INTRODUCTION
A subsurface drainage system is a significant financial investment. There is no better way to protect that investment than with regular and proper inspection and maintenance of the system. Even a well-designed and constructed system, built to last a lifetime, must be carefully maintained. This Factsheet provides information to help complete the initial and ongoing inspection and maintenance of a subsurface drainage system.

The five pillars of an effective subsurface drainage system are:

- quality material — including pipe, envelope/filter (if necessary), fittings, risers, etc.
- proper design — completed by a licensed drainage contractor or a professional engineer
- proper installation — completed by a licensed drainage contractor
- compatible land management practices
- regular inspection and maintenance

Properly designed and constructed drainage systems require minimal maintenance and repair after the first few years following installation. However, it is important that a new subsurface drainage system be carefully inspected and maintained for the first two or three years. Any weak spots that have developed in the lateral and main drains and any backfilled areas that have settled can be remedied and filled in. There is some ongoing maintenance to complete every year but this should be minimal for most systems.

THE IMPORTANCE OF THE DRAINAGE PLAN
A drainage plan indicates the location and layout of lateral and main drains, outfalls, surface water inlets and other structures in the field. It is a very important document to use for future maintenance. Keep this document with the property deed, so that even if the property ownership changes, the drainage information is kept with the farm. Some municipalities require or allow for storage of the drainage plan at their office. This creates a permanent record, which helps locate the drains for future subsurface drainage repair or improvements.

A good drainage plan includes the following:

- date of construction
- name of installer (i.e., contractor or landowner)
- identification of any changes made during installation from the original plan
- lateral spacing, size, depth, grade, footage and material
- main location, material, size, depth, grade and capacity
- details of any construction problems encountered during the installation
- location of all outfalls, surface water inlets and other structures
- location of utilities, sand pockets, springs, etc., that may affect future maintenance

The contractor should provide a copy of the plan of the drainage system to the landowner following the completion of the job. If a formal plan has not been provided by the contractor or if the landowner does the installation, a simple pencil sketch that provides the same information is acceptable. In the absence of a proper plan, obtain an aerial photograph of the work area, similar to that shown in Figure 1, to show the drainage system.
Global positioning systems (GPS) are increasingly being used for surveying and installation of drainage systems by contractors in Ontario. A GPS system generates a detailed drainage map showing the exact location of the drainage system as well as existing field conditions such as field boundaries, contours, etc. The contractor can provide a printed and/or digital version of the plan to the landowner following installation. If your contractor does not use GPS to install the system, use a handheld GPS to record the coordinates of all outfalls, surface water inlets and other structures.

It is important to keep the drainage plan up to date by revising it whenever changes or repairs are made to the system.

**INITIAL INSPECTION AND MAINTENANCE**
What happens during the initial period following the installation of the new subsurface drainage system is critical to ensuring it functions properly for years to come. The soil around and above the drains will still be loose and should be left alone to settle naturally with time and rain. Do not use equipment to pack down the soil over the drains, as any heavy pressure on the loose soil could damage or collapse the pipes. Minimize traffic on the field for as long as possible, and straddle the laterals and mains with equipment or work across (not parallel to) the drains when working the field in the first year after installation.

Using the drainage plan as a guide, locate, inspect and mark all outfalls and surface water inlets for reference when spreading nutrients on the property and for future maintenance. Use a durable, permanent marker that is highly visible above crops and tall grass. Ensure the workmanship of the system is good, as there will be limited time to access the warranty period provided by the contractor, typically one year following installation.

Confirm that all surface water inlets are fitted with a proper guard or grate to keep debris and trash out of the subsurface drainage system.
Ensure that a grate or rodent guard is installed on all outfall pipes to prevent unwanted entry by burrowing animals such as rodents, muskrats, rabbits and foxes (Figure 2). Check for burrowing animal activity around the outfalls; if any signs exist, arrange to have the animals legally removed.

To minimize ice damage and sedimentation, locate the bottom of the outfall pipe(s) at least 300 mm (12 in.) above the normal water level in the receiving drainage channel or natural watercourse. Otherwise, the outfall(s) may require additional ongoing maintenance. During the first year, sediment may appear in the outfall due to the soil settling. Under normal conditions, the outfall should flow free and clear from any sediment or debris.

Confirm that the contractor has installed a rigid, non-perforated end pipe. Standard corrugated plastic tubing is not satisfactory as it can be damaged. The pipe should be sufficiently durable to resist weather, animal damage, crushing, and ice or fire damage. It should extend into the ditch far enough that the flow will not erode the ditch bank. See OMAF and MRA Factsheet, *Subsurface Drainage System Outfalls*, Order No. 13-035, for additional details on the construction requirements for an outfall.

The water that discharges from the outfall can cause erosion in the receiving drainage channel or natural watercourse. Check to see if the contractor has installed sufficient erosion protection to prevent this from happening (Figure 3).

**ONGOING INSPECTION AND MAINTENANCE**

It is important that the drainage system is periodically inspected and maintained over its life span. The ideal time to inspect the system is in the spring, late fall and after a significant rainfall event — when the soil is wet and the drains are running. Prompt repair of any noted issues will ensure that the system is always in good working order and will prevent a more serious issue from developing.

Remember to make records of any maintenance/repairs and changes to the system on the drainage plan. This will ensure that there is always an accurate plan of the system for future inspection and maintenance.

**IN THE FIELD**

Check for any signs of erosion of the drainpipe trench following rain events, especially in the first few years. Inspect the mains and laterals a couple of days after a heavy rainfall to look for any signs of ponding or excessive wet spots in your field. This may indicate that a blocked drain exists and will need to be repaired.

Uniformity of crop growth is another good indicator of a properly functioning drainage system. Ideally, the field should dry evenly and produce similar yields. Watch for changes in crop yield in different areas of the field annually to see if there is a slower developing problem in the drainage system that may need repair. Take periodic aerial photographs of the farm to get an overview of the drainage system and to identify potential drainage problems.
When drains get plugged, water rises to the surface at the point of the water stoppage. Dig up the drain at the wet spot and repair it. Mark any locations of concern and contact a licensed contractor to complete the repair as soon as reasonably possible. If the fields are wet, it may be better to wait for drier conditions to make the repairs to avoid damaging the soil structure.

If drains carry water for a prolonged period during the growing season, they can become plugged by tree roots (Figure 4). A good design will route the drains (both laterals and mains) at least 30 m (100 ft) from water-loving trees such as willow, soft maple, elm and poplar and at least 15 m (50 ft) from all other types of trees.

If the drainage system becomes blocked with tree roots:
- Reroute the drainage pipe away from the tree(s).
- Remove and replace the section of blocked drains and remove the tree(s) causing the problem.
- Replace the drain using continuous non-perforated pipe for a distance of 15 m (50 ft) on either side of the tree.

Some commercial crops have roots that grow into drain lines and clog them. Roots from annual crops such as alfalfa, brome grass, rye grass, canola and sugar beets will usually clear themselves when the crop is harvested. If a problem is encountered:
- Avoid growing the problem crops again.
- Flush the roots from the drain pipe using low-pressure jet cleaning.
- Remove and replace the blocked section with a larger diameter drain pipe.

Silt boxes and catch basins are often installed at critical points in the system. Inspect and clean them out annually. Ensure their covers fit tightly and are free from structural damage. These structures should always remain locked to prevent unwanted access and tampering.

Check for any signs of wash-ins and blow-outs, which can indicate that there is a broken drain pipe, and surface water has entered the drain (Figure 5). At the first sign of the smallest surface hole, repair the damage before too much sediment enters the subsurface drainage system and reduces its hydraulic capacity (Figure 6).
Consider these options if the drainage system is filled with sediment and is not functioning properly:

- Renovate subsurface drains that have become filled or partly filled with sediment. This should only be completed when the cost of renovation does not exceed 70% of the cost of a new drain.
- Dig up, clean and re-lay existing clay or concrete drain pipes. While it is too costly to dig up and salvage drain pipe 150 mm (6 in.) or less in diameter, it is cheaper to salvage larger sizes, if they are still structurally sound. Consider digging and re-laying only where the drainage pipe is not damaged, carelessly laid with joints having wide gaps or not protected with a cover material to exclude sediment.
- Clean lateral drains through the use of sewer-cleaning rods or flushing if the deposit is only for a short stretch of pipe. Thick deposits over the length of the pipe are difficult to remove.

Cleaning subsurface drains uses the same procedures as cleaning sanitary sewers. Holes are dug down to the drain at intervals of 10–25 m (33–82 ft), depending upon the size of the drain and the amount of sediment to be removed. A short section of the drain is removed to allow a fabricated steel rod with a hook or corkscrew end, or short-jointed sewer rods, to be inserted into the drain. It may be convenient to dig the hole below the level of the drain as a temporary sediment basin. The steel rod with the corkscrew end is inserted from the lower end of the drain until resistance is encountered. The rod is screwed into the sediment and removed several times. After the rod has been pulled through the drain several times, clean the drain further with a ball of barbed wire or a chain.

Flushing the drain is also recommended. To flush and clean a drain, a reasonable supply of water must be available. Special drain-flushing equipment is available, and the success of the procedure depends on the nature of the deposit in the drain.

Use a large volume of water for flushing rather than high pressure. Low pressure (480 kPa) jet-cleaning of 100 mm (4 in.) drain pipe up to 175 m (574 ft) in length is successful when the deposits are mainly iron ochre and iron sulfide (FeS). In sandy areas, jet-clean the drain soon after the deposition occurs. The flow rate required is approximately 75 L/min (20 US gallons per minute).

High-pressure jet-cleaning will not clean a significant distance down the drain. However, high-pressure pumps (8,300 kPa) are successful in removing some sands from drains. In most cases, it usually only spreads out and levels the deposit.

A water supply is needed to flush the drainage system. Consider using an irrigation system if one is available on the farm. If the water supply is limited, a catch basin, or hole at the upper end of the plugged section will serve as a water reservoir. Block off the upper end of the drain and fill the catch basin or hole with water, then remove the block and allow the water to flush suddenly through the drain. This simple procedure of flushing may solve the problem.

There may be regulatory concerns with flushing any sediment into the receiving water body. Contact the local conservation authority or a Ministry of Natural Resources office prior to starting any flushing activities.

**SURFACE WATER INLETS**

Inspect all surface water inlets (Figure 7) twice a year (spring and fall), and ensure that all of the markers are still in place and clearly visible. Re-mark if necessary.

Remove any trash, debris or plant material that has accumulated around the inlet to make sure that it functions properly.

Check the structural integrity of the riser inlets and repair or replace, if necessary.
OUTFALLS
Make thorough inspections of all outfalls in the spring, fall and after severe storm events when the soil is wet and the subsurface drains are running. Make sure that all of the markers are still in place and clearly visible. Re-mark any if necessary.

Examine end pipes and any erosion control such as riprap aprons for scour and undermining and to confirm that water is not draining from under and/or around the end pipe.

Check the end pipe for damage caused by ice. Remove any trash, debris or plant material that has accumulated around the end pipe to ensure that it continues to function properly.

Make any repairs or replace the grate or rodent guard if necessary to prevent unwanted entry by burrowing animals. Check for any new animal activity around your outfalls. If signs exist, arrange to have the animals legally removed.

Look for any signs of reddish-orange slime coming from the outfall. This may indicate the presence of iron ochre, which can plug the drainage system.

Look for signs of sediment in drain discharge and in the receiving ditch. Sediment at the drain outfall indicates that there is soil entering the drainage system from bad joints, crushed pipe or the need for a drain envelope. Quite a bit of sediment may come out of the system in its first year, but this should not persist. Locate the area where the sediment is entering the drainage system and repair the drain or remove the sediment using one of the methods described earlier in this Factsheet.

Have the receiving drain cleaned if it has accumulated sediment and is negatively affecting the outfall. Contact the local municipality if the outfall discharges to a municipal drain — never complete any work on a municipal drain. Contact the local conservation authority or MNR office if the outfall discharges to a natural watercourse. In all cases, obtain all necessary approvals prior to starting any work.

RESOURCES
For more technical information on planning, design, construction and maintaining a drainage system, see OMAF and MRA Publication 29, *Drainage Guide for Ontario*.

For more information on complementary practices, see BMP 25, *Best Management Practices: Cropland Drainage*.

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