SF-760 (Revised)

AVAILABLE SOIL WATER IN NORTH DAKOTA AS OF NOVEMBER 5, 1991

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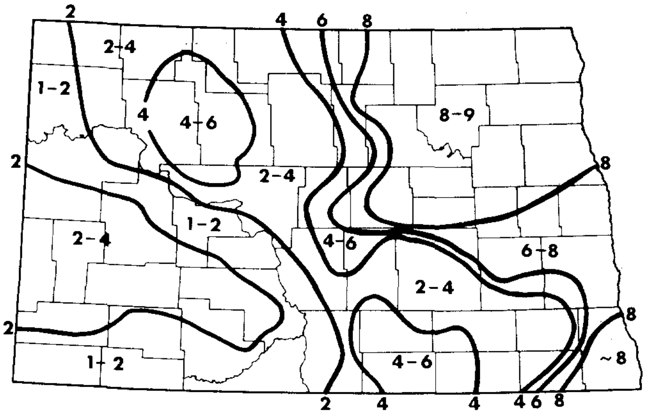
Survey Methods

Survey results are based on soil samples taken 15 to 30 miles apart by Soil Conservation Service personnel, samples from NDSU research sites, and on precipitation patterns. These results provide a general overview of stored soil water in the state, but are only representative of the gently sloping, medium-textured soils that were sampled. Results cannot be used on an individual field because of local variability in precipitation, the past years crop, soil texture, plant cover, and topography. In addition, local areas with high or low rainfall may not be identified by the National Weather Service precipitation network.

Producers are urged to check their fields to determine stored water content at their locations. Guidelines for estimating available soil water from moist soil depths are available in Bulletin 356, Soil Water Guidelines and Precipitation Probabilities in Montana and North Dakota.

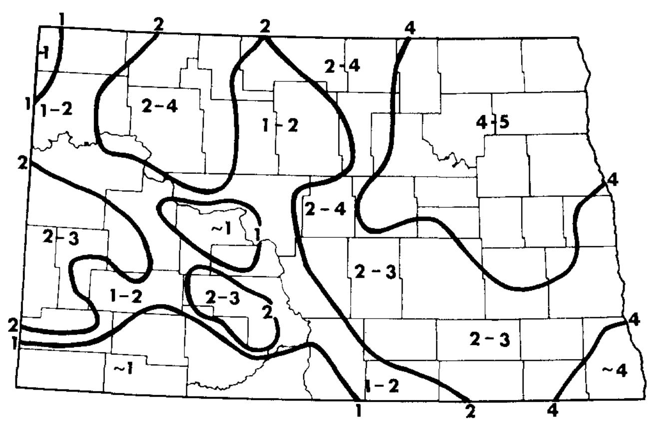


Plant Available Soil Water (inches) in 4 feet of soil (0-48")
November 5, 1991

Available Stored Soil Water On Stubble Ground

Conditions across North Dakota have changed markedly from last year at this time. Soil water storage was enhanced by plentiful precipitation during September and late October over most of the state. About 50 percent of last summer's small grain fields contain more than 4 inches of available stored water in the top 48 inches of soil. Relatively large areas in northeastern and extreme southeastern North Dakota contain more than 6 or 8 inches of available water. Eight inches is the approximate maximum amount of available water better North Dakota soils can store. Currently some of the surplus or free water is frozen in the upper soil layers, especially in the northeast. This water will drain from the soil and help to recharge ground water and wetlands following spring snowmelt. In a few northeastern locations, free water has drained throughout the autumn months.

Conditions this year are also brighter in the western half of North Dakota where the soils contain at least 1 to 4 inches of water. In addition, an area encompassing most of Ward

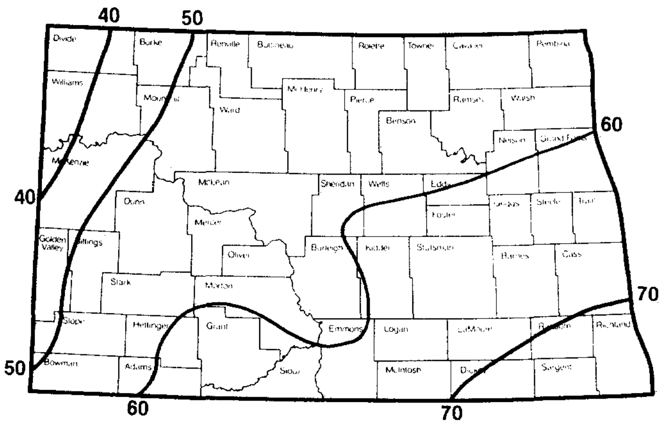


Plant Available Soil Water (inches) in 2 feet of soil (0-24")
November 5, 1991

NDSU EXTENSION SERVICE
North Dakota State University, Fargo, ND 58105
JANUARY 1992

and Mountrail counties contains nearly 6 inches while a large portion of southwestern North Dakota contains 2-4 inches. The driest area, with 1-2 inches, extends eastward in a relatively narrow band along the southern tier of counties, curves northward to Bismarck, than northwest to Williston, and finally, north to the Canadian border. The extreme southern part of this area was critically short of water throughout the 1991 season. October rain and snowfall provided all the available water in these regions.

Most of the available water in the drier (less than 4 inches) areas of the state is contained in the upper 12 or 24 inches of soil, while deeper soil layers are dry. Thus, the 48 inch depth map provides a clearer picture of available water than was possible during the past few years. In those years care was required to interpret the results because much of the soil water was stored below 24 inches in the soil profile and was unavailable to crops until the surface 24 inches was recharged.



Probability of receiving at least 3 inches of precipitation during April and May.

Stored Soil Water On Fallow Ground

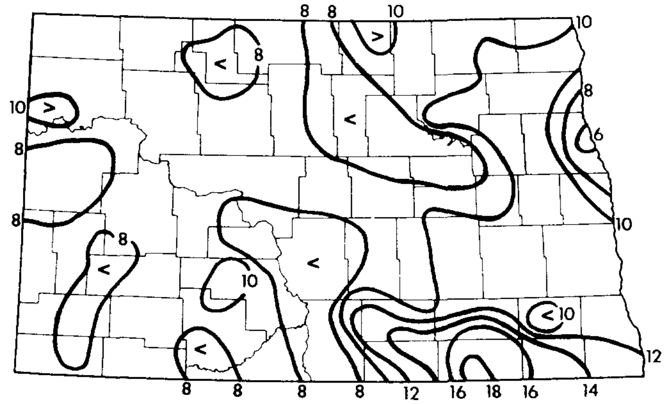
No samples were taken from soils fallowed during the 1991 growing season so only general comments based on growing season and autumn precipitation are possible. Rainfall throughout April-August was consistently greater than normal in the northern half of the state. In addition, precipitation during September and October ranged from 4 to 8 inches across this area. Based on these precipitation data, fallow land in the northern half of the state should be fully recharged.

Rainfall in the southern half of the state was plentiful (greater than 8 inches) during April-June, but it was sparse during July and August with less than 3 inches reported over most of the region. September and October precipitation was also extremely variable. Thus, fallow recharge would be variable throughout this area. Generally water content in fallow should be 2 to 4 inches greater than recrop, but this depends on the number and size of the early season storms and management variables such as weed control and tillage practices on individual farms.

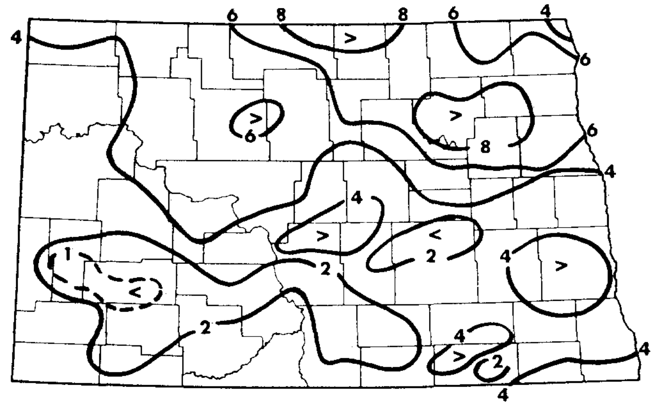
Crop Production and Stored Soil Water

Small grains require 4 to 6 inches of water to produce the first bushel of grain. Normally at least 8 to 10 inches of water, supplied by growing season rainfall and stored soil water, is necessary to minimize the risk of crop failure. There is a 90-95 percent probability of receiving at least 4 inches of rain during the growing season. Thus, 4 inches of available stored soil water at planting is recommended for recrop production.

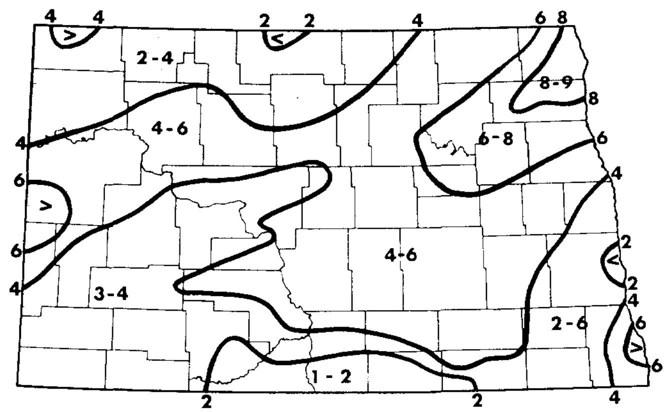
Stored soil water is usually enhanced by November precipitation, spring snow melt, and early spring rain. Snow melt can be especially effective in drier areas when efforts are made to trap snow where it falls. Unfortunately, when surface soils are wet during freeze-up an impermeable layer forms that limits infiltration in the spring. However, dry conditions at freeze-up provide an extremely favorable outlook for snow melt infiltration.



Total Rainfall (Inches), April-June, 1991



Total Rainfall (Inches), July-August, 1991



Total Precipitation (inches), Sept-Oct. 1991

1992 Crop Production Outlook

The initial outlook for 1992 crop production in North Dakota is favorable. Soils over about 50 percent of the state contain more than 4 inches of stored water and many of those soils are near field capacity. In addition, a relatively small area contains less than 2 inches of stored water.

Crop production outlook is good for those areas with more than 4 inches of available stored soil water. However, in areas with 2-4 inches, recharge from snow melt and spring rains will be necessary to minimize risk. The outlook for regions with 1 - 2 inches is marginal, but snow melt and spring rains can still enhance stored soil water. Snow melt infiltration and timely growing season rains will be essential to achieve harvestable crops in these drier regions.

It is important to note that abundant soil water storage does not guarantee bumper yields. Two years, 1987 and 1988, illustrate these conditions. In 1987 small grain yields were drastically curtailed by disease, and in 1988 high temperatures dessicated plants despite adequate available stored soil water. Conversely, dry conditions before seeding do not guarantee poor yields. Several years in the recent past, for example, 1977, 1981, 1989, 1990, and 1991, illustrate this fact. During these years growing season rainfall was either plentiful or timely and crops in many areas did well despite the limited stored soil water. However, in some areas, especially in 1989 and 1990, crops withered and died when timely rains did not occur. Unfortunately, high humidity and numerous raindays during 1991 caused severe disease problems and reduced yields in northeast North Dakota.

Local Influences Affect Soil Moisture Storage

This survey provides an overview of plant available stored soil water in last years small grain fields across the state. These data are representative of gently sloping, medium-textured soils. They tend to overestimate available soil water on a watershed basis. Sloping land may contain less water because of runoff, particularly if appreciable rain has fallen. Coarse-textured sandy soils have less storage capacity than medium-textured soils and will lose water to deep percolation. Fine-textured soils have high storage capacity but lower infiltration rates. They can have higher runoff rates with high intensity rainfall. Longer season crops such as corn, sunflower, beans, or sugar beets will have extracted more water than wheat. Those soils will be drier than wheat stubble fields.

The survey results can only be used as an approximation of the available soil water because of local variability in precipitation, last years crop, soil texture, plant cover, and topography. In addition, local areas with high or low rainfall may escape detection with the rainfall record-transect sampling system used to delineate various regions.

Stored soil water is variable in fields because of slope, cover conditions, and rainfall distribution. Producers are encouraged to check fields in the spring to determine the moist soil depth and estimate plant available soil water. Guidelines for estimating available soil water from moist soil depths and rainfall probability maps for various time periods are available in Bulletin 356, Soil water guidelines and precipitation probabilities in Montana and North Dakota. This bulletin can be obtained by writing to: NDSU Extension Service Distribution Center, North Dakota State University, Box 5655, Fargo, North Dakota 58105.

The only way to accurately evaluate local soil water is by checking individual fields.

Harvesting Snow and Protecting the Soil Resource

The equivalent of 3 to 5 inches of water falls as snow across North Dakota during a typical winter. If only 1 or 2 inches of this water is stored in the soil during spring snow melt it could be worth an additional 5 to 10 bushels of wheat, depending on the year. More important, it may be the difference between recropping or fallow in the spring.

Precipitation received after freeze-up does not contribute to soil water storage until the spring melt period. Unfortunately, winter winds remove most of the snow from unprotected fields across all of the Northern Plains. Snow collects leeward of the first downwind barrier and much of it is ultimately lost as runoff.

Standing crop residues effectively hold snow where it falls and trap drifting snow from adjacent upwind fields. Crop residue height is important because snow will accumulate only to the height of the residue. Standing sunflower or corn stalks and small grain stubble are particularly effective, although any standing crop residue performs well.

Overwinter water storage of more than 2 inches is common where standing residues are left to trap and hold snow. About 50 percent of the water trapped as snow is typically retained as stored soil water. Maximum infiltration of snow melt water occurs when surface soils are dry in the fall. However, if soils are wet during freeze-up an impermeable layer forms that can limit snow melt infiltration.

Standing crop residue also protects the soil resource throughout the winter by reducing wind speeds near the soil surface. Wind erosion is reduced because of the lower wind speeds and because the residue shields the soil surface from the direct effects of the wind. This is especially significant in those years with little snow cover when bare soil would be exposed all winter. In addition, research has shown that evaporation in the spring is reduced from soils covered with crop residue. Thus, even more water is conserved.

How Samples Were Collected and Analyzed

Soil scientists from the Soil Conservation Service (SCS) collected soil samples to a 4-foot depth during the week of November 5, 1991. Fields were sampled along five east-west transects at 15-30 mile intervals. Sampling sites were in fields with standing small grain stubble or stubble that had been fall tilled. Additional samples were obtained from NDSU Branch Experiment Stations and NDSU field trial sites. Sampling was restricted to medium-textured soils with high available water storage capacity on gently sloping or nearly level sites. Locations where water ponded or runoff occurred were avoided. The soil samples were weighed and oven dried and calculations made to determine available stored water.

Comparison of stored soil water at sampling sites with September and October rainfall at nearby recording stations allows soil water data to be extended to other rainfall stations where soil samples were not obtained.

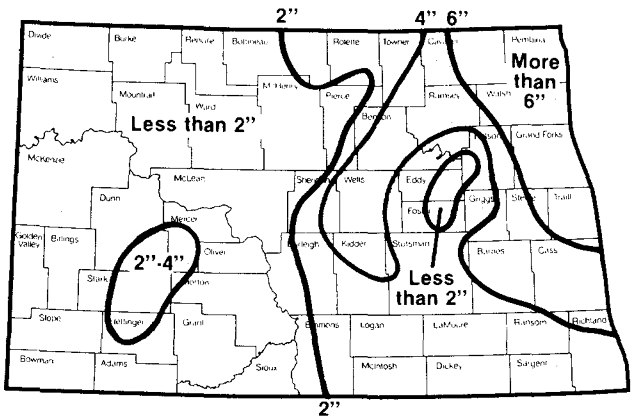
Historical Perspective

This is the eleventh year that a fall soil water survey has been conducted. Several of these soil water maps are included to provide perspective for 1992 growing season decisions and other interests.

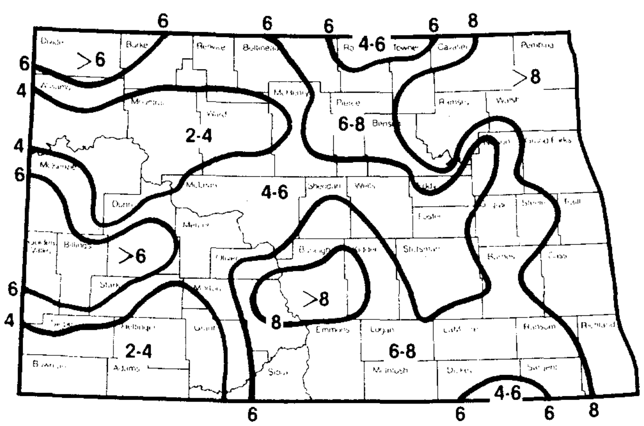
Drought conditions of 1980-81 prompted the initial survey. The outlook was dismal that first year because the survey showed half of the state had less than 2 inches of stored water. However, it also showed that conditions in the northeast were better than expected. That was the driest year for which surveys have been conducted.

Conditions during the fall of 1982 and 1986 were very wet. Soils over most of the state contained more than 4 inches of available water because of abundant fall precipitation. In 1982 southwestern North Dakota, typically the driest area, also had plentiful available water.

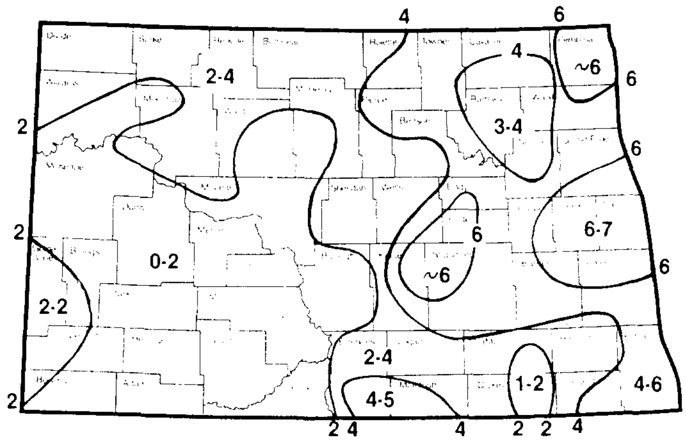
The majority of the years, 1983-85 and 1987-89, found fairly dry conditions in the western part of the state while the north-central, northeast, and portions of the east were wet. This is considered typical because of normal precipitation patterns and lower temperatures in the north. The 1990-91 surveys are similar in many ways to these typical years, but in both years conditions were nearly as dry as 1981, with an added feature of dryness in portions of the northeast.



Available soil water (inches), November 1, 1981



Available soil water (inches), November 1, 1986



Available soil water (inches), November 7, 1990

Acknowledgements

The authors wish to thank R. L. Clark, State Conservationist, members of his staff, and the USDA-Soil Conservation Service for their continued support of this project. The following soil scientists were responsible for soil sample collection and have first hand information on local variations in soil water. Their efforts were essential for this report and are greatly appreciated.

Fred Aziz	Watford City
Tom Champa	Dickinson
Lynn DesLauriers	Mandan
Larry Edland	Oakes
Earnest Jensen	Valley City
Richard Lee	Cando
Ron Luethe	Devils Lake
Mark Morrison	Fargo
Norm Prochnow	Jamestown
Richard Rolling	Crosby
Jim Seaholm	Fargo
Steve Sieler	Wishek
Michael Sucik	Williston

Special thanks to Donald E. Stoltz, Meteorologist In Charge, Bismarck National Weather Service Forecast Office for providing current climatic data and to the NDSU branch experiment station superintendents Ernie French, Tim Faller, Tom Conlon, Ben Hoag, John Lukach, Paul Nyren, and John Gardner, who have helped provide valuable soil water data throughout the year. The authors are also indebted to the many volunteers who monitor the weather each day.

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