Subsurface Drains

Figure 6.61 A gravel-filled trench is one of several ways to solve subsurface drainage problems. Note safety barrier around the trench. Source: Bob Clay, Missouri Department of Natural Resources, Nodaway County

Practice Description

A subsurface drain is a perforated pipe or continuous layer of porous material installed below the ground surface that intercepts, collects and carries excessive groundwater to a stable outlet. Subsurface drains by themselves do not provide erosion control.

The purpose of a subsurface drain is to reduce storm water runoff volumes, and improve soil moisture conditions, vegetation growth and ground stability. Subsurface drains also prevent wet, soft ground from interfering with construction activities. Drains may be constructed using a gravel-filled trench, perforated pipe in gravel bedding or manufactured drain panel products. This practice applies where groundwater is at or near the ground surface or where adequate drainage cannot be provided for surface runoff.

Recommended Minimum Requirements

Prior to start of construction, subsurface drains should be designed by a registered design professional. The site superintendant and field personnel should refer to plans and specifications throughout the construction process.

Drainage system layout, depth, construction details and specifications should be included in the design plans. Some aspects of the design may depend on-site specific conditions not known or only estimated prior to installation and will need to be verified or modified during construction.

The timing of construction of these devices is critical. They should not be installed prior to final stabilization of the area where they will collect sediment laden runoff. Subsurface drains are not intended to collect sediment. If they do, they may become blocked or clogged and need to be reconstructed.

During the construction process, prior to final stabilization, infiltration trench excavations shall be completely protected from storm water runoff. These protection methods may include diversions, berms and other approved runoff barriers. Final placement of subsurface drain fill material and connection to the storm sewer system shall take place after the drainage area from which it receives water is completely stabilized.

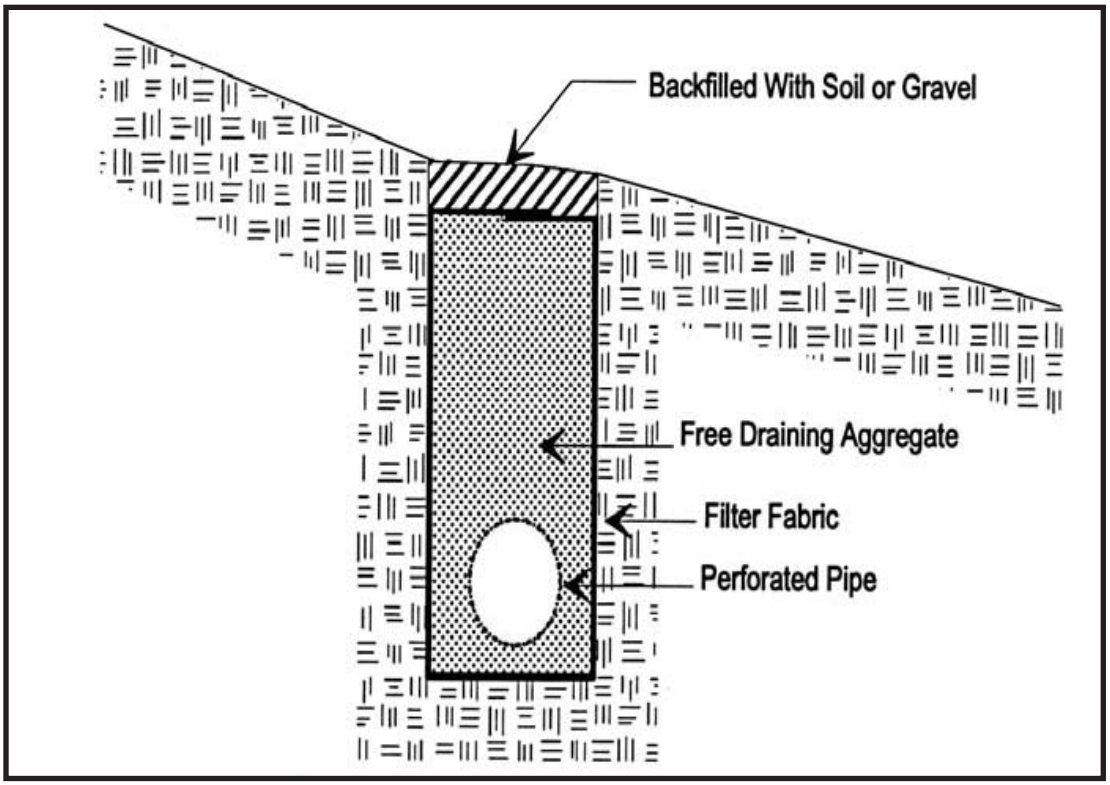

Figure 6.62 Typical Detail for Installation of Subsurface Drain

Layout and Depth

Generally, a depth of 3-feet and a spacing of 50 feet will be adequate.

Depth

Depth of the drain will determine how much the water table is lowered.

- Maximum: Limited by the impenetrable layer, and if pipe is used, by the allowable load on the pipe.
- Minimum: 2-feet under normal conditions.
- Spacing: Dependent on soil permeability and the depth of the drain.
- Multiple Drains: Determining the required spacing can be difficult. Install the first drain. Install an additional drain if seepage or high water table problems occur.

Location

Over 50 feet from the dripline of any trees.

Grade

Grade trench according to the design plan to prevent siltation within the drain. Steep grades should be avoided.

Gravel Bedding
Three inches or more of gravel placed completely around the drain and graded to prevent the infiltration of fine-grained soils into the drain.

Filter
As specified in design plan; determined by soil permeability. Usually filter fabric, although gravel bedding may be designed as a filter to prevent migration of fines.

Outlet
To a stable watercourse, with outlet above the mean water level in the receiving channel. Protect drains from erosion, undermining, damage from periods of submergence and the entry of small animals.

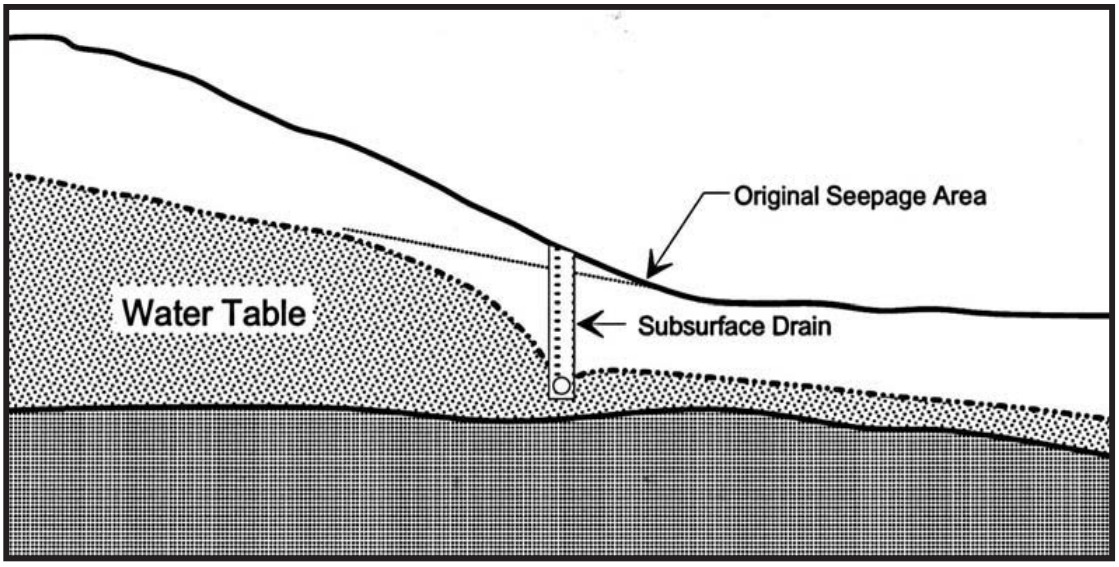

Figure 6.63 Detail of typical subsurface drain construction

Clean-outs
Required for long sections of drain.

Materials
Perforated, continuous closed-joint pipes of corrugated plastic, concrete, corrugated metal or bituminous fiber.

Strength and Durability
Should meet the requirements of the site in accordance with the manufacturer's specifications.

Construction
Installation
- Prior to excavation activities of any type, call 1-800-DIG-RITE (344-7483) to obtain utility locations.
- Dig a trench to specified grade at least 3-inches (or as shown on the design) below the design bottom elevation of the pipe to accommodate the gravel bedding or filter material.
- Line trench with filter cloth, providing enough material to fold it back over the top of the finished gravel bedding. This helps prevent movement of soil into the gravel.
- Lay pipe on the design grade and elevation avoiding reverse grade or low spots. Do not use damaged, deformed, warped or otherwise unsuitable pipe.

- Place bedding material around pipe with at least 3-inches (or as shown on the design) of material on all sides. Place gravel around drains for proper bedding and improved flow of groundwater into the drain.
- Ensure gravel for bedding around flexible pipe does not exceed 3/4 inch in size to prevent damage to the pipe.
- Fold filter cloth over the top of the gravel bedding.
- Backfill immediately after placement of the pipe and bedding. Ensure the material does not contain rocks or other sharp objects and place it in the trench in a manner that will not damage or displace the pipe. Overfill the trench slightly to allow for settlement.
- Install clean-outs for maintenance as shown on the design plan.
- Construct the outlet above the mean water level in the receiving channel as shown in the design plan. For the outlet section of the drain, use at least 10 feet of non-perforated corrugated metal, cast iron, steel or heavy-duty plastic pipe. Cover at least 2/3 of the pipe length with well compacted soil.
- Place a suitable animal guard securely over the pipe outlet to keep out rodents.
- Cap the upper end of each drain with a standard cap made for this purpose, with concrete or with other suitable material to prevent soil from entering the open end.

Erosion Control

- Stabilize any soft, yielding soils under the drain with gravel or other suitable material.
- Keep the settled fill over the pipe outlet slightly higher than the surrounding ground to prevent erosion and wash out from surface runoff. Apply seed and erosion control to the fill as soon as installation is complete.
- Provide for energy dissipation at the outlet of the pipe (see Energy Dissipators section.)

Safety

Narrow trenches are subject to collapse and can be a safety hazard to persons in the trench. No person should enter a trench without shoring protection or properly sloping the sides of the trench. Follow Occupational Safety and Health Administration, or OSHA, guidelines for trench safety.

Construction Verification

- Verify the dimensions shown on the plans for the following: location and length, depth and cross section of trench.
- The dimensions and specifications of the aggregate used in the bedding and manufactured materials such as pipe, tile or panel drain should be verified.

Maintenance, Inspection and Removal

- Inspect subsurface drains periodically to ensure they are free-flowing and not clogged with sediment.
- Keep outlet clean and free of debris.
- Keep surface inlets open and free of sediment and other debris.
- Trees located too close to a subsurface drain often clog the system with their roots. If a drain becomes clogged, relocate the drain. Drains should not be located within the dripline of trees.
- Where drains are crossed by heavy vehicles, inspect the pipe to ensure it is not crushed.
- If this practice is temporary for construction only, it must be removed and the site stabilized prior to filing *Form H: Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Troubleshooting

Consult with a registered design professional if any of the following occur:

- Variations in topography on-site indicate subsurface drains will not function as intended.
- Design specifications for aggregate or manufactured products cannot be met; substitutions may be required. Unapproved substitutions could result in failure of the drain to function as intended.
- Sediment discharges into the device clogging it; area draining to the subsurface drain must be stabilized prior to installing the drain.

Common Problems and Solutions

Problem	Solution
Poor drain performance; caused by bedding material that does not allow groundwater to free-drain or does not provide filtration for pipe.	Replace with properly graded material or filter fabric.
Poor drain performance; caused by pipe being crushed by construction traffic.	Replace damaged section of pipe.
Poor drain performance; caused by sediment clogging the pipe or gravel trench.	Stabilize area draining to trench, remove rock, clean out trench, reinstall pipe and clean the bedding material.