Soil, Water and Drainage of Oahe Project Lands

Cooperative Extension, South Dakota State University
Historical, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

For current policies and practices, contact SDSU Extension
Website: extension.sdstate.edu
Phone: 605-688-4792
Email: sdsu.extension@sdstate.edu

SDSU Extension is an equal opportunity provider and employer in accordance with the nondiscrimination policies of South Dakota State University, the South Dakota Board of Regents and the United States Department of Agriculture.
Soil, Water, Drainage Plans

Good soils and plenty of good water is necessary for efficient crop production but too much water causes problems and makes drainage a necessity.

SOILS

The project lands of the Oahe Unit are located in the northern portion of the eastern half of South Dakota. They comprise lands proposed for irrigation in the Missouri Slope in northwestern Sully County just east of the Oahe Reservoir, and in the Lake Plain of Brown, Spink, Marshall, and Day counties at the northern end of the James River Basin within South Dakota. The Lake Plain is divided by the James River into two natural areas called the West Lake Plain and the East Lake Plain.

Land surveys have been made by the Bureau of Reclamation over much of eastern South Dakota in an effort to establish a sound basis for the Oahe Unit. Most of the land classified is suitable for irrigation when considering only the upper 4 or 5 feet of soil. However, it was necessary to eliminate all lands which did not allow water to penetrate rapidly below the 4 or 5 feet depth. In general, good subsurface drainage will be required down to the 8 to 10 feet levels, in order to attain a minimum water table of 4 to 5 feet.

Mapped with Land Surveys

The Missouri Slope and the Lake Plain have been mapped with semi-detailed land surveys. For the present time, the semi-detailed survey has been checked by detailed surveys on five different sample blocks covering about 10% of the total area. The detailed survey results were projected to the entire Oahe Unit using the semi-detailed surveys as a guide.

"Irrigable" land is land which can be economically served with water. These lands are divided into three soils classes based upon their ability to produce and profitably utilize the irrigation water. Repayment capacity of the lands are based upon these soil classes. They are known as Class 1, 2, and 3. Any soils that do not fit these three classes are placed in Class 6 and are known as non-irrigable.

When detailed land classification surveys are completed, the location of each land class will be shown on a map of each quarter section of land. These maps will be furnished to each landowner in the Oahe Unit. They will be important and necessary for each farmer as he develops his land for irrigation.

A summary of the irrigable land resulting from the surveys, is shown in the table below:

<table>
<thead>
<tr>
<th>MISSOURI SLOPE SOILS AND TOPOGRAPHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Missouri Slope lies in an upland area where glacial drift overlies shales. The soils possess a cover of weathered, wind-blown soils to a depth of 4 feet or more. Below this depth, there is a containing porous material of loessial or glacial materials down to at least 8 feet. The Missouri Slope is marked by gently-rolling to rolling topography. Topography, as a single factor, does not account for a very high percentage of the nonirrigable land, but when in combination with other factors, about half of the land within the over-all boundaries of the Missouri Slope fall into that classification.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAKE PLAIN SOILS AND TOPOGRAPHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Lake Plain area is in the bed of Lake Dakota, formed by glacial melt water dammed at the southern end near the site where Redfield is now located. The</td>
</tr>
</tbody>
</table>
lake was drained by the James River which established a channel through the high ground and now divides the lakebed from north to south.

The soils are formed mainly of water born sediments, reworked on the surface by wind action and mellowed by many years of vegetative growth. These sediments overlie a glacial till found at depths from 20 to 40 feet in the center of the area and on the surface at the shoreline of the old lake.

The boundary of the area has been established at a line roughly paralleling the old lakeshore where the lake sediments are 10 feet deep. Thus, all of the Lake Plain soils consist of sediments 10 or more feet in thickness.

Free of Rock

The irrigable soils of the Lake Plain are the deep, medium-textured soils. The surface and subsoil are free of rock. Waterholding capacities are good. Laminated silts characterize all profiles beginning at depths varying from 24 to 48 inches below the surface. The soil overlying the laminated material has been modified by forces of weathering.

Silt loam is the dominant texture at all depths of the 5 foot profile over the Lake Plain irrigable lands, with loam and light silty-clay loam next in order but of much less importance.

The general slope of the Lake Plain from north to south is very flat, there being a difference of about 10 feet only in elevation in a 50 mile distance. In the east-west direction, the slope is toward the James River, but is no more pronounced than in the other direction.

Other than general lack of slope, the topography is very favorable for irrigation development.

Subsoils of the Lake Plain generally possess a high degree of salinity and alkalinity at a depth of 4 to 5 feet. This matter was given long and careful study in the field and in the laboratory and has been resolved by the development of the subsurface drainage system.

WATER

The water in the Oahe Reservoir and the James River runoff is suitable for irrigation and other multiple uses. The Missouri River water contains about 543 parts per million (ppm) of total dissolved solids (TDS). Water containing 1,600 ppm of TDS or more should not be used continuously for irrigation.

Water, when applied to the land, adds to the responsibilities of the farm manager. He will need to pay close attention to the balance of nutritive plant foods in the soil as well as the amount of soil water. Failure to heed good management practices will show up more quickly on irrigated land than on dryland farming.

Both farmers and government planners often fail to realize that when you supply plenty of water to soil and crops, you do more than merely add water; you change the effectiveness of every other factor in the system, and, consequently, need to develop a new system of management.

Need for New Crop Varieties

The varieties of crops grown before irrigation had probably been selected for generations for drought resistance. The farmer wanted a variety which would produce some food to feed his family even during a very dry year. The rare years in which there was plenty of rain did not greatly concern him. He merely got a little "bonus" during such years.

But the drought resistant variety is seldom capable of making maximum use of the improved water supply. A new variety that will give the highest yields under the new moisture regime is needed. New cultural practices are also needed. With plenty of water the plant population can be increased. Rate of fertilization and possibly even the ratio of nutrients in the fertilizer will have to be changed. Weed problems will be different. New crop rotations that will use the land more efficiently also become possible with a dependable water supply.

This will call for changes in the traditional marketing system. The amount of water used will have to be properly regulated. Too much or too little will reduce net returns.

Irrigation Changes Community

This list of changes is incomplete but is sufficient to show that when you make irrigation water available to a community, new changes in customs, management, and living result. If maximum use is to be made with a minimum of costly mistakes, an experimental farm should be set up in the area to work out the changes in soil and crop management needed 5 to 10 years before the irrigation water is to become generally available.

It is estimated on an average a farmer will use about 1 ½ acre feet per acre of water annually. In order to supply this amount to the farm, it will require that 1.65 acre feet of water be released at Oahe Dam and .85 acre feet from return flow and natural flow in the James River, per acre irrigated.

Approximately 40 to 50% of the water is lost in transporting it through reservoirs and canals, and by evaporation and seepage. Facilities will be built by the project to bring water to the high point of the farm. The farmer will have to level the land and build lateral ditches to carry the water where wanted on his farm.

The irrigator will need to do advanced planning
of his water needs. The system used in allocating water on various projects will be: (1) water on demand with 48 hours notice, or (2) in periods of high usage, a system of rotation may have to be used. This may be necessary so that everyone will be able to receive all of the water needed.

The supply works have been planned to have sufficient capacity to take care of the proposed irrigated lands during periods of the 5 driest years on record. However, during short periods of extreme drought and high temperature, rationing may be used.

Many Uses for Water

It has been planned in this project that the water would be used for many different purposes. In addition to irrigation, it could be used for municipal and industrial use, for water pollution abatement, for flood control, for fish and wildlife areas, and for recreational areas.

It is important that we develop as many multiple uses for the water as possible. If present trends continue, the outlook for the supply of needed water in the Upper Missouri basin for the years 1980 to 2000 is serious. If this area is to share in projected population and economic growth, increased attention must be placed on our water supply and its efficient use. Water is becoming an increasingly important economic factor in the welfare of the people who live in the Upper Missouri River Valley.

DRAINAGE

For successful and permanent irrigation of the Oahe Unit, it will be necessary to remove the water which penetrates below the root zone of the crops. Because of the physical characteristics of the project lands, artificial aids to this removal will be required.

The basic measure for drainage is that the upper 4 feet of soil must be drained in 48 hours, and 1.5 inches of water must move through the soil to the drains in 21 days. The latter (1.5 inches in 21 days) is an estimate of the drainage water that will accumulate with normal operation on alfalfa fields, and is probably more than would be needed to maintain a salt balance. Therefore, it is believed that a salt balance can be maintained that will allow full agricultural production, and water tables will be held to safe levels. Drains designed to these measurements will be adequate to also remove seepage from laterals crossing irrigable lands.

The data obtained shows that tile drains probably will be required under most irrigable land to drain the soils. Spacing of the tile will vary from location to location. On the Lake Plain, the spacing is estimated to average 330 feet, with an average tile depth of 9 feet. On the Missouri Slope, the tile spacing is estimated to average 200 feet at an average depth of 8 feet. The tile will be 6 inches or larger in diameter and will be laid in a gravel envelope. Open-ditch collector and outlet drains will carry the drainage water out of the area.

Depth to the existing water table on the Lake Plain averages about 17.5 feet as measured in observation wells throughout the area, and the average annual fluctuation is about 1.3 feet. On the Missouri Slope, the water table is at a greater depth, but available data are too meager to permit conclusions as to its average depth or annual fluctuation.

Drains Necessary

An extensive system of surface and subsurface drains will be necessary to remove irrigation water not consumed, as well as storm runoff.

Three features of the drainage system are as follows:

1. Main drains will make use of the natural drainage channels which are to be deepened, enlarged, straightened, or otherwise modified to permit them to serve as outlets for all surface and subsurface water coming from the unit.

2. Collector drains will be open ditches which collect ground water from the tile drains and surface water from the surface drains, discharging it into the main drains.

3. Tile drains will be located under irrigable land at the depth and spacing needed to control the ground water.

Farm drains for the disposal of excess surface water into the project drainage system from each quarter section under irrigation will be the responsibility of the landowner. All other drains, including subsurface tile drains within irrigated farm units and one surface-drain inlet for about each quarter section under irrigation will be built and financed as project works.