Drainage
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture and Food

Order No. 543.200-1
February 1985
Agdex 752

MAINTENANCE AND CHECKING OF PERFORMANCE OF SUBSURFACE DRAINAGE SYSTEMS

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Introduction

The main purpose of subsurface drainage of agricultural land is to remove excess water from the root zone adequately and quickly after snow melt and rains. Subsurface drained fields dry faster allowing earlier cultivation and planting of field crops. This results in a considerable increase in crop yield. Other benefits of subsurface drainage include warmer root zone soil, easier movement of farm machinery, fewer weeds, increase in useable land and better harvest conditions. The soil structure may show gradual improvement for some years after drainage.

Subsurface drainage is a high investment operation. A greater return from agricultural land is expected after installation of subsurface drains. This higher return cannot be achieved without first examining the cropping system and obtaining professional help, if needed, to prepare a new cropping and fertilization program. In the meantime, the original investment in drainage must be well guarded with good maintenance.

Carefully installed subsurface drainage systems normally require very little repair after the first two years following installation. However, if the minor repairs which may be required are neglected, damage to the drainage systems will become more extensive and major and expensive reconstruction may be needed. Important items to look for in inspections and the repairs that may be required are explained in the following pages.

Plan of Subsurface Drains

The plan, which indicates the location and layout of drains in the field, is a very important and useful reference. Keep a copy of the plan filed in a convenient place. It should be shown to any individuals or groups who contemplate carrying out construction activities in the fields such as: utility crossings, highway extensions, movement of heavy equipment, extensions of existing buildings or construction of new ones, water pipe installations, etc. Persons dealing with such projects should be made aware of what is underground and where it is located in order to prevent damage to the drainage system, accidentally or otherwise, and to take the necessary precautions.

Mark on the file copy of the plan any work that is done in the field which may effect the drainage. Locate these works on the plan along with their dates of completion. The works that may affect the drainage include: ditch cleaning, change of boundaries, changes to farm lanes, land smoothing (cut or fill), crossings of utilities (power, water, sewer, communications), extensions of farm buildings, installation of water supply pipes, septic tank disposal fields or widening of roads. Familiarize yourself with the plan and layout of drains in the field. Learn the locations of the outlets and the boundary of the area served by each outlet.

Inspection of Subsurface Drains

Some of the most important points to be checked in order to ensure full performance of a drainage system are presented here. In a later section, details of diagnosis of malfunctions and related repair work are given.

The first year after installation of a subsurface drainage system is the most critical period in its life. Careful inspection early in the spring after snowmelt and after a rainy period followed by prompt repairs, if needed, are of great importance. The following are the main items for inspecting a subsurface drainage system.

a) Walk along all collectors and laterals a day or two after a heavy rainfall or following the spring snowmelt. Observe the presence of pondings or excessively wet strips as they may indicate blockage of a drain.

b) Check the settlement of backfill along the trench especially after the first winter. Deep holes in the backfill may indicate an inrush of surface water due to broken tile or drainpipe. Additional soil should be graded in to fill any sections along a trench where the backfill has settled below the field surface.

c) Check for blowouts or washouts of the trenches in sloping fields.

d) It is desirable to remove small bushes and trees that are close to subsurface drainage lines before they develop roots which enter and block the drain.

e) Check the outlet pipe for the following:

    1. Stability of the banks of the outlet ditch, if necessary, bring in some soil to fill the area around the outlet pipe. Any such fill should be thoroughly compacted. Stones (rip-rap) can be placed around and below the pipe to stop the erosion at the outlet.
    2. The presence of sand or silt deposits inside the pipe. Excessive amounts of sand result from the failure of filter material, collapse of a drain or a loose connection. Filter material may be needed for some spots in the fields, which show sand deposit problems.
    3. The color of the water flowing from outlet. If the water is cloudy or has an unusual color, it may indicate that surface water is entering the drain directly. Surface water should only enter the drain by seepage through the soil or through a sand trap or gravel filled trench. Direct entrance of barn or household wastes into the drain can be detected by the color of flowing water. It should be prevented at all times. Wastewater can spread into the soil through a septic tank and weeping drains. The water could filter through the soil to field drains but the two systems should not be connected directly.
    4. The presence of red to yellow gelatinous sludge or excessive deposits of red crusts may indicate problems related to iron compounds. In this case, you should consult the nearest Agricultural or Drainage Specialist.
    5. For submerged outlets, remove some of the sediments at the bottom of the ditch below the outlet pipe to allow direct outflow of water from the outlet to the ditch and to prevent sediments in the ditch from blocking the outlet pipe.
    6. Remove any debris that may be found inside the pipe. Ensure the presence of a rodent guard grill at the mouth of the outlet pipe.
    7. Replace the outlet marker if it is lost or tipped over.

Things That May Harm Subsurface Drainage Systems

1. Do not plant willows near drain lines as their roots can block the drains.
2. Never connect a household or barn waste disposal to a subsurface drainage system. Waste sediments may settle out and the nutrients in the waste may encourage the growth of organisms, which can cause blockage, and deterioration of drains.
3. Avoid direct entrance of surface water to a subsurface drainage system. If necessary, install a sand trap or gravel filled trench over a branch drain line to filter out sediments and allow only water to enter the drain.
4. Do not drive heavy wagons or machinery along the trench in the first year after installation of the drains. In the first year, the soil has not yet reached its final settlement and may be unable to support the loads of these vehicles without causing damage to the drain tile or to the vehicle itself.

Maintenance and Repairs of Malfunctions of Subsurface Drains

As soon as any malfunctioning of drains is observed, diagnosis and repair work should proceed. This section presents a guide for the diagnosis and the repairs required for the most common malfunctions of subsurface drainage systems.

1. Ponding

The accumulation of surface water alongside or in the direction of a lateral drain which disappears 2 to 3 days following a rainstorm may indicate the presence of compacted soil with low permeability in this location. But if the water remains on the surface for extended periods after rainfalls while the rest of the field has dried, it may indicate malfunctioning of this drain, possibly a broken tile or damaged tubing. To verify this, mark the location with stakes and then in the dry period, dig out the subsurface drain at a location downstream from the ponding. Make an opening in the drainpipe and push a plumber's snake along to check for a blockage in the pipe. Repeat the digging at the place where the broken part is located. Replace this section of pipe carefully with tubing or tile of the same size and backfill again. Care must be taken to prevent the soil from entering the drain during repair work. That is why it is best to do the work during the relatively dry period. If the water flow rate in the drain is small and no blockage of the pipe is found, this indicates low permeability of the soil near the drain. In this case, slow drainage is due to the soil and not the drainpipe. A surface drain may be required to drain this part of the field in addition to the existing subsurface drains.

If the surface water is flowing to a ponding and not draining away fast enough to the subsurface drains, some land smoothing or filling and possibly a surface drainage furrow or ditch may be required. One or combination of these solutions will help in diverting the surface water from the pondings. This will help to make the whole field suitable for tillage or other operations at one time.

2. Blowout

A blowout is characterized by the flow of water from underground to the surface in a location where there is a subsurface drain. This occurs especially after a heavy rain and indicates that a pipe has been broken or has separated resulting in the flow of water being restricted downstream from the blowout. The water flowing from upstream builds up pressure which an force the water to rise to the ground surface. Blowouts are probable in a land with a steep grade and at the connections of drain lines. The repair work should be carried out during a dry period to avoid having a soupy condition in the trench. A trench can be dug along the location of the damaged pipe, usually downstream of the blowout. The damaged pipe should be replace by a new section of pipe or tile of the dame diameter and the trench should be backfilled with soil and compacted around the pipe.

3. Trench Washout

A washout of the trench is the removal of the backfilling soil and materials from the trench by erosion due to the rapid flow of surface water along the trench. In some severe cases of washout, the drainpipe may be partially or totally exposed or washed away and the sides of the trench may be badly eroded. This has happened in trenches of steep grade in the first year after installation during exceptionally heavy rainstorms or during the spring runoff. There are several factors that may cause a washout after rapid surface runoff. These factors include the instability of backfilling of the trench, saturation of the soil in addition to possible pressure build-up in the drainpipe.

During a relatively dry period, the repair work may proceed following these steps:

a) Clean out the debris and loose soil from the trench.

b) Dig up the exposed tile or tubing, examine it and discard if damaged.

c) Place the new tile or tubing, the same diameter as the old one, on firm ground at the bottom of the trench and keep the pipe on a constant grade. If the existing trench is badly eroded at the bottom, dig a new trench nearby at the same grade and place in the drain. Connect both ends carefully to the rest of the drain line.

d) Backfill the trench with soil and compact it around the drain. Allow extra soil to be left on the top of the trench for future settlement.

e) Make certain that loose soil does not enter the drain during the repair, and if the original drain is wrapped with a filter material, the new line must also be wrapped with a good quality filter material.

f) If the washout has been on a steep section of a collector line, it is probably best to replace this section with a non-perforated corrugated plastic drain tubing of equal diameter. If this section of collector pipe was intended to provide subsurface drainage, as well as collector drainage, a perforated 3 or 4 inch diameter lateral pipe could be installed in a new trench nearly or carefully installed 6 inches above the collector pipe on compacted soil in the same trench provided, there is 24 inches of cover for the special lateral pipe.

4. Erosion at Drain Outlet

When a subsurface drainage system has an outlet into a gully or creek with steep side slopes in areas where landslides are known to have occurred, erosion at the outlet site might occur during the spring runoff. The severity may range from slight bank erosion to a sizeable landslide. If either case occurs, corrective measures should be taken to stop any further extension of this erosion as soon as soil conditions permit working around the affected area.

The following steps may be taken:

a) Dig up the affected outlet pipe and drain tile or tubing until firm ground is reached.

b) Place a new section of non-perforated collector pipe of the appropriate diameter on grade on firm soil with adequate cover (at least 2 to 3 ft.). Compact the soil around this section of drainpipe.

c) Grade the eroded bank to a gentle slope of at least 2.5:1 side slopes, compact it and seed it with an appropriate grass to stabilize it.

d) Prevent surface runoff from the field from passing over this affected area by digging a shallow diversion channel to direct surface water into the ditch in an area where the bank is stable. Use a drop structure if necessary.

e) In some cases where the side slopes are very steep and the bottom of the watercourse is deep, liners, cribbing, a sheet metal retaining wall or gabion baskets may be used to protect the bank from erosion by placing them to form a wall parallel to the bank and anchored into firm ground.

5. Blocking of Drains by Sediment

Soils with a high content of fine sand or silt pose a hazard to the subsurface drainage system. The fine particles may flow into the drains and block them unless they are protected by a filter wrapping. If appreciable quantities of particles enter the drain, most of it remains inside the drainpipe reducing the available space for conveying water. To prevent this, the tile or drain tubing should be wrapped with filter material before or during installation to stop the fine particles from entering the drain, fine sands and silts may enter the drain. If the filter material is not of an appropriate kind or if it is not placed all around the drain, fine sands and silts may enter the drain and block it. Drain blockage can be observed by inspecting the outlet pipe first. If it shows accumulation of silt or fine sand, then the collector (the main) and possibly some lateral are affected by these sediments.

The laterals that are blocked can be located by the fact that it takes a longer time for the strip of land served by the lateral to drain comparison to the unblocked laterals in the same field. Digging up the lateral near the connection with the collector (main) will help to find out if either the lateral or collector is blocked. If water is readily available in the location, the drain can be flushed using high-pressure water jets and plastic pipe. It is practical to flush out pipes of 6 inch and larger diameter but it is less expensive and gives a better job to replace a 3 or 4 inch diameter drainpipe than to flush it out. Any pipe replaced due to blockage with sediment should be replaced with a filter-wrapped pipe.

6. Drains Blocked by Roots

Water-loving trees such as willows and elms growing near the drains may extend their root system to the drain in search for water during the dry season. The roots enter the drain through the openings or joints and extend themselves in the drain reducing the effectiveness of the drains in conveying water. When this happens, the area upstream will take a longer time to dry and may have water on the surface for extended periods. Digging a trench near the tree down to the drain will verify the root growth. If the tree is not essential, remove the tree and replace the affected section of drainpipe. If the tree is to be retained, replace the affected section of pipe with a continuous length of non-perforated pipe at least 200 ft long.

7. Collapsing of Drain Pipes by Heavy Loading

The subsurface drains are normally installed in the field with adequate cover of about 2 to 3 feet or more. This cover is enough to prevent collapse of the drain from normal loading by common farm vehicles and equipment. The deeper the drains, the more protection it has against heavy loads. However, in some instances, heavy equipment may be used in the field for non-agricultural purposes. Under some unfavorable conditions, with the presence of stones adjacent to drains, shallow cover, very soft soil and excessive or repeated loading by heavy equipment may cause deep ruts and crushing of the drainpipes. The result is a reduction of the water flow in the drain that may be observed by the presence of wet strips along the affected drain and in some cases, a blow out may occur upstream from the crushed drain. In such a situation, the damaged drain can be located, dug up and replaced by tubing or tile of the same diameter. Backfill the trench carefully removing any stones from the soil used (extra backfill is to be left on top of the trench for future settlement).Shallow drains crossing laneways should be replaced by a steel pipe.

2. Iron Oxide Blockage

In a few soils, iron compounds may be deposited around the drain forming an insoluble crust that can block the opening of the drain or filter materials around the drain and reduce the amount of water flowing to the drain. Some compounds enter the drain and are deposited inside or encourage a growth of organisms forming a gelatinous sludge which may cause blockage along the drain. The cause of these phenomena is not clearly known.

Recent research suggests that some microbial and chemical reactions under certain climatic and soil condition may lead to precipitation of iron compounds or sludge formation. An indication of the presence of such a problem is the presence of deposits of a hard crust or gelatinous sludge (red to yellow color) in the outlet pipe. If the effectiveness of the subsurface drainage system is reduced by this problem, the drains can be flushed with a pressurized water jet. This flushing may help to get the system operative for some time from recurring but cannot stop the problem from recurring.

Research work is underway in Canada, United States and Europe to obtain a better understanding of this problem and find some possible solutions.

8. Outlet Ditches

Open ditches convey excess water from the field to larger river channels. If a ditch is blocked by debris or weeds, or is silted up, its hydraulic capacity is reduced. This results in a delay in the removal of water from the field and possibly over bank flow and flooding of adjacent land. Care must be exercised continually to maintain open ditches especially those serving as outlets for subsurface drainage. The following are brief recommendations of what should be done:

a) Routinely check the ditch and remove all debris such as trees, timbers, branches, etc., from the channel and especially at culverts and bridges.

b) Keep the culverts clean by removing any sediment from the culvert and placing it on the bank.

c) Use electric fences to prevent cattle from grazing on the ditch banks.

d) Do not allow pigs in a ditch at any time.

e) To help stabilize the banks of newly dug ditches, the banks should be seeded with a grass mixture suitable for the soil and climatic region. The root system may stabilize the soil and the grass reduces erosion. This grass may be mowed in subsequent years and reseeded if necessary.

f) Some undesirable weeds or aquatic plants may thrive in the ditch reducing its effectiveness. Removal of these plants by burning or by some chemical method is possible, but special permission is required in each case. Check with the appropriate authority in the Provincial Ministry of Agriculture or Environment for regulation concerning use of chemicals or burning. A backhoe or drag line may be needed to remove these plants mechanically if the growth is thick. Some special ditch cleaning buckets for backhoes are now available.

g) Some sections of a ditch bank may slough off into the ditch because the soil has insufficient shear strength in a local area. In these special cases, the bank should be cut flatter with a backhoe and reseeded.

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