DRAINAGE FOR SALINITY CONTROL

INTRODUCTION

Saline seepage is a major soil problem in the North Western Great Plains Region. Of particular concern, is its continued increase in size and severity. Drainage is one of several promising control measures.

ALBERTA SITUATION

In Alberta approximately 100,000 hectares of dryland are severely affected by saline seepage. Another 200,000 hectares are affected to a lesser extent. The problem is increasing at an annual rate of about 10%.

In 1979, 750,000 meter of pipe was installed on farmland in Alberta, and half of that on dryland. In general plastic corrugated pipe of 10 mm diameter is used. It costs 84¢ per meter.

Seven drainage contractors are operating in Alberta. They obtain their plastic pipe from two manufacturers, Big "O" (Taber) and Daymond Ltd. (Calgary). Recently the contractors and pipe manufacturers formed the Alberta Land Drainage Association, which is intended to promote their industry and police the quality of their work. Contractors charge 10¢ per 30 cm length and per 30 cm depth for installation, but this varies according to the size of the job and its location.

Drainage districts are organized for the purpose of maintaining major surface drains. Counties and Municipal Districts take on the responsibility of supervising or carrying out the maintenance work and taxing the farmers for it. The Department of Environment insists on the formation of such drainage districts when it provides financial assistance for the construction of major surface drains.

SURFACE AND SUBSURFACE DRAINAGE

SURFACE DRAINAGE of the intermittent ponds in the recharge area and of ponded water in saline seeps is a first and most important control of dryland saline seepage. The reasons are many fold:

- Draining the intermittent ponds in the recharge area aids in preventing saline seepage.
- Drainage water from those intermittent ponds is non-saline, and thus is not a pollution hazard.

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- The recharge area is by its nature more elevated and therefore provides a greater choice of outlets for its ponds.
- A shallow ditch is often all that is required to drain such ponds and therefore, can be constructed with farm equipment at a minimum of expense.
- Draining the ponds in the spring permits a farmer to work his field earlier and in its entirety.
- Surface drainage provides immediate, visible results and therefore encourages the farmer to try other more expensive and risky dryland saline-seep control measures.

A great deal of surface water drainage is also done by tile, especially where deep cuts are required. For surface water drainage mainly 15 mm or larger diameter tile is used.

SUBSURFACE DRAINAGE is also an important control, especially for bringing reclamation to completion. Before embarking on this expensive and risky measure other controls should be attempted, such as surface drainage, recropping, high moisture use crops, and salt tolerant crops. These less expensive controls will at least reduce the size of the saline-seep and expose its focal point. They will also improve the accessibility onto the site and its soil structure.

The Alberta Department of Agriculture and Environment provide a subsurface drainage investigation and design service. Each subsurface drainage installation should be preceded by a soil and hydro geological investigation, because of the great variation of these factors between saline-seeps. The following aspects are being determined: texture, saturated layers, ground water level, topography, and soil chemistry. On the basis of this information the feasibility of a subsurface drainage project is determined.

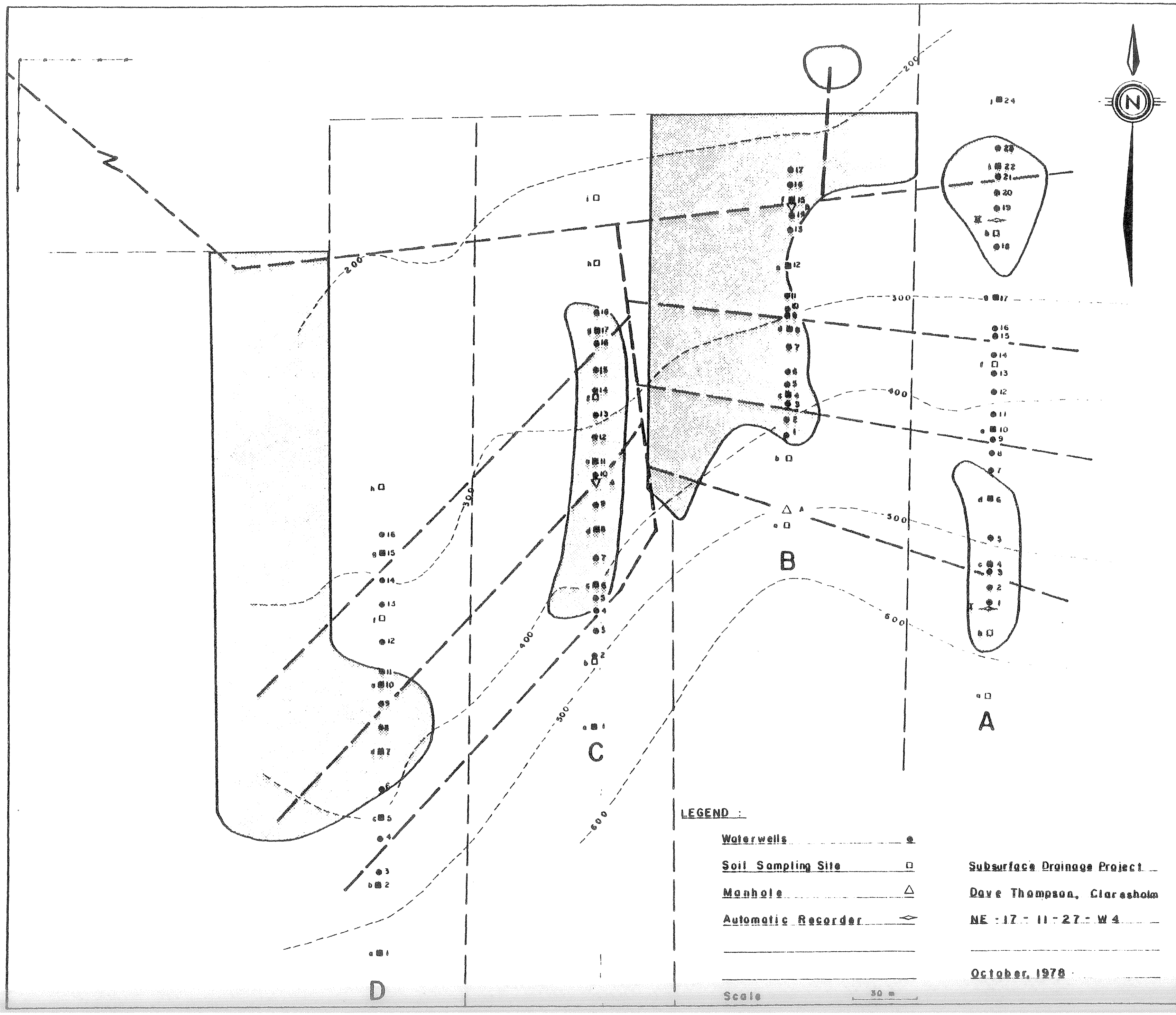
The recommendations in general are that subsurface drainage should not be considered for fine textured soils. The reasons being that the required close spacing makes the project prohibitive expensive and that until this date very few if any of such soils have proven to be reclaimable by this method. For the time being it would be safer and less expensive to continue to grow forages in and around such sites. For medium and coarse textured soils subsurface drainage systems are designed as part of the service. Generally these systems consist of a concentration of parallel lines in the center of the saline-seep, along with one or two interceptors placed slightly upslope. Lines are placed 15 to 25 meters apart, and at a depth of about 150 cm or more. Where a distinct, sizeable, permeable and saturated layer is present at about this depth the tile is placed at its bottom. Tile depth should be greater than the effective thickness of the capillary fringe of the soil plus the hydraulic head of the ground water between the tiles. Where 50% of the soil material is between .2 and .05 mm in size, or where the soil flows when wet, a filter is required. Mainly Dacron filters, prewrapped around plastic corrugated pipe is used at a cost of $.33 per meter.

Many failures of proper-designed subsurface drainage systems result from a reduction in the hydraulic conductivity of the soil material around the tile. This is caused by too much soil disturbance on account of improper installation conditions or practices. To prevent the loss of hydraulic conductivity, the following suggestions are given:

- Install tile in the latter part of the summer or fall. The water table is at its lowest and the soil is dry. Clod structure and aggregation are better maintained in a dry soil.
- Use a trencher in a layered, hard and dry soil. Its action will break up the layers and increase vertical permeability. On the other hand in a wet soil the trencher mixes and blends the excavated material to an extent that it becomes a structureless, deflocculated mess, unsuitable as a backfill. A plow causes less soil disturbance in such wet soils, although it does compact and smear the soil around the tile.
- To minimize the compaction by a plow, especially when ripping deep, we suggest to prerip to about 60% of its total depth. The prerip operation can be done when travelling back to the mainline, and thus causing no delay.
- To prevent shifting of the tile and washing and sorting of the blinding material by runoff, trenches should be back filled immediately and completely.
- To reduce pulverization of the soil and smearing of the walls run the wheel or chain of a trencher slow relatively to the forward speed of the machine.

During the last few years several subsurface drainage research projects have been installed on dryland saline-seeps in Southern Alberta. One of these is on a 10 hectare site, in the Granum area. Twenty-one hundred meter of 10 mm diameter plastic pipe was installed in October 1978, in a herringbone-grid fashion (see Figure 1). The average spacing was 50 meters and the average depth was 150 cm. The soil profile consisted of clayloam in the top 180 cm and sandy-clayloam below that. A hard, dry layer was encountered at a depth of approximately 250 cm on the upper

FIGURE 1



LEGEND :
Waterwells
Soil Sampling Site
Manhole
Automatic Recorder
Subsurface Drainage Project
Dave Thompson, Claresholm
NE - 17 - 11 - 27 - W4
October, 1978
Scale
30 m
A
B
C
D
200
300
400
500
600

part of the slope, and at greater depth on the lower end of the slope. The average electric conductivity of the soil was about 8 - 12 mS/cm, and the average sodium absorption ratio (SAR) 10 - 14, in October 1978. The highest salt concentration was at the lower end of the slope at a depth of 150 cm.

Water tables started to rise at the end of March, and reached their peak mid-May. Water table levels peaked simultaneously at the upper and lower end of the slope, indicating that the direction of ground water flow was upward rather than lateral. In mid-May water tables were well above the tile lines, and remained there for 1 to 3 months (see Figure 2). The tile on the upper end of the

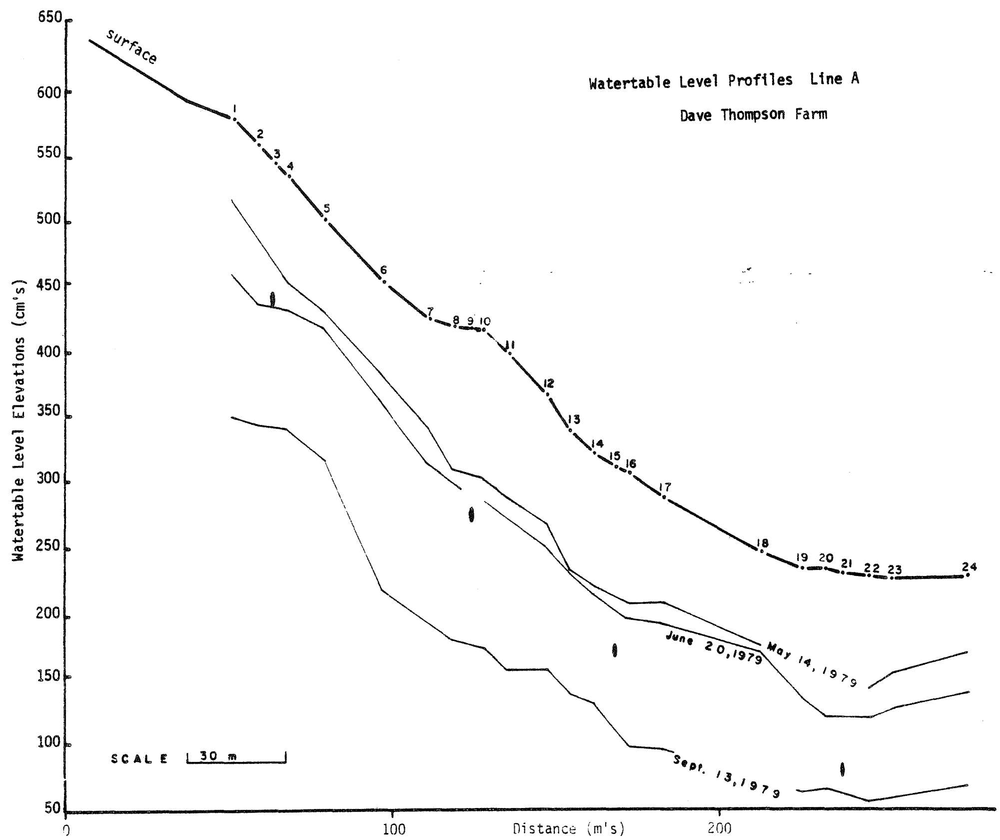


FIGURE 2 Water table level contours of line A in Mid-May, Mid-June and Mid-September 1979. Thompson Farm.

slope was operative for only one month. Definite areas of influence on the water table are noticeable above the tiles. These areas extend to approximately 20 meters, and on either side of the tile. The latter indicates that the tiles did not act as interceptors of a lateral flow.

Water tables dropped continuously during the next fall and winter.

Discharge rates reached a maximum of 80 L/min. in mid-May (see Figure 3). Flows tapered off gradually and stopped

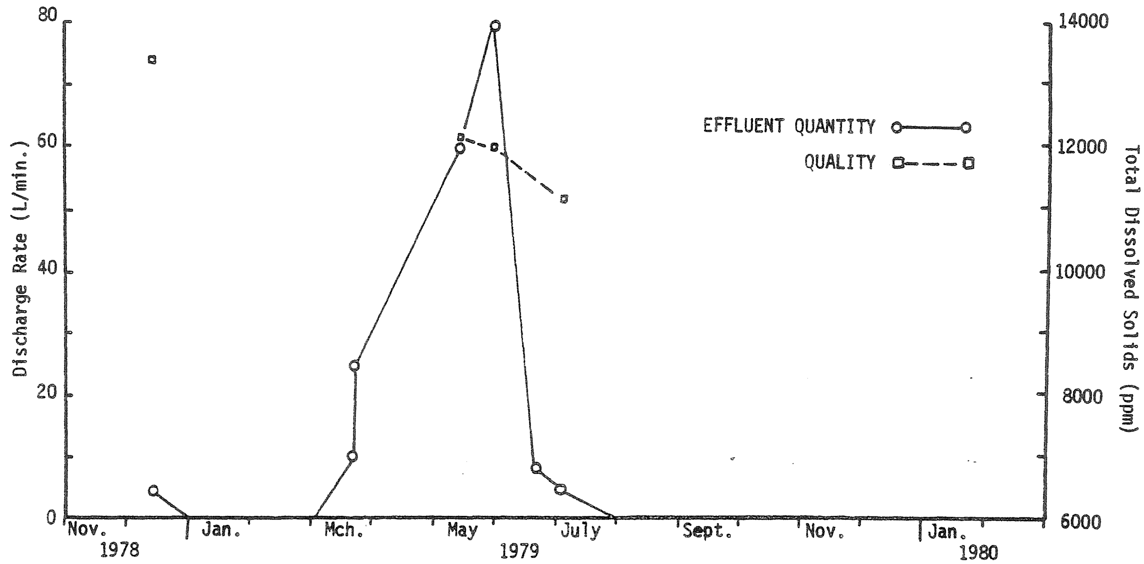


FIGURE 3 Effluent quantity and quality discharging from the outlet in 1979. Thompson Farm.

mid-July. A total of approximately 6000 cubic meters of effluent was discharged. Total dissolved solids (TDS) levels of the effluent were 11 - 12000 ppm, which resulted in a total discharge of roughly 66 tons of salt. The drain oulets into a saline closed basin.