

Drainage FACTSHEET



BRITISH
COLUMBIA

Ministry of Agriculture and Food

Order No. 541.300-1

November 1983

Agdex: 752

BACKHOE INSTALLATION OF SUBDRAINS USING THE “GRADE STAKE” METHOD

It is often difficult to obtain the services of properly equipped subdrain installation equipment for small jobs on a few acres, for small random systems or for work near buildings. Small tractor-mounted backhoes are readily available and can be used but accurate grade control is difficult, especially when shallow grades are required.

Constructed grades of subdrains should not deviate from the planned grade by more than 15% of the internal diameter of the drain (e.g. 15 mm in a 100 mm dia. drain). Under no circumstances should there be backfall in a drain.

Because of the lack of accurate grade control on the shovel of a backhoe, constant monitoring of the trench bottom elevation is required and minor adjustments must be made often by hand. Elevation monitoring can be done using an engineer's level on-site to measure progress in the trench. More simply, a sight-line method such as the grade stake method (extensively used with trenching equipment prior to the advent of laser grade control) can be adapted for use with a backhoe. Smaller laser systems as used in building construction could also be used.

Setting Grade Stakes

Grade stakes are essentially poles with adjustable cross-arm targets. At least three are required. One must be fixed permanently at either end of the line of the proposed drain. Additional grade stakes and a “base distance stake” will be required as the excavation work proceeds.

The “base distance” measures the difference between the line of sight which is usually above ground level and the grade line of the trench bottom.

For example, **Figure 1** shows a trench approximately 1.1 m deep using a base distance of 1.7 m. The cross-arm targets would be set approximately 0.5 m above the ground level.

An engineer's level should be used to establish elevation of the cross-arms on the permanently fixed grade stakes. The cross-arm elevations are adjusted to the set “base distance” above the proposed trench bottom. Choose the base distance for convenience.

If a “base distance stake” is used, monitor the trench bottom elevation by sighting over it to the grade stake cross-arms. A base distance a little less than “eye level” (e.g. 1.7 m) may be appropriate.

At least 3 consecutive grade stake targets should be set and spaced not more than 30 m apart. Because the backhoe works directly over the line-of-sight of the trench, foresights are not possible without requesting the backhoe to move to one side. However, backsights can be made regularly once the trench is in progress and that likely the establishment of new targets will be required regularly.

To speed the process of setting grade stakes, a “profile” of the proposed drain is useful. This is easily prepared in advance by the designer if a topographic survey has been accomplished. The profile should show the elevations of the ground surface and trench bottom.

From this, the “depth to dig” can be determined. The height to the grade stake cross-arms at selected locations can be calculated and a convenient base distance selected.

Construction of the trench will normally start at the outlet and proceed up grade. Constant monitoring of the grade of the trench bottom using the “base distance stake” will be required.

Adjustments must often be made by hand. If the trench is excavated slightly above grade, it may be most efficient to avoid over excavating by using a hand shovel to bring the bottom to final grade. If the trench is excavated below grade, it should be filled to the planned grade with gravel or well-pulverized soil and tamped to provide a firm foundation.

Plastic drain tubing or tile should be placed as the work proceeds with a 150 to 200 mm layer of soil backfill placed over the drain to fix it in place.

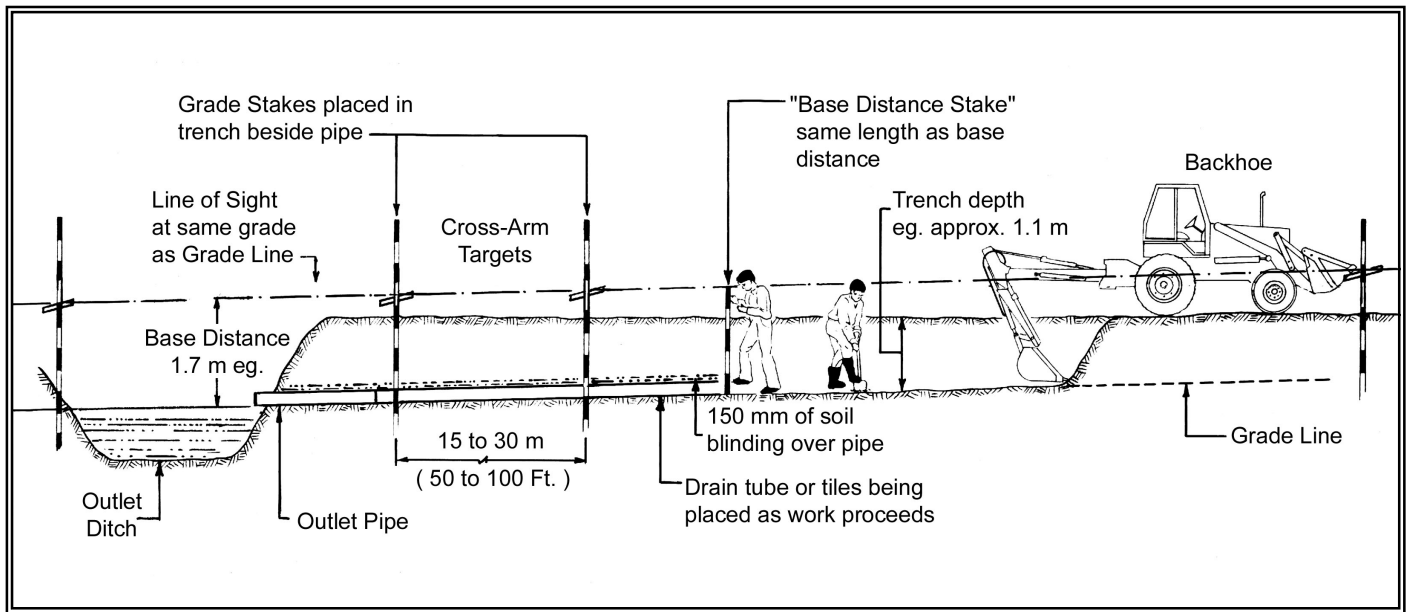


Figure 1

**Establishing Grade with a Backhoe
Using The “Grade Stake” Method**

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Resource Management Branch
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