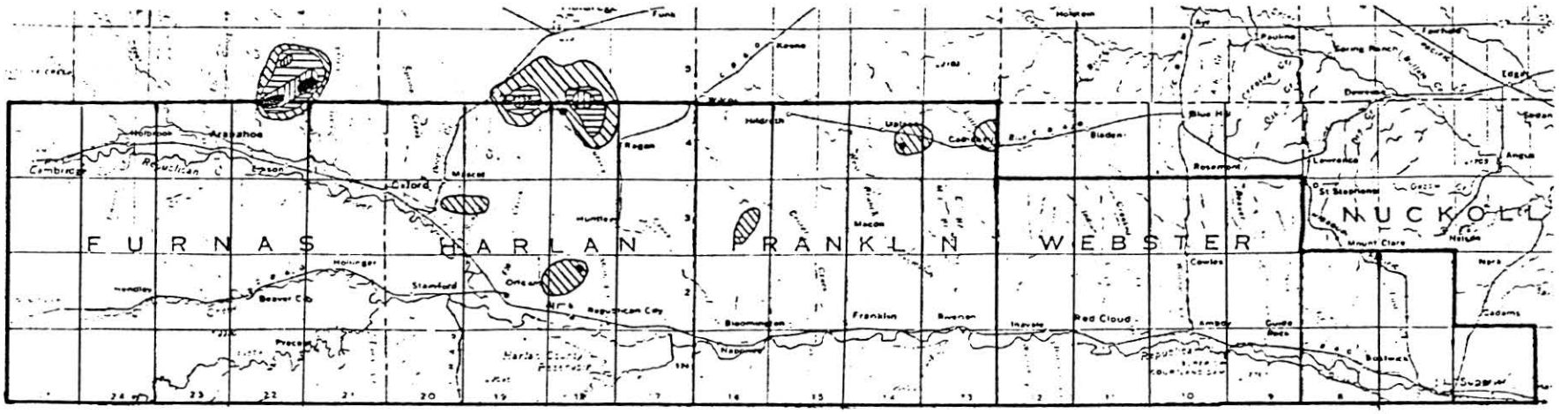
The Lower Republican NRD has administered a static water level monitoring program of our groundwater resource since 1976. These measurements are conducted each Spring and Fall, with a total of 64 wells currently being monitored. This Program aids our District in determining status of groundwater levels on an annual basis, and also to establish a long term trend for this resource. The trend will be important in decisions on whether to establish a control or management area, when to establish it, and the boundaries for a control area.

The information obtained from these semiannual measurements is also sent to the UNL - Conservation and Survey Division in Lincoln. The Conservation and Survey Division accumulates all static water level measurements, and once a year provides maps and other data giving the combined results of the measurements. Map # 14 on page 31 shows the results of measurements taken in 1984 and indicates the areas, according to Conservation and Survey Division data provided the Lower Republican NRD, where declines in the water levels occur, and to what extent. This map is a comparison of water levels to pre-irrigation development information. When comparing this map to the map showing the District's aquifer transmissivity, it appears that efforts to recharge the groundwater to address the declines, might be successful in most instances.

Graph # 1 on page 32, and Graph # 2 on page 33, show comparisons of spring static water measurements for the wells monitored by the Lower Republican NRD and County Extension Agents within the District. These annual comparisons, from 1976 - 1985, compare the static water level (this being the distance from the land surface to the current water level) at the date measured, to the level of water at the time the well was drilled.

Graph # 1 shows water levels on a District-wide basis in 1985 (for 64 wells monitored). Based on the wells measured throughout the Lower Republican NRD, less than a one-foot decline has occurred. When the Lower Republican NRD staff prepared the two graphs, on the Spring well measurements, a few of the extreme measurements (with a great rise in water level or with a great decline) were deleted. Averaging those figures into the totals on Graph # 1 and Graph # 2 makes only a slight difference.

AREAS OF DECLINES IN THE LOWER REPUBLICAN NRD GROUNDWATER AS DETERMINED BY UNL - CONSERVATION & SURVEY DIVISION



Decline, In Feet

- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

Key Observation Well ●

Scale

0 10 20 30 40 MILES

0 10 20 30 40 50 60 KILOMETERS

Source: Groundwater Levels in Nebraska: By Michael J. Ellis, U.S. Geological Survey, and Darryll T. Pederson, Conservation and Survey Division/Nebraska Water Survey Paper Number 59.

Date: June 1984

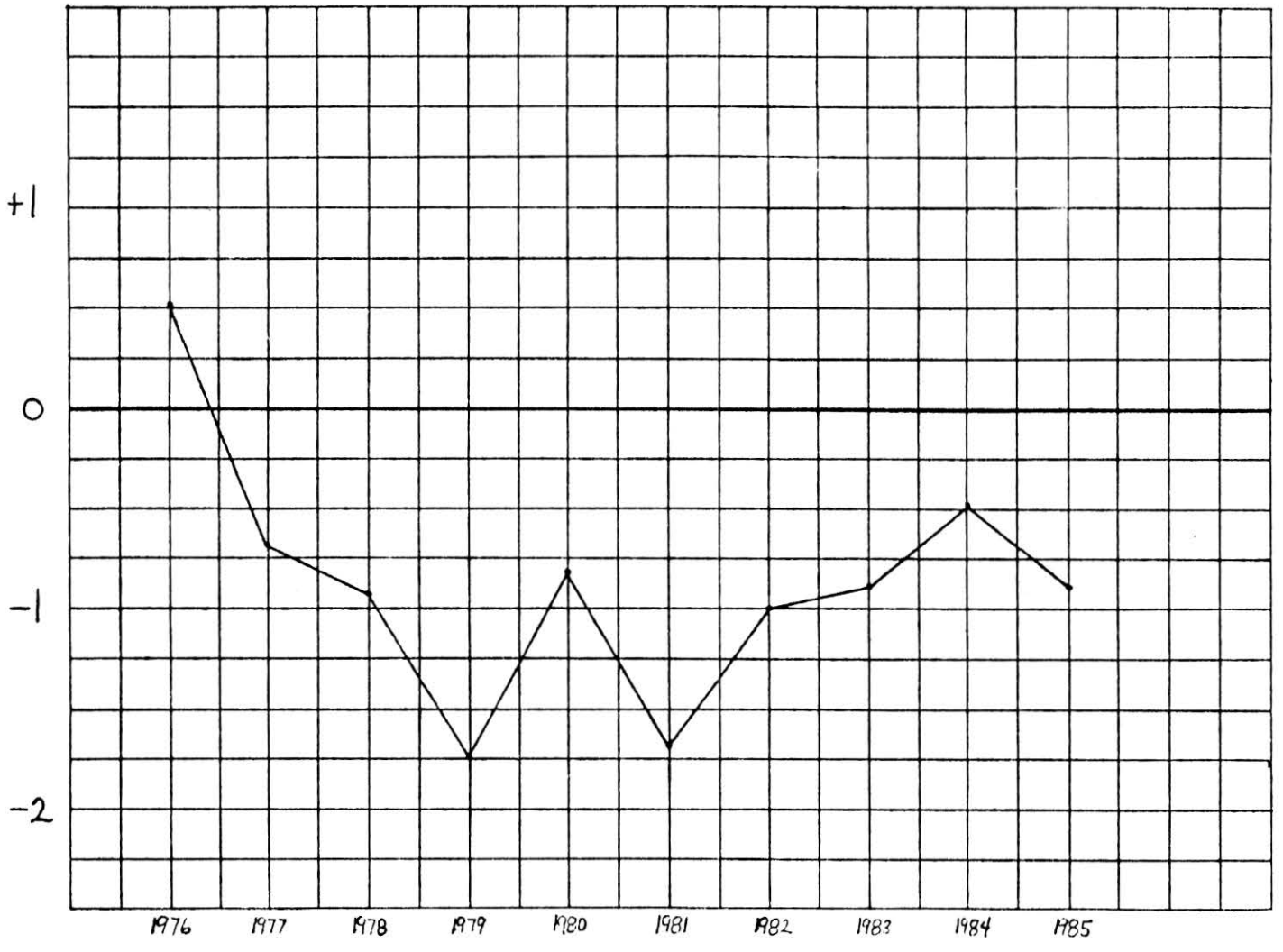
Map # 14

Graph #1

STATIC WATER LEVEL MONITORING PROGRAM IN LRNRD

Spring Well Measurements - Average of District

	'85	'84	'83	'82	'81	'80	'79	'78	'77	'76
Total no. Wells	64	58	48	51	59	41	27	32	26	26
Total Decline	-57.1	-28.6	-42.7	-50.9	-99.9	-33.8	-46.9	-29.8	-17.9	+13.3
Ave Decline(ft)	- .89	- .49	- .89	-1.00	-1.69	- .82	-1.74	- .93	- .69	+ .51



Source: Information compiled by LRNRD staff from LRNRD monitoring data

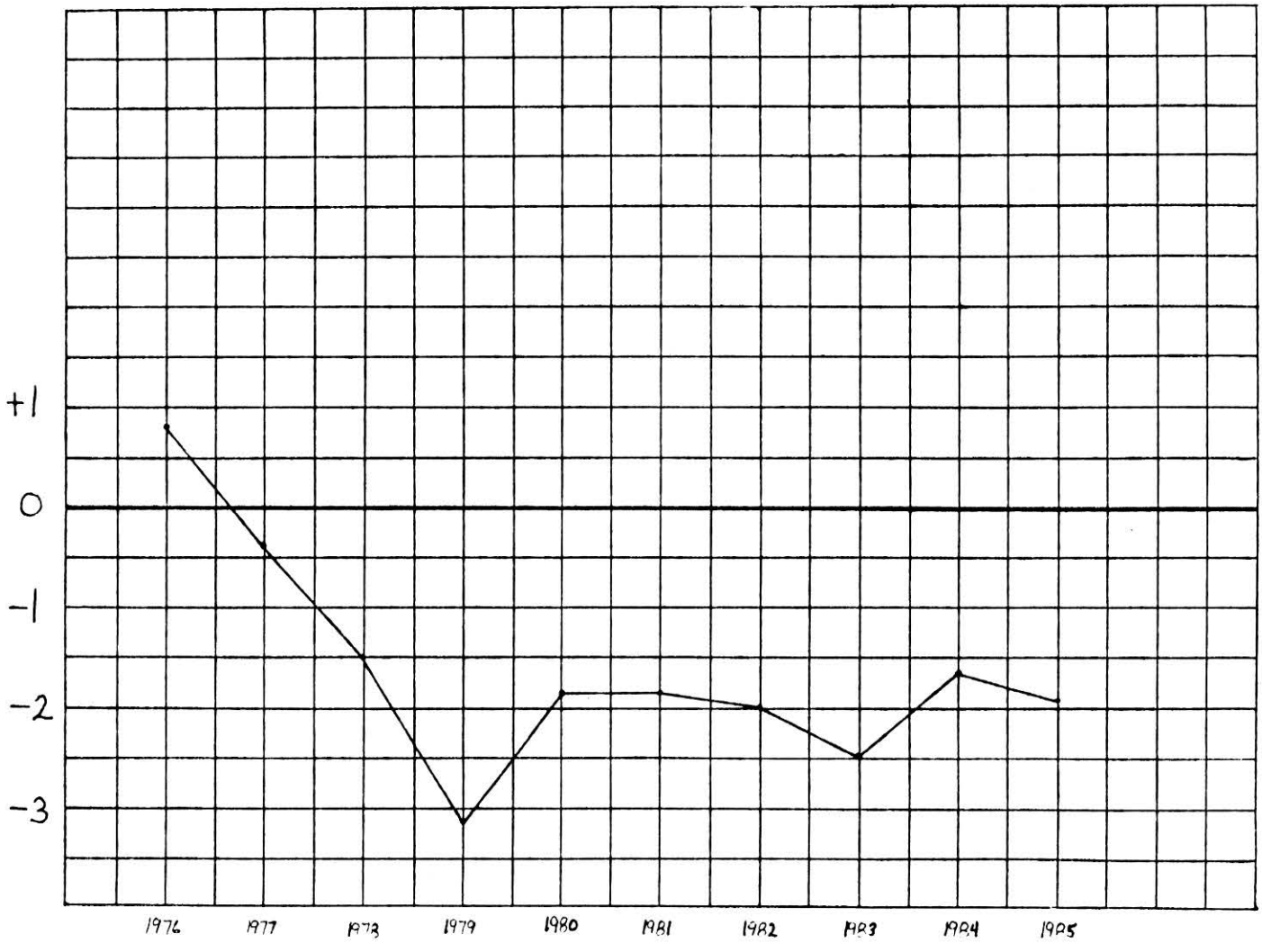
Date: 1985

Graph #2

STATIC WATER LEVEL MONITORING RESULTS IN TOWNSHIP 4 OF FURNAS, HARLAN, AND FRANKLIN COUNTIES

Spring Well Measurements - (minus large fluctuations)

	'85	'84	'83	'82	'81	'80	'79	'78	'77	'76
Total no. Wells	26	22	14	15	21	12	12	12	7	7
Total Decline	-49.8	-36.5	-34.6	-29.8	-38.8	-22.3	-37.7	-18.10	-2.9	+5.7
Ave Decline(ft)	-1.92	-1.66	-2.47	-1.99	-1.85	-1.86	-3.14	- 1.51	-.41	+.81



Source: Information compiled by LRNRD staff from LRNRD monitoring data

Date: 1985

The graph which the Lower Republican NRD considered in addressing the District's declining water table concern area, was Graph # 2 on page 33. This graph averages measurements of wells monitored in the northern tier of townships in Furnas, Harlan, and Franklin counties. The average decline shown for the 26 wells monitored in the problem area, to the Spring of 1985, is almost 2 feet. There are some wells, particularly in northern Harlan and Furnas County, which experience greater declines than this 2 foot average. In preparing the Management Options for this concern area, the District did not feel that an immediate need exists to establish a control area to address the concern. However, the District will continue to closely consider the need for mandatory controls in this portion of the NRD, to deal with the declining water table concern.

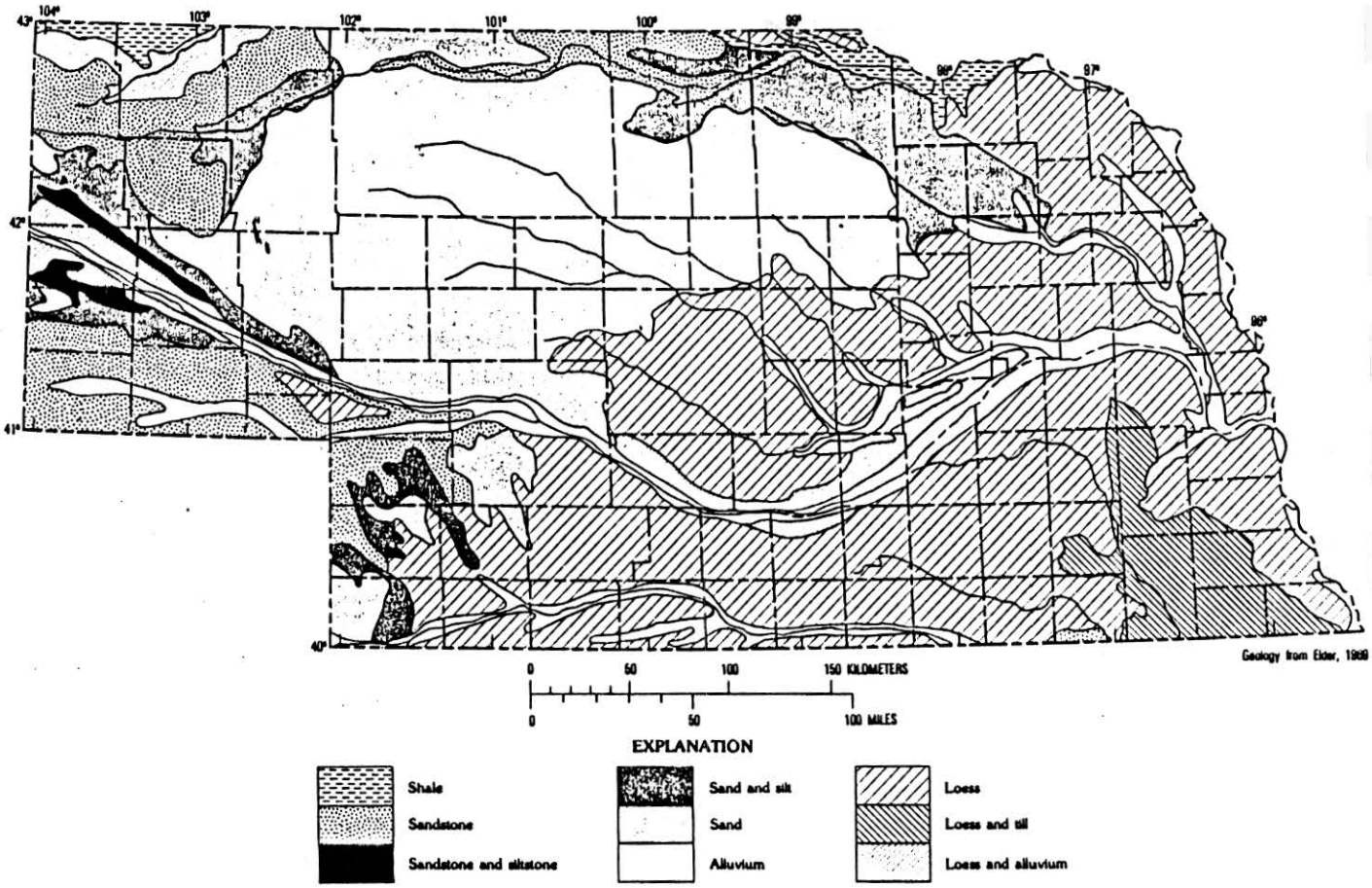
CLIMATIC IMPACTS ON GROUNDWATER USAGE

Average Annual Precipitation and the Variations Within the Area

In selecting the management options to address the future groundwater needs of the District, it was important to consider the annual precipitation and when this precipitation was usually received. Map # 15 on page 36 not only shows location of the soil parent materials, but also the climatic data for the State (with the LRNRD highlighted accordingly). This climatic data map shows that the LRNRD received an average annual precipitation ranging from 20 inches in the western portion of the District, to 26 inches in the extreme eastern portion. Illustration # 1 found on page 37 shows a table indicating temperatures (mean average, maximum mean, and minimum mean) to include Alma (center of District), Red Cloud (eastern portion of District) and McCook (not in LRNRD but representative of the extreme western portion of the District). The graph found on the same page indicates (on a monthly basis) temperatures likely to occur throughout the year for two locations in our NRD - Alma and Red Cloud.

Table # 2, page 38 and Table # 3, page 39 provide additional precipitation information about the LRNRD. Table # 2 shows annual average highs and lows in precipitation for two locations, Alma (center) and Red Cloud (eastern) within the District. This table illustrates when the annual precipitation for a year is toward the low side of the average, raising certain crops (without irrigation) is not practical - especially when the majority of the precipitation within a year can occur in only a few rainfall events and not at the time of the year critical for crop production. Table # 3 provides a list of figures for Beaver City (western portion of District) showing this annual variation of precipitation for the period of time from 1900 to 1979.

Graph # 3 through Graph # 7 (pages 40 to 44) illustrates rainfall computed from two weather stations located in our NRD, and operated by our NRD, and one operated by Tri-Basin NRD located in Holdrege, Nebraska, throughout the irrigation season for crop water use data provided to farmers. These graphs further illustrate variations of rainfall in and around our NRD for the years 1981 through 1985. The locations of these weather stations are the Red Cloud Powerplant, the Paul Schroeder farmstead several miles south and west of Arapahoe, and the Tri-Basin NRD office in Holdrege, Nebraska.



PARENT MATERIALS OF SOILS

Source: "Hydrologic Characteristics of Nebraska Soils", Jack T. Dugan
USGS, WSP #2222, page 3.

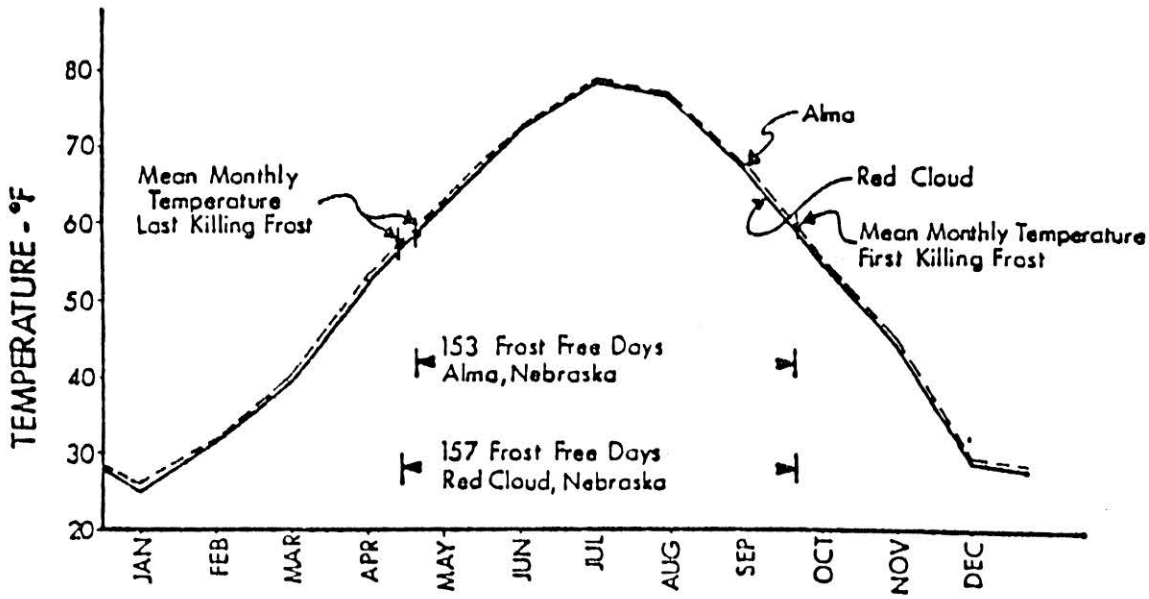
Date: 1985

Temperature Summary for Representative Climatological Stations

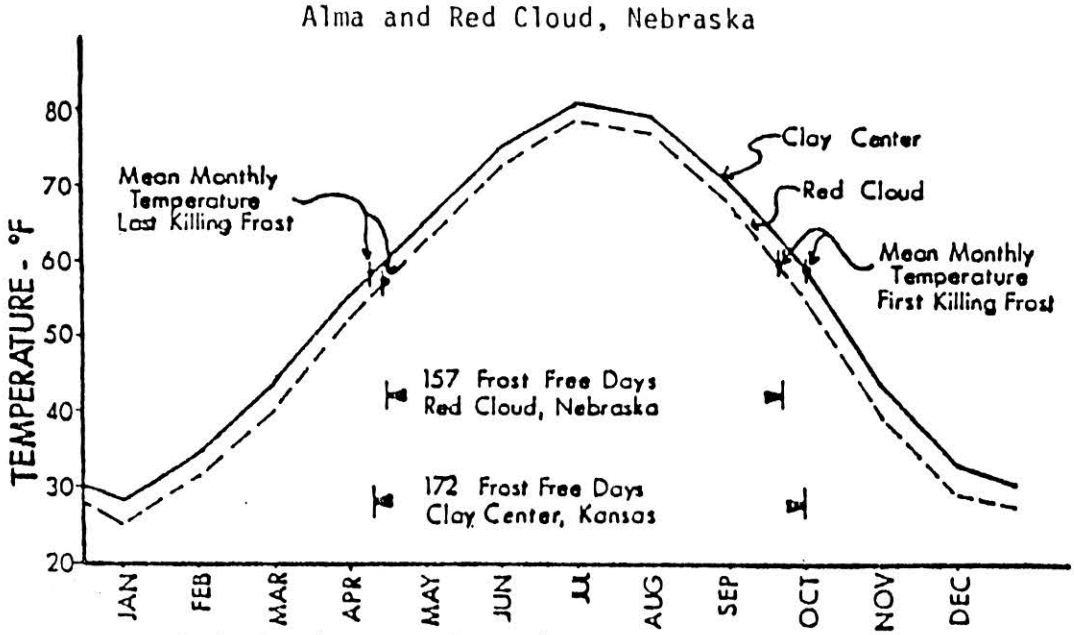
Illustration #1

Station	1920-1978 mean annual temperature (°F)	Maximum mean monthly temperature (°F)	Minimum mean monthly temperature (°F)
Wray, CO	51.2	81.8	10.8
McCook, NE	52.3	84.6	13.3
Alma, NE	52.8	86.8	10.1
Red Cloud, NE	52.6	87.6	10.0
Clay Center, KS	55.5	89.6	13.2

Below predicts average monthly temperatures, last and first killing frost dates, and frost-free days for the five stations.



Alma and Red Cloud, Nebraska



Red Cloud, Nebraska and Clay Center, Kansas

Source: Special Report-Republican River Basin Water Management Study, Colorado-Nebraska-Kansas, Dept. of Interior-Bureau of Reclamation

Date: February 1985

Precipitation Summary For

Representative Climatological Stations

Station	1920-1978 Mean Annual (in)	Maximum Annual (in)	Minimum Annual (in)
Wray, Colorado	17.63	30.36	7.29
McCook, Nebraska	20.15	38.26	9.69
Alma, Nebraska	21.42	37.75	11.73
Red Cloud, Nebraska	24.14	40.42	11.94
Clay Center, Kansas	29.68	53.86	13.88

Reference: "Special Report - Republican River Basin Water Management Study" - February 1985 - Department of Interior-Bureau of Reclamation

PRECIPITATION DATA FOR BEAVER CITY

Table # 3

DECILE VALUES OF PRECIPITATION (IN INCHES) FOR BEAVER CITY, 1900-1979.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
LOWEST	0.00	0.00	0.00	0.05	0.00	0.65	0.22	0.10	0.00	0.00	0.00	0.00	11.30
DECILE 1	0.01	0.07	0.14	0.48	1.01	1.04	1.17	0.84	0.33	0.09	0.03	0.01	14.62
DECILE 2	0.10	0.18	0.34	0.90	1.60	1.56	1.46	1.30	0.64	0.31	0.08	0.09	17.76
DECILE 3	0.18	0.23	0.53	1.13	2.21	2.12	1.74	1.65	1.10	0.51	0.17	0.18	18.89
DECILE 4	0.24	0.39	0.75	1.48	2.62	2.66	2.13	1.94	1.33	0.78	0.30	0.20	19.96
DECILE 5	0.32	0.57	0.93	1.90	3.05	3.32	2.62	2.48	1.54	0.91	0.45	0.38	22.11
DECILE 6	0.46	0.67	1.22	2.30	3.52	3.78	2.95	2.88	2.01	1.19	0.73	0.53	23.47
DECILE 7	0.59	0.83	1.46	2.74	4.27	4.73	3.79	3.29	2.29	1.44	1.05	0.72	24.75
DECILE 8	0.70	1.04	1.86	3.45	4.94	5.17	5.33	3.65	2.91	2.01	1.49	0.89	25.95
DECILE 9	0.94	1.41	2.46	3.95	5.91	6.40	6.31	4.36	3.89	3.42	2.12	1.22	28.92
DECILE 10	2.56	2.83	4.65	7.58	11.05	9.00	13.90	9.97	7.19	7.62	4.08	4.75	39.50
MEAN	0.46	0.66	1.17	2.16	3.41	3.59	3.27	2.64	1.96	1.34	0.82	0.60	22.08
MEDIAN	0.32	0.57	0.93	1.90	3.05	3.32	2.62	2.48	1.54	0.91	0.45	0.38	22.11

FIRST AND SECOND DECILE VALUES OF PRECIPITATION (IN INCHES) FOR VARIOUS PERIODS ENDING IN THE MONTH SHOWN FOR BEAVER CITY, 1900-1979.

PERIOD		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1MONTH	1ST	0.01	0.07	0.14	0.48	1.01	1.04	1.17	0.84	0.33	0.09	0.03	0.01
	2ND	0.10	0.18	0.34	0.90	1.60	1.56	1.46	1.30	0.64	0.31	0.08	0.09
2MONTHS	1ST	0.27	0.25	0.53	1.15	2.34	3.51	3.07	2.77	2.09	1.12	0.25	0.20
	2ND	0.40	0.50	0.72	1.65	3.04	4.48	4.00	3.40	2.95	1.52	0.73	0.34
3MONTHS	1ST	0.58	0.70	0.80	1.52	3.24	5.05	5.61	5.73	4.51	2.66	1.58	0.73
	2ND	0.78	0.85	1.03	2.19	4.31	5.90	6.76	6.49	5.44	3.76	1.89	1.10
4MONTHS	1ST	1.21	1.11	1.29	1.39	4.04	6.07	7.32	8.04	6.90	4.88	3.71	1.85
	2ND	1.66	1.35	1.67	2.40	4.54	7.66	8.28	9.33	8.29	6.07	4.36	2.60
5MONTHS	1ST	2.34	1.68	1.80	2.36	4.54	6.72	8.39	9.34	9.74	7.68	5.30	4.15
	2ND	2.97	2.08	2.33	3.27	5.25	8.07	9.85	11.11	11.09	9.20	7.08	4.77
6MONTHS	1ST	4.40	3.09	2.58	3.00	5.12	7.01	8.88	10.32	10.99	10.32	8.21	6.12
	2ND	5.26	3.99	3.20	3.61	5.98	8.57	10.47	12.13	12.52	12.19	9.61	7.58
7MONTHS	1ST	6.42	5.06	4.12	3.84	5.81	7.62	8.99	10.64	11.67	11.79	10.98	9.22
	2ND	8.40	5.96	4.78	4.76	6.82	9.33	10.70	12.39	13.96	13.65	12.45	10.29
8MONTHS	1ST	9.29	6.87	6.00	5.12	7.19	8.92	9.96	11.32	12.74	12.93	12.68	11.70
	2ND	10.78	8.80	6.84	6.34	7.72	9.91	11.36	12.77	14.53	14.56	14.16	12.96
9MONTHS	1ST	12.17	9.52	8.16	7.60	7.91	9.59	10.83	11.73	13.03	13.90	13.79	13.28
	2ND	13.83	11.52	9.69	8.50	9.56	10.75	12.20	13.37	14.83	14.84	15.85	15.04
10MONTHS	1ST	13.57	12.66	10.82	9.37	11.00	11.34	11.47	12.86	13.56	13.90	14.01	14.11
	2ND	15.93	14.03	12.19	11.27	11.26	12.23	13.22	14.61	15.54	15.97	16.57	16.88
11MONTHS	1ST	14.34	14.24	13.00	12.28	12.73	12.84	12.94	13.77	15.13	14.38	14.18	14.36
	2ND	17.08	16.40	15.66	14.25	14.60	15.47	14.67	16.08	16.31	17.12	17.25	17.22
12MONTHS	1ST	15.01	14.70	14.83	14.73	14.16	15.41	15.44	15.95	16.23	15.92	14.92	14.61
	2ND	17.67	17.76	18.07	16.74	18.45	17.83	17.47	17.53	17.61	17.61	17.03	17.76

LOWEST PRECIPITATION VALUES (IN INCHES) FOR VARIOUS PERIODS ENDING IN THE MONTH AND YEAR SHOWN FOR BEAVER CITY, 1900-1979.

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1MONTH	0.00	0.00	0.00	0.05	0.00	0.65	0.22	0.10	0.00	0.00	0.00	0.00
	1964	1970	1910	1946	1966	1933	1917	1928	1922	1952	1959	1970
2MONTHS	0.00	0.06	0.07	0.25	0.78	1.72	2.07	1.68	1.40	0.08	0.00	0.00
	1909	1904	1910	1910	1966	1901	1933	1932	1947	1922	1939	1959
3MONTHS	0.26	0.07	0.26	0.32	1.98	3.79	3.02	3.63	2.52	1.46	0.41	0.20
	1964	1904	1910	1910	1966	1924	1901	1936	1974	1939	1939	1938
4MONTHS	0.60	0.59	0.34	0.51	2.94	4.53	5.84	5.95	5.98	3.75	1.46	0.90
	1964	1933	1904	1910	1910	1910	1931	1956	1936	1907	1939	1950
5MONTHS	1.23	1.11	1.05	1.65	3.13	4.60	6.06	7.59	7.10	6.12	3.79	2.36
	1951	1946	1904	1936	1910	1910	1910	1956	1956	1936	1939	1939
6MONTHS	3.30	1.86	1.61	2.32	4.13	4.79	6.13	7.82	8.74	8.37	6.15	4.69
	1940	1923	1911	1946	1966	1910	1910	1956	1956	1956	1936	1939
7MONTHS	5.12	4.14	2.19	2.63	4.15	6.12	6.32	8.31	8.97	10.01	8.44	6.97
	1908	1940	1904	1946	1966	1910	1910	1956	1956	1956	1956	1936
8MONTHS	7.76	5.97	5.37	4.12	4.91	6.51	7.65	8.78	9.46	10.24	10.08	8.64
	1957	1957	1933	1926	1956	1911	1910	1956	1956	1956	1956	1956
9MONTHS	8.82	8.09	6.31	6.44	6.76	6.63	7.88	9.28	9.93	10.64	10.31	10.28
	1957	1957	1908	1908	1911	1911	1956	1956	1956	1910	1956	1956
10MONTHS	10.46	9.15	9.19	7.29	8.51	8.21	8.28	9.40	10.43	10.83	10.72	10.51
	1957	1957	1911	1908	1956	1911	1956	1956	1956	1910	1910	1956
11MONTHS	10.69	10.79	11.27	10.50	10.58	10.63	9.94	9.80	10.55	11.70	10.91	11.00
	1957	1957	1957	1926	1908	1956	1926	1956	1956	1956	1910	1956
12MONTHS	11.18	11.02	12.06	13.20	12.76	12.55	11.88	12.50	10.95	11.82	11.30	11.30
	1957	1957	1911	1908	1911	1911	1956	1956	1956	1956	1956	1910

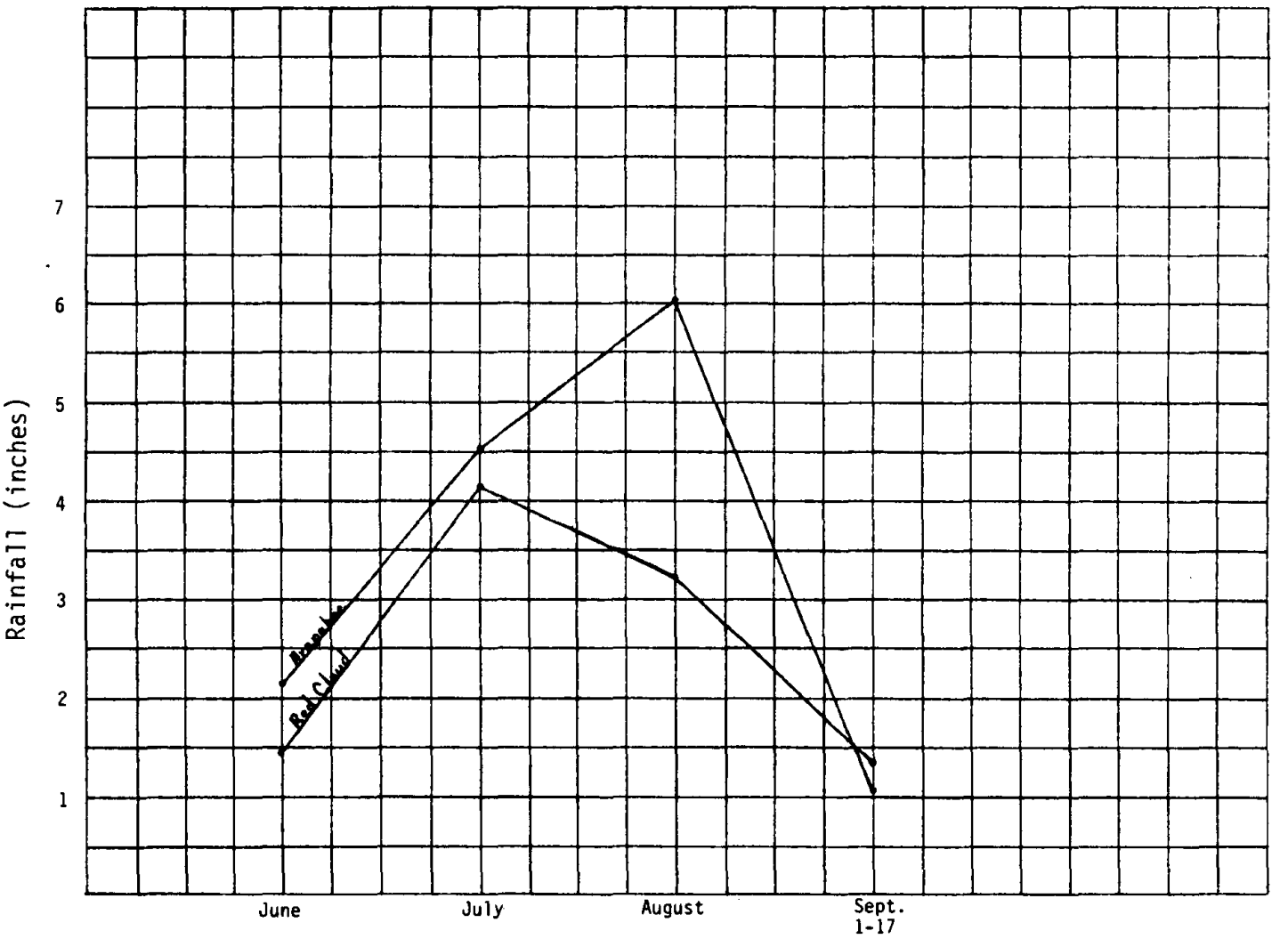
TO CONVERT TO MILLIMETERS MULTIPLY BY 25.4

Source: An Analysis of Nebraska Precipitation Climatology, University of Nebraska

Date: August 1981

Graph #3

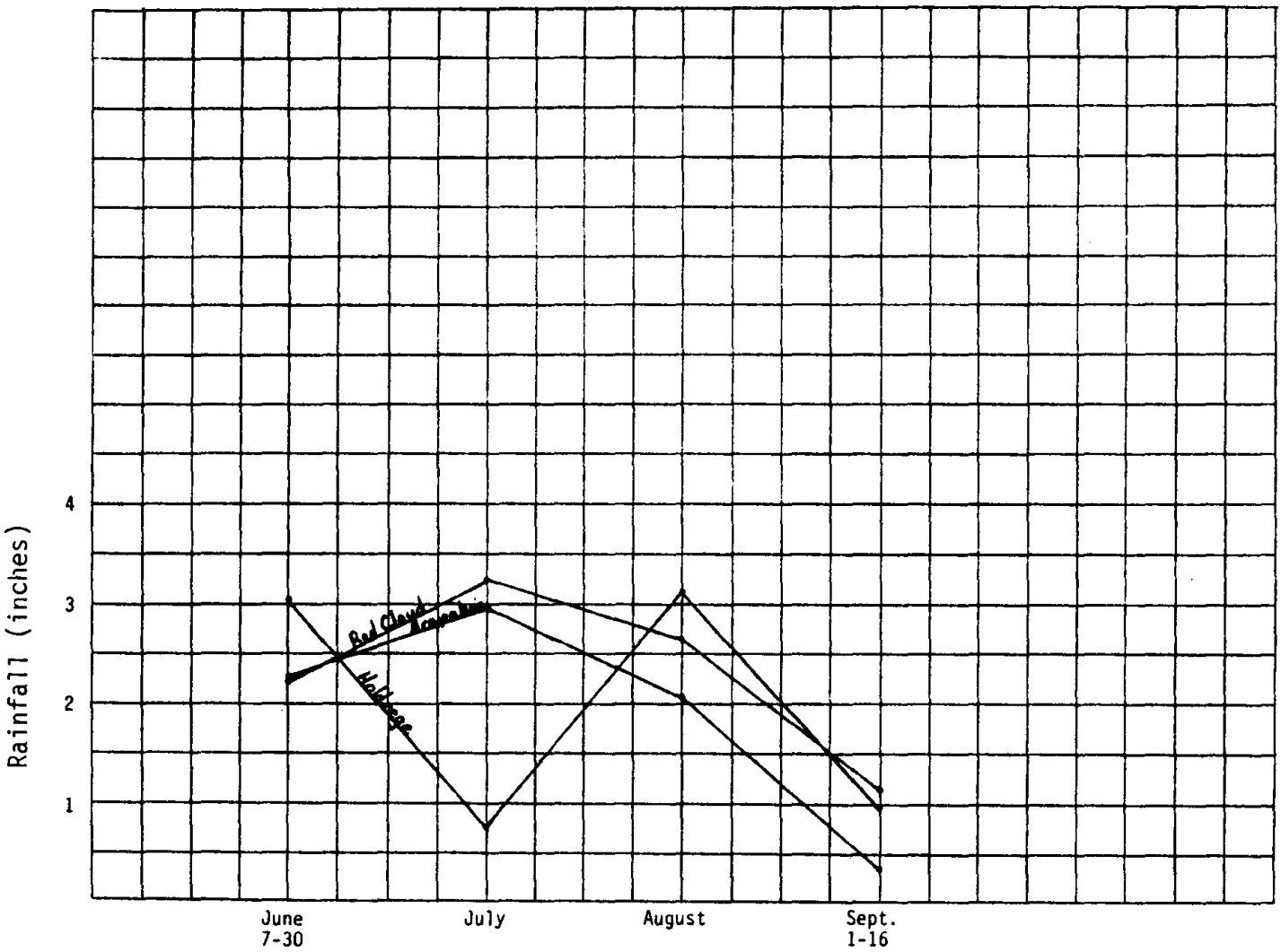
Recorded Precipitation
1981



Source: Information compiled by LRNRD staff using predictive data from Arapahoe, Red Cloud, and Holdrege, Nebraska weather stations.

Date: 1985

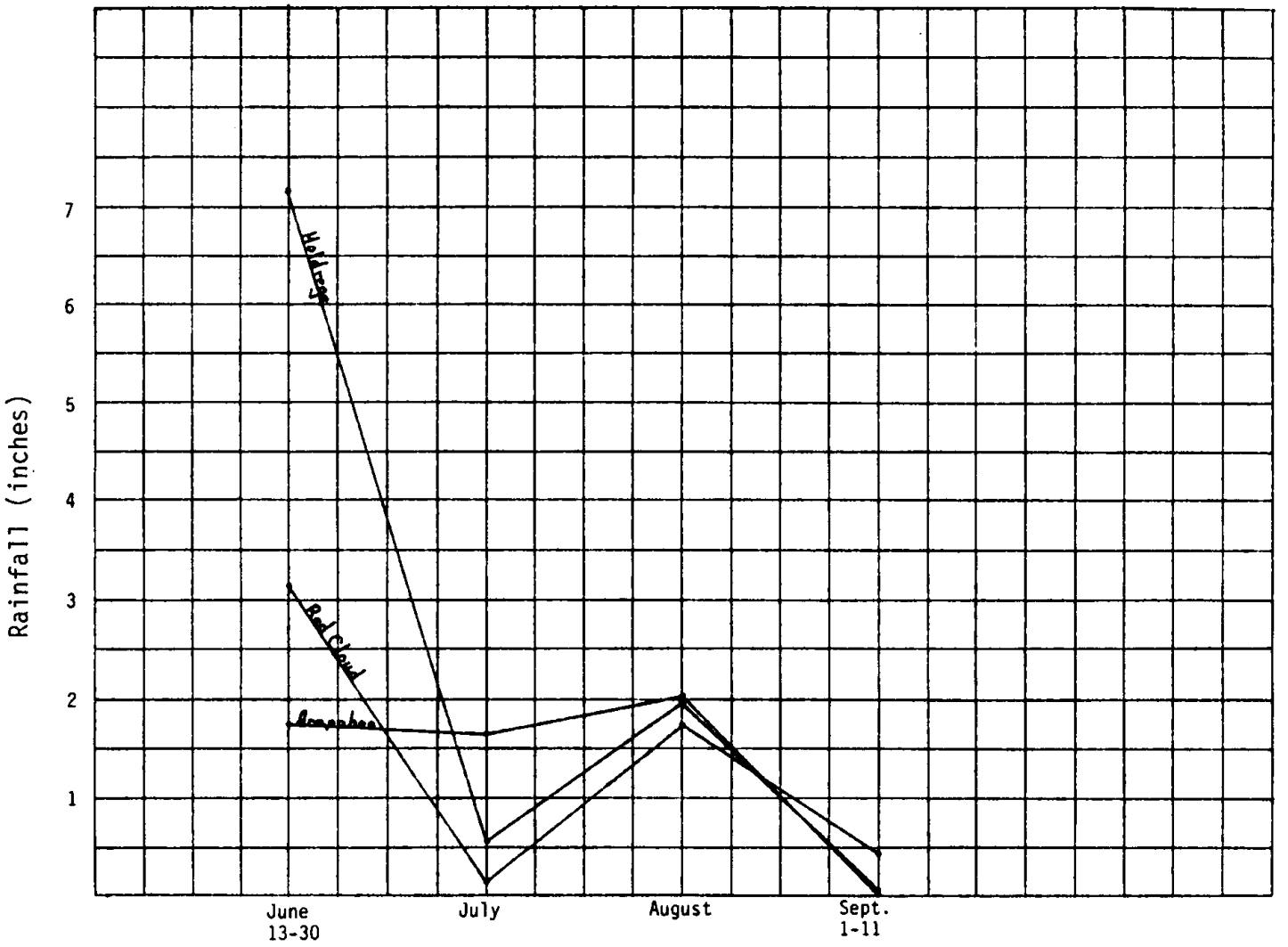
Recorded Precipitation
1982



Source: Information compiled by LRNRD staff using predictive data from Arapahoe, Red Cloud, and Holdrege, Nebraska weather stations.

Date: 1985

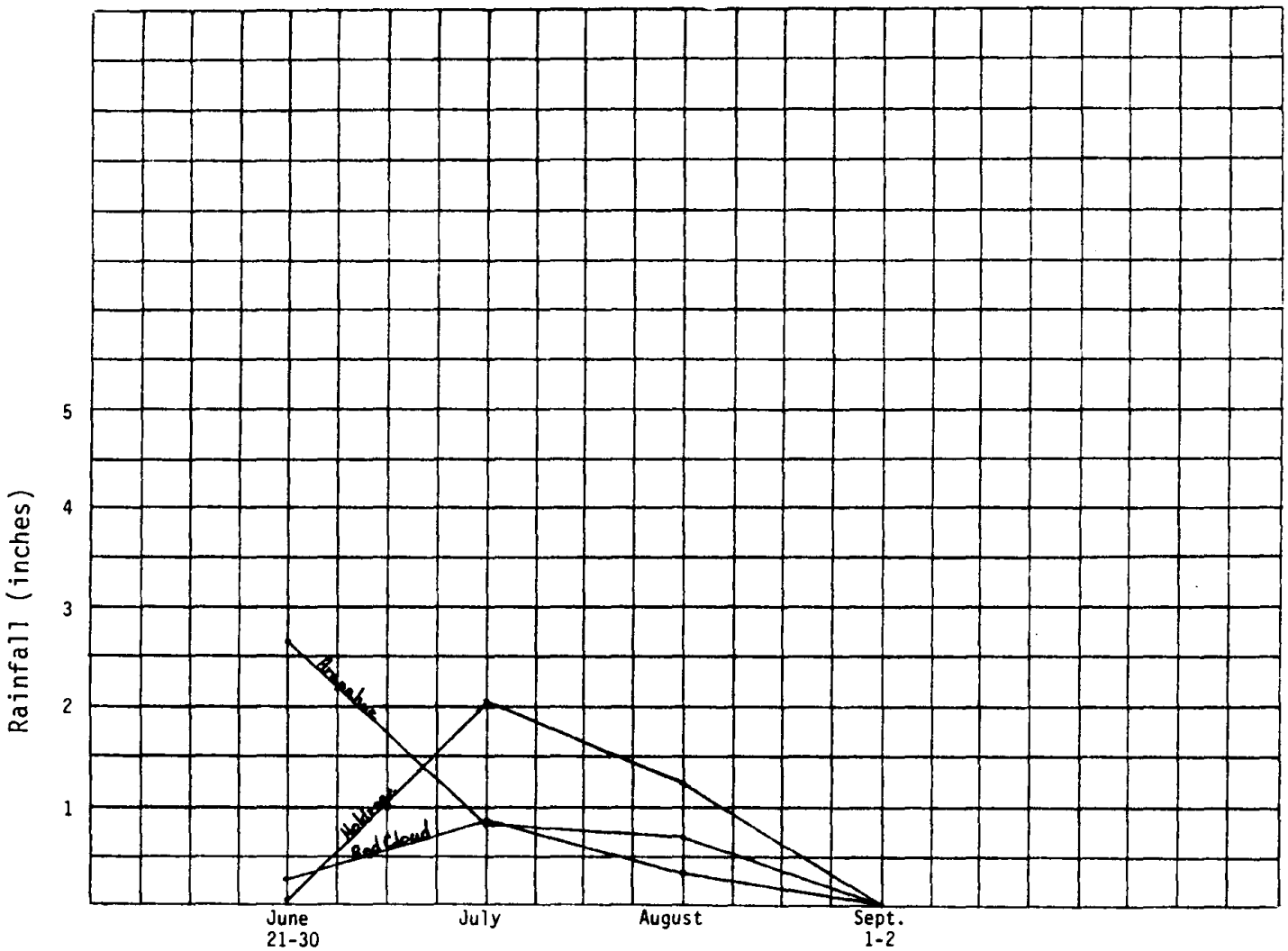
Recorded Precipitation
1983



Source: Information compiled by LRNRD staff using predictive data from Arapahoe, Red Cloud, and Holdrege, Nebraska weather stations.

Date: 1985

Recorded Precipitation
1984



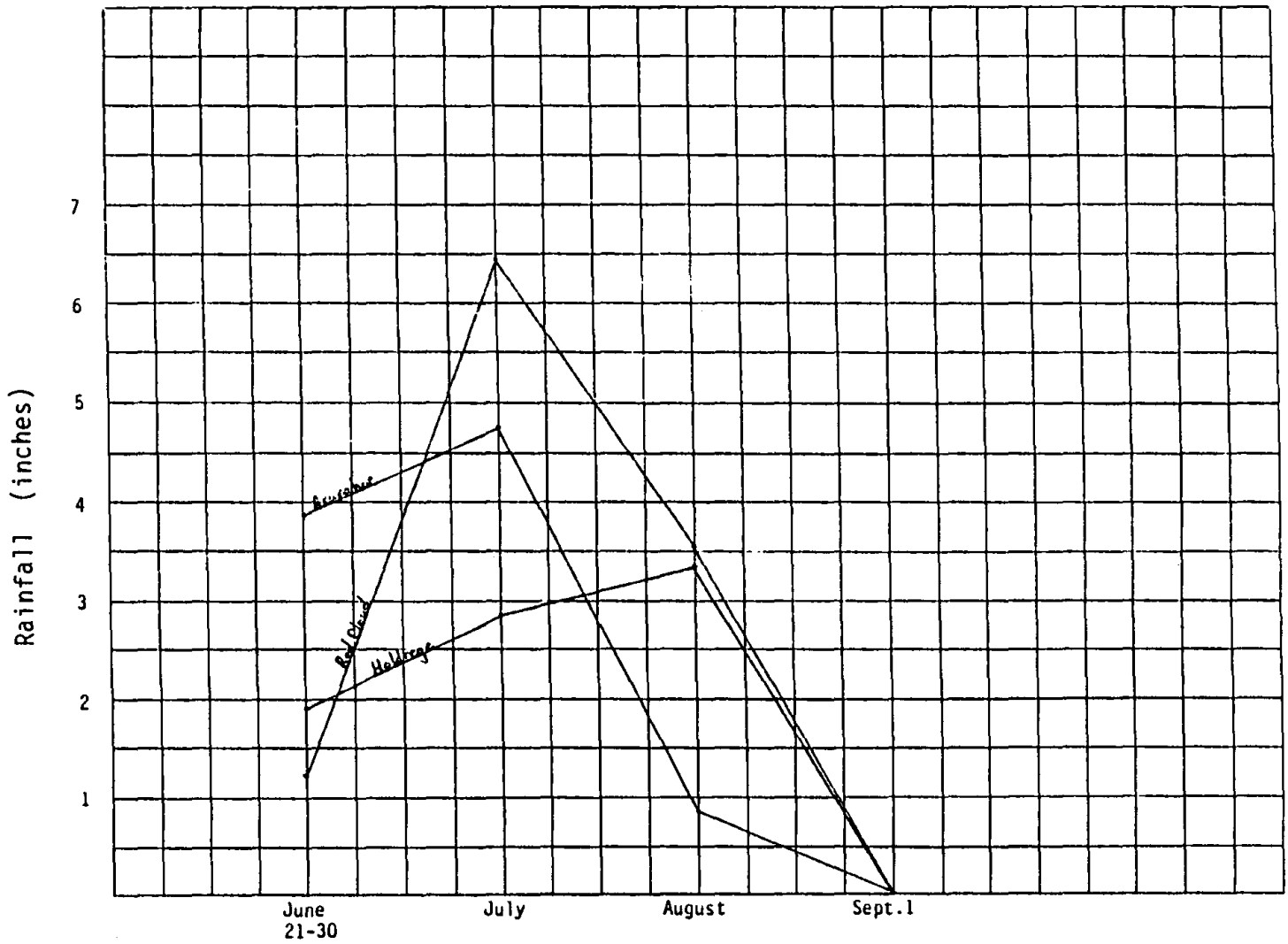
Source: Information compiled by LRNRD staff using predictive data from Arapahoe, Red Cloud, and Holdrege, Nebraska weather stations.

Date: 1985

Graph #7

Recorded Precipitation

1985



Source: Information compiled by LRNRD staff using predictive data from Arapahoe Red Cloud, and Holdrege, Nebraska weather stations.

Date: 1985

Crop Water Needs Within the Area

To manage a groundwater reservoir, a knowledge of crop water needs for the District is required. Raising certain crops require more moisture to successfully produce the yields desired than do other crops. Thus, the demand on the reservoir is affected by the crop planted if irrigation is used to raise the crop.

Table # 4 on pages 46 and 47 shows 1984 acreage and production of five main crops in the Lower Republican NRD - corn, sorghum, alfalfa, soybeans, and wheat. Only with wheat is there a slight positive impact found in using irrigation. The per acre yield of the other five crops was significantly affected, in a positive way, by irrigation.

The map #'s 16 through 21 (pages 48 to 53) show net irrigation needed to raise a maximum crop for corn, sorghum, and field beans for both 10 out of 20 year and 15 out of 20 year intervals. This information provides the Lower Republican NRD with a guideline on the amount needed in the irrigation process for three crops produced within the District. The social acceptance of any control measures applied to irrigation practices within the Lower Republican NRD will depend on restrictions in usage of water close to the amount needed to raise a maximum crop. Educational and informational efforts within the District on conservation of our groundwater will also center around the information contained in these maps.

PREDOMINANT CROPS PRODUCED IN LOWER REPUBLICAN NRD — Table # 4

CORN FOR GRAIN - 1984

COUNTY		IRRIGATED Acres Harvested	IRRIGATED Yield Harv. Acre	IRRIGATED Production Bushels	NON-IRRIGATED Acres Harvested	NON-IRRIGATED Yield Harv. Acre	NON-IRRIGATED Production Bushels
Franklin		51,000	130.0	6,643,000	500	58.0	29,000
Furnas		34,700	123.0	4,268,100	10,300	53.0	545,900
Harlan		53,300	124.0	6,609,200	2,200	62.0	136,400
Nuckolls	*	36,000	145.0	5,220,000	700	72.0	50,400
Webster	*	22,600	138.0	3,118,800	1,400	68.0	95,200
District Totals		197,600	132.0	25,859,100	15,100	62.6	856,900
Nebraska Totals		4,700,000	133.0	625,100,000	2,250,000	77.4	174,150,000

SORGHUM HARVESTED FOR GRAIN - 1984

Franklin		4,400	105.0	462,000	35,600	66.0	2,349,600
Furnas		900	90.0	81,000	55,900	52.0	2,906,800
Harlan		1,800	96.0	172,800	28,900	57.0	1,647,300
Nuckolls	*	7,000	99.0	693,000	71,300	58.0	4,135,400
Webster	*	2,900	106.0	307,400	55,100	59.0	3,250,900
District Totals		17,000	99.2	1,716,200	246,800	58.4	14,290,000
Nebraska Totals		205,000	90.0	18,450,000	1,695,000	60.9	103,150,000

ALFALFA HAY - 1984

Franklin		1,200	5.00	6,000	4,700	3.60	16,920
Furnas		1,300	5.00	6,500	11,500	3.30	37,950
Harlan		900	5.20	4,680	7,900	3.40	26,860
Nuckolls	*	1,100	5.20	5,720	7,800	3.50	27,300
Webster	*	1,100	4.80	5,280	10,100	2.90	29,290
District Totals		5,600	5.04	28,180	42,000	3.34	138,320
Nebraska Totals		416,000	4.10	1,706,000	1,184,000	2.88	3,414,000

SOYBEANS - 1984

Franklin		7,200	42.0	302,400	6,700	22.0	147,400
Furnas		6,900	40.0	276,000	4,800	16.0	76,800
Harlan		4,100	41.0	168,100	5,500	17.0	93,500
Nuckolls	*	12,800	40.0	512,000	11,900	18.0	214,200
Webster	*	3,800	39.0	148,200	6,800	18.0	122,400
District Totals		34,800	40.4	1,406,700	35,700	18.2	654,300
Nebraska Totals		693,000	36.0	24,948,000	1,857,000	20.9	38,802,000

Note: 75% of Webster County and 31% of Nuckolls County of totals *

Source: Nebraska 1984 Preliminary County Estimates and State Agriculture Data, Nebraska Department of Agriculture, Division of Agriculture Statistics

Date: July 1985

PREDOMINANT CROPS PRODUCED IN LOWER REPUBLICAN NRD (continued)

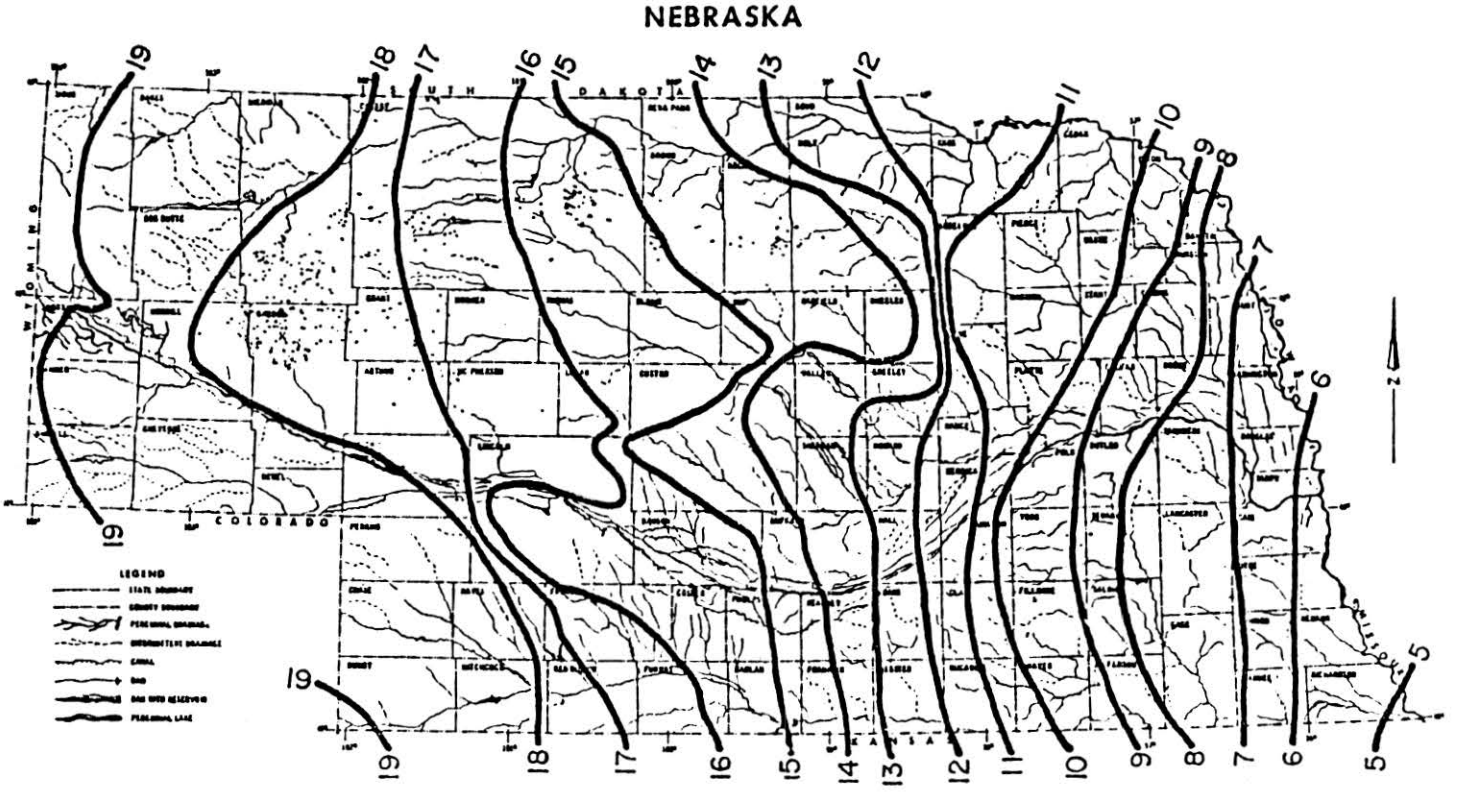
WHEAT FOR GRAIN - 1984

COUNTY AND DISTRICT	All Wheat				Grown on Irrigated Land			
	Acres Planted	Acres Harvested	Yield Harv. Acre	Production Bushels	Acres Planted	Acres Harvested	Yield Harv. Acre	Production Bushels
Franklin ...	35,000	19,900	37.1	738,700	2,100	1,900	43.0	81,700
Furnas	82,000	73,000	43.4	3,171,200	2,500	2,000	46.0	92,000
Harlan	44,000	41,400	42.3	1,749,900	4,800	4,600	48.0	220,800
Nuckolls ...*	65,000	35,100	32.8	1,151,400	2,600	1,500	34.0	51,000
Webster ....*	55,000	30,200	33.1	999,900	3,900	3,500	42.0	147,000
Nebraska Totals	3,200,000	2,500,000	36.0	81,000,000	220,000	165,000	52.0	8,580,000

Note: 75% (Webster County) and 31% (Nuckolls County) of totals *

Source: Nebraska 1984 Preliminary County Estimates and State Agriculture Data, Nebraska Department of Agriculture, Division of Agriculture Statistics

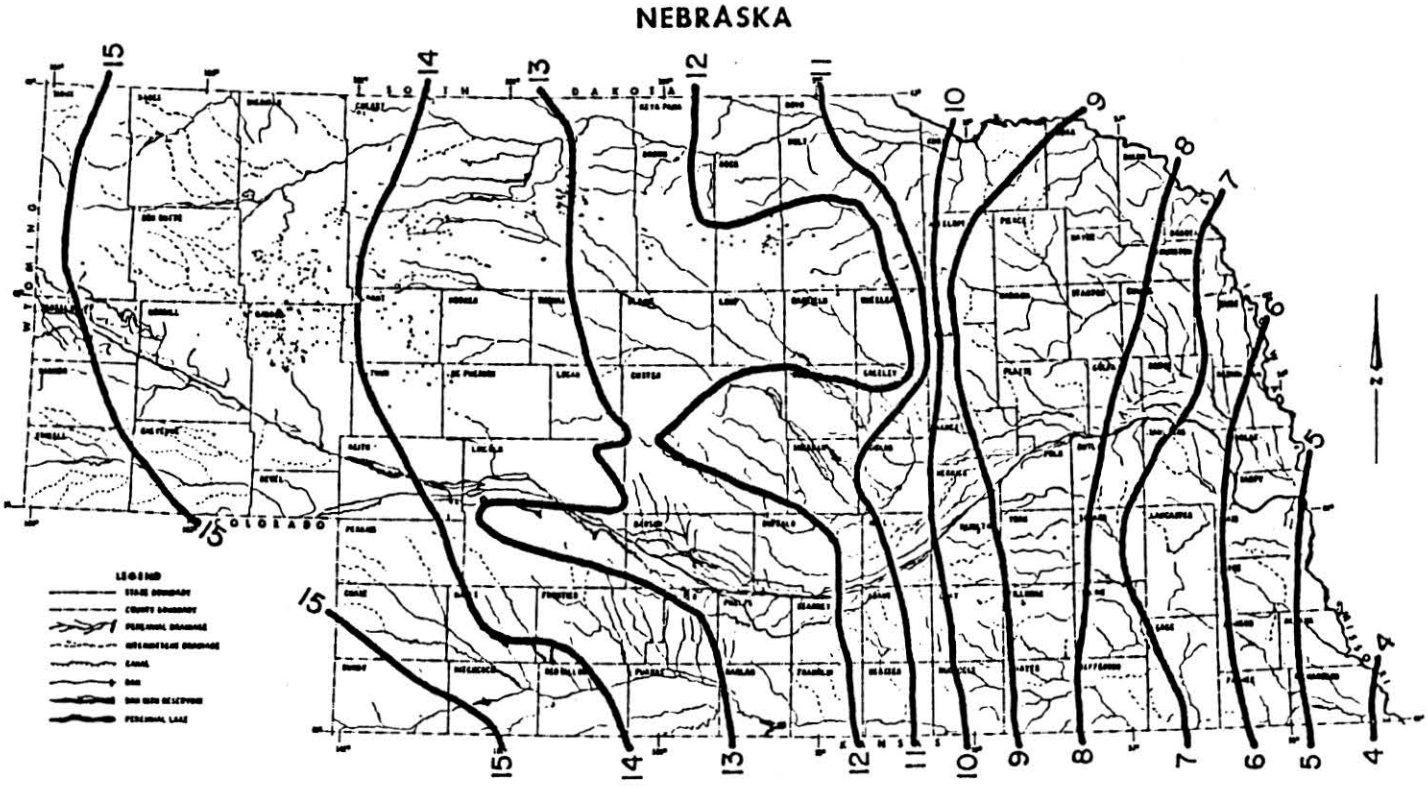
Date: July 1985



ADDITIONAL NET IRRIGATION NEEDED TO RAISE A MAXIMUM CORN CROP
10 OUT OF 20 YRS (MEDIAN YEAR)

Scale: 1" = 316,800'

Source: 1970 National Atlas of the United States of America and 1974 State Highway Map, United States Department of Agriculture - Soil Conservation Service, Figure 683-1

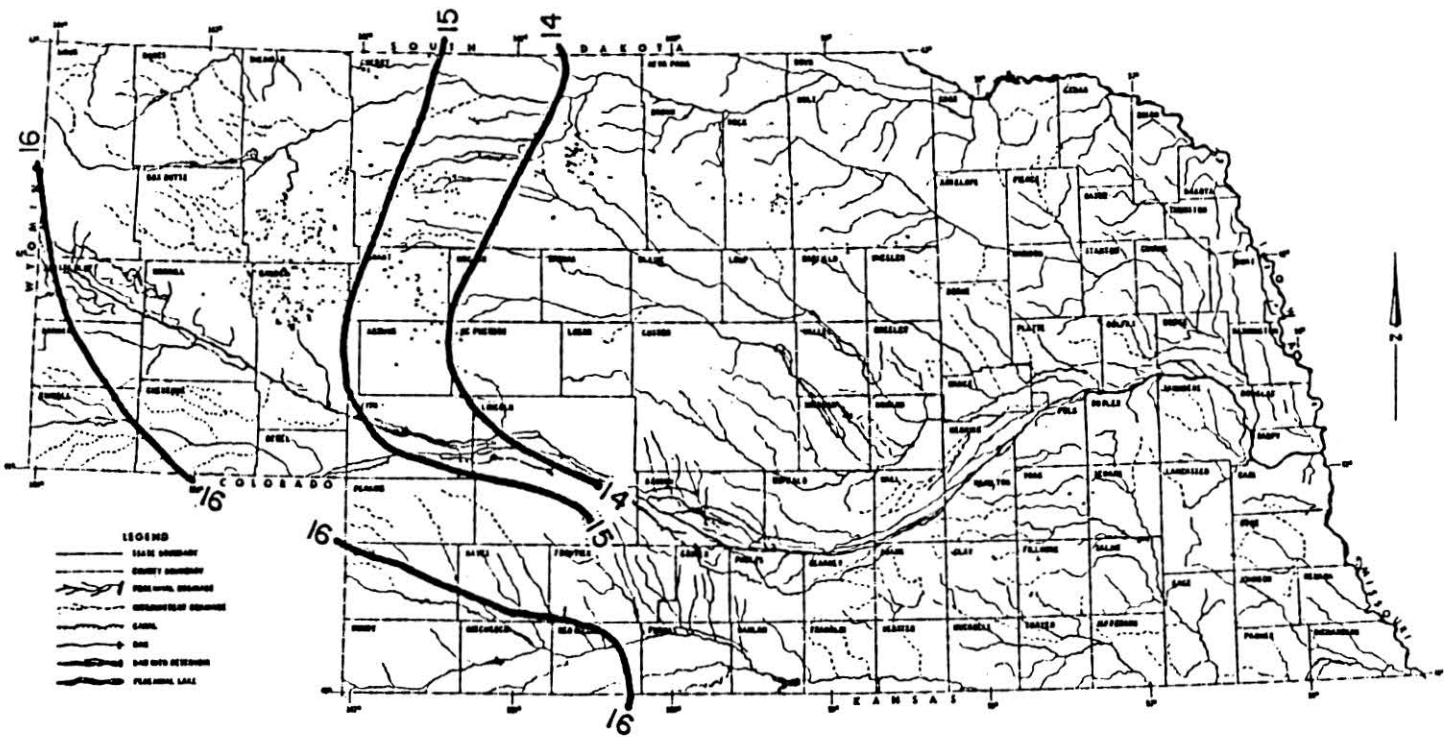


ADDITIONAL NET IRRIGATION NEEDED TO RAISE A MAXIMUM SORGHUM CROP 10 OUT OF 20 YRS (MEDIAN YEAR)

Scale: 1" = 316,800'

Source: 1970 National Atlas of the United States of America and 1974 State Highway Map, United States Department of Agriculture - Soil Conservation Service, Figure 683-2

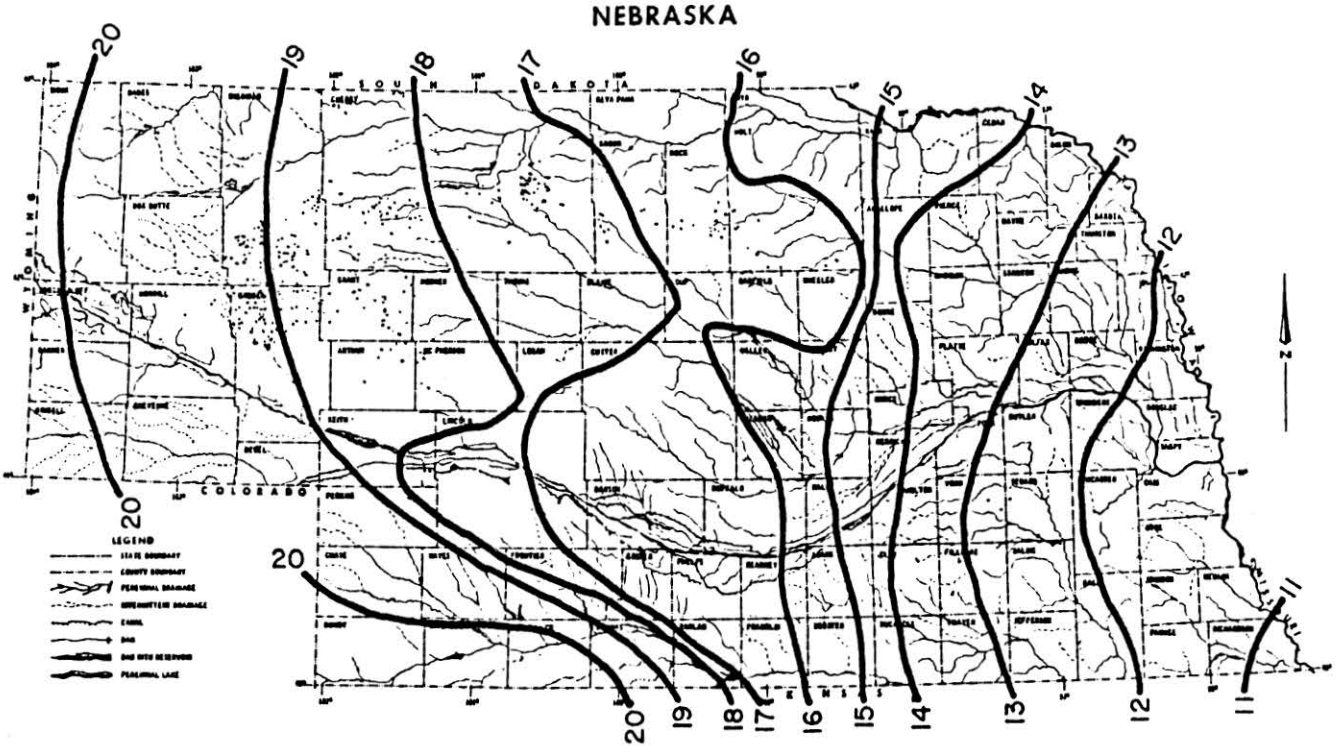
NEBRASKA



ADDITIONAL NET IRRIGATION NEEDED TO RAISE A MAXIMUM FIELD BEAN CROP 10 OUT OF 20 YRS (MEDIAN YEAR)

Scale: 1" = 316,800'

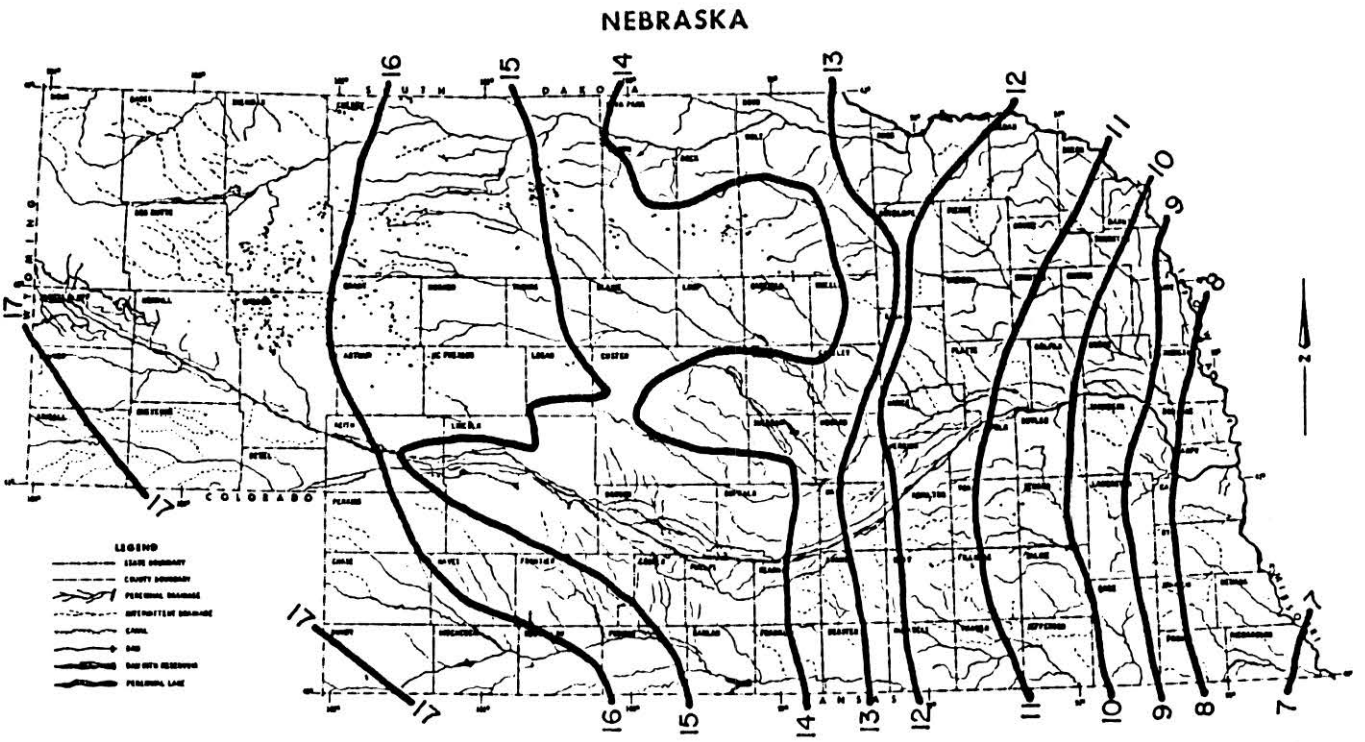
Source: 1970 National Atlas of the United States of America and 1974 State Highway Map, United States Department of Agriculture - Soil Conservation Service, Figure 683-3



ADDITIONAL NET IRRIGATION NEEDED TO RAISE A MAXIMUM CORN CROP 15 OUT OF 20 YRS

Scale: 1" = 316,800'

Source: 1970 National Atlas of the United States of America and 1974 State Highway Map, United States Department of Agriculture - Soil Conservation Service, Figure 683-5

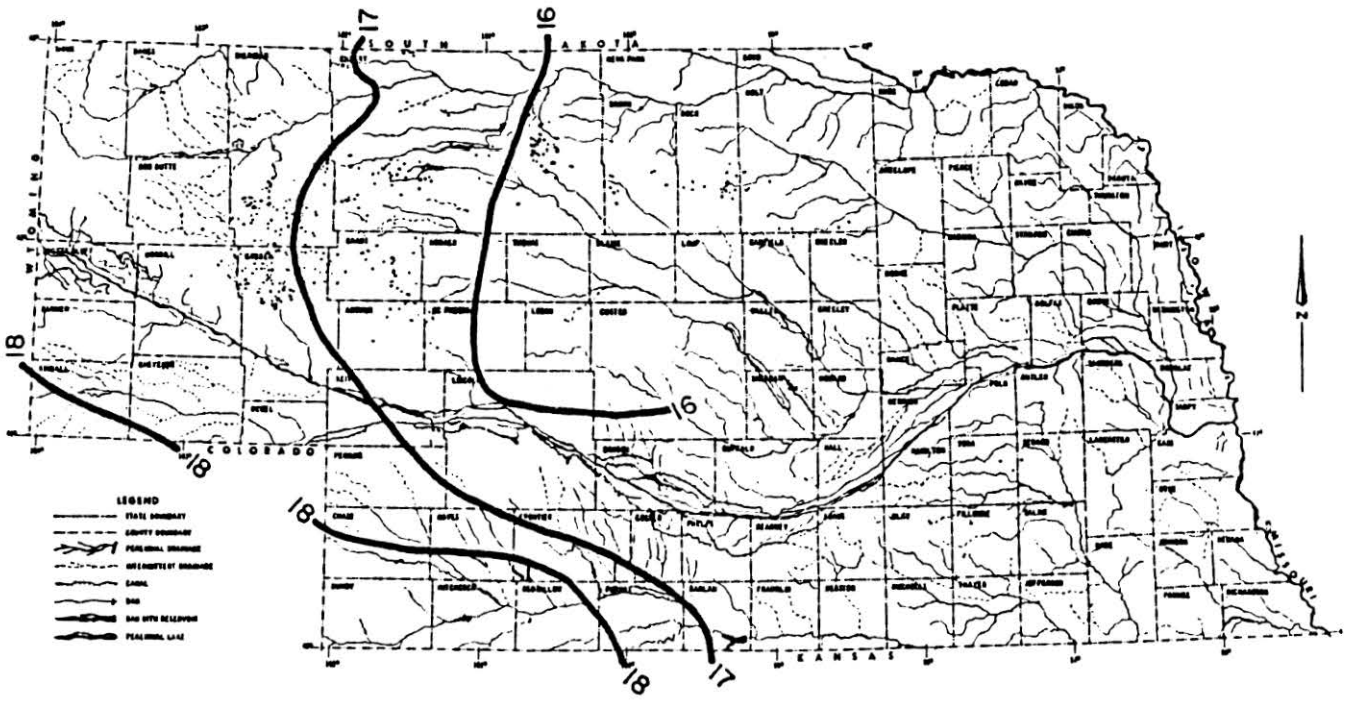


ADDITIONAL NET IRRIGATION NEEDED TO RAISE A MAXIMUM SORGHUM CROP 15 OUT OF 20 YRS

Scale: 1" = 316,800'

Source: 1970 National Atlas of the United States of America and 1974 State Highway Map, United States Department of Agriculture - Soil Conservation Service, Figure 683-6

NEBRASKA



ADDITIONAL NET IRRIGATION NEEDED TO RAISE A MAXIMUM FIELD BEAN CROP 15 OUT OF 20 YRS

Scale: 1" = 316,800'

Source: 1970 National Atlas of the United States of America and 1974 State Highway Map, United States Department of Agriculture - Soil Conservation Service, Figure 683-7

EXISTING SUBIRRIGATION USES IN LOWER REPUBLICAN NRD

Subirrigation Defined

Subirrigation is the process by which growing plants obtain water from saturated subsoils, resulting from high water tables.

Within the Lower Republican NRD there are no major areas of subirrigation occurring. However, within 1/4 to 1/2 mile of the Republican River channel, there are some isolated areas of subirrigation; alfalfa is the main crop planted there. Because of the proximity of the bedrock to the land's surface, the fluctuation of the Republican River flow, variations in annual precipitation in the Basin, and groundwater irrigation development on the upland areas north of the river, large areas of subirrigation have not developed. Within the past few years, both the Frenchman-Cambridge Irrigation District and the Bostwick Irrigation District have taken measures to reduce the canal seepage impact, thus lowering the water table level adjacent to the Republican River (primarily on the north side of the river).

It appears that there is no future potential for increased subirrigation within the Lower Republican NRD - unless a change to increase the base flow of the Republican River occurs. In fact it appears possible that to sustain the number of acres currently subirrigated may be difficult.

Subirrigation, compared to the other irrigation methods utilized in the District, is not enough of a concern to initiate efforts to increase the acreage of this crop water supply source. The increased economic benefit in doing such, and local social acceptance to implement increased subirrigation acreage, is probably not worth consideration at this point of planning.

Wetlands

The only major wetlands area in the Lower Republican NRD is located in northeastern Harlan and northwestern Franklin County (part of the Rainwater Basin area) but they contribute little or no subirrigation benefits.

RELATIVE ECONOMIC VALUE OF DIFFERENT USES OF GROUNDWATER PROPOSED OR EXISTING WITHIN AREA

A Natural Resources Commission Policy Issue Study on "Groundwater Reservoir Management" indicates that there appears to be a strong likelihood that sorghum will replace most of the non-irrigated corn acreage in Nebraska in the next two decades. Approximately 70% of Nebraska corn acreage is irrigated, with this percentage being somewhat greater in the Lower Republican NRD. With conservation practices, such as the construction of parallel flat channel terraces and no-till or minimum tillage practices, the option of planting dryland corn is greater than in the past. However, with the limited, timely precipitation in the Lower Republican NRD (especially the western 1/2 of the District), dryland corn will remain a risky venture.

In a Natural Resources Commission Policy Issue Study, the following observation bears consideration at this point. This observation states that "considering the greater stress tolerance of sorghum and its ability to use nitrogen fertilizer more effectively than corn, a higher yield potential than in the past may lead to its replacing substantial acreages of irrigated corn across central and southern Nebraska". This Natural Resources Commission observation appears to be coming true in the Lower Republican NRD as more irrigated land is being replaced with sorghum, where once there was corn. If this continues into the future, and present conditions indicate it will, then there will be less demand on the groundwater reservoir as sorghum requires less water to make a crop then corn.

Many farmers within the Lower Republican NRD are switching to a crop of less water demand than corn because of the energy costs to irrigate. Table # 5, page 56 illustrates, as an example, the 1985 energy costs for different power units on center pivots. Even though these figures include a broader area than just the Lower Republican NRD, the figures show why some of our farmers are switching to less water demanding crops.

Table # 6, page 57 shows a list of prices received by farmers in Nebraska for the year 1984 for different commodities sold throughout the year. Prices declined during the year. This reduction in prices

"1985 Estimated Energy Costs"

Estimated 1985 Energy Costs For Alternative Power Units For Irrigation With Center-Pivot Installations, Ranging From 100-130 hp, Nebraska at three levels of pumping 600, 900 and 1,200 hrs for eastern, central and western Nebraska

Compiled June 19, 1985 by Dr. Leslie F. Sheffield, Extension Farm Management Specialist, Institute of Agriculture & Natural Resources, University of Nebraska-Lincoln. (Based on 130 acres irrigated 325 ft. of total dynamic head, 800 gpm, 65 psi at pivot, 110 continuous brake horsepower engine or 100 hp electric motor and 75% pumping plant efficiency with three different seasonal pumping averages, 600 hrs for eastern Nebraska, 900 hrs for central Nebraska and 1.200 hrs for western Nebraska.)

Type of Power Unit	Estimated 1985 Energy Prices	*Whp-hrs Per Unit of Energy	Estimated Energy Use/hr	Estimated Total Energy Used for the Season			Estimated Energy Cost For 130 Acres for Season			Estimated Energy Cost Per Acre for the Season		
				600 hrs	900 hrs	1,200 hrs	600 hrs	900 hrs	1,200 hrs	600 hrs	900 hrs	1,200 hrs
							Acre-Inches of Water Pumped =			8.16"	12.24"	16.32"
I. Electric **	$ .07/Kwh	0.885/Kwh	74.2 Kwh	44,520 Kwh	66,780 Kwh	89,040 Kwh	$3,116.40	$4,674.60	$6,233.15	$23.97	$35.96	$47.95
	.08/Kwh	0.885/Kwh	74.2 Kwh	44,520 Kwh	66,780 Kwh	89,040 Kwh	$3,561.60	$5,342.40	$7,123.20	$27.40	$41.10	$54.79
II. Natural Gas (MCF = 1,000 cu. ft.) (Approximately 35% Nebraska Irrigators on Straight Rate 65% on Firm Rate)												
A. Straight Rate	$3.25/MCF	61.7/MCF	1.0641 MCF	638 MCF	958 MCF	1,277 MCF	$2,073.50	$3,113.50	$4,150.25	$15.95	$23.95	$31.95
B. Firm Rate	$3.30/MCF	61.7/MCF	1.0641 MCF	638 MCF	958 MCF	1,277 MCF	$2,105.40	$3,161.40	$4,214.10	$16.20	$24.32	$32.42
III. Propane	$ .55/gal	6.89/gal	9.53 gal	5,718 gal	8,577 gal	11,436 gal	$3,144.90	$4,717.35	$6,289.80	$24.19	$36.29	$48.38
	.65/gal	6.89/gal	9.53 gal	5,718 gal	8,577 gal	11,435 gal	$3,716.70	$5,575.05	$7,433.40	$28.59	$42.89	$57.18
IV. Diesel	$ .90/gal	12.5/gal	5.25 gal	3,150 gal	4,725 gal	6,300 gal	$2,835.00	$4,252.50	$5,670.00	$21.81	$32.71	$43.62
	.95/gal	12.5/gal	5.25 gal	3,150 gal	4,725 gal	6,300 gal	$2,992.50	$4,488.75	$5,985.00	$23.02	$23.02	$46.04
	1.05/gal	12.5/gal	5.25 gal	3,150 gal	4,725 gal	6,300 gal	$3,307.50	$4,961.25	$6,615.00	$25.44	$38.16	$50.88

* Based on Nebraska Performance Standards For Deep Well Turbine Pumping Plants, Based on Water Horsepower Hours. Whp. hours = $\frac{\text{Total Dynamic head X GP}}{3960}$

** Based on estimated average of irrigation power rates to be charged by the various REA Districts in Nebraska in 1985. This includes standby horsepower charge or annual hook-up charge based upon nameplate horsepower rating for the irrigation motor.

Table # 5

NEBRASKA - PRICES RECEIVED BY FARMERS, 1984

Commodity	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Ave.
	Dollars												
*Corn, bu.	3.10	2.99	3.12	3.24	3.29	3.33	3.18	3.07	2.88	2.68	2.57	2.50	3.00
*Wheat, bu.	3.35	3.28	3.45	3.48	3.40	3.29	3.27	3.39	3.33	3.31	3.28	3.24	3.34
Oats, bu.	1.91	1.91	1.92	1.91	1.95	1.93	1.76	1.67	1.67	1.81	1.73	1.68	1.82
*Grain Sorghum, cwt.	4.82	4.62	4.75	4.85	4.89	4.86	4.79	4.38	4.16	3.76	3.82	3.88	4.47
Dry Beans, cwt.	19.60	18.90	17.40	17.90	17.50	17.00	15.10	14.20	14.60	14.00	13.30	13.60	16.09
*Soybeans, bu.	7.78	7.06	7.42	7.67	8.00	7.92	7.17	6.49	5.91	5.85	5.80	5.57	6.89
*Hay (Baled)													
All, ton	58.00	60.00	61.00	57.00	56.00	55.00	50.00	48.00	50.00	51.00	50.00	52.00	54.00
Alfalfa, ton	62.00	66.00	65.00	61.00	60.00	57.00	52.00	50.00	51.00	53.00	52.00	54.00	56.92
*Beef Cattle, cwt.	61.70	63.60	64.60	64.40	63.40	62.00	63.20	62.70	61.50	60.20	61.80	63.00	62.68
Steers & Heifers, cwt.	65.10	65.40	66.20	65.90	64.10	63.20	64.60	63.70	62.50	60.70	63.50	64.50	64.12
Cows, cwt.	33.50	39.70	41.90	40.50	40.00	40.10	39.70	38.40	36.10	36.20	35.70	35.70	38.13
*Calves, cwt.	65.00	65.80	66.80	66.60	64.30	62.20	63.70	61.50	60.80	65.00	65.40	65.90	64.42
*Hogs, cwt.	49.00	45.70	46.40	47.90	47.40	49.40	51.40	50.00	46.40	43.80	47.20	49.00	47.80
Sheep, cwt.	18.30	21.10	19.20	17.20	13.10	16.20	17.20	17.60	16.80	18.30	20.40	22.10	18.13
Lambs, cwt.	57.50	56.30	54.70	57.50	60.20	59.50	59.50	62.60	62.80	62.60	63.80	59.60	59.72
Milk Cows, head	820.	-----	-----	850.	-----	-----	860.	-----	-----	850.	-----	-----	
Wool, lb.	.50	.60	.68	.63	.61	.71	.59	.54	.51	.57	.56	.60	.59
Milk, Wholesale, cwt.	13.70	13.50	13.50	13.40	13.00	12.90	12.80	13.10	13.70	14.20	14.40	14.20	13.53

*Primary Commodity in Lower Republican NRD

Source: Nebraska 1984 Preliminary County Estimates and State Agriculture Data, Nebraska Department of Agriculture, Division of Agriculture Statistics

Date: July 1985

Table # 6

will undoubtedly force farmers to consider ways to cut costs in production, and may lead to the reduction of groundwater demand. This table and the table showing 1985 energy costs are indicators as to why our District chose to identify the Economic Concern in one portion of our District as one of the 10 specific groundwater concerns in this Plan.

The reason table # 7 (pages 59 and 60) was included in this Plan is because it shows trends of crops grown in our NRD (although the figures on the table were taken from Nebraska Crop Reporting Service Information for the entire state) for the past three years, number of acres planted, acres harvested, yield and value of production. This information also helps our District establish our Management Options which deal with economic values of our groundwater.

Past, Present and Potential Groundwater Use Within the Area

In determining our potential groundwater use in the effort to manage our reservoir on an infinite time basis, we considered the information provided in the five tables included in this technical requirement section. Many variables enter into these tables, which affect projections of our future groundwater use, such as the overall farm economy, social and legislative acceptance of developing marginal lands for irrigation, research on reduced crop water demands, etc. These variables entered into our management option scheme as we considered this information.

Table # 8, page 61 shows the total number of wells registered in our NRD as of January 1, 1985, and the number of acres irrigated from 1980 - 1984 within the District.

Table # 9, page 62 shows what has been projected, within a Natural Resources Commission Policy Issue Study, as the potential for irrigation development (for each county in the NRD), through the year 2020.

Table # 10, page 63 is the first of three tables reproduced (at least in part) from a Bureau of Reclamation Study Report on the Republican River Basin (dated February 1985). Even though these tables are somewhat generalized (on a Republican River Sub-Basin basis) in nature, an indication is given to our NRD as to the estimated volume of groundwater stored in the Lower Republican NRD on a pre-development irrigation basis, and then what was estimated to be in storage from 1977 to 1978.

CROPS MOST COMMONLY MARKETED IN LOWER REPUBLICAN NRD

LRNRD---ANNUAL CROP SUMMARY, 1982-1984

CROP	Unit	Year	Acres Planted	Acres Harvested	Yield per Acre	Production	Value of Production 1/ Unit 1/	Value of Production 1/ Per Acre	Value of Production 1/ Total
			1,000 acres			1,000	Dollars		1,000 dol.
Corn for All Purposes		1982	7,300	7,250	---	---	---	---	---
		1983	5,300	5,260	---	---	---	---	---
		1984	7,400	7,330	---	---	---	---	---
Corn for Grain	Bu.	1982	---	6,800	110.0	748,000	2.85	313.50	2,131,800
		1983	---	4,850	97.0	470,450	3.12	302.60	1,467,804
		1984	---	6,950	115.0	799,250	2.70	310.50	2,157,975
Corn for Grain, Irrigated	Bu.	1982	---	4,500	123.0	553,500	2.85	350.60	1,577,475
		1983	---	3,250	116.0	377,000	3.12	361.90	1,176,240
		1984	---	4,700	133.0	625,100	2.70	359.10	1,687,770
Corn for Grain, Non-Irrigated	Bu.	1982	---	2,300	84.6	194,500	2.85	241.10	554,325
		1983	---	1,600	58.4	93,450	3.12	182.20	291,564
		1984	---	2,250	77.4	174,150	2.70	209.00	470,205
Corn for Silage	Ton	1982	---	440	14.5	6,380	---	---	---
		1983	---	400	14.0	5,600	---	---	---
		1984	---	365	14.0	5,110	---	---	---
Corn for Forage		1982	---	10	---	---	---	---	---
		1983	---	10	---	---	---	---	---
		1984	---	15	---	---	---	---	---
All Wheat	Bu.	1982	3,050	2,900	35.0	101,500	3.45	120.80	350,175
		1983	2,800	2,300	43.0	98,900	3.39	145.80	335,271
		1984	3,200	2,250	36.0	81,000	3.30	118.80	267,300
Oats	Bu.	1982	560	460	58.0	26,680	1.45	84.10	38,686
		1983	670	310	44.0	13,640	1.69	74.40	23,052
		1984	420	300	50.0	15,000	1.70	85.00	25,500
Sorghum for All Purposes		1982	1,950	1,910	---	---	---	---	---
		1983	1,200	1,160	---	---	---	---	---
		1984	2,100	2,050	---	---	---	---	---
Sorghum Grain	Bu.	1982	---	1,760	73.0	128,480	2.50	182.50	321,200
		1983	---	1,000	61.0	61,000	2.65	161.70	161,650
		1984	---	1,900	64.0	121,600	2.18	139.50	265,088
Sorghum Silage	Ton	1982	---	80	12.0	960	---	---	---
		1983	---	70	11.5	805	---	---	---
		1984	---	70	10.0	700	---	---	---
Sorghum Forage		1982	---	70	---	---	---	---	---
		1983	---	90	---	---	---	---	---
		1984	---	80	---	---	---	---	---
Soybeans for Beans	Bu.	1982	2,300	2,250	35.0	78,750	5.50	192.50	433,125
		1983	2,100	2,070	28.5	58,995	7.64	217.70	450,722
		1984	2,600	2,550	25.0	63,750	5.95	148.80	379,313

Source: Nebraska 1984 Preliminary County Estimates and State Agriculture Data, Nebraska Department of Agriculture, Division of Agriculture Statistics

Date: July 1985

LRWRD---ANNUAL CROP SUMMARY--1982-1984 (Cont.)

CROP	Unit	Year	Acres Planted	Acres Harvested	Yield per Acre	Production	Value of Production 1/ Unit 1/	Value of Production 1/ Per Acre	Value of Production 1/ Total
			1,000 acres			1,000	Dollars		1,000 dol
		1982	---	3,700	2.12	7,855	46.00	97.50	361,330
All Hay	Ton	1983	---	3,650	2.09	7,635	51.00	106.60	389,38
		1984	---	3,700	2.04	7,535	52.50	107.10	395,58
		1982	---	1,600	3.40	5,440	---	---	---
Alfalfa Hay	Ton	1983	---	1,550	3.30	5,115	---	---	---
		1984	---	1,600	3.20	5,120	---	---	---
		1982	---	1,750	1.00	1,750	---	---	---
Wild Hay	Ton	1983	---	1,750	1.10	1,925	---	---	---
		1984	---	1,750	1.05	1,840	---	---	---
All Other Hay		1982	---	2,100	1.15	2,415	---	---	---
(Includes	Ton	1983	---	2,100	1.20	2,520	---	---	---
Wild Hay)		1984	---	2,100	1.15	2,415	---	---	---
		1982	19,115	18,846	---	---	---	---	3,735,85
TOTAL 3/		1983	15,610	15,122	---	---	---	---	2,936,942
		1984	18,942	18,623	---	---	---	---	3,563,49

1/ Includes allowance for loans outstanding and purchases by the Government valued at the average loan and purchase rate. 1984 season's value per unit is preliminary as of January 1985.
2/ Per hundred pounds.
3/ Planted total includes harvested acres for hay, wheat and rye.

Source: Nebraska 1984 Preliminary County Estimates and State Agriculture Data, Nebraska Department of Agriculture, Division of Agriculture Statistics

Date: July 1985

LRNRD--IRRIGATION STATISTICS, 1980-1984

COUNTY AND DISTRICT	Wells Registered to Jan. 1, 1985	Total Acres Irrigated				
		1980	1981	1982	1983	1984
Franklin.....	821	74,000	77,000	83,000	87,000	88,000
Furnas.....	617	54,000	55,000	55,000	56,000	57,000
Harlan.....	822	73,000	75,000	75,000	76,000	77,000
Nuckolls.....	* 535	57,000	58,000	58,000	58,000	61,000
Webster.....	* 442	42,000	44,000	44,000	44,000	44,000
Nebraska Totals	70,767	7,200,000	7,500,000	7,600,000	7,700,000	7,800,000

Note: 75% (Webster County) and 31% (Nuckolls County) of totals *

Source: Nebraska 1984 Preliminary County Estimates and State Agriculture Data, Nebraska Department of Agriculture, Division of Agriculture Statistics

Date: July 1985

POTENTIAL GROWTH RATES IN LOWER REPUBLICAN NRD TO YEAR 2020

County	Ground-water 1977 Irrigation	Annual Rate From 1967 to 1977	Maximum Ground-water Acreage	Years to reach Maximum	Potential Growth 1985	1990	2000	2020
Franklin	61,540	3,260	221,635	49.1	87,620	103,920	136,520	201,720
Furnas	32,179	1,640	108,810	46.7	45,299	53,499	69,899	102,6[illegible]9
Harlan	58,926	3,710	170,809	30.2	88,606	107,156	144,256	170,809
Nuckolls	50,000	1,200	242,462	106.4	59,600	65,600	77,600	101,6[illegible]0
Webster	27,452	1,740	70,522	24.8	41,372	50,072	67,472	70,522
TOTALS	230,097	11,550	814,238	257.2	322,497	380,247	495,747	647,350

Source: Condensed from Policy Issue Study on Groundwater Reservoir Management, Page Number 26, Table 1-12, Nebraska Natural Resources Commission

Date: March 1982

Table # 10

Predevelopment and 1977-1978 Volumes of Groundwater in Storage and Change in Storage

Subbasin	Predevelopment Volume in Storage (acre feet)	1977-1978 Volume in Storage (acre feet)	Change in Storage (acre feet)	Percent Change
* Beaver and Sappa	42,166,800	38,351,300	-3,815,500	-9
* Prairie Dog	7,211,500	6,946,700	- 264,800	-4
* Republican above Harlan County Dam	38,002,600	38,903,000	900,400	2
* Republican from Harlan County Dam to Nebraska-Kansas State line	14,747,400	15,147,000	399,600	3

* All or a portion subbasin figure apply to LRNRD

Reference: "Special Report - Republican River Basin Water Management Study" - February 1985 - Department of Interior - Bureau of Reclamation

Table # 11 , page 65 and Table # 12 , page 66 make two projections into the future storage of our groundwater - one with no additional well development after 1978, and the other with future well development within the listed subbasins. The two Bureau of Reclamation tables also show how the utilization of groundwater impacts the base flow of the Republican River. This information was considered when we established our specific concern area on instream flows in our Plan.

Another present and future value of groundwater deals with its impact on the base flows of the Republican River tributaries in the Lower Republican NRD. This important consideration of groundwater use is beneficial not only to wildlife and recreational interests, but also to other uses of these stream flows, such as livestock water and some irrigation uses. In an attempt to better understand the relationship of groundwater irrigation development impact on the base flow of our streams, our NRD has agreed to provide an assistantship to a UNL graduate student to conduct a study on Elm Creek (Webster County). The purpose of this study will be to utilize a computer model to aid in determining long-term effects that groundwater use will have on this stream. Elm Creek is one of the streams in our NRD which is of particular interest to our District for its instream flow values. Hopefully, the Elm Creek study will be of future value in determining the effects of groundwater development to other spring-flow streams in our NRD. Also, the District hopes that it will provide a predictive method as to how to manage our groundwater accordingly.

Summary of projected ground-water budget based on condition of no additional well development after 1978 **

Subbasin	1978 storage volume (acre-ft)	2020 storage volume (acre-ft)	Change in storage (acre-ft)	Percent change in storage	2020 streamflow depletion (acre-ft/yr)	1969-1978 average base flow (acre-ft/yr)	2020 base flow (acre-ft/yr)
* Beaver and Sappa	38,351,300	26,761,500	-11,589,800	-30	66,100	2,300	(0 in 1979)
* Prairie Dog	6,946,700	5,817,600	- 1,129,100	-16	12,500	4,700	2,000
* Main Stem Republican above Harlan County Dam	38,903,000	40,795,100	+ 1,892,100	+ 5	83,400	46,000	16,000
* Republican from Harlan County Dam to Nebraska-Kansas State line	15,147,000	14,802,700	- 344,300	- 2	66,100	102,600	67,600

* Partially or wholly within boundaries of LRNRD

** Based on "Special Report - Republican River Basin Water Management Study" February 1985 Department of Interior - Bureau of Reclamation

Table # 11

Summary of projected ground-water budget based on condition of additional well development after 1978 **

Subbasin	1978 storage volume (acre-ft)	2020 storage volume (acre-ft)	Change in storage (acre-ft)	Percent change in storage	2020 streamflow depletion (acre-ft/yr)	1969-1978 average base flow (acre-ft/yr)	2020 base flow (acre-ft/yr)
Beaver and Sappa	38,351,300	25,157,000	- 13,194,300	-34	66,700	2,300	(0 in 1979)
Prairie Dog	6,946,700	5,649,400	- 1,297,300	-19	14,400	4,700	(0 in 2006)
* Main Stem Republican above Harlan County Dam	38,903,000	31,851,400	- 7,051,600	-18	102,500	46,000	(0 in 1996)
* Republican from Harlan County Dam to Nebraska-Kansas State line	15,147,000	11,100,400	- 4,046,600	-27	110,700	102,600	23,000

* Partially or wholly within boundaries of LRNRD

** Based on "Special Report - Republican River Basin Water Management Study" February 1985 Department of Interior - Bureau of Reclamation

Table # 12

GROUNDWATER QUALITY CONCERNS IN THE LOWER REPUBLICAN NRD

The Lower Republican NRD's public involvement process, early in the planning effort, indicated that our citizens have a genuine concern about the quality of the District's groundwater. This concern is understandable when one considers that all cities within the Lower Republican NRD depend on groundwater to supply their needs. The District's domestic rural needs also depend heavily on our groundwater resource.

When addressing the Lower Republican NRD's water quality concern in this Plan, the first step was to determine whether or not the public concern was valid for present conditions. Information to help the Lower Republican NRD consider management procedures (and when to implement them), appeared to be non-existent or too generalized to give the District direction. Therefore, the Lower Republican NRD expanded a staff-administered nitrate testing process in the summer of 1985 (originally begun in the summer of 1984). This nitrate testing was conducted throughout the District where nitrate problems might be suspected, or was generally known from previous tests. The majority of this testing of 150 wells was on wells utilized by humans for drinking. The greatest concern for the water quality in the District obviously centers around the health of our citizens. The procedure utilized by the Lower Republican NRD was for district staff to take samples primarily from domestic wells and test these samples with a Hach colorimeter owned by the NRD. This procedure was utilized only as an indicator of possible high nitrate area within the NRD.

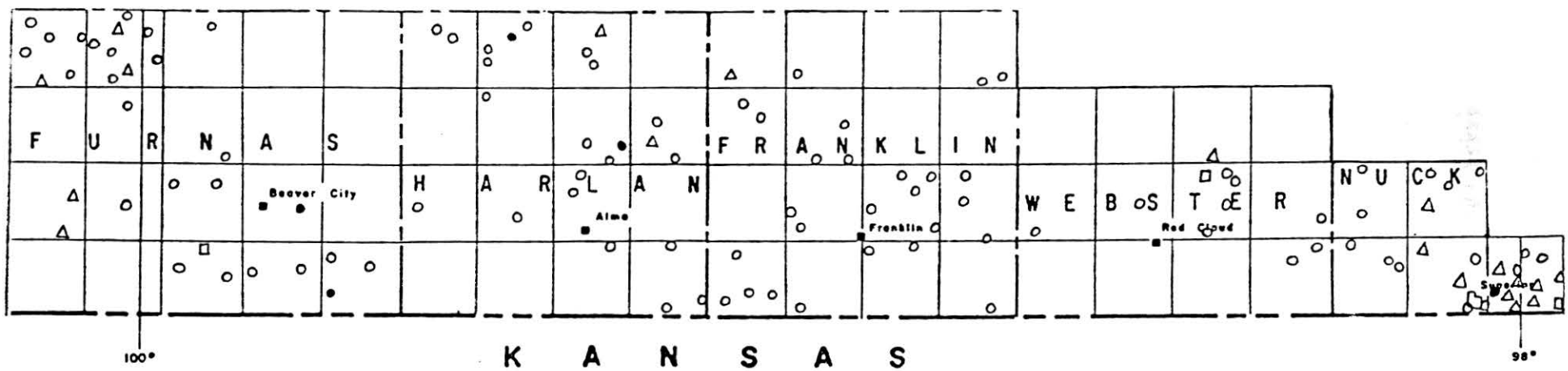
Map # 22 , page 68 shows the results of the Lower Republican NRD 1985 groundwater nitrate testing program. It indicates scattered concentrations above 10 ppm (current safe drinking standard for nitrates) throughout the Lower Republican NRD, but only the area around Superior, Nebraska, appears to have a concern (at the present time) to the extent to warrant specific consideration by the Lower Republican NRD.

Illustration # 2 on page 69 shows sketches of the chemical process of nitrogen. This helps to give an understanding of what happens to this substance and sources of where it can be found in our environment.

Illustration # 3 on page 70 uses a sketch to show what the

LRNRD NITRATE-NITROGEN MONITORING SURVEY

○ - Less than 7.6 ppm (or mg/1)
● - 7.6 to 9.9
△ - 10 to 20
□ - Greater than 20



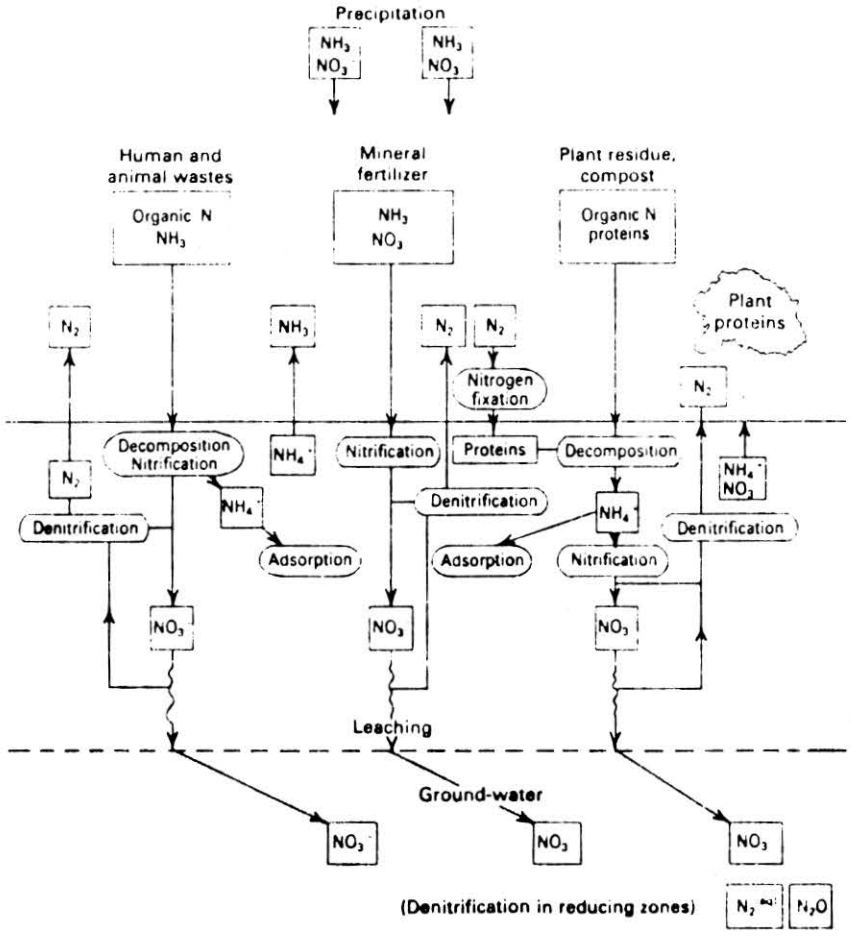
Source: Data compiled by NRD staff

Date: June and July 1985

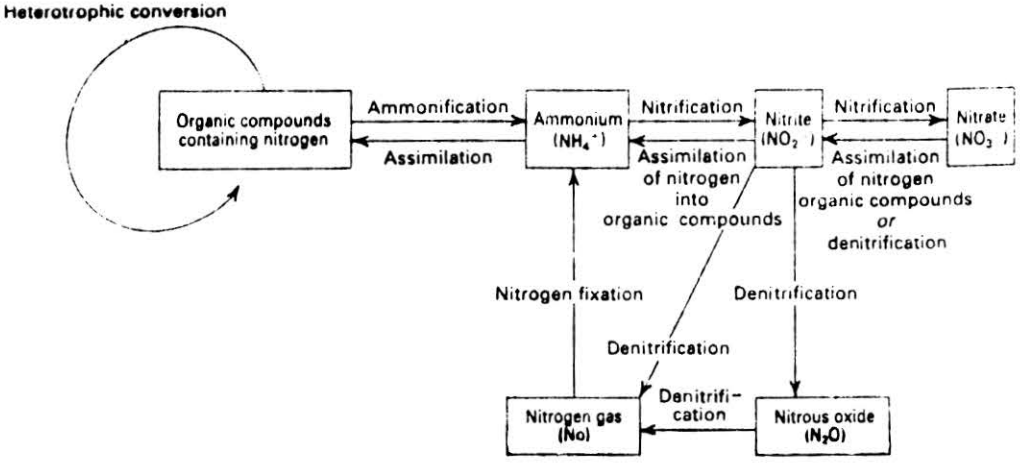
Scale: 1" = 12 miles

Map #22

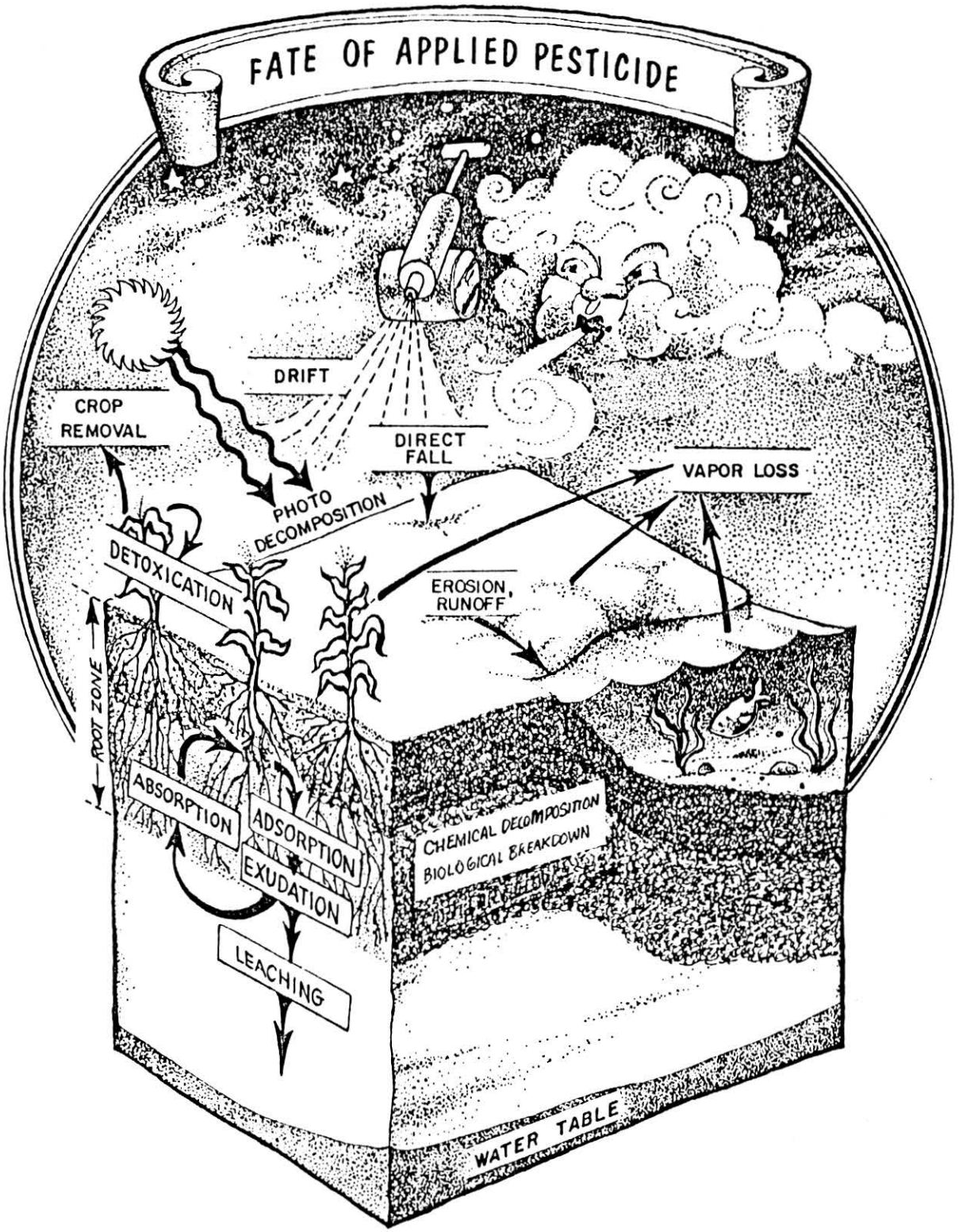
CHEMICAL PROCESS OF NITROGEN



Sources, movement, and reaction of nitrogen in soils and ground water. (Chemical symbols: N, elemental nitrogen; N_2, nitrogen gas; N_2O, nitrous oxide; NO_2^-, nitrite; NO_3^-, nitrate; NH_3, ammonia, NH_4^+, ammonium; N_2(aq), nitrogen gas; dissolved in water. (Source: Modified from Freeze and Cherry, 1979, p. 414.)



Simplified biological nitrogen cycle, showing some environmentally important reactions of nitrogen. Other biological reactions evolving nitrogen also occur. (Source: Modified from National Research Council, 1978, p. 23.)



Processes influencing the fate and behavior of pesticides.

Source: "Strategies for Reducing Pollutants from Irrigated Lands in the Great Plains"-1982-M. L. Quinn, Editor, Nebraska Water Resources Center and U.S. Environmental Protection Agency

fate of a pesticide applied to the land can be. The Lower Republican NRD is not only concerned about protection of our groundwater from high concentrations of nitrates, but from any chemical which can have an adverse impact on our environment or to the health of our citizens. The above mentioned illustration charts the fate of a pesticide applied onto the land and how this chemical can move through the soil into the groundwater. The application of chemicals through groundwater irrigation systems can pose an even more dangerous situation. This method of applying chemicals through irrigation systems is known as "chemigation".

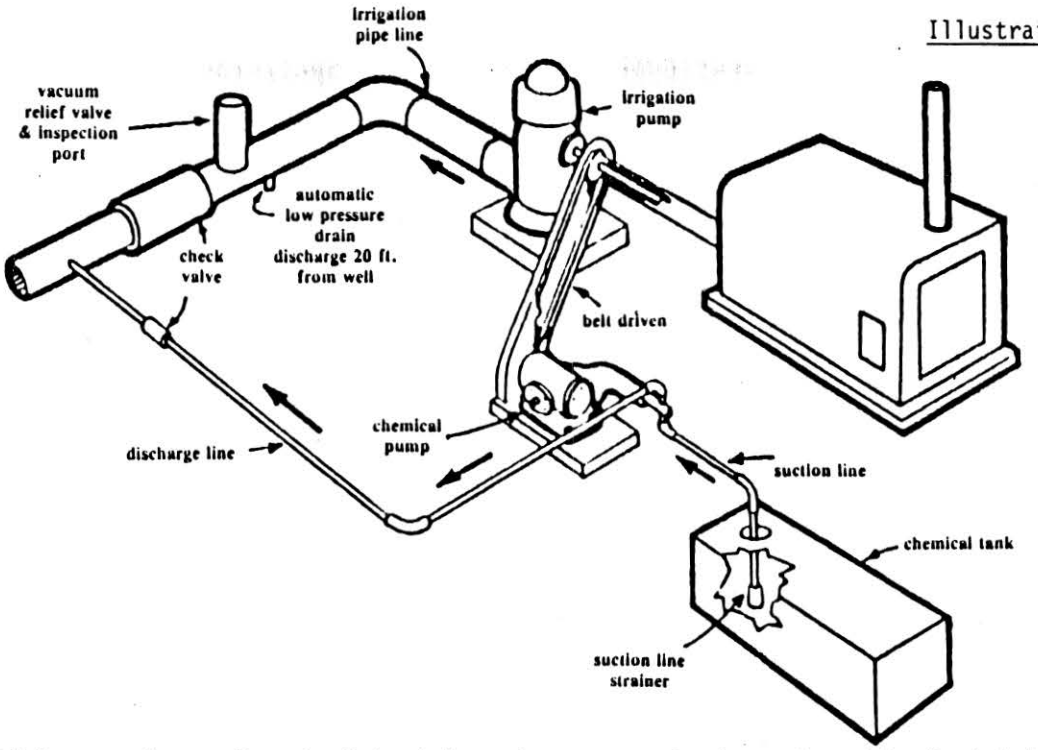
During the 1984 Nebraska Legislative Session, a bill was introduced as a method to help safeguard against irrigators who use their systems for the application of chemicals in an unsafe manner. Currently, Nebraska law requires a "check valve" to be installed when using chemicals via an irrigation system. Illustration # 4 on page 72 shows minimum requirements for anti-pollution devices and the manner and location of these devices.

The proposed "chemigation bill" held over from the 1984 Legislative Session, if passed in 1985, would require an irrigator to obtain a permit (probably from the local NRD office) before he could legally apply chemicals through his system. Before a permit would be issued to the irrigator, an inspection of the equipment to prevent chemicals from siphoning directly down the well into the groundwater reservoir would be required. The Lower Republican NRD endorses this type of legislation for any chemical applied via the irrigation system, and the management options section of this Plan addresses this concern.

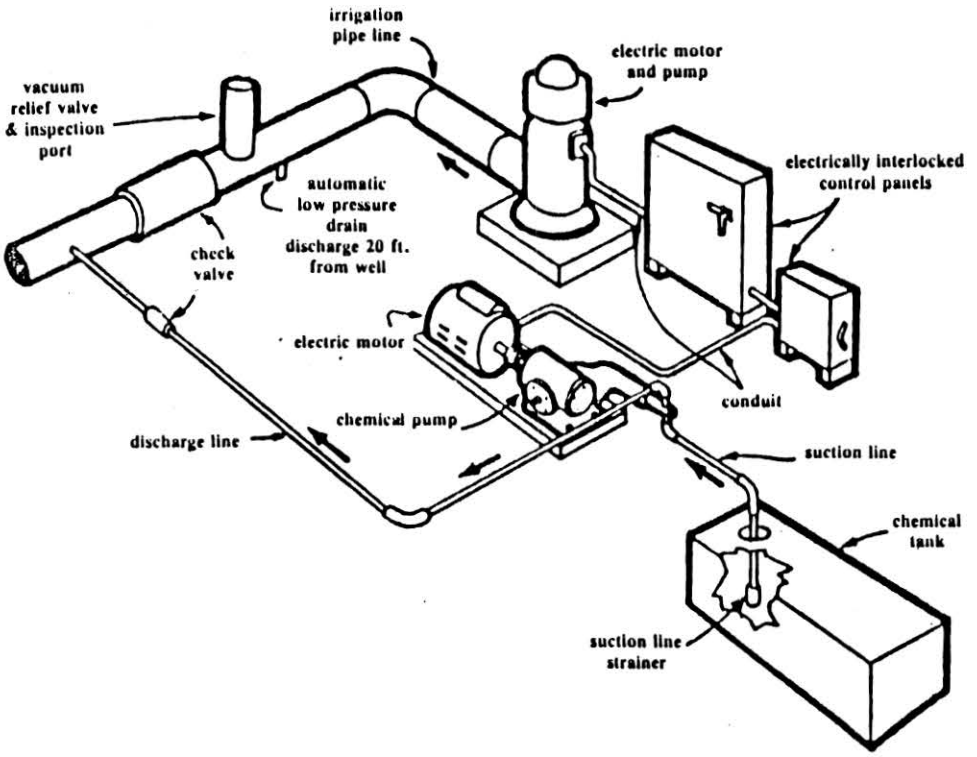
Table # 13, page 73 lists the total number of center pivot irrigation systems located in the Lower Republican NRD from 1978 - 1984. This information is included in the technical requirement dealing with water quality primarily because this method of irrigation is best suited for the chemigation process. It is estimated that 25 - 50% of the center pivots in the Lower Republican NRD currently apply chemicals through them. Because of the ability of this system to adapt to rough terrain, many of the pivots within the Lower Republican NRD are located on land with high potential for water quality problems from sediment moving via the irrigation process or from rainfall. Since there is an opportunity for additional center pivot development within the Lower Republican NRD, coupled with economic conditions which encourage more efficient management schemes, such as chemigation, the Lower Republican NRD believes the potential for increased concern for our future water

MINIMUM REQUIREMENTS FOR APPLYING CHEMICALS THROUGH IRRIGATION SYSTEM

Illustration # 4



Minimum requirements for anti-pollution devices and arrangement of equipment for applying chemicals through the irrigation system (engine drive).



Minimum requirements for anti-pollution devices and arrangement of equipment for applying chemicals through the irrigation system (motor drive).

Source: NebGuide -- Anti-Pollution Devices for Applying Chemicals Through the Irrigation System, Cooperative Extension Service UNL

Date: Revised August 1984

Lower Republican Natural Resources District

Center Pivot Information

Period Through 1984

County Name	1978	1979	1980	1981	1982	1983	1984
Franklin	104	117	131	151	165	181	193
Furnas	34	42	57	61	72	74	75
Harlan	73	77	102	107	118	130	142
Nuckolls *	41	48	56	65	76	85	91
Webster *	103	119	139	148	151	154	165

75% (Webster County) and 31% (Nuckolls County) of totals *

Source: Information compiled from maps (Center-Pivot Irrigation Systems in Nebraska) provided by Conservation & Survey Division

Date: Maps from years 1978 - 1984

quality is valid.

Water quality concerns are not limited strictly to health matters, but also relate to nuisance situations. Some of the District's water contains high bacteria counts, with sulfur an occasional problem. Algal concentrations can also be a nuisance and the hardness of water can be an economic headache to the user.

The Ogallala, which is the largest supplier of groundwater in both the Republican River Basin and our NRD, contains water of good to excellent quality. This reservoir of underground water is located in the northern 1/2 of the District. Most of the current groundwater quality problems, other than nitrates and other chemicals applied by irrigation, are located south of the Republican River in the District. Water from the Ogallala tends to be a calcium-magnesium-bicarbonate type when the formation overlies the Pierre Shale, and a calcium-bicarbonate type when it overlies the Niobrara Chalk.

Alluvium and terrace deposits in the Lower Republican NRD show a decline in the quality of the District's water. Samples taken from these deposits show a high percentage, exceeding the maximum contaminant levels, for total dissolved solids, sulfate, chloride, and nitrate-nitrogen. When compared to Ogallala water, water from alluvial deposits shifts to a sodium-bicarbonate-sulfate type.

A public input questionnaire circulated throughout the Lower Republican NRD in 1985 indicated that many of the District's citizenry believe we have a current water quality problem. Almost daily the news media discuss the topic of water quality. Water quality is very important; however with the exception of the Nuckolls County-Superior area in the District, people should determine from a reputable laboratory facility whether their water is safe for drinking or not. By "reputable", the District is inferring that the water sample be checked by a laboratory that provides an unbiased result. This laboratory should have Environmental Protection Agency certified equipment for any water test desired.

The Lower Republican NRD's future involvement with the water quality issue may be as much finding out <u>if</u> a major concern exists rather than acting as if one already exists, and keep our public informed accordingly. Hopefully, people will know what the actual condition of their water is before investing in devices to purify their groundwater for safety reasons.

The following quote was obtained from an article found in the July 1985 issue of "Selling Direct" magazine (page 6) as written by Wendy Parker:

> "A health conscious America has made the water filtration and purification industry boom in recent years. Here's a look at how a fast-expanding market can mean big profits for you."

The article then describes that this business has experienced "phenomenal surges in sales as a health and nutrition conscious public becomes more concerned about the quality of their drinking water. With an estimated $150 million in sales in 1984 of water filtration, conditioning and purification products, manufacturers point out that their industry is no longer a fad, but a growing and lasting force in the movement to eliminate harmful chemicals from the environment. While the clean water concept wasn't a part of America's initial fascination with jogging, natural food and spa workouts that began in the early 1970's, it has grown to become a central focus of environmentalists and consumers alarmed at the spread of toxic waste dumps, hazardous pesticides, and contaminants in groundwater supplies."

Articles, such as the one just quoted, indicate that the water quality issue will need to be a major part of the Lower Republican NRD's future groundwater planning efforts. Since the public is continually exposed to this justified concern over the quality of the water we drink, the Lower Republican NRD believes that it is important to find out <u>exactly</u> what the quality of the District's water is. The quality of safe drinking water is not always evidenced by taste or smell. The public could be easy prey for those trying to sell water purification products, when the problem may not even exist. This is the reasoning behind the emphasis of management options which relate to the District's monitoring of water quality, especially for safe drinking purposes.

PROPOSED WATER CONSERVATION AND SUPPLY AUGMENTATION PROGRAMS FOR DISTRICT

Groundwater Conservation

The Lower Republican NRD addresses, in the Management Options section of the Plan, the basic approach our District proposes to address the conservation of our groundwater reservoir. However, our approach appears to follow this basic format.

1) Use education and information to encourage water users to utilize only water needed.
2) Encourage research in plant varieties needing less water.
3) Provide financial incentives to encourage application of water conservation practices to land.
4) Research methods of recharging groundwater reservoir from surface water storage facilities and land treatment practices applied to land.
5) Use control methods to insist upon conservation of groundwater - this is to be the last resort in water conservation.

Surface Water Conservation

The Frenchman-Cambridge and Bostwick Irrigation Districts, located within the Lower Republican NRD, supply some of the NRD's irrigation water needs. Since conservation efforts on their water usage could affect the management of the District's groundwater, the Lower Republican NRD will include a "water management and conservation program" considered for both irrigation districts in this technical requirement. The following description of this water conservation attempt is quoted from a Bureau of Reclamation Study completed in February 1985 entitled "Republican River Basin Water Management Study".

Surface Water Management and Conservation Program

The WMC (Water Management and Conservation) Program seeks to provide better management and more efficient use of water, energy, and other resources on operating irrigation projects. The WMC Program was developed by Reclamation as a means to promote improvements in project and onfarm water systems and management practices.

The principal activities of the WMC Program include:

1) Determination of irrigation requirements.
2) Field and farm irrigation scheduling demonstrations.

3) District management

   a. Water delivery policies and standards
   b. Ditchrider rules and regulations
   c. Improved water management technology

4) Distribution system operation

   a. Water measurement capabilities
   b. Operating practices and procedures
   c. System scheduling procedures
   d. Technical reviews
   e. Planning for system improvements and/or optimization of operations
   f. Upgrading of data processing capabilities
   g. Technical assistance to identify and reduce system losses

An analysis was conducted to determine the potential for establishing a WMC program for the Bostwick, Frenchman-Cambridge, and Kansas Divisions in the states of Kansas and Nebraska. Two programs were analyzed to manage a total of 122,809 acres (based on 1980 irrigation acreage). A three-year WMC Program provided for an intensive and concerted effort to realize the anticipated benefits of such a program as rapidly as possible. A lower cost alternative would be a continuous program which would require fewer personnel. Benefits of this program, however, would be realized at a slower rate.

The estimated annual cost of implementing the three-year program based on January 1983 price indexes would total $170,000 or $1.38/acre. The annual cost of the continuous program would be $49,000 or $0.40/acre. It is anticipated that increased productivity from the program will generate revenues sufficient to pay for the program.

The anticipated benefits of a WMC Program instituted in the Republican River Basin include the following:

1) Effective and efficient utilization of the available water resources.
2) Continued productivity of irrigated croplands.
3) Minimized requirements for structural improvements and capital investments.
4) Improved public cooperation and support.

The Lower Republican NRD believes the Surface Water Conservation Program, like the one previously described, and a groundwater recharge effort (described in the following section of this Plan) helps to provide an <u>augmentation system</u> to supplement our future water needs.

EFFECTS OF SUPPLEMENTAL WATER SUPPLIES AND RECHARGE TO GROUNDWATER

Availability of Supplemental Water Supplies, Including the Opportunity for Groundwater Recharge

The Lower Republican NRD has two Irrigation Districts (Frenchman-Cambridge Irrigation District and Bostwick Irrigation District) which help supplement the demand for groundwater used for irrigation purposes. Before describing these two irrigation districts, Map # 23, page 79 shows the amount of water (in acre feet) diverted, and the location of where, in the Republican River Basin, this water is diverted from the River, or Reservoirs located in the Republican Basin. Note the portion of this map from Cambridge, Nebraska (toward the center part of the page) downstream (moving from left to right) to the Kansas-Nebraska state line. This portion of the map shows the acre feet of surface water diverted in the Lower Republican NRD to meet the irrigation needs. Table # 14, page 80 further illustrates this existing supplemental water benefit. Note that this table describes, for both the Frenchman-Cambridge and Bostwick Irrigation Districts, the point that the water is diverted in the Basin, acres supplied by diversion, and average annual net water supplied in acre feet (1969 - 1978).

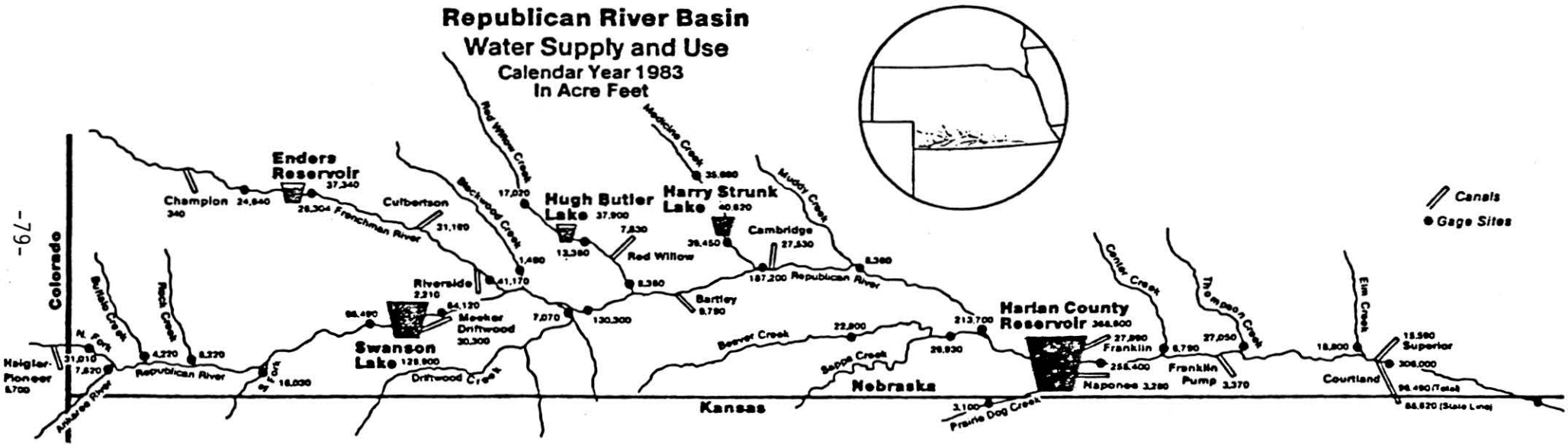
Frenchman-Irrigation District

The Frenchman-Cambridge Irrigation District is located in southwestern Nebraska and extends from Palisade, Nebraska, southeastward along the Frenchman River, and from Swanson Lake eastward along the Republican River to the Harlan County Reservoir (located approximately midway in the Lower Republican NRD on the Republican River).

Storage facilities for this irrigation district consist of Enders Reservoir, Swanson Lake, Hugh Butler Lake, and Harry Strunk Lake. Again, referring back to Map # 23, page 79 will help in locating these storage facilities. The four irrigation supply units provided by the Frenchman-Cambridge Irrigation District are the Meeker-Driftwood, Frenchman, Red Willow, and Cambridge Units. The Red Willow and Cambridge Units supply the Lower Republican NRD.

The Red Willow Unit receives water from Hugh Butler Lake, located on

Map #23



Source: Bureau of Reclamation

Surface Water
Supplementing Irrigation Water Needs by
Two Irrigation Districts within LRNRD

Conveyance Systems and Diversions

Conveyance system	Point of diversion	Acres supplied	1969-1978 Average annual net supply (acre-ft)	Diversion Minimum (acre-ft)	Year	Maximum (acre-ft)	Year
Upper Republican Division							
Hale Ditch	Bonny Dam	743	2,543	1,600	1978	3,950	1969
Frenchman-Cambridge Division							
Meeker-Driftwood	Trenton Dam	15,112	38,036	28,425	1977	42,960	1970
Red Willow	Red Willow Creek Diversion Dam	4,439	9,759	7,539	1977	12,037	1976
Bartley Canal	Bartley Diversion Dam	5,925	12,395	9,828	1969	14,935	1976
Cambridge	Cambridge Diversion Dam	15,958	34,787	15,088	1971	32,089	1976
Culbertson	Culbertson Diversion Dam	8,249	19,330	15,687	1978	22,333	1971
Culbertson Extension	Culbertson Diversion Dam	10,846	21,441	15,953	1978	26,980	1969
Total		60,529	135,748				
Kanaska Division							
Almena	Almena Diversion Dam	5,118	5,758	2,576	1972	10,091	1970
Bostwick Division							
Franklin	Harlan County Dam	9,806	29,229	21,554	1969	34,665	1976
Naponee	Harlan County Dam	1,472	3,530	2,222	1969	4,661	1976
Franklin South Side Pump	Franklin South Side Pumping Plant	1,978	3,408	1,806	1969	4,312	1971
Superior	Superior-Courtland Diversion Dam	5,125	14,589	10,262	1969	20,199	1976
Courtland-Nebraska	Superior-Courtland Diversion Dam	1,575	10,008	1,015	1969	3,261	1976
Courtland-Kansas	Superior-Courtland Diversion Dam	10,049	67,405	18,343	1972	38,614	1976
Courtland below Lovewell	Lovewell Dam	19,439	45,803	30,206	1973	71,792	1976
Total		49,444	173,972				

Source: Special Report: Republican River Basin Water Management Study, Colorado, Nebraska, Kansas - Department of the Interior - Bureau of Reclamation

Date: February 1985

Red Willow Creek north of McCook, Nebraska. The unit is located along the north side of the Republican River from the confluence of Red Willow Creek and the Republican River to Cambridge, Nebraska, on the south side of the Republican River between the Bartley Diversion Dam and Holbrook, Nebraska. Water right filings for the Red Willow Unit provide for the irrigation of 25,029 acres.

The Cambridge Unit is located along the north side of the Republican River between the towns of Cambridge and Alma, Nebraska. Water for this unit is supplied by Harry Strunk Lake, located on Medicine Creek, and by natural flow of the Republican River. Water rights filed for the Cambridge Unit provide for the irrigation of 34,994 acres.

Bostwick Irrigation District

The Bostwick Irrigation District is located in southcentral Nebraska and northcentral Kansas. It extends from Harlan County Lake, located on the Republican River in Nebraska, to Concordia, Kansas, and includes land on both sides of the Republican River.

Water for the Bostwick Irrigation District is stored in the Harlan County Lake in Nebraska, and Lovewell Reservoir located on White Rock Creek in Kansas. A water right to store 350,000 acre-feet in Harlan County Lake was filed in January 1948. Lovewell Reservoir has a water right which was filed in October 1955 and provides for the storage of 41,690 acre-feet. Of this storage within Lovewell Reservoir, 19,700 acre-feet annually can be supplied from White Rock Creek with the remainder to come from the Republican River through canal diversion.

Three units are located within the Bostwick Division. These are the Franklin, Superior-Courtland, and Courtland Units in Kansas.

The Franklin Unit diverts water directly from Harlan County Lake and from the Republican River through a pumping station 17 miles downstream from the reservoir. This unit extends from Harlan County Lake along the north side of the Republican River to a point 47.9 miles east. In addition, it extends approximately 10 miles along the south side of the Republican River from Harlan County Lake, and five miles along the south side from the pumping station. Associated water rights filings provide for the irrigation of 30,607 acres.

The Superior-Courtland Unit originates at the Superior-Courtland Diversion Dam, located on the Republican River in Nebraska. It extends

30 miles eastward along the north side of the Republican River to near the Nebraska-Kansas State line. South of the Republican River, the Superior-Courtland Unit extends just past the Nebraska-Kansas State Line to Lovewell Reservoir in Kansas. Water right filings for this unit provide for the irrigation of 31,341 acres.

Expanded Supplemental Water Uses

Map # 24, page 83 shows that there is a future opportunity for four specific supplemental water uses within the Republican River Basin. These four uses would be irrigation, municipal, livestock-rural domestic and for fish, wildlife, and outdoor recreation. Each of these uses is a possibility in the Lower Republican NRD. An example of two proposed projects aimed at providing additional future supplemental water to the Lower Republican NRD, are the Catherland Irrigation Project and the Enders (Reservoir) Diversion Project.

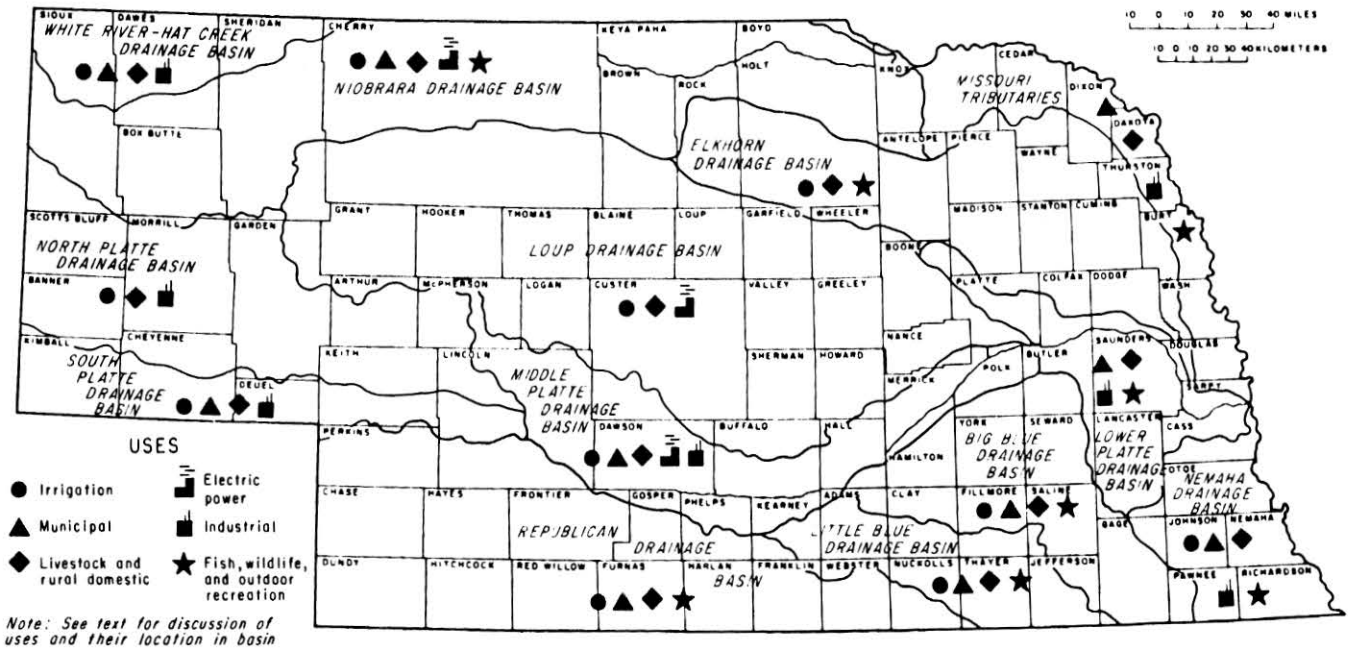
Catherland Irrigation Project

The Catherland Irrigation Project proposes to utilize excess Platte River water diverting it to a reservoir, which would probably be located northwest of Campbell, Nebraska on the Little Blue River. Campbell is located in the northeastern portion of Franklin County. The proposed reservoir would almost entirely be situated within the boundaries of the Lower Republican NRD. Approximately 15% of the land proposed to be surface irrigated by this Project would be located in the Lower Republican NRD. The Catherland Reclamation Project also should provide a recharge benefit, especially in the area around the structure site with much of this benefit being realized by this NRD. The Lower Republican NRD has, throughout the past several years, provided some financial assistance toward the litigation of this Project's water right.

If the Catherland Irrigation Project is completed, Map # 25, page 84 shows the proposed transportation system to move water from the Tri-County Irrigation Supply Canal to the reservoir site, and then to the two service units (north and central). Supplement # 2 on page 85 is a more complete description of this Project.

Enders Diversion Project

Another proposed water diversion project which, if constructed, would transfer Platte River water to the Republican River Basin to

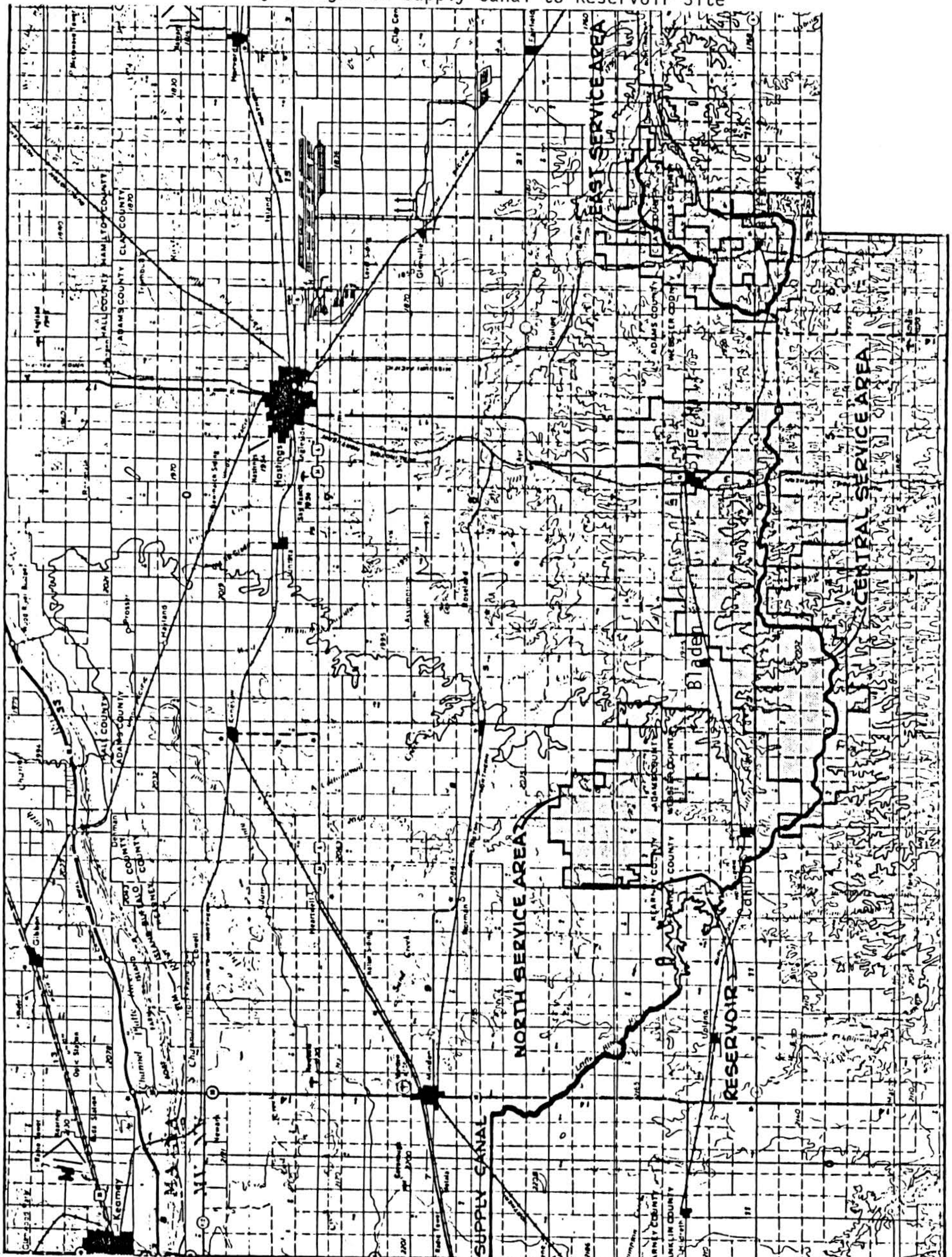


OPPORTUNITIES FOR SPECIFIC USES OF SUPPLEMENTAL WATER BY BASIN

Source: Nebraska Natural Resources Commission Policy Issue Study, "Supplemental Water Supplies"

Date: January 1984

Proposed Transportation System to Move Water From Tri-County Irrigation Supply Canal to Reservoir Site



Source: Little Blue Water Resources Project--Prefeasibility Engineering & Economic Report on Proposed Plan of Irrigation Development

Date: September 1976

CATHERLAND IRRIGATION PROJECT SUPPLEMENT

In 1968, the late John Fox, Webster County Extension Agent, envisioned transferring water from available sources for irrigation of land in the Campbell, Bladen, Blue Hill, and Lawrence vicinities that do not have groundwater. Following exploritory meetings during early 1976 in the project area, the Little Blue Natural Resources District, recognizing the real and strong local interest, elected to sponsor further studies. As a result, a water right was applied for by the Little Blue Natural Resources District. In 1980, a petition was circulated and the Catherland Reclamation District was formed.

NEEDS

Due to the lack of sufficient ground water and the erratic rainfall amounts, crop yields vary greatly from year to year. The project area receives an average yearly rainfall of 24 inches of which 16 inches is available during the growing season. This is far short of the amount needed to produce optimum yields on the project's irrigable land.

BENEFITS

The benefits of the project are many. Some of the most obvious benefits are:

Irrigation - 66,500 acres in Adams, Webster, Nuckolls, Clay, Kearney, and Franklin counties would be irrigable.

Recharge - there would be recharge of underground aquifer in deep well pumping areas.

Efficiency - the project would "piggy-back" on the Tri-County Irrigation System, it would use an existing canal plus 24 miles of new canal for inlet supply.

Flood Control - it would help allivate the threat of floods along the Little Blue River.

Stream Flow Enhancement - it is expected the Little Blue River would become a live and viable stream below the dam.

Recreation - swimming, boating, fishing, and hunting.

Wildlife Enhancement - ideal wildlife habitate.

Stabilization - of economy and population, the quality of human existance in the region will be improved.

PROJECT FEATURES

Dam	Rolled Earth
Reservoir Capacity	120,500 acre-feet
Surface Area	4,630 acres
Irrigable lands	66,500 acres
Inlet Supply Canal	24 miles
Project Service Areas	3
Canal & Lateral Capacity	3.24 inches per acre in a 10 day period

SUMMARY

The Catherland Project has tremendous local support. Ever since the idea was first conceived by the late John Fox, the Webster County Extension Agent, until present, the local citizens have rallied behind the project with great enthusiasm. The project is the result of three NRD's: Little Blue, Tri-Basin, and Lower Republican all working cooperatively toward a single goal. The project began taking shape with a reconnaissance study which was funded in part by $15,000 from local contributions. The Reclamation District was formed by the signatures of landowners, representing over half the land in the district, when only a third of the land needed valid landowner signatures. When the project is completed it will be the result of the dedication of many people working toward a single goal.

Source: Catherland Reclamation District Pamphlet

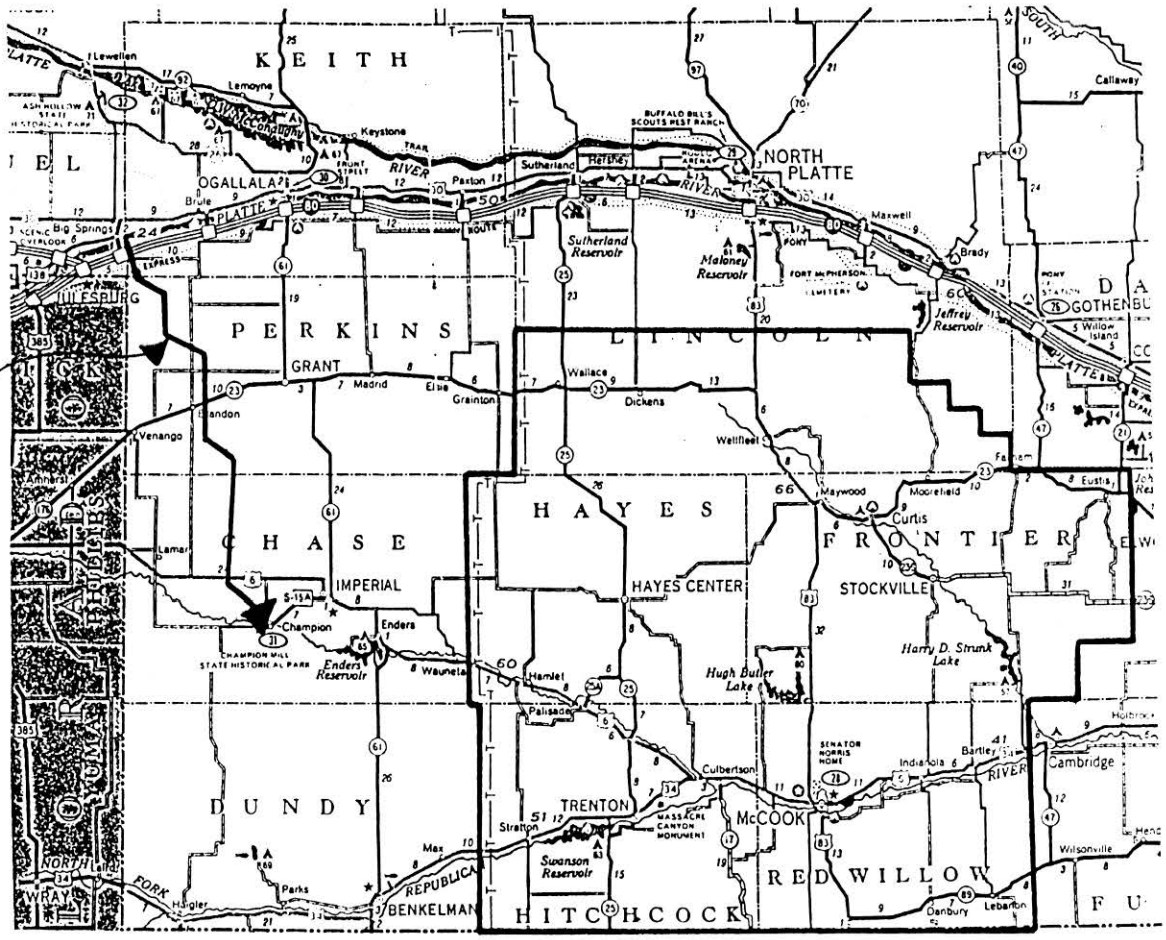
supplement the groundwater needs of the Basin in the Enders Diversion Project. Map # 26 , page 87 shows the approximate location of the water transportation route to divert South Platte River water southward to Frenchman Creek and then to Enders Reservoir.

The Lower Republican NRD has also assisted financially in an attempt to obtain a water right on the Enders Diversion. Even though no direct water benefit would be received with this diversion, this NRD believes that there could be a supplemental water source to the Republican River (upstream from the Harlan County Reservoir). This would be due to return flows to the River from the upstream Frenchman-Cambridge Irrigation District. This return flow could help with the instream flow concerns from Cambridge, Nebraska, to the Harlan County Reservoir in the Republican River. This supplemental benefit may delay any future groundwater control measures along this section of the River for the Lower Republican NRD.

The primary purpose behind the Enders Diversion Proposal is partially due to the extensive groundwater development above Enders Reservoir, resulting in a reduction in flows of the Frenchman Creek into the Enders Reservoir. Thus, there has been a continual decline in water available to irrigators in the Frenchman Unit since the late 1960's and early 1970's. The U.S. Geological Survey has projected that even without further groundwater development, perennial flows in Frenchman Creek (above Enders Reservoir) are expected to be reduced to zero by 1991. In April of 1980, the Bureau of Reclamation was requested to provide an assessment regarding the potential to divert water as described in this Plan.

The transfer of water from one hydrologic basin to another is a fairly common practice throughout the United States. However, until a 1980 Nebraska Supreme Court decision to reverse an earlier (1936) decision, the transfer of water from one Nebraska river basin to another was prohibited. The Catherland Irrigation Project helped to bring about this change in Nebraska's water policy. The Lower Republican NRD believes that there is excess water flowing out of our State via the Platte River, which often times cause flooding problems to landowners along that river. Perhaps some of this water could be put to a greater beneficial use to our State by diverting the excess water to the Republican River Basin to supplement the groundwater needs of the Basin, including the Lower Republican NRD.

Proposed Project Location



APPROXIMATE LOCATION MAP - ENDERS DIVERSION PROJECT
DWR APPLICATION NO. A-15738, DECEMBER 19, 1980
45,000 ACRE FEET PER YEAR

Source: Middle Republican NRD Groundwater Management Plan

Date: January 1, 1986

Local Recharge Characteristics

The Lower Republican NRD was hopeful that the South Central Hydrogeologic Study (in progress but not complete) could help address this Technical Requirement of the Plan. Unfortunately, this Study was not available to use. However, some of the data obtained from this Study was made available for a study of the groundwater recharge potential within the Tri-Basin NRD. The Tri-Basin NRD adjoins the northern portion of the Lower Republican NRD touching the following counties in the District: Furnas, Harlan, and Franklin.

The Tri-Basin Recharge Study's scope was expanded beyond the recharge potential of their NRD, but significant time in this Study was spent in looking at recharge potential to help declines experienced in the southern portion of their NRD. This Study boundary was expanded south of the Tri-Basin border into the northern tier of the townships of Furnas, Harlan, and Franklin County in the Lower Republican NRD. The Tri-Basin Study has already proven beneficial to the Lower Republican NRD in looking at potential recharge sites which would have some impact on a declining water table concern in the Lower Republican NRD's northern tier of townships of the three counties previously noted. If this NRD chose to pursue a groundwater recharge program to address this declining water table concern, coordination with the Tri-Basin NRD seems likely.

Also, the Tri-Basin Study identified a groundwater table "mounding" effect resulting from the Tri-County Irrigation Canal seepage - primarily west of Holdrege. The Study indicates that the declines experienced in the northern portion of our NRD (especially in Furnas and Harlan County) would be more dramatic if this canal seepage (causing the groundwater build-up - "mounding") was not occurring. If the Tri-County Irrigation District makes major efforts in reducing this mounding, a great decline in the static water level would likely occur. Signs of this Tri-County "mounding" of groundwater into the Lower Republican NRD appear to be verified from a static water test of an irrigation well located in the northern portion of the northwest township of Harlan County. During the Lower Republican NRD semi-annual (spring and fall) static water level measurement this well's water level rose 15.5 feet from 1978 to 1979, where wells monitored east of this well 3 - 4 miles showed a slight decline. This well has continued to rise since the 1979 measurement,

but only slightly. The only explanation apparent is that the Tri-County mounding had reached that far south in the Lower Republican NRD. The wells located to the east of this well in our NRD did not experience noticeable effect, partly because of the greater irrigation development directly north of those wells in the Tri-Basin NRD.

Map # 27 on page 90 was reproduced from the Tri-Basin Study. This map shows the current water table (note northern tier of Townships in the Lower Republican NRD on map) since pre-development. Map # 28, page 91 and Map # 29, page 92 indicate preliminary results of the Natural Resources Commission computer program for the year 2000 (Map # 28) and 2020 (Map # 29). The results of this projection into the groundwater table future indicate that declines could become significant in both the southern part of the Tri-Basin NRD, and also the northern portion of the Lower Republican NRD.

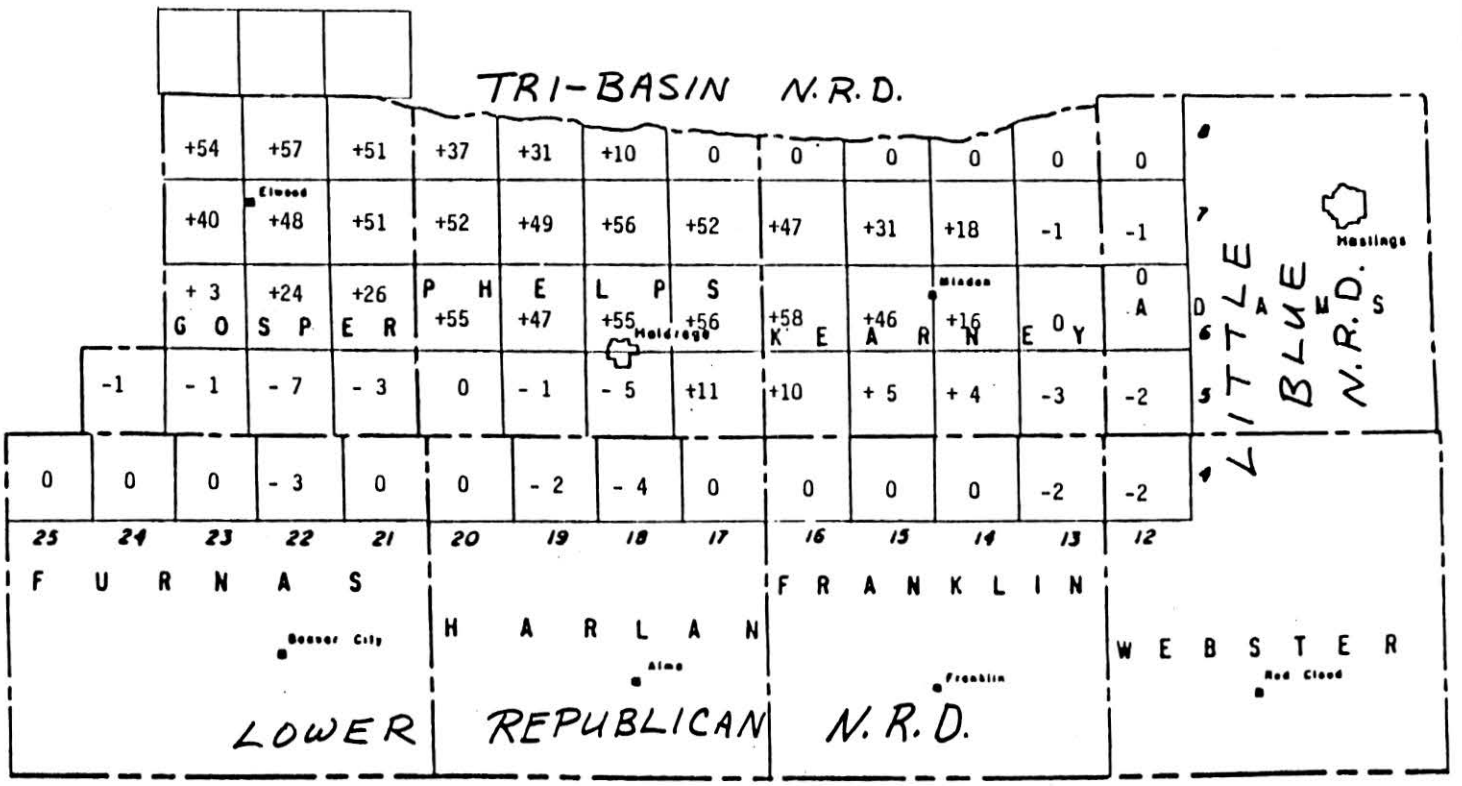
Because of the geologic configuration within the Lower Republican NRD and the location of the Republican River throughout most of the District, recharging of our groundwater appears to be limited to the Tri-County Irrigation System in the Tri-Basin NRD. In order to provide a positive impact on the Lower Republican NRD's groundwater levels, recharge structures, especially where water bearing materials are present, seem to be a desirable future management alternative. Only slight recharge benefits are recognized by the flows in the Republican River, thus to increase the River's flows to provide recharge benefits does not appear to be a justified management objective.

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

Much of the technical requirement relating to the Lower Republican NRD's "opportunity to integrate and coordinate the use of water from different sources" has already been covered. The supplemental water section of this Plan identified two proposed projects, Catherland Irrigation Project and the Enders Diversion Project, which propose using Platte River Basin water to help with our water needs. Also, in the recharge portion of this Plan, the possibility of using water via precipitation caught in surface storage structures to add to the District's groundwater reservoir was discussed.

The Tri-Basin Study indicates a potential (although future study may show it to be unfeasible) to use some method of moving Tri-County

CURRENT WATER LEVEL PROJECTIONS FROM TRI-BASIN RECHARGE STUDY



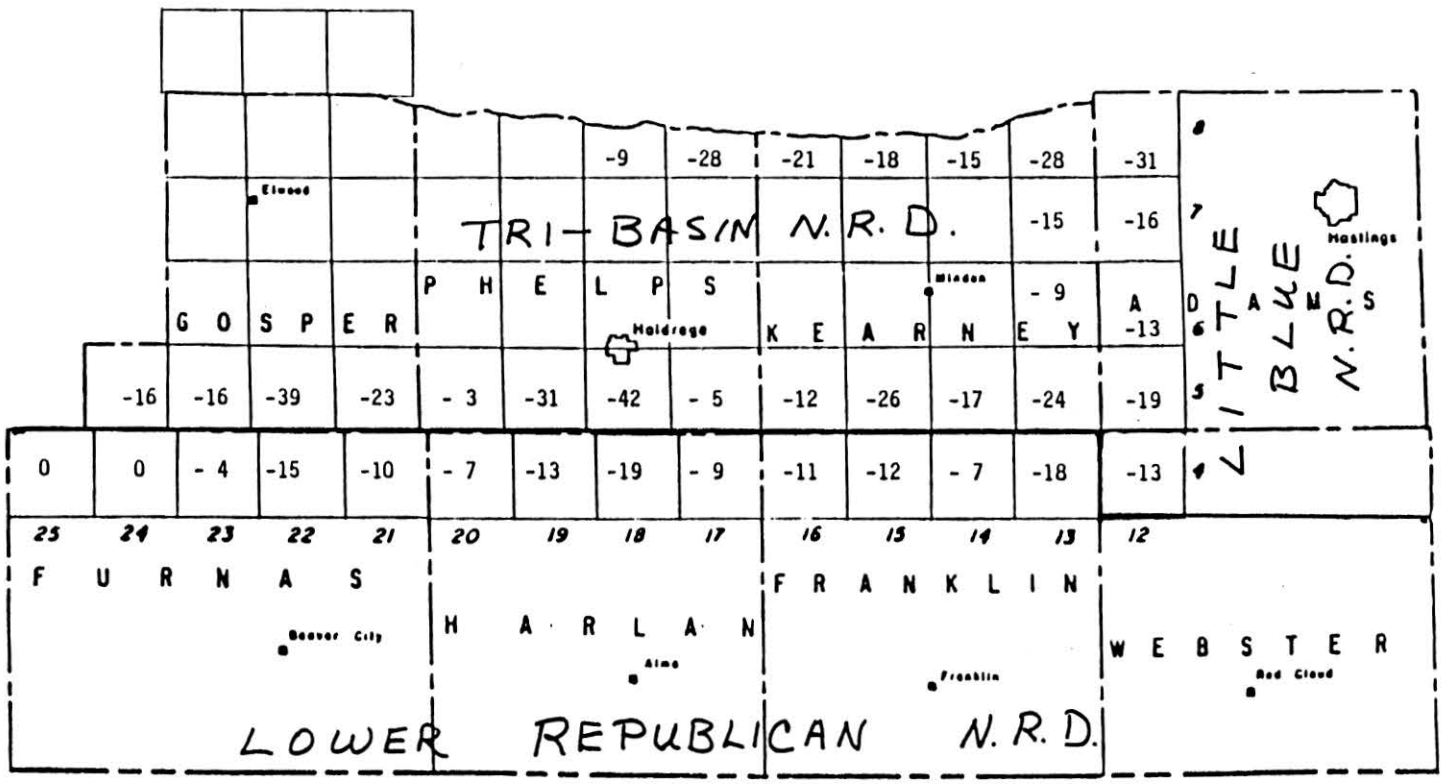
Calculated Average Decline (-) and Rises (+)
in Water Table Conditions Since Predevelopment (1954)
Using the Calibrated Data Base

Source: Tri-Basin Natural Resources District Groundwater Recharge Program 1983, Henningson, Durham and Richardson

Date: November 1983

Units: Average Depth in Feet

WATER LEVEL PROJECTIONS FROM TRI-BASIN RECHARGE STUDY



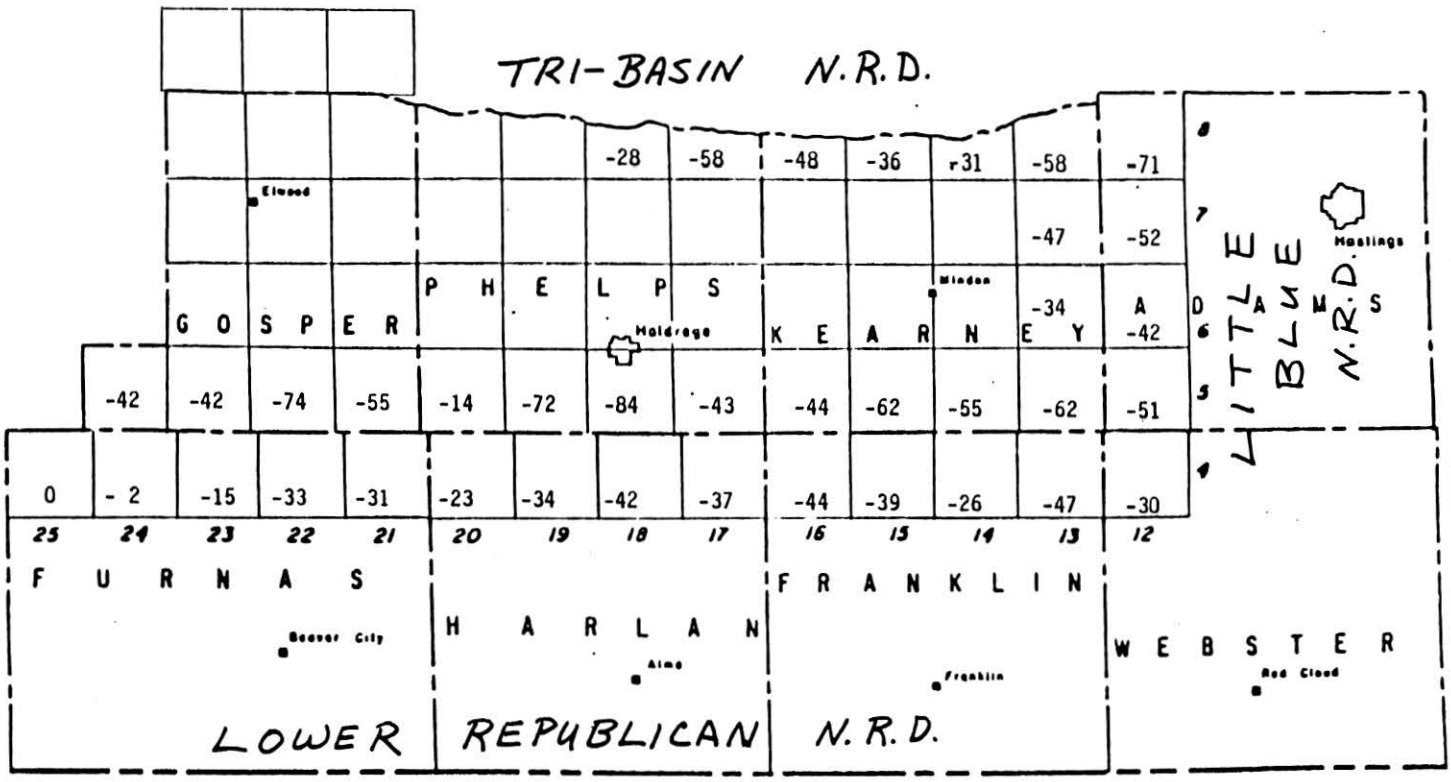
Projected Approximate Year 2000 Declines (-) in Water Table Conditions Using the NRC Accounting Method.

Source: Tri-Basin Natural Resources District Groundwater Recharge Program 1983, Henningson, Durham and Richardson

Date: November 1983

Units: Average Depth in Feet

WATER LEVEL PROJECTIONS FROM TRI-BASIN RECHARGE STUDY



Projected Approximate Year 2020 Declines (-) in Water Table Conditions Using the NRC Accounting Method.

Source: Tri-Basin Natural Resources District Groundwater Recharge Program 1983, Henningson, Durham and Richardson

Date: November 1983

Units: Average Depth in Feet

Canal seepage water (causing localized high water problems) south to storage sites in the southern portion of the Tri-Basin NRD or northern portions of the Lower Republican NRD. This water would be pumped in the high water table area and transported by a pipeline. This idea is just that, and is certainly not a tool this NRD can work into the management portion of this Plan.

Weather Modification

The average annual precipitation received in the Lower Republican NRD is relatively low, and it is known that the precipitation received does not always occur when needed for raising crops. The idea of trying to make rain when it is needed is not new; however, recent attempts to scientifically cause rain have been tested close to the Lower Republican NRD - enough to cause this NRD to consider the results of these attempts within this section of the Plan.

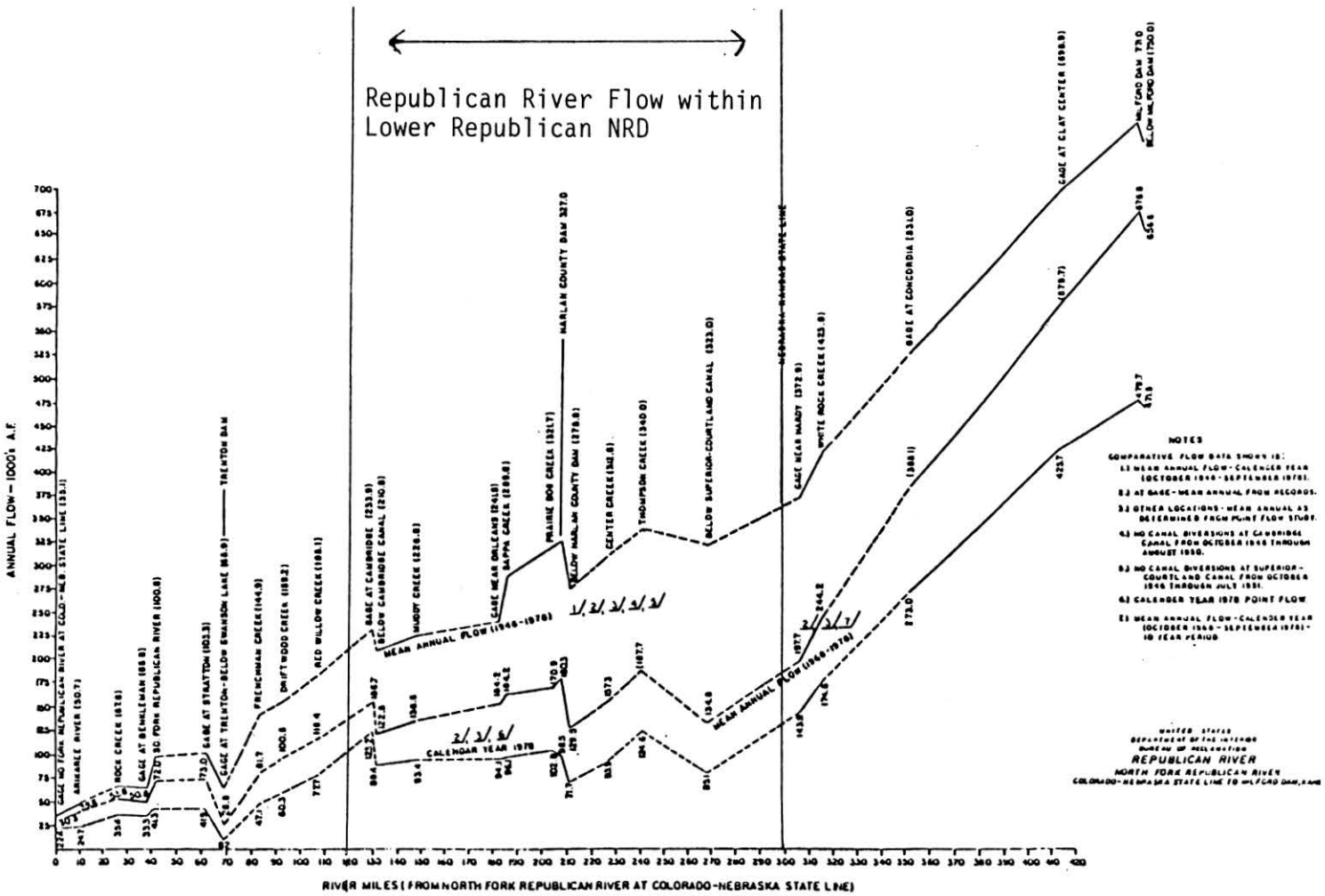
The following is quoted from a Bureau of Reclamation Study on the Republican River Basin Study (completed in 1985):

> A major field program to develop and evaluate the use of seeding techniques for the enhancement of precipitation in the High Plains area of Kansas, Colorado, and Nebraska was conducted by the Bureau of Reclamation from 1976 to 1980. The summary of results of this Study is included in the final report of the Hiplex Program in Colby-Goodland, Kansas: 1976-1980. The results of the program indicate that by using weather modification techniques an increase of less than 4 percent in rainfall could be realized. The cloud seeding program was primarily conducted from June through September on convective-type storms. It can be concluded from this study that seeding methods could not significantly enhance precipitation in the Republican River Basin.

It appears that weather modification, unless a newly devised technique is developed, is not a tool that the Lower Republican NRD can use to significantly provide additional water to supply the District's needs.

Increased Republican River Flows to Meet Future Needs

Another consideration to supply our future water needs would be increased flows on the Republican River throughout the Lower Republican NRD. However, because of the water right appropriations on the River, conservation practices applied to the land within the River Basin (according to the Bureau of Reclamation - Republican River Basin Study - 1985) and groundwater development primarily on Republican River tributaries, the likelihood of increased flows appear dim. Graph # 8, page 95 shows a comparison of the Republican River mean annual flows throughout the years 1946 - 1978, 1968 - 1978, and calendar year 1978. This graph shows a steady decline in the Republican River flows throughout the entire River Basin (note portion of graph showing Lower Republican NRD).



Source: Special Report -- "Republican River Basin Water Management Study", Colorado-Nebraska-Kansas, Department of Interior - Bureau of Reclamation

Date: February 1985

Reservoir Life Goal
for
Groundwater Resource in Lower Republican NRD

Goal Statement: The Lower Republican NRD Groundwater Reservoir Life Goal is to provide quality water in the quantity needed for an infinite period of time.

Terms in Goal Defined:

1) Quality Water: The Lower Republican NRD definition of this term is water which is safe for human consumption, considering all possible chemical, physical, biological, and radiological contaminants, using numerical standards established by the State Department of Environmental Control.

2) Quantity Needed: The Lower Republican NRD will strive to maintain a groundwater reservoir capable of supplying the following future needs: municipal, domestic, irrigation, industrial, wildlife, and other beneficial needs as identified by the District. The District will encourage conservation practices of all groundwater users to strive to maintain the groundwater storage at or near the quantity as determined to be available in 1981 (1981 will serve as base year for quantity management activities since data compiled for the USGS-NRC South Central Nebraska Hydrogeologic Study gives the District predictive information, currently available, to project future Lower Republican NRD groundwater quantity information). To provide for the future groundwater needs, it is anticipated that mandated reductions in water usage (for each of the described beneficial uses) may be necessary to achieve this projected goal.

OVERVIEW OF TRIGGERING MECHANISMS TO INITIATE LRNRD ACTION

Levels of Management	(To Begin This Management Level, These Conditions Exist:) Quality	(To Begin This Management Level, These Conditions Exist:) Quantity
1 - Data Collection		
2 - Establish Extent of Concern	70% MCL (municipal) 80% MCL (domestic)	Decline trend over 3 years based on 1981 water level and aquifer priority for Level II
3 - Voluntary Management (To Stabilize Or Reduce Concern)	75% of locations of minimal size area - 4-16 square miles (municipal) or 36 square miles (domestic) 80% MCL (municipal) 90% MCL (domestic)	75% of locations in 16 square miles or 36 square miles - declines at Level III aquifer priority for 3 year trend
4 - Mandatory Management (To Stabilize Or Reduce Concern)	80% of locations of minimal size area - 4-16 square miles (municipal) or 36 square miles (domestic) 90% MCL (municipal) 100% MCL (domestic)	80% of locations in 16 square miles or 36 square miles - declines at Level IV aquifer priority for 5 year trend
-- Speeding Up Process -- (From One Level To Another)	Emergency Provision	(No Emergency Provision) Law Dictates Reaction Time

The LRNRD will annually review these parameters which are part of the Plan's policy to trigger action when quality or quantity concerns arise.

OUTLINE OF THE FOUR LEVELS
OF
LOWER REPUBLICAN NRD GROUNDWATER QUALITY MANAGEMENT

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The Lower Republican Natural Resources District
Policy and Implementation Mechanism
for Reaching Groundwater Quality Goal

O V E R V I E W

The Lower Republican NRD has established four levels of management objectives, which will be implemented in order that the groundwater quality goal of the Groundwater Management Plan may be reached.

The entire Lower Republican Natural Resources District will be placed under Level I Groundwater Quality Awareness, unless the District Board of Directors and/or the District Management staff determines that certain areas would benefit from higher levels of management.

At Level I, the lowest level of management will be undertaken, wherein the District will continue existing informational and educational programs regarding groundwater resource management, promote voluntary implementation of the Best Water Resource Management Practices by groundwater users, expand (as budget allows) certain programs such as: groundwater quality monitoring (in order to establish an awareness of groundwater quality conditions which exist in the District) or the data base of information regarding water quality within the District. The Lower Republican NRD decided to include (in Level I) a detailed explanation of the process of administering the provisions of the Nebraska Chemigation Act passed into law in the 1986 Legislative session. Although this extensive explanation is not essential to meet the legal requirements of this Plan, it was thought to be helpful for readers who may be unfamiliar with the District's involvement in the administration of this important legislation dealing with the protection of Nebraska's groundwater quality.

The implementation of any Level of Groundwater Quality Management higher than Level I, will be triggered when a significant increase in the level of contaminants contained within groundwater monitored by the District, or other reputable agency, occurs over an area of significant size over a significant period of time. The 'triggering parameters' to be used by the District in determining the 'significance' of a groundwater quality concern area will be based on those stated within the Implementation of Groundwater Quality Management Levels Procedures, but the District Board of Directors reserves the right to make exceptions. Exceptional cases of existing or rapidly-developing high-level groundwater

contamination are to be dealt with by procedures described in the Emergency Provision of the Lower Republican NRD Groundwater Management Plan. Municipal water sources will be given highest priority over all other quality problems. The District will use a priority system in addressing water quality concerns using the population of the municipality and the saturated thickness of the aquifer underlying the municipal well as the basis for this system.

An Emergency Provision has been established whereby the process of establishing some level of Groundwater Quality Management will be more rapidly facilitated for areas in which high levels of contamination exist prior to the time when this Plan goes into effect and/or are rapidly approaching the Maximum Contaminant Levels established by the Environmental Protection Agency under the Provisions of the Safe Drinking Water Act, or in other exceptional cases unforeseen to the District at this time.

The implementation of any Level of Groundwater Quality Management will be based on the most reliable data sources available to the District at that time. Furthermore, the District reserves the right to continually review existing Groundwater Quality Management Areas and to dissolve, or reassign, any established Groundwater Quality Management Area when reliable trends indicate that there has been a significant improvement in the groundwater quality within an area of significant size over a significant period of time.

At any subsequent Level of Groundwater Quality Management, <u>all</u> quality management objectives undertaken at lower Groundwater Quality Management Levels will be voluntary on the part of groundwater users, except for Level IV Quality Management or Protection Areas, wherein the use of certain Management Practices will be required or modified, as necessary, to meet mandates established by the State of Nebraska in LB 894 (passed 4-14-86; signed 4-18-86) under authority of the Department of Environmental Control.

At Level II, the District will attempt to determine facts regarding the presence of a high level of contamination discovered at any site(s) within the District. The District will intensify groundwater quality research in the immediate area of the site(s) in order to determine the significance and magnitude of the contamination.

Level III Groundwater Quality Pre-Regulatory Objectives will be implemented when groundwater contamination is widespread and the drinking water supply is seriously threatened. The District will encourage landowners

to voluntarily make use of certain Groundwater Quality Management Practices in an attempt to stabilize and/or improve groundwater quality.

Level IV Groundwater Quality Management and Protection Area objectives will be implemented by the District in areas where it has been determined, by the District, that there is severe contamination of the groundwater. This level will first implement the "Management Area" authority, provided to NRD's to address the concern by requiring certain procedures be enacted in an area (meeting the District standards established for this level). If the management area concept fails to improve the water quality of the area, the District will request assistance from the State Department of Environmental Control to establish a "Special Protection Area". This approach undoubtably initiates more stringent procedures to be implemented in the area of concern, thus making this phase of Level IV the most restrictive management process contained in this Plan. The required practices to be implemented in this "Special Protection Area" phase will be conducted in accordance with state laws using the provisions of LB 894 as the basis for their implementation.

All areas within the District will be placed into one of the Four Levels of groundwater quality management. The District Board of Directors will continually review the status of all Groundwater Quality Levels and evaluate the effectivess of District efforts within them to maintain groundwater quality according to the goal of the Lower Republican NRD Groundwater Management Plan. This goal basically states that the Lower Republican NRD will strive to provide the current yield and quality of groundwater, for beneficial uses, for an infinite period of time throughout the District.

Where funding limitations or legislative authority will prevent the District from meeting the objectives described in each management level, the Lower Republican NRD will search for funding sources and initiate legislative changes as necessary to address the District's Groundwater Management Goal.

Policy and Implementation of Levels of Groundwater Quality Management

LEVEL I. GROUNDWATER QUALITY AWARENESS

-- Establishing Groundwater Quality Awareness --

The Level I Groundwater Quality Awareness Objectives Are:

A. Continue Existing Programs

Objective 1. Encourage Voluntary Use of Groundwater Quality Conservation Practices.

a) The District encourages the use of practices which inhibit transfer of agricultural chemicals below the root zone of plants, such as:

1) The District provides a HOTLINE telephone information service during the irrigation season to help irrigators determine how much and when to irrigate.

2) The District promotes proper construction and use of active and abandoned groundwater wells.

3) The District promotes adequate waste disposal by potential groundwater recharge sites, such as irrigation runoff, and/or reuse ponds, municipal sewage lagoons, feedlot runoff collection sites, private entities, etc.

4) The District encourages voluntary monitoring of groundwater and soil for the quantity of fertilizers and pesticides already present to determine the need for additional chemicals.

5) The District encourages the growers to become familiar with Soil Capabilities and Crop Water Use Information.

6) The District encourages competent use of agricultural chemicals, in accordance with LB 284 (The Nebraska Chemigation Act: passed 4-9-86) where applicable.

7) The District will make available to the public information emphasizing groundwater quality conservation, such as:

a) efficient chemical applications

b) proper chemigation techniques

c) information regarding water quality throughout the District

d) information as to where individuals can voluntarily have their groundwater quality evaluated

Objective 2. Establish a Reliable Base of Information.

a) Monitor, collect, review data obtained by other agencies regarding the locations and quantities of chemical compounds (or other contaminants) present within the District.

b) Continue existing well monitoring program which consists of approximately 150 locations randomly distributed throughout the District (as shown on Map #22, page 68) being monitored annually for nitrate-nitrogen levels.

   1) 90% of the wells monitored are active or inactive (if no possible contamination from surface) domestic wells, and 10% are active or inactive irrigation wells. This percentage of domestic vs. irrigation is based on District's concern to address what the quality of drinking water is for the portion of the aquifer used by domestic wells. This percentage ratio may fluctuate according to the determined reliability of domestic well sampled and the portion of the aquifer the sample is being taken from when monitoring the domestic well vs. an irrigation well in that part of the District.

   2) The wells are monitored each year during the same season (usually: May - July) as an indicator of annual trends.

   3) Data obtained from monitoring approximately 150 locations each year will be correlated to other quality data obtained by the District as well as data obtained from other sources.

METHOD OF QUALITY SAMPLE ANALYSIS

1. Parties currently using groundwater within any of the approximately 150 locations annually monitored by the District will be mailed, each year prior to the May-July sampling period, at home water quality sampling bottles, complete with instructions and return postage. The groundwater user should specify on the attached document that the analysis results should be returned both to them and to the District to be kept on record. This endeavor will be financed by the District.

2. The Hach Colorimeter Nitrate-Nitrogen Field Analysis technique is to be used for field investigation studies to be conducted by District personnel. Each analysis conducted by means of this technique will be replicated three times to insure accuracy.

   10% of the samples (from domestic wells) which show (by the Hach Colorimeter Analysis technique) a content of 5 ppm (or greater) nitrate-nitrogen compound, will be sent to a professional accredited laboratory for analysis, to be financed, as budget permits, by the District.

3. The process the Lower Republican NRD intends to use throughout the four levels of management described in this Plan, whether using sampling data obtained from a NRD program, or data received from other reliable sources, is described in the following supplement #4, and flow chart entitled "Water Quality Monitoring Throughout LRNRD's Planning Process".

WATER QUALITY MONITORING THROUGHOUT LRNRD'S PLANNING PROCESS

The purpose of this detailed explanation is to hopefully cover different circumstances which the District may be faced with in the future relating to water quality and to show how the monitoring process will be administered throughout the four levels of management contained in this Plan. This monitoring data will either be provided to the District from other sources (and evaluated accordingly) or will be obtained through the LRNRD sampling process. A flow chart of this monitoring-planning process explanation is included on page 108.

If, in Level I, random sampling does not reveal any contaminant greater than or equal to Level II percent of MCL, further sampling will resume after a period of five years, except for nitrates which will be checked on an annual basis. If the random sampling in Level I does reveal any contaminant greater than or equal to Level II percent of MCL, level II sampling will be initiated.

If, at any time during Level II sampling, one sample every six months for two years, two consecutive samples of less than the standards of that level are observed, sampling will end at that level. Three years will elapse before random sampling resumes at Level I, except for nitrates which will be sampled annually.

If, at any time, during the two-year sampling period of Level II, two consecutive samples are greater than or equal to the standards of that level, but less than 150% MCL, sampling will be at the next higher level. If these two consecutive samples are greater than or equal to 150% MCL, the Board may invoke the Emergency Provision clause and move directly into Level IV.

If, at the end of the two-year sampling period of Level II, two consecutive sample results do not direct the District to: 1) end sampling for a three-year period, 2) move to the next higher level, or 3) resume sampling at Level II and there is not a definite trend established which would direct the District to either discontinue sampling for a three-year period or continue sampling in Level III, the decision as to how to proceed will be determined by averaging the initial sample plus results of the two-year sample period of Level II. If the average is greater than or equal to Level II standards but less than Level III standards, sampling will continue in Level II. If the average is less than Level II standards, sampling will be discontinued for a period of

three years before resuming random sampling in Level I, except for nitrates which will be sampled annually. If the average is greater than or equal to Level III standards, sampling will be continued under Level III criteria.

If, at any time, during Level III sampling (one sample every six months for two years) two consecutive samples of less than the standards of that level are observed, sampling will end at that level. The District will wait for two years and then randomly sample 25% or 10 wells, whichever is less, throughout the entire sample area. One sample will be taken every six months for one year, except for nitrates which will have a two-year sampling program. If the MCL is less than Level II standards, the District will resume Level I random sampling after waiting three years; one year for nitrates. If the MCL is greater than or equal to Level II but less than Level III standards, sampling will be continued in Level II. If the MCL is greater than or equal to Level III standards, sampling will resume in Level III.

If, at any time, during the two-year sampling period of Level III, two consecutive samples are greater than or equal to the standards of that level, but less than 150% MCL, sampling will be at the next higher level. If these two consecutive samples are greater than or equal to 150% MCL, the Board may invoke the Emergency Provision clause and move directly into Level IV.

If, at the end of the two-year sampling period of Level III, two consecutive sample results do not direct the District to: 1) end sampling for a two-year period, at which time the District will wait for two years and then randomly sample 25% or 10 wells, whichever is less, throughout the entire sample area. One sample will be taken every six months for one year, except for nitrates which will have a two-year sampling program. If the MCL is less than Level II standards, the District will resume Level I random sampling after waiting three years; one year for nitrates. If the MCL is greater than or equal to Level II but less than Level III standards, sampling will be continued in Level II. If the MCL is greater than or equal to Level III standards, sampling will resume in Level III, 2) move to the next higher level, or 3) resume sampling at Level III and there is not a definite trend established which would direct the District to either discontinue sampling for a three-year period or continue sampling in Level IV, the decision as how to proceed will be determined by averaging the initial sample plus results of the two-year sample

period of Level III. If the average is greater than or equal to Level III standards but less than Level IV standards, sampling will continue in Level III. If the average is less than Level III standards, sampling will be discontinued for a period of two years, at which time 25% or 10 wells, whichever is less, in the sample area will be randomly sampled to determine how the District will proceed. If the average is greater than or equal to Level III standards, sampling will be continued under Level IV criteria.

When, in Level IV, the water contamination concentration has improved and stabilized at less than Level III standards for two years, the District will wait for a period of two years, at which time 50% or 20 wells, whichever is less, throughout the entire sample area will be randomly sampled - one sample every six months for one year, except for nitrates which will have a two-year sampling program. If the MCL is less than Level IV standards, the District will wait for two years and then randomly sample 25% or 10 wells, whichever is less, throughout the entire sample area. One sample will be taken every six months for one year, except nitrates which will have a two-year sampling program. If the MCL is less than Level II standards, the District will resume Level I random sampling after waiting three years; one year for nitrates. If the MCL is greater than or equal to Level II but less than Level III standards, sampling will be continued in Level II. If the MCL is greater than or equal to Level III standards, sampling will resume in Level III. If, after randomly sampling 50% or 20 wells, whichever is less, in the sample area, the MCL is greater than or equal to Level III but less than Level IV, sampling will be continued in Level III. If the MCL is greater than or equal to Level IV standards, sampling will resume in Level IV.

If, under Level IV sampling, the water contamination concentration does not improve and stabilize at less than Level III standards, sampling will continue in Level IV twice annually; one sample every six months until the water quality improves and stabilizes at less than Level III standards.

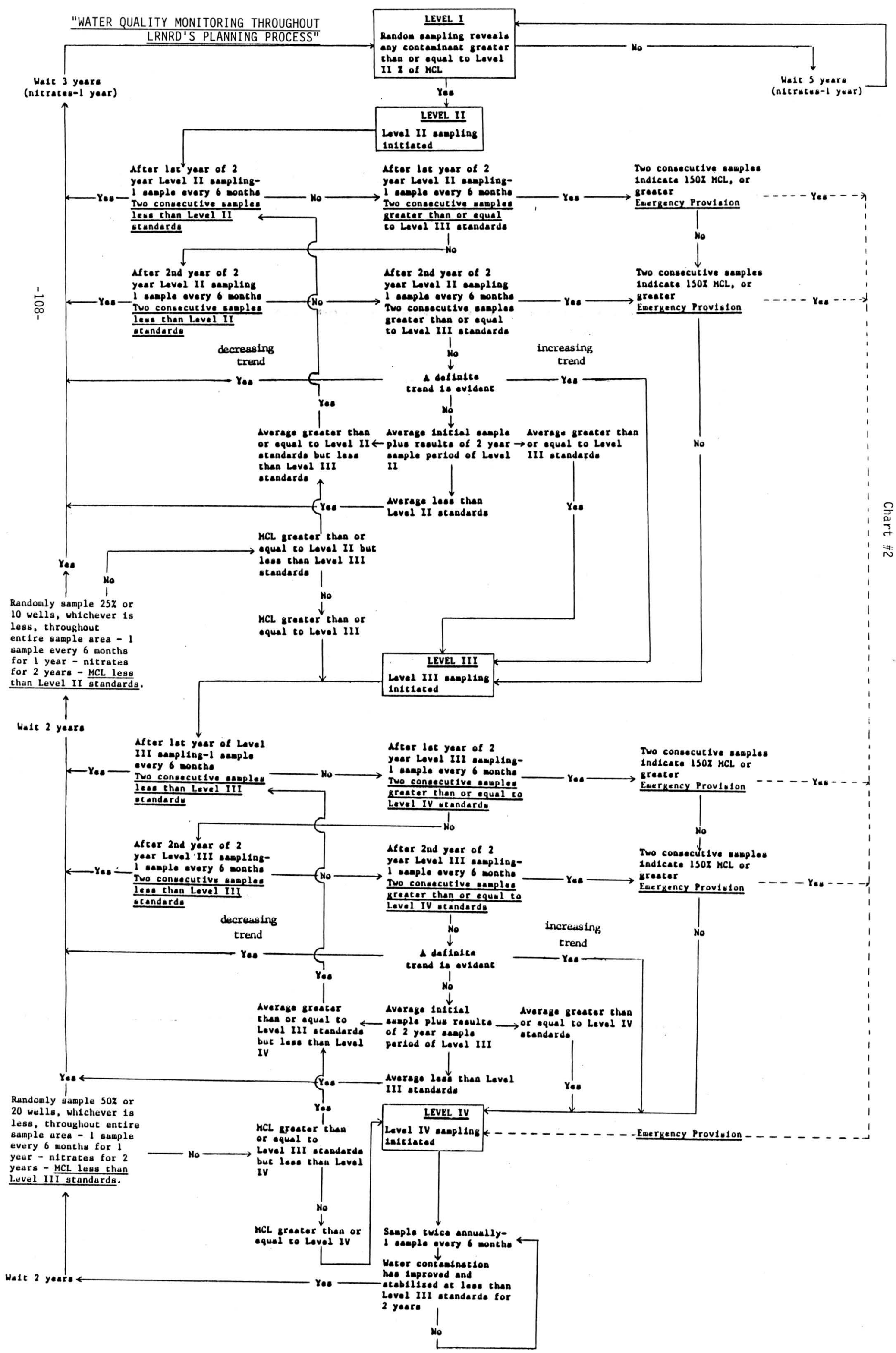
"WATER QUALITY MONITORING THROUGHOUT LRNRD'S PLANNING PROCESS"
LEVEL I
Random sampling reveals any contaminant greater than or equal to Level II % of MCL
No
Wait 5 years (nitrates-1 year)
Wait 3 years (nitrates-1 year)
Yes
LEVEL II
Level II sampling initiated
After 1st year of 2 year Level II sampling- 1 sample every 6 months Two consecutive samples less than Level II standards
Yes
No
After 1st year of 2 year Level II sampling- 1 sample every 6 months Two consecutive samples greater than or equal to Level III standards
Yes
Two consecutive samples indicate 150% MCL, or greater Emergency Provision
Yes
No
No
After 2nd year of 2 year Level II sampling 1 sample every 6 months Two consecutive samples less than Level II standards
Yes
No
After 2nd year of 2 year Level II sampling 1 sample every 6 months Two consecutive samples greater than or equal to Level III standards
Yes
Two consecutive samples indicate 150% MCL, or greater Emergency Provision
Yes
decreasing trend
Yes
No
A definite trend is evident
increasing trend
Yes
Yes
No
Average greater than or equal to Level II standards but less than Level III standards
Average initial sample plus results of 2 year sample period of Level II
Average greater than or equal to Level III standards
No
Yes
Average less than Level II standards
Yes
MCL greater than or equal to Level II but less than Level III standards
Yes
No
No
MCL greater than or equal to Level III
Randomly sample 25% or 10 wells, whichever is less, throughout entire sample area - 1 sample every 6 months for 1 year - nitrates for 2 years - MCL less than Level II standards.
LEVEL III
Level III sampling initiated
Wait 2 years
After 1st year of Level III sampling-1 sample every 6 months Two consecutive samples less than Level III standards
Yes
No
After 1st year of 2 year Level III sampling- 1 sample every 6 months Two consecutive samples greater than or equal to Level IV standards
Yes
Two consecutive samples indicate 150% MCL or greater Emergency Provision
Yes
No
No
After 2nd year of 2 year Level III sampling- 1 sample every 6 months Two consecutive samples less than Level III standards
Yes
No
After 2nd year of 2 year Level III sampling- 1 sample every 6 months Two consecutive samples greater than or equal to Level IV standards
Yes
Two consecutive samples indicate 150% MCL or greater Emergency Provision
Yes
decreasing trend
Yes
No
A definite trend is evident
increasing trend
Yes
No
Yes
No
Average greater than or equal to Level III standards but less than Level IV
Average initial sample plus results of 2 year sample period of Level III
Average greater than or equal to Level IV standards
Yes
Yes
Average less than Level III standards
Yes
Yes
Randomly sample 50% or 20 wells, whichever is less, throughout entire sample area - 1 sample every 6 months for 1 year - nitrates for 2 years - MCL less than Level III standards.
No
MCL greater than or equal to Level III standards but less than Level IV
LEVEL IV
Level IV sampling initiated
Emergency Provision
No
MCL greater than or equal to Level IV
Sample twice annually- 1 sample every 6 months
Wait 2 years
Yes
Water contamination has improved and stabilized at less than Level III standards for 2 years
No

Chart #2

c) All reliable data regarding the presence of nitrate-nitrogen compounds in groundwater that can be obtained by the District will be observed for evidence of developing nitrate trends.

d) The District will keep in contact with other agencies which maintain water quality records, and will monitor recorded levels of contaminants present within water supplies monitored by other agencies.
(For example: The State of Nebraska Department of Health periodically monitors municipal water supplies for various contaminants. The District recommends that municipalities relay this information to them to be placed on record.)

e) The District will work closely with neighboring NRD's on common quality issues.

f) The District will inventory municipal groundwater supply sites and corresponding data and assist them in planning for future groundwater supplies and regulation of nearby land use.

B. Expand Existing Programs

Objective 1. Expand Educational Programs Dealt with in Section I-A to Promote Public Support for and Participation in Management of Groundwater Resources.

a) The District will hold informative classes, workshops, and demonstrations, concerning groundwater.
For example:
   1) efficient application of chemicals and water applied to land
   2) care in installing new wells used for drinking
   3) proper disposal of domestic, industrial, and municipal wastes which could lead to point source pollution of groundwater

b) As time and budget permits, District personnel will provide technical assistance to users interested in implementing techniques mentioned in Level I-A-1 as to proper installation and/or use of water or chemical use equipment. The District will work with the Soil Conservation Service, the Department of Environmental Control, the Department of Health, the Water

Well Driller's Association, and the municipalities in the District in accomplishing this goal.

Objective 2. Expand Groundwater Quality Monitoring Activities.

a) As budget allows, the District will expand the monitoring survey to include at least 10% of all accessible wells which are located in potential problem areas (areas reported by outside reliable agencies to contain other chemicals at or near maximum contaminant levels established by the EPA as mandated by the Safe Drinking Water Act) and will expand the base of information regarding the presence of such compounds within the District.

b) As budget allows, the District will gradually increase the number of wells randomly monitored for nitrates.

c) As budget allows, the District will gradually increase the number of wells randomly monitored for various chemical compounds.

d) As budget allows, the District will expand monitoring activities to include deep soil testing in areas adjacent to feedlots, irrigation runoff sites, etc.

C. Implement New Programs (to be implemented as budget permits)

Objective 1. Expand Information Available to the Public.

a) The District will make available to the public information obtained directly through District water quality monitoring activities.

b) The District will make available to the public information obtained from other agencies regarding water quality within the District.

c) The District will correlate District water monitoring data with other data regarding aspects affecting water resources within the District, such as: environmental (i.e. climatic, geomorphic, etc.) or economic (i.e. land use, surface water projects, etc.)

d) The District will send out newsletters periodically and continually work with news media in order to inform the public of water quality situations within the District.

e) The District will integrate the study of groundwater quality

into its educational programs for schools.

Objective 2. Expand Water Quality Monitoring Activities.

a) The District will keep records regarding all potential recharge systems (i.e. irrigation canals, water retention structures, springs, streams, etc.) in regard to groundwater contamination resulting from private, agricultural, or municipal waste disposal.

b) The District will consider installing some observation wells to be used by the District for monitoring purposes, especially in areas where there are few accessible wells, therefore insufficient data.

c) The District will, as budget allows, cooperate with cities and/or counties to establish groundwater monitoring sites around community (or county) solid waste disposal sites. This will also be planned for municipal sewage treatment facilities.

Objective 3. Provide Technical Assistance for Voluntary Use of Quality Conservation Practices.

Objective 4. As Budget Allows, the District Will Offer Cost-sharing, or Direct Purchase of Water Saving or Fertilizer Conserving Equipment.

Objective 5. Monitoring Potential Pollution to Groundwater Reservoir From Chemicals Not Intentionally Applied to Land Via Agricultural Practices.

a) The District will monitor chemical spills which could result in the contamination of the groundwater reservoir. A method to be used to monitor these chemical spills will be the Environmental Protection Agency's (Regional Emergency Response Team's) "Incident Activity Report" published periodically. This report identifies such things as:

1) responsible party of the spill
2) nature of emergency and volume of material spilled
3) source category/material -- what was spilled
4) responding agency to spill
5) nature of response -- what action should be taken regarding spill
6) spill location

7) action by EPA on reported spill and date action taken

Additional State or Federal information to help the District monitor spills will also be used as made available.

b) The District will also monitor the transportation and use of hazardous substances (as identified by the Environmental Protection Agency and the Department of Environmental Control). This will be primarily accomplished by using information provided by the Federal Emergency Management Agency. Again, a potential exists for groundwater contamination with improper handling and deposition of hazardous wastes.

c) The District will attempt to locate specific sites used by companies (applying and/or supplying chemicals, including fertilizers, for agricultural purposes), (located in the LRNRD) as clean-out areas for their agricultural equipment and storage sites for chemicals which provide potential sources of contamination to the groundwater reservoir.

d) The District will attempt to locate and monitor activities of storage sites containing materials (not included in item "c") which, if introduced into the groundwater reservoir, would cause a contamination problem.

e) The District will monitor the mining process of natural resources which could result in the contamination of the NRD's groundwater reservoir. This monitoring process will include data collection describing disposal system and storage processes of the waste products generated by the mining activity and other measures necessary to be applied by the mining company to insure protection of the groundwater reservoir. As an example -- for the mining of oil, a protective measure would include constructing wells with casing designed to safeguard the groundwater used for drinking and agricultural purposes. Another protective measure would be the capping of unused wells according to standards which would prevent contamination of the reservoir.

Objective 6. Establish Chemigation Management Program.

a) The District will establish a chemigation management program based on LB 284 - The Nebraska Chemigation Act - (passed 4-9-86).

b) Effective January 1, 1987, individuals who intend to practice chemigation must apply for a permit annually that authorizes application of agricultural chemicals through any system which may permit a backflow of the chemicals into the groundwater well.

c) Permits must be purchased for each site upon which chemigation is to be practiced.

d) Applications will be approved or rejected within 45 days of the receipt, based on an inspection conducted by District personnel, of the required equipment accompanying the irrigation distribution system:

   1) a check and vacuum relief valve in the irrigation pipe
   2) an inspection port for the check valve in the irrigation pipe
   3) an automatic low pressure drain between the main check valve and the irrigation pump
   4) a check valve in the chemical injection line
   5) a simultaneous interlock device between the power system for the injection unit and the irrigation pumping plant

e) The applicator must be certified by the State of Nebraska Department of Environmental Control.

   1) The DEC will conduct training sessions (or can contract with the Extension Service) and written examinations.
   2) Applicator's certificates must be renewed every two years.

f) The initial permit fee is $30.00 ($25.00 will go to the District and $5.00 will go to the DEC). The annual renewal fee is $10.00 ($8.00 will go to the District and $2.00 will go to the DEC).

g) Provisional permits may be issued during the first year the program is in effect (January 1, 1987 - September 30, 1987) if the District does not have the time to conduct an equipment inspection during the 45-day deadline or if the applicator has not had time to meet certification requirements. Effective on January 1, 1988, however, provisional permits are to be revoked and original requirements of the Chemigation Act must be met.

h) Emergency permits can be issued at a fee of $100.00 ($90.00 will go to the District and $10.00 will go to the DEC).

1) Applicators must be certified to obtain an emergency permit.
2) District personnel will inspect required mechanical devices within 48 hours of the application filing. The emergency permit will be considered "approved" unless the NRD notifies them that it has not been approved within this time.
3) Emergency permits are only good for 45 days and can be revoked without a hearing in the event of a violation.

i) If a field has been treated with chemicals appearing on the Federal Insecticide, Fungicide and Rodenticide Act, or if chemical labels require posting, signs must be posted stating that a field has been treated with chemicals in the irrigation water.

j) Applicators and permitholders must report any actual or suspected accident to the NRD and the DEC.
1) Both entities will investigate, and if either finds an "adverse effect" caused by the accident, the DEC will assume responsibility for the public protection, cleaning-up, and recovery responses.
2) If a permitholder fails to notify appropriate authorities of a real or suspected accident, they will be subject to a $500.00 fine for the first offense, and a Class III misdemeanor prosecution for subsequent offenses.

k) The District will conduct periodic inspections to insure compliance with the Chemigation Act. If the NRD plans to revoke, refuse renewal of, suspend, or deny a permit, they will give the applicator or permitholder 10 days notice, during which the applicator or permitholder may request a hearing before the NRD Board of Directors. If no hearing has been requested within 10 days following notice, the proposed action will become final.

l) The NRD or DEC can immediately suspend operation of a chemigation system if either determines that there is an actual or imminent threat to the environment or the people caused by the operation of that system.
1) The permitholder or applicator will have 10 days to

request a hearing before the NRD Board of Directors, and such a hearing must be held within 10 days of the request. If, after the hearing, the District or DEC concludes that the suspension should be continued, the District or the DEC can apply for a restraining order or injunction against the offending party.

2) After January 1, 1988, the DEC can assume a District's responsibilities in regard to the Chemigation Act if, after a hearing, they determine that the NRD is not properly exercising its authority.

RECOMMENDED AND/OR REQUIRED SAFETY PRECAUTIONS FOR CHEMIGATION ARE:

1. A properly installed check valve with positive closure and inspection port.
2. A vacuum relief valve between the check valve and well.
3. A low pressure drain between the check valve and well.
4. A chemical injection line check valve.
5. A simultaneous interlock between the power system of the chemical injection unit and the irrigation pumping plant.
6. Properly posted signs alerting the public of the chemigation activity.
7. A chemical suction line strainer.
8. Chemical resistant hoses, clamps, and fittings.
9. A normally closed solenoid valve in the chemical suction line.
10. Check all equipment before each chemigation.
11. Take the time to calibrate your application accurately.
12. Use the minimum needed water application rate to prevent runoff.
13. Do not chemigate when wind speed exceeds 10 mph.
14. Be certain end guns are not spraying chemical on to roads or adjacent property.
15. Flush injection system and irrigation system after every application.
16. Read chemical labels carefully and follow all safety requirements.
17. Keep a log of all chemicals applied.
18. Report any spill or back flow of chemical to the NRD or Department of Environmental Control immediately.

Objective 7. Seek Additional Funding, When Necessary, to Initiate Groundwater Management Programs.

Some possibilities are:

a) NRD tax authority -

1) The District will consider increasing the general tax levy in order to facilitate Level IV of the Groundwater Quality Management Plan. (i.e. Special Groundwater Quality Protection Areas as established by LB 894.)

b) State of Nebraska authority -

1) The District will encourage the State of Nebraska to pass legislation which will provide for, at least in part, additional funding for NRD administered groundwater management programs, at any level of management.

2) The District will support legislative efforts which will provide NRD's with a portion of the funding states receive from Federal agencies to clean-up hazardous waste materials. (For example: the States are to receive funds to gather data, etc. through the Superfund Program and the local levels of management. (NRD's may be able to receive a portion of it.)

3) The District will receive additional funding to manage chemigation activities through the sale of chemigation permits. The District will support legislation in which the fees are increased as the costs of management increase. It is the view of the District that the administration of chemigation management should be self-supporting.

The District feels that legislation should provide for an additional source of funding in the event that proceeds from the sale of chemigation permits is inadequate in financing the clean-up of point-source groundwater pollution directly resulting from chemigation activities.

c) Other governmental agencies -

1) The District will monitor and apply for any Federal or State funding opportunities available in order to establish a groundwater management program.

2) The District will pursue cost-share funding from Federal and State agencies for data collection programs for which there is a common interest.

d) Private sources of funding -

1) The District will consider establishing trust funds to be used especially for groundwater management programs (i.e. to provide better management by the District and to help finance individuals who are interested in voluntarily implementing groundwater quality conservation techniques.

2) The District will seek possible research grants from businesses and industry to help defray administrative costs at all management levels.

Objective 8. Monitor Construction of New Wells.

a) The District will monitor the status of groundwater withdrawal subject to LB 310, the Water Well Standards and Contractor's Licensing Act, effective as of October 1, 1986, to insure that wells being drilled are properly constructed according to the mandates of the Act. The District supports this Act because it protects groundwater from contamination resulting from the construction and resulting presence of groundwater wells.

LEVEL II. GROUNDWATER QUALITY INVESTIGATION

-- Defining Areas of Concern --

The implementation of a Level II Groundwater Quality Investigation will be triggered by the following groundwater quality parameters established by the Lower Republican Natural Resources District, which represent the threshold at which contamination of the groundwater at a site is probable and it is the belief of the District that groundwater users in the area would benefit from an in-depth groundwater quality investigation.

> The District will respond by declaring the immediate area around the site(s) a Level II Groundwater Quality Investigation Area, when it has been determined that a site(s) repeatedly reveals (refer to monitoring flow chart found in Level I, page 108) that there is a content of 70% for municipal water supplies, or 80% for domestic water supplies, of the Maximum Contaminant Level Standards established by the Department of Environmental Control. This will hold true whether a well(s) is routinely monitored for groundwater quality by District personnel, or if groundwater quality data has been obtained by some other reliable means. Standards have been established by the Department of Environmental Control for various compounds which, if present, within the water resources of Nebraska, could adversely impact the health of humans (or animals) if consumed.

The Level II Groundwater Quality Investigation Objectives Are:

A. Define Area of Concern

Objective 1. Intensify Investigation in the Area of Concern.

a) The District will initiate a study of the concern area within 30 days of the discovery of a site(s) containing significant quantities of a recognized contaminant (based on parameters established by the District for the implementation of Level II Groundwater Quality Investigation) in an attempt to determine the magnitude of the contamination.

b) The District will conduct an intense groundwater quality monitoring survey in the immediate area surrounding the site which has been determined to contain significant quantities of contamination. All accessible groundwater wells occurring within a minimum area of 36 square miles (for domestic concerns) or 4-16 square miles (for municipal concerns) will be monitored for quality and quantity. Table #15, page 119 will serve as a reference in determining action

by the District when a contamination concern involves an area where a municipal well is located. This action priority table will be used to help the LRNRD determine action, when funding necessary to remedy the concern is unavailable to address all municipal concerns at the same time. This table will serve as a reference to determine the size of an area which will help the District decide when to trigger water quality action in Levels II - IV of this Plan. The municipal priority established in Table #15 is based on considerations given to the number of municipal users and the saturated thickness of the aquifer where the municipal well is located.

TABLE #15

Priority of Municipal Concern to Trigger Action	Population	Saturated Thickness	Size of Area To Initiate Action
#1	$\geq$ 1,000	$<$ 50'	* 4 $mi.^2$
#2	$<$ 1,000	$<$ 50'	* 4 $mi.^2$
#3	$\geq$ 1,000	$\geq$ 50'	16 $mi.^2$
#4	$<$ 1,000	$\geq$ 50'	16 $mi.^2$

* The District will take samples from existing wells in this area. If no existing wells are available then the area size will be increased accordingly.

Table #16, page 120 shows how the municipal priority system (identified on Table #15 impacts the different cities in the LRNRD who provide water to their occupants using a centralized distribution system. This table not only indicates the priority standard set for each of these municipalities but it also includes valuable information to the District. This information should aid the NRD in addressing municipal water quality concerns.

INFORMATION ON MUNICIPAL WELLS IN LRNRD AND PRIORITY ESTABLISHED FOR EACH MUNICIPALITY

Municipalities in LRNRD with Central Distribution Center	Number of Wells Per Municipality	Population of Municipality (1980 Census)	Approximate Saturated Thickness Underlying Registered well(s)	LRNRD Priority Standard for Municipality
Alma	7	1369	55'	#3
Arapahoe	5	1107	45'	#1
Beaver City	5	775	25'	#2
Bloomington	2 (1 unregistered)	138	15'	#2
Cambridge	4	1206	45'	#1
Campbell	3	441	95'	#4
Edison	2 (1 unregistered)	210	45'	#2
Franklin	8 (6 unregistered)	1167	70'	#3
Guide Rock	2	344	15'	#2
Hildreth	2 (2 unregistered)	394	150'	#4
Holbrook	4 (1 unregistered)	297	45'	#2
Naponee	2 (1 unregistered)	160	40'	#2
Orleans	4	527	25'	#2
Oxford	6 (4 unregistered)	1109	60'	#3
Ragan	1 (1 unregistered)	71	175'	#4
Red Cloud	5 (3 unregistered)	1300	120'	#3
Republican City	3 (2 unregistered)	231	45'	#2
Riverton	4 (1 unregistered)	212	30'	#2
Stamford	5 (5 unregistered)	214	25'	#2
Superior	10	2502	30'	#1
Upland	3 (2 unregistered)	192	160'	#4
Wilsonville	2	189	25'	#2

The LRNRD calculated the approximate saturated thickness of the aquifer underlying the municipal wells from data obtained from the NRC-USGS South Central Hydrogeologic Study, well registration information from the Department of Water Resources, and information from the Department of Health. In some cases the data seems to conflict, therefore the LRNRD will plan to further investigate these situations to determine the actual saturated thickness accordingly.

Source: Information compiled from NRC-USGS South Central Hydrogeologic Study, Department of Water Resources, and Department of Health.

Date: October 1986

Table #16

All quality samples obtained for Level II Groundwater Quality Investigation purposes will be sent to an accredited laboratory for analysis of the presence of nitrate-nitrogen and coliform bacteria and/or other contaminants. Samples obtained for Level II purposes will be collected by District personnel.

c) The District will review any available information regarding water quality within or surrounding the area of concern.

d) As budget and time permits, the District will examine potential groundwater recharge sources for the area of concern by means of surface water quality monitoring and/or reviewing information regarding surface water quality obtained from other reliable sources. (i.e. water retention structures, flowing and intermittent streams, springs, irrigation diversion structures, etc.)

e) As budget and time permits, the District will conduct deep soil quality analyses in the area of concern, especially in the area of structures, man-made or natural, which are known to contribute to the accumulation of chemicals or biologic compounds within associated groundwater reservoir formations.

f) Correlating all available information regarding the quality of the groundwater within the area of concern, the District will attempt to define the following:
   1) the extent of the contamination
   2) the type of contamination
      a) point source
      b) non-point source
   3) the cause of the contamination
   4) the significance of the contamination
   5) the source of the contamination
   6) the potential impact of the contamination
      a) social/economic
      b) environmental
   7) the quantity and recharge capacity of groundwater within the area
   8) possible solutions

Objective 2. Evaluate the Situation at the District Level.

a) Once all the information obtained during the initial investigation has been compiled, the District Board of Directors and/or the Management Staff will evaluate the status of groundwater quality within the area of concern and determine what the next course of action (on the part of the District) regarding groundwater quality management will be.

b) If the information collected in a Level II Groundwater Quality Investigation Area which has undergone the initial investigation is inconclusive, the Level II classification of the area may be extended for a period of 18 months, during which time the District will monitor groundwater quality within the area every 6 months. An attempt will be made to determine groundwater quality trends. District personnel will monitor the same wells and collect any reliable information from outside sources regarding groundwater quality which might be useful for this investigation. The District will reevaluate the status of the area under Level II Investigation at the end of the extended period and determine which level of groundwater quality management would best benefit groundwater users within the area at that time. Residents whose groundwater sources are known to be contaminated, but who may live in areas which do not meet the criteria for a higher level of management to be established by the District, will be advised to install efficient point-of-use devices which will reduce the level of contamination in their drinking water to acceptable EPA standards or to seek new and/or additional sources of water to meet their domestic needs. If, after the initial 18-month extension, the District is unable to establish a trend which indicates that the study area should be placed into another Management Level, the Board will continue to extend additional 18-month monitoring study periods until a clear trend is identified.

c) If, following the initial Level II Investigation, the groundwater underlying an area of concern is significantly

contaminated (based on quality parameters established by the District as thresholds whereby higher levels of groundwater quality management or control are to be triggered), the District will determine potential boundaries designating the extent of the area of concern (these boundaries are to be determined on the basis of the manifestation of the groundwater aquifer formation within the area and possible sources of groundwater recharge that exist in areas adjacent to the area of concern from a management point of view).

d) Placing an area of groundwater quality concern under any level of quality management or control at this point (following a Level II Investigation), will be based on the significance and magnitude of the groundwater contamination. In order for the District to determine that the contamination of groundwater within an area is of the significance and magnitude to trigger higher levels of management, 75% of all locations analyzed for groundwater quality by the District within a defined area of groundwater quality concern must show reliable evidence that the compound(s) which are responsible for the contamination of groundwater in the area are present within the groundwater at, or above, the levels established by the District to be used as triggering mechanisms for the implementation of specific levels of groundwater quality management. The District will attempt to insure that the analyses used to determine the significance of groundwater contamination within an area is truly representative of the entire saturated aquifer formation underlying the area. The District will annually review the standards which determine a definition of significance (quantitative) and magnitude (area size).

e) The District will compile all the data and resulting interpretations from the Level II Investigation as well as a detailed map of the proposed boundaries of a groundwater quality management or protection area, for a source of public and institutional information.

f) The District will notify and seek recommendations from the State of Nebraska Department of Environmental Control and the State of Nebraska Department of Health at this time.

B. Continue Existing Programs

Objective 1. Continue Level I Groundwater Quality Awareness Programs.

a) Regardless of which subsequent level of groundwater quality management is being exercised within an area, the routine groundwater quality monitoring survey (Level I Groundwater Quality Awareness) will be continued. When an area is being monitored for groundwater quality under the provisions of subsequent levels of investigation or management, the data obtained thereof will be entered into the District's permanent data files.

b) Regardless of which subsequent level of groundwater quality management is being exercised within an area, the District will continually encourage groundwater users to voluntarily use conservative techniques in their use of the resource.

c) The District will, as for any level of groundwater management, make available to the public information regarding the quality and quantity of the groundwater within the District as well as information concerning techniques which users might employ which would help meet the groundwater quality goals of this Plan.

C. Intensify Educational and Informational Programs Within the Area of Concern

Objective 1. Inform the Public That the Area of Concern Will Be Undergoing a Level II Groundwater Quality Investigation.

a) The District will inform the public (through the news media, private organizational meetings, etc.) that it has implemented a Level II Groundwater Quality Investigation within a certain area, and why, within 60-90 days of the discovery of a site containing significant quantities of a contaminant(s). The public will be informed that the Level II Investigation is to be conducted so that the magnitude of groundwater contamination within the area of concern can be determined.

b) District personnel will attempt to visit landowners in the area of concern personally and review the situation with them prior to notifying the general public.

c) The District will inform landowners that there will be an intensified groundwater quality monitoring survey conducted in the area of concern to more clearly define the significance and magnitude of the contamination. The District will ask for voluntary assistance in obtaining samples and possible contaminant source information.

d) The District will inform the public of the results of the Level II Groundwater Quality Investigation, regardless of the outcome.

LEVEL III. GROUNDWATER QUALITY PRE-REGULATORY AREA

-- Establishing Groundwater Quality Voluntary Management --

The District will implement Level III Groundwater Quality Pre-Regulatory Objectives within an area when a significant portion of the data obtained in a Level II Groundwater Quality Investigation of the area has repeatedly shown that the groundwater is largely contaminated over an area of significant size, and it is the belief of the District (in regard to the future availability of good quality groundwater) that the area would benefit from voluntary management of the resource by users in the present.

The groundwater quality parameters established by the District, which represent the threshold at which contamination of the groundwater in an area is significant enough to warrant the implementation of Level III Pre-Regulatory Objectives are:

> The District will respond by declaring the immediate area around the site(s) a Level III Groundwater Quality Pre-Regulatory Area if 75% of all locations monitored within an area of minimal size established by the District, repeatedly reveals (refer to monitoring flow chart found in Level I on page 108) that there is a content of 80% for municipal water supplies, and 90% for domestic water supplies, of the Maximum Contaminant Level Standards established by the Department of Environmental Control. The minimal size established by the District for the management area will be 4-16 square miles for municipal concerns (see Table #15, page 119) and 36 square miles for domestic concerns. Standards have been established by the Department of Environmental Control for various compounds, if present within the water resources of Nebraska, could adversely impact the health of humans (or animals) if consumed.

The District will use The Nebraska Groundwater Management and Protection Act cited in statutes 46-656 to 46-673, 46-673.01 to 46-673.13, and 46-674 included in Laws 1975, LB 577, Section 24; Laws 1981, LB 146, Section 12; Laws 1982, LB 375, Section 22 as a guideline in establishing a Level III Groundwater Quality Pre-Regulatory Area.

The Level III Groundwater Quality Pre-Regulatory Objectives Are:

A. Define Level III Groundwater Pre-Regulatory Area

Objective 1. Intensify Investigation in the Level III Groundwater Quality Pre-Regulatory Area.

a) The District will expand research in the Level III Groundwater Quality Pre-Regulatory Area within 60-90 days of the decision

made by the District Board of Directors and/or Management to designate that area a Level III area.

b) Contacts will be kept with the State of Nebraska Department of Environmental Control and the State of Nebraska Department of Health and their recommendations will be sought at this time.

c) As budget permits, the District will conduct extensive deep soil tests (to the shale formation underlying the groundwater aquifer formation) around potential point sources of contamination.

d) The District will review the status of groundwater withdrawal within the Level III Groundwater Pre-Regulatory Area in regard to LB 886 -- the Well Registry with the State of Nebraska Department of Water Resources and LB 310 -- The Water Well Standards and Contractor's Licensing Act.

e) The District will attempt to estimate the total amount of groundwater which may be withdrawn within the Level III Groundwater Pre-Regulatory Area according to the guidelines of LB 375; 46-673.08, consistent with the Reservoir Life Goal established by the District in the Lower Republican NRD Groundwater Management Plan. The District will attempt to estimate the ratio between actual withdrawals being made and the total allowable withdrawals. (Tools which may be used in determining this parameter are historical climatic and water resource data which has been collected by the District as well as other accredited agencies and/or computerized groundwater predictive models.)

f) The District will consult with underground water storage permitholders prior to adopting any rules or regulations for a management or control area according to the provisions of LB 198; statutes 46-666.01 and 46-673.09.

g) The District will attempt to obtain information from the State Fire Marshall regarding the location of registered underground fuel storage tanks within management or protection areas.

Objective 2. Determine Which Type of Groundwater Quality Concerns Exist in the Area.

a) Based on data gathered in the Level II Groundwater Quality Investigation, the District will determine the type of groundwater quality concern(s) which will be dealt with under Level III Groundwater Quality Pre-Regulatory Objectives.
   1) domestic only
   2) municipal only
   3) domestic and municipal
   4) other

Objective 3. Establish Boundary of Level III Groundwater Quality Pre-Regulatory Area.

a) The District will establish specific geographic and stratigraphic boundaries of the Level III Groundwater Quality Pre-Regulatory Area at this point.

b) The minimal areal size that the District feels would be feasible for a Level III Groundwater Quality Pre-Regulatory Area to be established is: 4-16 square miles for a municipal groundwater concern (see Table #15, page 119) and 36 square miles for domestic groundwater concerns. (The District reserves the right to alter these sizes, in exceptional cases, in order to attain the goals of Level III objectives.)

c) As soon as the boundary has been established by the District, the public will be informed as to the locations of the boundary and the implications of Level III Groundwater Quality Pre-Regulatory management in the area.

d) Individuals owning land or withdrawing groundwater within the Level III Groundwater Quality Pre-Regulatory Area will be mailed a map showing the specific boundaries around the area as well as a copy of the procedures to be implemented therein within 90 days of the official designation of the Level III Groundwater Quality Pre-Regulatory Area boundary.

B. Promote Voluntary Groundwater Quality Management

Objective 1. Inform Residents of Potential Solutions and/or Management Procedures.

a) The District will inform the landowners and/or rentors of the designated Level III Groundwater Quality Pre-Regulatory

Area of the nature of the programs which will be implemented and of possible methods available to attempt to manage groundwater quality according to the guidelines of LB 375.

b) The District will encourage conservative groundwater withdrawal by residents (landowners or rentors) in a Level III Groundwater Pre-Regulatory Area in order to attain the objectives of the Reservoir Life Goal established in the Groundwater Management Plan.

c) The District will provide technical assistance to landowners interested in voluntarily controlling applications of fertilizers and/or other agricultural chemicals. Annual workshops on fertilizer and pesticide use will be conducted.

d) The District will encourage growers to conduct annual deep soil tests (to a depth of 4 feet) so that they can take advantage of fertilizers already present within the root zone.

e) The District will introduce techniques whereby groundwater users may utilize EPA approved point-of-use mechanisms or techniques for individual domestic water supplies.

f) The District will introduce the concept of establishing a Rural Water District (under the provisions of NRD law, Chapter 46, Article 2, 2-3233) to residents in a Level III Groundwater Pre-Regulatory Area. If this management tool appears to be all or part of a solution which will provide safe drinking water for an area, then the idea will be pursued further.

LEVEL IV. GROUNDWATER QUALITY MANAGEMENT AND PROTECTION AREA

-- Enforcing Groundwater Quality Management and Protection Area --

The District will implement Level IV Groundwater Quality Management or Protection Objectives within an area when it has been determined that the groundwater is in fact contaminated over an area of significant size and that the required practices necessary for stabilizing and reducing such "life-threatening" contamination would be more successful if they were enforced by the District under the guidance of the Department of Water Resources (LB 375 - Groundwater Management Act) or the Department of Environmental Control (LB 894 - Special Groundwater Protection Areas).

The Groundwater quality parameters established by the District, which represent the threshold at which the contamination of groundwater in an area is significant enough to warrant the implementation of either a groundwater management area or a Level IV Groundwater Quality Protection Area are:

> The District will respond by declaring the immediate area around the site(s) a Level IV Groundwater Quality Management or Protection Area if 80% of all locations monitored within an area of minimal size established by the District, repeatedly reveals (refer to monitoring flow chart in Level I on page 108) that there is a content of 90% for municipal water supplies, and 100% for domestic water supplies, of the Maximum Contaminant Level Standards established by the Department of Environmental Control. The minimal size established by the District for the protection area will be: 4-16 square miles for municipal concerns (see Table #15, page 119) and 36 square miles for domestic concerns. Standards have been established by the Department of Environmental Control for various compounds which, if present, within the water resources of Nebraska, could adversely impact the health of humans (or animals) if consumed.

The Level IV Groundwater Quality Management and Protection Area Objectives Are:

A. Establish the District's Groundwater Management Area

Objective 1. The District Will Begin to Require the Use of Certain Water Quality Practices Which Were Encouraged in Level III of This Plan But Were Strictly Voluntary At That Point.

a) The Groundwater Reservoir Life Goal of this Plan is to insure good quality groundwater for an infinite period of time.

If the District feels that limiting withdrawal will have a positive effect in regard to stabilizing or improving the quality of groundwater in an area, then it will be suggested that groundwater users utilize water conservation practices.

b) The Lower Republican NRD has chosen to use a voluntary approach (Level III) to address groundwater quality concerns to stabilize or improve the contamination at the standards set for Level III. However, if this process proves unsuccessful, the District will require the use of some, or all, of the following practices in a designated Level IV Groundwater Management Area to improve the water quality to, at least, the contaminate standards established for Level III:

1) Implementation of Best Management Practices designed to stabilize or improve the quality of the groundwater when applied to the land. Activities which often fall into this category on agricultural land are: a) irrigation scheduling, b) fertilizer application management, and c) pesticide management

2) Allocating the total permissible withdrawal of groundwater.
   a) Should allocation be adopted for use of irrigation purposes in a management area, such allocation shall specify the total number of acre-inches that are to be equally allocated per irrigated acre per year, except that the District may allow a groundwater user to average their allocation over any reasonable period of time (not to exceed five years). A groundwater user may apply their allocation to any part of or all of the irrigated acres to which the allocation applies.

3) Rotation of the use of groundwater.
   a) Should rotation be adopted, times for irrigation by each irrigator in a given area would be scheduled by the District.

4) Well-spacing requirements.
   a) Should well spacing requirements be adopted, the

District would limit the density of irrigation wells by restricting well-spacing requirements to a greater extent than those found in LB 375; Sections 46-609 and 46-651.

5) Use of flow meters on wells.

a) Should the use of flow meters be adopted by the District in order to allocate groundwater pumping, installation, registering, and use of required equipment would be established by the District. (refer to Supplement #6, pages 168 - 170)

c) The District also has been given the authority to administer and enforce any, or all, of the following to "effectuate the policy of the State and to conserve groundwater resources" (under the provisions of Laws 1975, LB 577, Section 8; Laws 1979, LB 26, Section 2; Laws 1982, LB 375, Section 18, Statute 46-663):

1) The District may, following a public hearing (having been given following procedures provided in Section 46-658), adopt rules and regulations necessary to administer duties assigned in the Groundwater Management Act.

2) Require reports from groundwater users as may be necessary.

3) Conduct investigations, and cooperate or contract with Federal, State (and political subdivisions of the State), public, private, corporate, associated, and/or individual on any matter relevant to the administration of the Groundwater Management Act.

4) Report to and consult with the State of Nebraska Department of Environmental Control on all matters concerning the entry of pollution or polluting materials into groundwater supplies; and

5) Issue cease and desist orders to enforce the provisions of the Groundwater Management Act.

d) If, in the future, it becomes evident that these management area efforts are largely ineffective in inhibiting the continued degradation of the quality of groundwater, the District will request DEC assistance in designating the area to be a Level IV Groundwater Quality Protection Area

in compliance with LB 894 and any, or all, of the preceding practices (controls) will be put into use in an attempt to meet the groundwater quality goals of this Plan.

Objective 2. Increase Funds Available to the District to Implement Procedures Required to Manage a Level IV Groundwater Quality Management and Protection Area.

a) The Natural Resources Districts have been given the authority by the State of Nebraska Legislature to levy a tax not to exceed one and eight-tenths on each one hundred dollars annually on all taxable property within the designated groundwater management areas in addition to the general tax levy authorized to administer NRD programs. Such levy will be utilized only for the costs of carrying out the provisions of Sections 46-656 to 46-658.01, 46-659 to 46-673, 46-673.01 to 46-673.13, and 46-674 within such area.

B. Establishing the Protection Area in Compliance with State Law

Objective 1. The District Will Coordinate all of its Efforts Regarding the Establishment and Administration of Level IV Groundwater Quality Protection Objectives With the State of Nebraska Department of Environmental Control Under the Provisions of LB 894 -- Special Groundwater Protection Areas.

a) The District will compile all available information regarding the Level IV Groundwater Quality Protection Area and inform the DEC of the status of groundwater quality within the area.

b) The DEC will initiate a preliminary investigation of its own to determine the reliability of the information. Once the reliability of the information is established, the DEC will conduct a study to determine the source(s) of the contamination and the area affected. The DEC is required (by law) to issue a report regarding this study within 1 year of the date it is initiated.

c) If the contamination appears to be caused by point sources, the DEC will exercise its authority to control the problem.

If the contamination is not coming from point sources, the DEC will consult with the NRD(s) as to where the contamination is coming from.

d) A public hearing will be held regarding whether or not a special protection area should be designated. The Director of the DEC will have to consider whether contamination is likely to occur in the foreseeable future or has occurred in the past, whether groundwater users are experiencing hardships or are likely to experience substantial economic hardships as a direct result of the activities causing the contamination, and administrative factors affecting the ability to carry out regulatory activities.

e) When a Special Protection Area is designated, the reasons for the designation, all possible causes, and a geographic and stratigraphic definition of the area will be issued.

f) Within 180 days of the designation of a Special Protection Area, the Natural Resources District(s) affected will submit an action plan to the DEC describing the procedures that the District will implement in an attempt to stabilize or reduce the contamination level. This plan of action will include:

1) an educational program to inform area residents of the methods available to control the contamination (and at least one of the following provisions:)
2) a requirement that water users participate in educational programs
3) a requirement that Best Management Practices be used

and/or: 4) other reasonable requirements necessary to achieve the purpose of the designation

g) If two or more NRD's are involved in the establishment of a Special Protection Area, they must coordinate all actions regarding the implementation of LB 894 statutes.

h) The DEC will evaluate the plan within 120 days and may hold another hearing prior to rejecting or approving it. In the event that a proposed action plan is rejected,

the NRD can, but it is not required to, submit a revised plan to the DEC within 60 days.

i) If the District does not submit a proposed action plan within 180 days of designation of the protected area; fails to submit a revised plan following rejection of its initial plan, or if the revised plan is also rejected, the DEC has the power to specify what the "protective measures" for the Protection Area will be. In the event that the DEC adopts measures to implement the Protection procedures, those measures would be the responsibility of the DEC.

j) A District can petition the DEC for the removal of a Special Protection Area at any time, and the DEC can remove the designation provided it has determined that the contamination responsible for the designation has stabilized at, or been reduced to a level not detrimental to beneficial uses of groundwater.

Objective 2. Increase Funding Available to the District to Implement Objectives of a Level IV Groundwater Quality Protection Area.

a) The District can, according to the provisions of LB 894, levy a tax of two cents per one hundred dollars of value on the taxable property within the Special Protection Area.

C. Implementation of New Programs at the District Level

Objective 1. Require the Use of Any or All of the Best Management Practices Within the Level IV Groundwater Quality Protection Area. Groundwater Users are Encouraged to Practice All of the Following Measures in Order to Meet the Groundwater Quality Goals Established in This Plan.

a) install flow meters

b) install and use irrigation re-use pits

c) use moisture blocks or other methods for irrigation scheduling

d) report to the District the spring static water level for each well, and other water use data as available from flow meters or equivalent methods on forms provided

by the District

e) utilize reasonable methods to aid in the gathering of information regarding, and the use of groundwater in order to prevent further degradation of quality

f) restrict water usage (refer to Level IV, A-1, a)

g) utilize minimum tillage methods

h) utilize crop rotation practices

i) attain most economical use of water

j) utilize any other reasonable measures to conserve water quality and quantity

k) administer programs which control use of chemicals

<u>Objective 2.</u> Other Measures Which May Be Required by the District in the Event that Limiting Withdrawal Using the Following Practices Would Have a Positive Effect on Groundwater Quality.

a) Allocating the total permissible withdrawal of groundwater.

   1) If allocation is adopted for use of irrigation purposes in a management area, such allocation shall specify the total number of acre-inches that are to be equally allocated per irrigated acre per year, except that the District may allow a groundwater user to average their allocation over any reasonable period of time (not to exceed five years). A groundwater user may apply the allocation to any part of or all of the irrigated acres to which the allocation applies.

b) Rotation of the use of groundwater.

   1) Should rotation be adopted, times for irrigation by each irrigator in a given area would be scheduled by the District.

c) Well-spacing requirements.

   1) Should well-spacing requirements be adopted, the District would limit the density of irrigated wells by restricting well-spacing requirements to a greater extent than those found in LB 375; Sections 46-609 and 46-651.

d) Use of flow meters on wells.

   1) Should the use of flow meters be adopted by the District in order to allocate groundwater pumping, installation,

registering, and use of required equipment would be established by the District.

e) The District also has been given the authority to administer and enforce any, or all, of the following to "effectuate the policy of the State and to conserve groundwater resources" (under the provisions of Laws 1975, LB 577, Section 8; Laws 1979, LB 26, Section 2; Laws 1982, LB 375, Section 18, Statute 46-663):

1) The District may, following a public hearing (having been given following procedures provided in Section 46-658), adopt rules and regulations necessary to administer duties assigned in the Groundwater Management Act.
2) Require reports from groundwater users as may be necessary.
3) Conduct investigations, and cooperate or contract with Federal, State (and political subdivisions of the State), public, private, corporate, associated, and/or individual on any matter relevant to the administration of the Groundwater Management Act.
4) Report to and consult with the State of Nebraska Department of Environmental Control on all matters concerning the entry of pollution or polluting materials into groundwater supplies; and
5) Issue cease and desist orders to enforce the provisions of the Groundwater Management Act.

f) Under the provisions of LB 146; 46-659, the District may require that person(s) intending to construct a new well within a control or management area file an application to the District (for a permit) stating where the well will be located, and its intended use. Before any well having a capacity of less than one hundred gallons per minute is modified to withdraw groundwater at a rate greater than one hundred gallons per minute, an additional permit may be required.

<u>Objective 3.</u> Expand Educational and Informational Activities.

a) The District will promote the establishment of a Rural Water District (under the provisions of NRD law, Chapter 46, Article 2, Section 2-3233) within the Level IV Groundwater Protection Area, if applicable.

b) The District will expand educational efforts as needed to address specific concerns within the protection area.

c) The District will consider establishing a certification system in which an educational program followed by an examination upon which certification will be based in Level IV Groundwater Quality Protection Areas as an attempt to insure proper chemical applications.

<u>Objective 4.</u> Provide Technical and Financial Assistance to Residents in Solving or Coping with Groundwater Contamination.

a) The District will consider establishing a cost-share, loan, or grant program for individuals or municipalities seeking solutions to a contaminated groundwater supply. For example:

   1) well relocation - construction only
   2) installation of a point-of-use treatment system which will reduce groundwater contamination to (or below) the MCL
   3) exploratory well drilling to search for clean water
   4) locating and construction of source of water other than groundwater
   5) installation of recharge structures to enhance or develop a new groundwater well field

b) The District will promote legislative acts which will provide additional financial assistance for individuals and municipalities seeking solutions to a contaminated groundwater supply.

EMERGENCY PROVISION

-- Speeding Up The Process --

It is the view of the District, that for exceptional and/or extreme cases of groundwater quality degradation, it may become necessary to "speed up the process" whereby some level of groundwater quality management or protection is established within the area. The Emergency Provision, which has been established by the District for that purpose, is as follows:

> If it becomes evident to the District that an area of the minimal size required by the District for the implementation of Level III or IV Groundwater Quality Management or Protection Objectives is experiencing severe and/or rapidly increasing groundwater contamination (refer to parameters established in the provisions of Level III or IV which represent the significance of the contamination and are the triggering mechanisms for the implementation of higher levels of management or protection), and it is the belief of the District Board of Directors that (regarding the future availability of good quality groundwater) the area would benefit from a higher level of management, the District Board of Directors may decide which level of management would be most beneficial to the area, and immediately designate (or request the DEC to designate) the area to be under that level of management.

The District reserves the right to continually review the status of existing groundwater quality management or protection areas at any time and the District Board of Directors may reassign, or dissolve, any level of groundwater quality management that is designated to an area, provided the decision to do so is based on reliable evidence that the manifestation of groundwater contamination in the area has been altered in some significant way, whether due to natural or artificial causes. (refer to LB 375; Section 46-673.13 and Monitoring Flow Chart found in Level I on page 108)

NATIONAL INTERIM PRIMARY DRINKING WATER STANDARDS

Constituent	Maximum Contaminant Level (in mg/l or ppm unless specified)
Inorganic chemicals	0.05
Arsenic	0.05
Barium	1
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Fluoride	1.4 - 2.4
Organic chemicals turbidity	1 tu up to 5 tu*
Coliform bacteria	1/100 ml (mean)
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2, 4-D	0.1
2, 4, 5-TP (Silvex)	0.01
Radionuclides	
Radium 226 & 228 (Combined)	5pCi/l**
Gross alpha particle activity	15pCi/l
Gross beta particle activity	4 mrem/year***
Total Trihalomethanes	0.1

* tu = turbidity unit
** pCi/l = picocuries/liter
*** mrem = millirem/year

Source: U.S. EPA, Office of Drinking Water

OUTLINE OF THE FOUR LEVELS
OF
LOWER REPUBLICAN NRD GROUNDWATER QUANTITY MANAGEMENT

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The Lower Republican Natural Resources District
Policy and Implementation Mechanism
for Reaching Groundwater Quantity Goal

O V E R V I E W

The Lower Republican NRD has established four levels of management objectives, which will be implemented in order that the groundwater quantity goal of the Groundwater Management Plan may be reached.

The entire Lower Republican Natural Resources District will be placed under Level I Groundwater Quantity Awareness, unless the District Board of Directors and/or the District Management determines that certain areas would benefit from higher levels of management.

At Level I, the lowest level of management will be undertaken, wherein the District will continue existing informational and educational programs regarding groundwater resource management, promote voluntary implementation of the Best Water Resource Management Practices by groundwater users, expand (as budget allows) certain programs such as: groundwater quantity monitoring (in order to establish an awareness of groundwater quantity conditions which exist in the District) or the data base of information regarding water availability within the District.

The implementation of any Level of Groundwater Quantity Management higher than Level I, will be triggered when a significant decrease in the saturated thickness and/or static water level of the groundwater aquifer has occurred (or is steadily occurring) in groundwater monitored by the District, or other reputable agency, over an area of significant size over a significant period of time. The 'triggering parameters' to be used by the District in determining the 'significance' of a groundwater quantity concern area will be based on those stated within the Implementation of Groundwater Quantity Management Levels Procedures, but the District Board of Directors reserves the right to make exceptions.

The implementation of any Level of Groundwater Quantity Management will be based on the most reliable data sources available to the District at that time. Furthermore, the District reserves the right to continually review groundwater quantity management levels and to dissolve, or reassign, any established Groundwater Quantity Management or Protection Area when reliable trends indicate that the decrease in the saturated thickness, or increase in depth of water level, of the groundwater aquifer

has stabilized or improved within an area of significant size over a significant period of time.

At any subsequent Level of Groundwater Quantity Management, all quantity management objectives undertaken at lower Groundwater Quantity Management Levels will be voluntary on the part of groundwater users, except for Quantity Management Levels III or IV wherein the use of certain Management Practices will be required or modified, as necessary, to meet mandates established by the State of Nebraska in The Groundwater Management and Protection Act (as amended) cited in Statutes 46-656 to 46-673, 46-673.01 to 46-673.13, and 46-674 included in Laws 1975, LB 577, Section 24; Laws 1981, LB 146, Section 12; Laws 1982, LB 375, Section 22.

At Level II, the District will attempt to determine facts regarding the documented decline discovered of any site(s) within the District. The District will intensify groundwater quantity research in the immediate area of the site(s) in order to determine the significance and magnitude of the decrease in the saturated thickness, or increase in depth of water level, of the groundwater aquifer.

Level III Groundwater Quantity Pre-Regulatory Objectives will be implemented in an area when it has been determined that the decrease in the saturated thickness, or increase in depth of water level, of the groundwater aquifer is widespread and it is the belief of the District that continued development and consumption of groundwater at present rates within the area could seriously threaten the availability of groundwater in the future. The District will encourage landowners to voluntarily make use of certain groundwater quantity management practices in an attempt to stabilize and/or improve the saturated thickness of the groundwater aquifer.

Level III Groundwater Quantity Management or Control Objectives will begin if voluntary efforts prove to be unsuccessful, and contamination levels continue to increase within the Level III Pre-Regulatory Area, the District has been given the authority by the State of Nebraska to require that residents make use of certain water quantity conservation practices with the intent of inhibiting the rate of decrease in the saturated thickness of the groundwater aquifer and stabilizing or improving groundwater quantity.

Level IV Groundwater Quantity Management and Control Objectives will be implemented by the District in areas where it has been determined

by the District that the saturated thickness, or increase of depth of water level, of the groundwater aquifer has in fact decreased significantly over an area of significant size in cooperation with the State of Nebraska Department of Water Resources under the provisions of Laws 1975, LB 577, Section 3 and Laws 1981, LB 146, Section 6 - the establishment of Groundwater Quantity Control Areas.

initially ?

All areas within the District will be placed into one of the Four Levels of groundwater quantity management. The District Board of Directors will continually review the status of all groundwater quantity management levels and evaluate the effectiveness of District efforts within them to maintain groundwater availability according to the goal of the Lower Republican NRD Groundwater Management Plan. This goal basically states that the Lower Republican NRD will strive to provide quality groundwater in the quantity needed to meet various beneficial uses of this resource for an infinite period of time throughout the District.

Where funding limitations or legislative authority will prevent the District from meeting the objectives described in each management level, the Lower Republican NRD will search for funding sources and initiate legislative changes as necessary to address the District's Groundwater Management Goal.

Summary of Triggering Action To Management Levels By Aquifer Priority Quantity

Aquifer Priority	Level II	Level III	Level IV
#1	6% saturated thickness	8% saturated thickness	10% saturated thickness
#2	8% saturated thickness	10% saturated thickness	12% saturated thickness
#3	6' static water level decline	8' static water level decline	10' static water level decline
#4	8' static water level decline	10' static water level decline	15' static water level decline

This summary is a composite of Table #'s 17, 18, and 19, pages 152, 161, and 172 respectively. The method used to establish the aquifer priority by the Lower Republican NRD can be found by looking at anyone of these three tables. This priority will be to initiate District action to address a quantity concern using Table 16 - 18 parameters.

Aquifer Priority is based on the depth to water (static water level) and saturated thickness "yielding" groundwater when pumped for all beneficial purposes. This "yielding" portion of the aquifer's saturated thickness should be referenced to throughout the Plan's Quantity management sections.

Priority #1 - static water level 100 feet or deeper and saturated thickness of less than 100 feet.

Priority #2 - static water level less than 100 feet and saturated thickness less than 100 feet.

Priority #3 - static water level 100 feet or deeper and saturated thickness 100 feet or greater.

Priority #4 - static water level less than 100 feet deep and saturated thickness 100 feet or greater.

Goal of this Process - To stabilize declines from 1981 figure data to Level III percentages or feet decline figures noted above, first using voluntary processes (Level III) then mandatory controls (Level IV) if necessary.

The Lower Republican Natural Resources District
Policy and Implementation Mechanism
for Reaching Groundwater Quantity Goal

LEVEL I. GROUNDWATER QUANTITY AWARENESS

-- Establishing Groundwater Quantity Awareness --

The Level I Groundwater Quantity Objectives Are:

A. Continue Existing Programs

Objective 1. Encourage Voluntary Use of Groundwater Conservation Practices.

a) The District encourages use of the Best Management Practices.

1) The District will promote the establishment of techniques which prohibit surface water runoff, in order to enhance groundwater recharge and to make efficient use of groundwater withdrawn for any purpose, for example:

a) construction and operation of irrigation water reuse pits, or any other surface water storage structure

b) use of contour farming, furrow diking

c) use of conservation tillage (eco-fallow) techniques

d) use of Soil Capabilities' Classifications in determining land use and development

e) encourage use of cablegation irrigation systems where applicable

2) The District promotes the use of irrigation scheduling techniques in order to insure efficient application of irrigation water, for example:

a) The District provides a HOTLINE telephone information service during the irrigation season to help irrigators determine how much and when to irrigate.

b) The District encourages voluntary use of soil moisture analysis equipment, such as: moisture blocks, tensio meters, etc.

c) The District encourages growers to become familiar with Cropwater Use Information (refer to pages 45 - 53 of the LRNRD Groundwater Management Plan).

b) The District will make available to the public information emphasizing groundwater conservation such as:

1) efficient irrigation scheduling techniques
2) information regarding the availability of groundwater throughout the District
3) techniques for inhibiting and/or making use of surface water run-off
4) continued efforts on wise use with Extension Service, Soil Conservation Service, and/or other agencies
5) information regarding programs currently being undertaken by the District, such as: static water level monitoring data, crop water use tables
6) up-to-date research involving studies of plants which require less water, etc.

Objective 2. Establish a Reliable Base of Information.

a) Monitor, collect, and review data obtained by other agencies regarding the status of the groundwater resource within, and adjacent to, the District. (For example: refer to Map #14 on page 31; "Areas of Groundwater Decline", by UNL Conservation and Survey Division.)

b) Continue existing well monitoring program which now consists of approximately 64 locations randomly measured throughout the District as shown on Graph #1, page 32. Graph #2, page 33 shows the number of wells measured by the District in the northern 4 townships of Harlan, Furnas and Franklin counties. This is the area anticipated to be of greatest groundwater quantity concern.

1) Approximately 100% of the wells being monitored at this time are active or inactive irrigation wells.
2) The wells are monitored each year during the spring and fall seasons, using the spring measurement as an indicator of annual trends.
3) Data obtained from monitoring approximately 64 locations each year will be correlated to other groundwater quantity data obtained by the District as well as to data obtained

from other sources.

c) All reliable data regarding the status of the groundwater resource that can be obtained by the District will be observed for evidence of trends (in regard to water table fluctuations).

d) The District will keep in contact with other agencies which maintain water quantity records, and will monitor observations made by these agencies.

e) The District will work closely with neighboring NRDs on common groundwater quantity issues.

f) The District will inventory municipal groundwater supply sites and corresponding data and assist them in planning for future groundwater supplies and regulation of nearby landuse.

g) The District will obtain projections regarding the past, present, and future status of groundwater from the U.S. Geological Survey and the Natural Resources Commission's South Central Hydrogeologic Study -- which includes a computerized hypothetical model of groundwater quantity in the area as a function of all contributing factors. This information will help to provide the District with a source of predictive data to be used in making future management decisions.

B. Expand Existing Programs

Objective 1. Expand Educational Programs Dealt With in Section I-A to Promote Public Support for and Participation in Management of Groundwater Resources.

a) The District will hold informative classes, workshops, and demonstrations concerning groundwater conservation practices, for example:

1) efficient applications of irrigation water
2) technological advances regarding efficient irrigation techniques
3) agricultural practices which inhibit surface water runoff or leaching of nutrients below the root zone

b) As time and budget permits, District personnel will provide technical assistance to users interested in implementing

techniques mentioned in Level I-A-1 as to proper installation and/or use of water use equipment. The District will work with the Soil Conservation Service, the Extension Service, the Water Well Driller's Association, and other agencies in accomplishing this goal.

Objective 2. Expand Groundwater Quantity Monitoring Activities.

a) As budget allows, the District will expand the monitoring survey to include at least 10% of all accessible wells which are located in potential problem areas (areas observed by outside reliable agencies to have groundwater quantity problems, such as: a declining groundwater table, a high groundwater table, a lack of groundwater due to various causes, etc.) in order to expand the base of information regarding the status of the groundwater resource within the District.

b) As budget allows, the District will gradually increase the number of wells randomly monitored for the static water level each spring and fall.

C. Implement New Programs (to be implemented as budget permits)

Objective 1. Make New Information Available to the Public.

a) The District will make available to the public information obtained directly through District water quantity monitoring activities.

b) The District will make available to the public information obtained from other agencies regarding water quantity within the District.

c) The District will correlate District water monitoring data with other data regarding aspects affecting water resources within the District, such as: environmental (i.e. climatic, geomorphic, etc.) or economic (i.e. land use, surface water projects, etc.)

d) The District will periodically send out newsletters and continually work with the news media in order to inform the public of water quantity situations within the District.

e) The District will integrate the study of groundwater availability into its educational programs for schools.

Objective 2. Expand Water Quantity Monitoring Activities.

a) The District will keep records regarding all potential recharge systems (i.e. irrigation canals, water retention structures, springs, streams, etc.) and their contributions to the availability of groundwater within the District.

b) The District will, as budget allows, begin to annually conduct tests at a few strategic locations to determine physical parameters such as aquifer transmissivity, drawndown and recovery rates, etc.

Objective 3. Seek Additional Funding, When Necessary, to Initiate Groundwater Management Programs. Some Possibilities Are:

a) NRD tax authority -

1) The District will consider assessing a special tax levy to landowners within a Level IV area in order to facilitate this part of the groundwater quantity management plan according to Nebraska Statute 46-673.

b) State of Nebraska authority -

1) The District will encourage the State of Nebraska to pass legislation which will provide for, at least in part, additional state and/or local funding for NRD administered groundwater management programs, at any level of management.

2) The District will support legislative efforts which will provide NRD's with a source of funding for data collecting efforts in which the District and the State agencies share a common interest.

3) The District feels that legislation should provide for an additional source of funding in the event that current NRD funding is inadequate in financing the implementation of more intensive groundwater management procedures.

c) Other governmental agencies -

1) The District will monitor and apply for any Federal or State funding opportunities available in order to establish a groundwater management program.

2) The District will pursue cost-share funding from

Federal and State agencies for data collection programs for which there is common interest.

3) The District will encourage the State to increase funding for cost-share programs which will help landowners apply Best Management Practices to their land for the purpose of conservation and recharge of groundwater.

d) Private sources of funding -

1) The District will consider establishing trust funds to be used especially for groundwater management programs (i.e. to provide better management by the District and to help finance projects designed to conserve or otherwise enhance the groundwater reserve within the District consistent with the Reservoir Life Goal of this Plan. (For example: parties, such as municipalities, may wish to set up a groundwater recharge project or to find an alternative source of water to supplement the groundwater source which may be declining. A centralized rural supply system may also be considered under the private trust fund management objectives.

Objective 4. Monitor Construction of New Wells.

a) The District will monitor the status of groundwater withdrawal subject to LB 310, the Water Well Standards and Contractor's Licensing Act, effective as of October 1, 1986, to insure that wells being drilled are properly constructed according to the mandates of the Act. The District supports this Act because it encourages groundwater conservation (i.e. due to the well spacing requirements).

LEVEL II. GROUNDWATER QUANTITY INVESTIGATION

-- Defining Areas of Concern --

The implementation of a Level II Groundwater Quantity Investigation will be triggered by the following groundwater quantity parameters, which have been determined by the Lower Republican Natural Resources District to represent the threshold at which a significant decline in the static water level affecting the saturated thickness is probable and it is the belief of the District that groundwater users in the area would benefit from an in-depth groundwater quantity investigation.

> If it has been determined that records from a site(s) (whether it is a well(s) routinely monitored for static water level by District personnel, or if data regarding trends in the static water level, or aquifer's saturated thickness, has been obtained by some other reliable means) reveal that there has been a declining trend in the spring static water levels, based on the slope of the trend line that best fits the data over a continuous three-year period, that exceeds the limits given in Table #17 based on the Spring 1981 Levels of Record obtained from the USGS-NRC South Central Nebraska Hydrogeologic Study, the District will respond by declaring the immediate area around the site(s) a Level II Groundwater Quantity Investigation Area.

Table #17 shows a priority system the District has established to use as a guide in deciding if a Level II Investigation should be initiated. This table is based on the District recognizing four main categories of aquifers in the Lower Republican NRD, using depth to water (static water level) and portion of aquifer's saturated thickness to establish the priority system.

TABLE 17

Priority #	Description of Category (1981 Base Year Comparison) Static Water	(yielding) Saturated Thickness	Triggering Action When Decline From 1981 Reaches
#1	$\geq$ 100'	$<$ 100'	6% Saturated Thickness
#2	$<$ 100'	$<$ 100'	8% Saturated Thickness
#3	$\geq$ 100'	$\geq$ 100'	6' Static Water Level
#4	$<$ 100'	$\geq$ 100'	8' Static Water Level

The purpose of this level of management is to initiate an extensive study to determine whether a suspected problem actually exists (and to what extent) and whether the problem area is of significant enough size (determined by establishing boundaries) to warrant public involvement (via the Lower Republican NRD) to help solve the problem. This solution would be sought through Level III and Level IV of this Plan.

The Level II Groundwater Quantity Investigation Objectives Are:

A. Define Area of Concern

Objective 1. Intensify Investigation in the Area of Concern.

a) The District will initiate a study of the concern area within 12 months of the discovery of a site(s) showing a net decline in static water level over a three-year period in an attempt to determine the extent of the decline.

b) The District will conduct an intense groundwater quantity monitoring survey in the immediate area surrounding the site(s) which has experienced a net decline in static water level over a three-year period.

All accessible groundwater wells occurring within a minimum of a three-mile radius (for domestic, irrigation, and industrial concerns) or a two-mile radius (for municipal concerns) will be monitored for quantity and/or quality. (The quality monitoring survey will be included unless the District has reliable data that quality is not a concern in the area.) The static water level data collected for Level II purposes will be obtained by District personnel. The District will determine the extent of the aquifer's saturated thickness which will yield water when pumped.

c) The District will review any reliable, relevant information regarding the status of the groundwater resource within or surrounding the area of concern.

d) The District will review the status of surface water resources (both natural and artificial; located within or outside the area of concern) which may have an impact

on the quantity of groundwater within the area of concern, and will examine such information for possible correlations. (An example of a correlation which the District will be attempting to make at this point is: to observe surface water retention structures (natural and/or artificial) as potential sources of groundwater recharge.)

e) The District will seek additional information regarding the status of the groundwater aquifer formation underlying the area of concern (and, as necessary, surrounding areas) and the quantity of groundwater it contains. The following list contains examples of where the District might obtain such useful information.

   1) The District will attempt to obtain copies of logs made by drilling contractors (such vertical drilling may have been done for many reasons: geophysical, groundwater or other mineral mining, exploratory, etc.) in order to gain useful information regarding the static water level, the extent and composition of geological formations (especially groundwater aquifer formations), and the depth to the shale layer which forms the base of the groundwater aquifer. (This data can be used to make mathematical calculations necessary in determining parameters such as: the saturated aquifer thickness, the aquifer transmissivity, and others.)

   2) As budget permits, the District may decide to conduct exploratory ('test hole') water well drilling on sites within, or around the area of concern where there is insufficient data and/or to gain knowledge about the geologic formations (especially the groundwater aquifer) underlying the area of concern. The District will install permanent observation wells as necessary to obtain information regarding the status of the groundwater reserve.

   f) The District may gain additional insight into the status of groundwater within an area of concern at this point by making applications of data collected for Level II

purposes through the use of predictive groundwater models which project what future conditions might be as a function of various related factors. (i.e. "The South Central Nebraska Hydrogeologic Study") conducted in cooperation with the U.S. Geological Survey and the Nebraska Natural Resources Commission is one tool the District intends to use to obtain this predictive information.

g) Correlating all available information regarding the quantity of groundwater within the area of concern, the District will attempt to define the following:
   1) the regional expanse of the decline
      a) past
      b) present
      c) projected into the future
   2) the rate of decline per unit of time
      a) past
      b) present
      c) projected into the future
   3) possible causes of the decline
      a) natural
      b) due to economic activities
   4) The quantity and recharge capacity of groundwater within the area
   5) the potential impact of the decline
      a) social/economic
      b) environmental
   6) possible solutions

<u>Objective 2.</u> Evaluate the Situation at the District Level.

a) The District will compile all information obtained in the Level II Investigation within <u>6 months</u> of the completion of the third consecutive spring monitoring survey. Once all the information obtained during the initial investigation has been compiled, the District Board of Directors and/or the management will evaluate the status of groundwater quantity within the area of the concern and determine what the next course of action (on the part of the District) regarding groundwater quantity management will be.

b) If the information collected in a Level II Groundwater Quantity Investigation Area which has undergone the initial investigation is inconclusive, the Level II classification of the area may be extended for a period of two years, during which time the District will monitor the static water level, within the area each spring. An attempt will be made to determine if trends exist which indicate that the static water level is declining.

District personnel will monitor the same wells and collect any reliable information from outside sources regarding groundwater quantity which might be useful for this investigation.

The District will reevaluate the status of the area under Level II Investigation at the end of the extended period and determine which level of groundwater quantity management would best benefit groundwater users within the area at that time. Users of groundwater within an extended Level II Investigation Area whose groundwater sources are known to be declining, but who may live in areas which do not meet the criteria for a higher level of management as established by the District, will be advised to seek new and/or additional sources of water to meet their needs.

c) If, following the initial Level II Investigation, trends regarding the underlying groundwater resource indicate that there is a significant decline (based on quantity parameters established by the District as thresholds whereby higher levels of groundwater quantity management or control are to be triggered), the District will determine potential boundaries designating the extent of the area of concern (these boundaries are to be determined on the basis of the manifestation of the groundwater aquifer formation within the area and possible sources of groundwater recharge (or depletion) that exist in areas adjacent to the area of concern from a management point of view.)

d) Placing an area of groundwater quantity concern under any

level of quantity management or control at this point (following a Level II Investigation), will be based on the significance and magnitude of the declining groundwater table. In order for the District to determine that the groundwater quantity decline within an area is of the significance and magnitude to trigger higher levels of management, 75% of all locations monitored for groundwater quantity by the District within a defined area of groundwater quantity concern must show reliable evidence that the decline in the static water level or saturated thickness has occurred in quantities and at rates established by the District to be used as triggering mechanisms for the implementation of specific levels of groundwater management. The District will attempt to insure that the static water level survey data used to determine the significance of the decline in the quantity of groundwater within an area is truly representative of the entire saturated aquifer formation underlying the area.

The District will annually review the standards which determine a definition of significance (quantitative) and magnitude (regional expanse).

e) The District will compile all the data and resulting interpretations from the Level II Investigation as well as a detailed map of the proposed boundaries of a groundwater quantity management or protection area, for a source of public and institutional information.

f) The District will notify and seek recommendations from the State of Nebraska Department of Water Resources, and/or the Nebraska Natural Resources Commission, the University of Nebraska Conservation & Survey Division, any/or any other agency (Federal, State or local) which may have an interest in areas within the State of Nebraska experiencing a significant decline in the groundwater table.

B. Continue Existing Programs

Objective 1. Continue Level I Groundwater Quantity Awareness Programs.

a) Regardless of which subsequent level of groundwater quantity

management is being exercised within an area, the routine groundwater quantity monitoring survey (Level I Groundwater Quantity Awareness) will be continued. When an area is being monitored for groundwater quantity under the provisions of subsequent levels of investigation or management, the data obtained thereof will be entered into the District's permanent data files and also transferred to the University of Conservation & Survey Division to be recorded on permanent state files.

b) Regardless of which subsequent level of groundwater quantity management is being exercised within an area, the District will continually encourage groundwater users to voluntarily use conservative techniques in their use of the resource.

c) The District will, as for any level of groundwater management, make available to the public information regarding the quality and quantity of the groundwater within the District as well as information concerning techniques which users might employ which would help meet the groundwater quantity goals of this Plan.

C. Intensify Educational and Informational Programs Within the Area of Concern

Objective 1. Inform the Public That the Area of Concern Will Be Undergoing a Level II Groundwater Quantity Investigation.

a) The District will inform the public (through the news media, private organizational meetings, etc.) that it has implemented a Level II Groundwater Quantity Investigation within a certain area, and why, within 6 months of the discovery of a site(s) showing a significant decline in the static water level. The public will be informed that the Level II Investigation is to be conducted so that the magnitude (regional expanse) of the groundwater table decline within the concern area can be determined.

b) District personnel will attempt to visit landowners in the area of concern personally and review the situation with them prior to notifying the general public.

c) The District will inform landowners that they will be

intensifying the static water level monitoring survey in the area of concern in order to more clearly define the significance and magnitude of the saturated thickness or static water level decline. The District will ask for voluntary assistance in measuring the static water level in wells, a copy of any drillers' logs referring to previous water well (or other) contracting work conducted on land within the area of concern, and/or any other information which may be useful in investigating the status of groundwater in the area of concern.

d) The District will inform the public of the results of the Level II Groundwater Quantity Investigation, regardless of the outcome.

LEVEL III. GROUNDWATER QUANTITY PRE-REGULATORY AREA

-- Establishing Groundwater Quantity Voluntary Management --

The District will implement Level III Groundwater Quantity Pre-Regulatory Objectives within an area when a significant portion of the data obtained in a Level II Groundwater Quantity Investigation of the area has repeatedly shown that the saturated thickness or static water level of the underlying groundwater reservoir is steadily declining over an area of significant size, and it is the belief of the District (in regard to the future availability of groundwater) that the area would benefit from voluntary management of the resource by users in the present.

The Groundwater quantity parameters established by the District, which represent the threshold at which a decline in the static water level of the underlying groundwater reservoir is significant enough to warrant the implementation of Level III management objectives are:

> If 75% of all locations monitored each spring within an area of minimal size established by the District (the minimum size of a Level III Groundwater Quantity Pre-Regulatory Area is: 16 square miles for municipal concerns and 36 square miles for domestic, irrigation, industrial, and other concerns) reveals that there has been a declining trend in the saturated thickness or static water level of the groundwater aquifer, over a continuous three-year period, determined from the slope of the trend line that best fits the data that exceeds the limits given in Table #18, page 161, (based on Spring 1981 groundwater information obtained from water data provided by the USGS-NRC South Central Hydrogeologic Study) the District will respond by establishing official boundaries, for management purposes, around the area and declaring it a Level III Groundwater Quantity Management Area. An aquifer priority system has been developed by the District to show the four basic categories of aquifers in the Lower Republican NRD. These categories give priority of future District action to address a concern based on the distance to water from the ground's surface (static water level) and the total saturated thickness (which will yield water) at the well location. Table #18, page 161, shows the method used by the District to trigger action based on aquifer priority and the effect a continuous three-year decline (compared to 1981 data) has on the particular aquifer being considered as a potential management area.

TABLE 18

Priority #	Description of Category (1981 Base Year Comparison) Static Water	(yielding) Saturated Thickness	Triggering Action When Decline From 1981 Reaches:
#1	$\geq$ 100'	$<$ 100'	8% in saturated thickness
#2	$<$ 100'	$<$ 100'	10% in saturated thickness
#3	$\geq$ 100'	$\geq$ 100'	8' static water level
#4	$<$ 100'	$\geq$ 100'	10' static water level

The purpose of this level of Pre-Regulatory Management is to stabilize the aquifer at the level noted in Table #18 for the future, utilizing voluntary Best Management Practices to accomplish this goal.

The Level III Groundwater Quantity Pre-Regulatory Objectives Are:

A. Define Level III Groundwater Pre-Regulatory Area

Objective 1. Intensify Investigation in the Level III Groundwater Quantity Management Area.

a) The District will expand research in the Level III Groundwater Quantity Pre-Regulatory Area within 12 months of the decision made by the District Board of Directors and/or Management staff to give that area a Level III designation.

b) Contacts will be kept with the State of Nebraska Department of Water Resources, and/or the Nebraska Natural Resources Commission, and/or any other agency involved in the quantity management of groundwater resources in the State of Nebraska and their recommendations will be sought by the District at this point.

c) The District will review the status of groundwater withdrawal within the Level III Groundwater Pre-Regulatory Area in regard to LB 886 -- the Well Registry with the State of Nebraska Department of Water Resources and LB 310 --

the Water Well Standards and Contractors' Licensing Act as amended by Nebraska Legislature in the spring of 1986.

d) The District will attempt to estimate the quantity of groundwater being consumed within (and/or in areas surrounding or otherwise affecting) the Level III Groundwater Quantity Pre-Regulatory Area by compiling all available groundwater quantity data for that area and subsequently subtracting the total estimated volume of groundwater extracted from the groundwater reservoir from the sum of all incoming sources of groundwater plus the volume of the saturated aquifer underlying the area. This parameter will be useful to the District in determining the total amount of groundwater which may be withdrawn in the Level III Groundwater Pre-Regulatory Area using LB 375; Statute 46-673.08 as a guideline, consistent with the Reservoir Life Goal established by the District in this LRNRD Groundwater Management Plan.

1) The District will attempt to estimate the quantity of water being subtracted from the groundwater reservoir within (and/or in areas surrounding or otherwise affecting) the Level III Groundwater Quantity Pre-Regulatory Area. Some of the phenomenon which result in a subtraction of volume from the groundwater reserve are shown on Chart #3 found on page 164. The District will encourage all users who are presently and/or intend to withdraw significant quantities of groundwater within (and/or in areas surrounding or otherwise affecting) the Level III Groundwater Pre-Regulatory Area to voluntarily install flow meters on their groundwater extraction systems (well/pump), to periodically record usage, and to subsequently report quantities of water withdrawn to the District for their records. Entities which may withdraw significant quantities of groundwater would include: agricultural, municipal, and industrial users.

The success (or failure) of this effort will depend on

the support and voluntary assistance of the public involved in a Level III Groundwater Pre-Regulatory Area.

2) The District will attempt to estimate the quantity of water being added to the groundwater reservoir within (and/or in areas surrounding or otherwise affecting) the Level III Groundwater Pre-Regulatory Area. Some of the phenomenon which result in an addition of volume to the groundwater reserve are shown on Chart #3, page 164.

3) The District will attempt to obtain copies of data from outside agencies involved in surface or groundwater projects which will have a quantitative impact on the groundwater reserve. Also, the District can make use of data prepared by agencies involved in the study of groundwater as a function of additive and subtractive forces (i.e. the "South Central Nebraska Hydrogeologic Study" done in cooperation with the U.S. Geological Survey and the Nebraska Natural Resources Commission).

CHART #3

FORCES WHICH MAY ADD TO OR SUBTRACT FROM THE GROUNDWATER RESERVE

		ADDITIVE SUBTRACTIVE
Naturally Occurring Forces:	-- natural groundwater flows	<---------->
	-- natural surface water flows	<---------->
	-- climatic (i.e. seasonality, precipitation, temperature, etc.)	<---------->
	-- biologic (i.e. transpiration of phreatophytes (-) vs. conservation tillage (+)	<---------->
	-- geologic (i.e. formation transmissivity, aquifer thickness, etc.)	<---------->
	-- others	<---------->
Artificially Occurring Forces:	-- direct extraction via well/pump systems	---------->
	-- inhibition of natural recharge from the surface (i.e. lined, unlined surface water retention structures, diversions, etc.)	<---------->
	-- inhibition of natural groundwater recharge from below the surface (i.e. high water well densities per unit area, high withdrawal rates during the irrigation season	---------->
	-- others	<---------->
		Total Impact of the Additive and Subtractive Forces on the Groundwater Reserve

* The subtractive impact of many of the forces listed above can be reduced through management.

e) The District will attempt to estimate the total amount of groundwater which may be withdrawn within the Level III Groundwater Pre-Regulatory Area using LB 375; Statute 46-673.08 as a guideline, consistent with the Reservoir Life Goal established by the District in this Lower Republican NRD Groundwater Management Plan. The District will attempt to estimate the ratio between actual withdrawals being made and the total allowable withdrawals. (Tools which may be used in determining this parameter are historical climatic and water resource data that has been collected by the District as well as from other accredited agencies and/or computerized groundwater predictive models.)

f) The District will consult with underground water storage permitholders prior to adopting any rules or regulations for a management or control area according to the provisions of LB 198; Statutes 46-666.01 and 46-673.09.

Objective 2. Determine Which Type of Groundwater Quantity Concerns Exist in the Area.

a) Based on the data gathered in the Level II Groundwater Quantity Investigation, the District will determine the type of groundwater quantity concern(s) which will be dealt with under Level III Groundwater Quantity Management Objectives.

1) domestic
2) municipal
3) agricultural
4) industrial
5) any combination of the above

Objective 3. Establish Boundary of Level III Groundwater Quantity Pre-Regulatory Area.

a) The District will establish specific geographic and stratigraphic boundaries of the Level III Groundwater Quantity Pre-Regulatory Area at this point.

b) The minimal areal size that the District feels would be feasible for a Level III Groundwater Quantity Pre-Regulatory Area to be established is: 16 square miles for municipal

groundwater concerns and 36 square miles for domestic, irrigation, and industrial groundwater concerns. (The District reserves the right to alter these sizes, in exceptional cases, in order to attain the goals of Level III Objectives.)

c) As soon as the boundary has been established by the District, the public will be informed as to the locations of the boundary and the implications of Level III Groundwater Quantity Pre-Regulatory in the area.

d) Individuals owning land or using groundwater within the Level III Groundwater Quantity Pre-Regulatory Area will be mailed a map showing the specific boundaries around the area as well as a copy of the procedures to be implemented in the area within 90 days of the official designation of the Level III Groundwater Quantity Pre-Regulatory Area boundary.

B. Promote Voluntary Groundwater Quantity Management

Objective 1. Inform Residents of Potential Solutions and/or Management Procedures.

a) The District will inform the inhabitants within the designated Level III Groundwater Quantity Pre-Regulatory Area of the nature of the programs which will be implemented and of possible methods available to attempt to manage groundwater quantity according to the guidelines of LB 375.

b) The District will encourage conservative groundwater withdrawal by residents in a Level III Groundwater Quantity Pre-Regulatory Area in order to attain the objectives of the Reservoir Life Goal established in this LRNRD Groundwater Management Plan.

c) The District will provide technical assistance to landowners interested in voluntarily controlling applications of groundwater. Annual workshops regarding technological advances in efficient irrigation techniques.

d) The District will introduce technical specifications for the selection of water flow meters to groundwater users interested in voluntarily implementing groundwater conservation practices in order to increase efficiency

in their agricultural enterprises while making conservative use of the resource.

The specifications found in Supplement #6 found on page #'s 168 - 170 will apply to water flow meters to be installed in groundwater irrigation pipelines and utilized by individuals in the event that the District adopts a groundwater allocation program (Level IV) in an attempt to stabilize or reduce the rate of groundwater decline at the standard set for Level III.

e) The District will introduce the concept of establishing a Rural Water District (under the provisions of the NRD law, Chapter 46, Article 2, Section 2-3233) to residents in a Level III Groundwater Pre-Regulatory Area. If this management tool appears to be all or part of a solution which conserves the depleted groundwater reserve in an area, then the idea will be pursued further.

SUPPLEMENT #6

SPECIFICATIONS FOR SELECTION, INSTALLATION, AND MAINTENANCE OF WATER FLOW METERS

1) Technical Specifications for Selection of Flow Meters.

The following specifications pertain to water flow meters installed in irrigation pipelines and utilized for administration of a groundwater allocation program.

a) All flow meters shall meet American Water Works Association standards C704-70 as well as other technical specifications stated herein. In case of conflict, the specifications herein shall apply.

b) Meters shall be of the velocity propeller-type, and made of non-corrosive materials. The propeller shall rotate on a minimum of two bearings. Bearings shall be made of stainless steel or equivalent non-corrosive material. The propeller should have a diameter not less than 70% of the meter size. With flows of less than 500 gallons per minute, meters with small propellers may not be accurate.

c) The meter registry shall have a visual, volume-recording totalizer which shall record in acre-inches or gallons. (Acre-inches is recommended over gallons.) The registry shall be adequately protected from the elements. The totalizer shall have sufficient capacity to record the quantity of water diverted from each well or combination of sources for multiple well installation during the period of one year. The totalizer shall be direct reading and the multiplier shall be clearly indicated. The meter shall also have a rate-of-flow indicator showing:

   1) instantaneous flow in gallons per minute (GPM), or
   2) a sweep hand indicator from which rate-of-flow can be determined by timing

d) The registry shall be provided with a method for sealing with a wire or lead seal to prevent unauthorized tampering or removal.

e) The meter totalizer shall have a rated accuracy of plus or

minus two percent of actual flow for all rates of flow within the range of flow for which the meter is designed when installed in accordance with the manufacturer's specifications. The meter shall be capable of accurately registering the expected operating range of discharge.

f) A meter shall have a pressure rating to fit the expected application and shall be used only within its designed pressure range.

g) The meter size, serial number and direction of flow shall be clearly stamped on the body of the meter. The inside pipe diameter for which the meter has been calibrated shall be clearly shown on the meter to the nearest one-thousandth (0.001) of an inch.

2) Standard for Flow Meter Installation.

a) The meter shall be installed in accordance with the manufacturer's specifications and in such a manner that there shall be a full pipe flow of water at all times while water is being pumped. Full pipe flow may be obtained by using butterfly valves or by raising the pipe beyond the meter to a point above the level of the meter.

b) The meter shall be placed in the pipe not less than five pipe diameters downstream from any valves, elbows or other obstructions which might create a turbulent or jetting flow, or as otherwise recommended by the manufacturer. There shall also be at least one pipe diameter of unobstructed flow on the downstream side of the meter. Straightening vanes shall be installed in the pipe in the manner recommended by the manufacturer of the meter, if the above conditions can not be met.

c) It is recommended that provisions be made for future testing of meters including such provisions as:

1) using a uniform or standard weld-on saddle mount meter to allow for easy removal and interchange of meters;

2) an open discharge pipe which would allow installing a testing meter; or

3) any other means which would permit the easy installation of a testing meter or other electronic measuring devices

d) A single meter may be installed in such a manner as to measure the combined flow from two or more wells.

e) The meter propeller shaft shall be positioned parallel to the pipe and aligned with the center-line of the pipe.

3) Recommended Operation and Maintenance of Flow Meters.

a) Meters should be kept clear of debris, vegetative growth or any other material which could impede proper operation of the meter.

b) Meters should be stored in such a manner that will prevent freezing or damage by rodents and livestock.

Source: Upper Big Blue Natural Resources District Groundwater Management Plan, 1986

LEVEL IV. GROUNDWATER QUANTITY MANAGEMENT AND CONTROL AREA

-- Enforcing Groundwater Quantity Management and Control Areas --

The District will implement Level IV Groundwater Quantity Management and Control Objectives within an area when it has been determined that the depth to water or saturated thickness has in fact declined over an area of significant size and that the required practices necessary for stabilizing and improving such decline would be more successful if they were enforced by the District under the guidance of State of Nebraska Laws 1975, LB 577, Section 3; and Laws 1981, LB 146, Section 6; Statute 46-658.

The groundwater quantity parameters established by the District, which represent the threshold at which a decline in the saturated thickness or static water level of the underlying groundwater reservoir is significant enough to warrant the implementation of a Level IV Groundwater Quantity Management and Control Area are:

> If 80% of all locations monitored each spring within an area of minimal size established by the District (the minimum size of a Level IV Groundwater Quantity Management or Control Area is: 16 square miles for municipal concerns and 36 square miles for domestic, irrigation, industrial, and other concerns) reveals that there has been a declining trend in the saturated thickness or static water level of the groundwater aquifer, over a continuous three-year period, determined from the slope of the trend line that best fits the data, that exceeds the limits given in Table #19, page 172 (based on Spring 1981 groundwater information obtained from water data provided by the USGS-NRC South Central Hydrogeologic Study) the District will respond by establishing official boundaries, for the purpose of controlling withdrawal from the aquifer, around the area and decide that a Level IV Groundwater Quantity Management or Control Area should be established. An aquifer priority system has been developed by the District to show four basic categories of aquifers in the Lower Republican NRD. These categories give priority of future District action to address a concern based on the distance to water from the ground's surface (static water level) and the total saturated thickness (which will yield water) at the well location. Table #19, page 172 shows the method used by the District to trigger action based on aquifer priority and the effect a continuous five-year decline (compared to 1981 data) has on the particular aquifer being considered for a potential control area. The District will first establish a management area which will begin certain regulatory functions, if this process does not accomplish the purposes established by the District then the LRNRD will accelerate the regulatory process by requesting the Department of Water Resources to establish a control area.

TABLE 19

Priority #	Description of Category (1981 Base Year Comparison) Static Water	(yielding) Saturated Thickness	Triggering Action When Decline From 1981 Reaches
#1	$\geq$ 100'	< 100'	10% in saturated thickness
#2	< 100'	$\geq$ 100'	12% in saturated thickness
#3	$\geq$ 100'	< 100'	10' static water level
#4	< 100'	$\geq$ 100'	15' static water level

The purpose of this level of management is to impose mandatory management practices to strive to return the aquifer to the condition noted for the different aquifer priorities in Level III (as noted on Table 18, page 161) of this Plan.

The District will use the Nebraska Groundwater Management and Protection Act cited in Statutes 46-656 to 46-673, 46-673.01 to 46-673.13, and 46-674 included in Laws 1975, LB 577, Section 24; Laws 1981, LB 146, Section 12; Laws 1982, LB 375, Section 22 as a guideline in establishing a Level IV Groundwater Quantity Management and Control Area.

The Level IV Groundwater Quantity Management and Control Objectives Are:

A. Establish a Management Area in Compliance With the Statutes of State Law

Objective 1. The District Will Utilize the Management Authorities Provided by State Law Which Allows an NRD (Without State Direct Involvement) to Implement Certain Required Activities to Address Groundwater Quantity Concerns in an Area. It is the Intent of this "Management Area" Approach That the More Restrictive Activities Outlined in the "Control Area" Portion of Level IV Can Be Avoided When Addressing a Quantity Concern.

a) The Groundwater Reservoir Life Goal of this Plan is to insure sufficient good quality groundwater, for all beneficial uses, over an infinite period of time. If the District feels that limiting withdrawal will have a positive effect in regard to stabilizing or improving a decline in the

quantity of groundwater within an area, then it will be suggested that groundwater users utilize conservation practices.

b) It is the belief of the Lower Republican NRD that stabilizing or reducing declines in groundwater levels should first be encouraged on a voluntary basis as described in this Plan's Level III Pre-Regulatory area section. However, the District will require the use of some, or all, of the following practices in a designated Level IV Groundwater Management Area if voluntary methods are ineffective in stabilizing or improving the groundwater table decline to standards equal to (or less than) those established for Level III.

1) allocating the total permissible withdrawal of groundwater

a) Should allocation be adopted for use of irrigation purposes in a management area, such allocation shall specify the total number of acre-inches that are to be equally allocated per irrigated acre per year, except that the District may allow a groundwater user to average their allocation over any reasonable period of time (not to exceed five years). A groundwater user may apply their allocation to any part of or all of the irrigated acres to which the allocation applies.

2) rotation of the use of groundwater

a) Should rotation be adopted, times for irrigation by each irrigator in a given area would be scheduled by the District.

3) well-spacing requirements

a) Should well-spacing requirements be adopted, the District would limit the density of irrigation wells by restricting well-spacing requirements to a greater extent than those found in LB 375; Sections 46-609 and 46-651. (i.e. there is to be no irrigation well drilled closer than 1,000 feet

from another irrigation well owned by a different party) or 1,200 feet when a municipal well is involved.

4) use of flow meters on wells

a) should the use of water flow meters be adopted by the District in order to allocate groundwater pumping, installation, registering, and use of required equipment would be established by the District. (refer to Supplement #6, pages 168 - 170)

c) The District also has been given the authority to administer and enforce any, or all, of the following to "effectuate the policy of the state and to conserve groundwater resources" (under the provisons of Laws 1975, LB 577, Section 8; Laws 1979, LB 26, Section 2; Laws 1982, LB 375, Section 18, Statute 46-663):

1) The District may, following a public hearing (having been given the following procedures provided in Section 46-658), adopt rules and regulations necessary to administer duties assigned in the Groundwater Management Act.

2) Require reports from groundwater users as may be necessary.

3) Conduct investigations, and cooperate or contract with Federal, State (and political subdivisions of the State), public, private, corporate, associated, and/or individuals on any matter relevant to the administration of the Groundwater Management Act.

4) Report to and consult with the State of Nebraska Department of Environmental Control on all matters concerning the entry of pollution or polluting materials into groundwater supplies; and

5) Issue cease and desist orders to enforce the provisions of the Groundwater Management Act.

d) If, in the future, it becomes evident that voluntary and/or the limited required efforts are largely ineffective in inhibiting the continued decline in the groundwater table, the District will designate the area to be a Level IV Groundwater Quanity Control Area in compliance with Laws 1975, LB 577, Section 3; Laws 1981, LB 146, Section 6;

and Statutes 46-658 - 46-674.01, and any, or all, of the preceding practices (controls) will be put into use in an attempt to meet the Reservoir Life Goal of the LRNRD Groundwater Management Plan.

Objective 2. Increase Funds Available to the District to Implement Procedures Required to Manage a Level IV Groundwater Quantity Management Area.

a) The Natural Resources Districts have been given the authority by the State of Nebraska Legislature to levy a tax not to exceed one and eight-tenths on each one hundred dollars annually on all taxable property within the designated groundwater management areas in addition to the general tax levy authorized to administer NRD programs. Such levy will be utilized only for the costs of carrying out the provisions of Sections 46-656 to 46-658.01, 46-659 to 46-673, 46-673.01 to 46-673.13, and 46-674 within such area.

B. Establishing the Control Area in Compliance with State Law

Objective 1. The District will Coordinate all of its Efforts Regarding the Establishment and Administration of Level IV Groundwater Quantity Control Objectives with the State of Nebraska Department of Water Resources under the provisions of Laws 1975, LB 577, Section 3 and Laws 1981, LB 146, Section 6.

a) The District will compile all available information regarding the Level IV Quantity Control Area and inform the Department of Water Resources of the status of groundwater quantity within the area.

b) An area may be designated a control area by the Director of the Department of Water Resources following a hearing initiated in accordance with subsection (3) of Nebraska Statute 46-658 if it shall be determined, following evaluation of relevant hydrologic and/or climatic data, history of developments, and projection of effects of current and new development, that development and utilization of the groundwater supply has caused or is

likely to cause within the reasonably foreseeable future the existence of either of the following conditions:

1) an inadequate groundwater supply to meet present or reasonably foreseeable needs for beneficial use of such water supply; or
2) dewatering of an aquifer, resulting in a deterioration of the quality of such groundwater sufficient to make such groundwater unsuitable for the present purposes for which it is being utilized; or
3) pollution of groundwater has occurred or is likely to occur in the reasonably foreseeable future

c) When determining whether to designate a control area because of the existence of any of the conditions listed above, the Director's considerations shall include, but not be limited to, whether conflicts between groundwater users are occurring or may be reasonably anticipated, or whether groundwater users are experiencing, or will experience within the foreseeable future, substantial economic hardships as a direct result of current or anticipated groundwater development or utilization, or as a direct result of current or reasonably anticipated activities which cause or contribute to the pollution of groundwater.

d) A hearing to designate a control area may be initiated by a District whenever it has information, sufficient in the opinion of the Board of Directors, to require that any portion of such District should be designated as a control area. The Board of Directors shall report such information to the Director with a request that a hearing be held to determine if a control area should be established. The request shall be accompanied by a general description of the area proposed for inclusion in such control area.

1) Within thirty days after a hearing has been initiated pursuant to subsection (3) of Nebraska Statute 46-658, the Director shall consult with the District and fix a time and place for a public hearing to consider the information supplied and to hear any other evidence.

The hearing shall be held within one hundred twenty days after it has been initiated, shall be open to the public, and shall be located within, or in reasonable proximity to, the area proposed for designation as a control area. If, from information submitted by the District or otherwise available to the Director, the Director has reason to believe that area other than that identified by the District should be considered for inclusion in any control area which would be established as a result of such request, he or she shall so notify the District or Districts whose boundaries encompass such additional area. Notice of the hearing shall be published in such newspapers as are necessary to provide for general circulation within the geographic area at least once each week for three consecutive weeks, the last publication to be not less than seven days prior to the hearing. The notice shall provide a general description of all area which will be considered by the Director for inclusion in the control area.

2) At the hearing, all interested persons shall be allowed to appear and present testimony. The Conservation & Survey Division of the University of Nebraska, the Nebraska Natural Resources Commission, and the Department of Environmental Control shall offer as evidence any information in their possession which they deem relevant to the purposes of the hearing. After the hearing and after any studies or investigations conducted by or on behalf of the Director as he or she deems necessary, the Director shall determine whether a control area shall be designated. If the Director determines that no control area shall be established, he or she shall issue an order declaring that no control area shall be designated.

3) If the Director determines that a control area shall be established, he or she shall consult with such relevant state agencies named in subdivision (b) of

this subsection and with the District or Districts affected, and determine the boundaries of the control area, taking into account the considerations enumerated in subsection (1) of Nebraska Statute 46-658, the effect on political subdivisions and the socio-economic and administrative factors directly affecting the ability to implement and carry out local groundwater management, control, and protection.

4) If the Director determines the contiguous area within the jurisdictional limits of one or more Districts other than the District or Districts which initiated the hearing is subject to the conditions identified in this section and therefore appropriate for inclusion in such control area, he or she shall so notify such other District or Districts prior to issuance of the order designating the control area. Such additional area shall not be included in the control area unless any such other District consents in writing to such inclusion within sixty days of such notification by the Director.

5) When the boundaries of a control area have been determined, the Director shall issue an order designating the area as a control area. Such an order shall include a geographic and a stratigraphic definition of the control area. Notice of the order shall be provided in the same manner as that provided for the hearing.

e) Modification in control area boundaries or dissolution of a control area may be accomplished utilizing the procedure established in this section for the initial designation of such areas as control areas, but hearings for designation, modification, or dissolution of such control area may not be initiated more often than once a year.

f) The District will subdivide the control area based on varying groundwater uses, different irrigation distribution systems, climatic, hydrologic, geologic, and/or soil conditions existing in the area, in the event that a uniform application of any, or all, of the management

controls would fail to carry out the intent of the Groundwater Management Act in a reasonably effective and equitable manner in compliance with State of Nebraska Statute 46-666, subdivision (5). Any difference in such provisions shall recognize and be directed toward such varying groundwater uses or conditions. The provisions of all controls for different categories of groundwater use shall be uniform for all portions of the area which have substantially similiar climatic, hydrologic, geologic, and soil conditions.

Objective 2. Increase Funds Available to the District to Implement Procedures Required to Manage a Level IV Groundwater Quantity Control Area.

a) The Natural Resources Districts have been given the authority by the State of Nebraska Legislature, through the Groundwater Management Act, to levy a tax not to exceed one and eight-tenths on each one hundred dollars annually on all taxable property within the designated groundwater control areas in addition to the general tax levy authorized to administer NRD programs. Such levy will be utilized only for the costs of carrying out the provisions of Sections 46-656 to 46-658.01, 46-659 to 46-673, 46-673.01 to 46-673.13, and 46-674 within such area.

C. Implementation of New Programs at the District Level

Objective 1. Require the Use of Any or All of the Best Management Practices Within the Level IV Groundwater Quality Control Area. Even Though Groundwater Users May Not Be Required to Use All of the Best Management Practices in the Control Phase of Level IV, They Will Be Encouraged to Practice All of the Following Measures in Order to Meet the Groundwater Quantity Goals Established in This Plan.

a) install flow meters

b) install and use irrigation re-use pits

c) use moisture blocks or other methods for irrigation scheduling

d) report to the District the spring static water level for each well, and other water use data as available from flow meters or equivalent methods on forms provided by the District

e) utilize reasonable methods to aid in the gathering of information regarding, and the use of groundwater in order to prevent further degradation of quantity

f) restrict water usage (refer to Level IV, A-1, a)

g) utilize minimum tillage methods

h) utilize crop rotation practices

i) attain most economical use of water

j) utilize any other reasonable measures to conserve water quality

<u>Objective 2.</u> Other Measures Which May Be Required By the District in the Event That Limiting Withdrawal Using the Following Practices Would Have a Positive Effect on Groundwater Quantity.

a) allocating the total permissible withdrawals of groundwater

   1) If allocation is adopted for use of irrigation purposes in a management area, such allocation shall specify the total number of acre-inches that are to be equally allocated per irrigated acre per year, except that the District may allow a groundwater user to average their allocation over any reasonable period of time (not to exceed five years). A groundwater user may apply the allocation to any part of or all of the irrigated acres to which the allocation applies.

b) rotation of the use of groundwater

   1) Should rotation be adopted, times for irrigation by each irrigator in a given area would be scheduled by the District.

c) well-spacing requirements

   1) Should well-spacing requirements be adopted, the District would limit the density of irrigated wells by restricting well-spacing requirements to a greater extent than those found in LB 375; Sections 46-609 and 46-651.

d) use of flow meters on wells

1) Should the use of flow meters be adopted by the District in order to allocate groundwater pumping, installation, registering, and use of required equipment would be established by the District.

e) The District also has been given the authority to administer and enforce any, or all, of the following to "effectuate the policy of the State and to conserve groundwater resources" (under the provisions of Laws 1975, LB 577, Section 8; Laws 1979, LB 26, Section 2; Laws 1982, LB 375, Section 18, Statute 46-663):

1) The District may, following a public hearing (having been given following procedures provided in Section 46-658), adopt rules and regulations necessary to administer duties assigned in the Groundwater Management Act.
2) Require reports from groundwater users as may be necessary.
3) Conduct investigations, and cooperate or contract with Federal, State (and political subdivisions of the State) public, private, corporate, associated, and/or individual on any matter relevant to the administration of the Groundwater Management Act.
4) Report to and consult with the State of Nebraska Department of Environmental Control on all matters concerning the entry of pollution or polluting materials into groundwater supplies; and
5) Issue cease and desist orders to enforce the provisions of the Groundwater Management Act.

<u>Objective 3.</u> Constructing a New Well in a Level IV Groundwater Quantity Control Area.

a) Under the provisions of LB 146; 46-659, State law requires that person(s) intending to construct a new well within a control area file an application to the District for a permit before commencing construction.

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The application for construction of a new well within a Level IV Groundwater Quantity Control Area will be accompanied by a seventeen

dollar and fifty cent filing fee payable to the District. (except as provided for in subsection (9) of Statute 46-666) and shall contain the following information:

1) the name and post office address of the applicant(s)
2) the nature of the proposed use
3) the intended location of the proposed well
4) the intended size, type, description, and estimated depth (if known) of the proposed well
5) the estimated pumping capacity of the well (in gallons per minute - GPM)
6) the acreage and legal description of the location (if the well is to be used for irrigation)
7) a description of the proposed use if for other than irrigation purposes
8) other information the District may require

Before any well having a pumping capacity of less than one hundred gallons per minute (GPM) is modified to withdraw groundwater at a rate equal to or greater than 100 GPM, an application shall be filed for a permit prior to such modification.

Any person who fails to obtain a permit to construct a new well in a Level IV Groundwater Quantity Control Area will be required to apply for a late permit. An application for a late permit shall be accompanied by a two hundred fifty dollar fee payable to the District (except as provided for in subsection (9) of Statute 46-666) and shall contain the same information required for a permit application.

According to Nebraska Statute 46-660, an application for a permit or late permit application shall be denied only if the District in which the well is to be located finds that:

1) the location or operation of the proposed well (or related structures) conflicts with any regulations or controls adopted by the District regarding Level IV Groundwater Control Objectives
2) the proposed use would not be a beneficial use of water for domestic, agricultural, manufacturing or industrial purposes
3) in the case of a late permit only, the applicant did not act in good faith in failing to obtain a timely permit
4) information included in the application is incorrect (in which case, the District will allow the applicant sixty days

to make corrections)

According to Nebraska Statute 46-660, all permits will be issued or denied within thirty days after receipt by the District of a properly prepared application. Issued permits will specify all Level IV Groundwater Control Area requirements adopted by the District relevant to the construction or utilization of the proposed well. No refund of any application fees shall be made regardless of whether the permit is issued, cancelled, or denied. One copy of each permit issued will be transmitted to the Director of the State of Nebraska Department of Water Resources.

The applicant may commence construction of a new well in a Level IV Groundwater Quantity Control Area immediately after a permit has been issued and is required by Nebraska Statute 46-662 to have completed such construction within one year, unless it is clearly demonstrated in the application that it will require a longer period of time to complete construction.

Objective 4. Expand Educational and Informational Activities.

a) The District will promote the establishment of a Rural Water District (under the provisions of NRD law, Chapter 46, Article 2, Section 2-3233) within the Level IV Groundwater Quantity Control Area, if applicable.

b) The District will expand educational efforts as needed to address specific concerns within the protection area. (Emphasis will be placed on informing citizens of applying Best Management Practices to their land and other ways to conserve and efficiently use their groundwater resources.)

Objective 5. Provide Technical and Financial Assistance to Residents in Solving or Coping With a Declining Groundwater Reserve.

a) The District will consider establishing a cost-share, loan, or grant program for individuals or municipalities seeking solutions to a declining groundwater supply. For example:

1) locating and construction of source of water other than groundwater

2) installation of recharge structures to enhance or develop a new groundwater well field

b) The District will promote legislative acts which will provide additional financial assistance for individuals and municipalities seeking solutions to a declining groundwater supply.

LOWER REPUBLICAN NRD GROUNDWATER MANAGEMENT PLAN

List of References

The following reference sources are considered to be public domain by the Lower Republican Natural Resources District. It was found in preparing this Plan that several of the references contained the same or similiar information. These two conditions gave cause to not using footnotes or providing credit lines for all reference matter in formulating the Plan.

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-- U.S. Geological Survey, Water Supply Paper 1489, (This map was reproduced from "Prefeasibility Engineering and Economic Report", Boyle Engineering Corporation, September 1976

-- "Special Report - Republican River Basin Water Management Study", February 1985, Department of Interior, Bureau of Reclamation

-- Groundwater Levels in Nebraska: By Michael J. Ellis, U.S. Geological Survey, and Darryll T. Pederson, Conservation & Survey Division, Nebraska Water Survey Paper No. 59 - June 1984

-- "Hydrogeologic Chacteristics of Nebraska Soils", Jack T. Dugan USGS, WSP #2222, page 3, 1985

-- An Analysis of Nebraska Precipitation Climatology, University of Nebraska, August 1981

-- Nebraska 1984 Preliminary County Estimates and State Agricultural Data, Nebraska Department of Agriculture, Division of Agricultural Statistics, July 1985

-- 1970 National Atlas of the United States of America and 1974 State Highway Map-United States Department of Agriculture, Soil Conservation Service, Figure 683-1

-- "Estimated 1985 Energy Costs for Alternative Power Units for Irrigation with Center-Pivot Installations", compiled by Leslie F. Sheffield, Extension Farm Management Specialist, Institute of Agricultural and Natural Resources, University of Nebraska Lincoln, June 1985

-- National Research Council, 1978, page 23

-- Freeze and Cherry, 1979, page 414

-- "Strategies for Reducing Pollutants from Irrigated Lands in the Great Plains", 1982 - M.L. Quinn Editor, Nebraska Water Resources Center and U.S. Environmental Protection Agency

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-- NebGuide - Anti-Pollution Devices for Applying Chemicals Through the Irrigation System, Cooperative Extension Service, UNL, revised August 1984

-- "Supplemental Water Supplies", Nebraska Natural Resources Commission Policy Issue Study, January 1984

-- Middle Republican NRD Groundwater Management Plan, Map #23, January 1, 1986

-- Tri-Basin Natural Resources District Groundwater Recharge Program, 1983, Henningson, Durham and Richardson, November 1983

-- USGS-NRC South Central Hydrogeologic Study, October 1986

-- Miscellaneous Records, Reports and Files as Maintained by the Lower Republican Natural Resources District

-- Information obtained from Bureau of Reclamation

-- Information obtained from Catherland Reclamation District

-- Information obtained from Conservation & Survey Division

-- Upper Big Blue Natural Resources District Groundwater Management Plan, 1986