



**NATURAL RESOURCES CONSERVATION AND
DEVELOPMENT**

Level-II

Learning Guide-68

Unit of Competence: Assist Operation and

Maintenance of Irrigation and Drainage

Module Title: Assisting Operation and Maintenance

Of Irrigation and Drainage

LG Code: AGR NRC2 M15 L04-LG-68

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LO4: Set out and excavate trenches

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Determining Location and depths of trenches
- Setting out and marking Trench location
- cleaning out Trenches

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, **upon completion of this Learning Guide, you will be able to:**

- Determine Location and depths of trenches
- Set out and marking Trench location
- clean out Trenches

Learning Instructions:

- ✓ Read the specific objectives of this Learning Guide.
- ✓ Follow the instructions described below 3 to 6.
- ✓ Read the information written in the information “Sheet 1, Sheet 2 and Sheet 3”.
- ✓ Accomplish the “Self-check 1, Self-check 2 and Self-check 3” **in page -3, 7 and 9** respectively.
- ✓ If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 and Operation Sheet 2” **in page -10.**
- ✓ Do the “LAP test” **in page – 11**(if you are ready).

Information Sheet-1	Determining Location and depths of trenches
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1.1 Determining Location and depths of trenches

A trench is a hollow cut into the ground, usually with parallel sides and which is typically deeper than it is wide. Trenches were used in the First World War as a means of conducting combat as they offered a degree of protection and cover from enemy fire.

The trench excavation should not be too far ahead of the pipe-laying team to ensure a better control of the trench and for safety reasons. The excavated soil should be placed on one side of the trench leaving the other side, clear for equipment and pipe handling. If the trench consists of various layers of soils, these should be placed separately in order to use the stone-free granular material for backfill.

1.1.1 Trench Width

The trench width must be maintained within certain limits. A very wide trench will increase the volume of backfill material required, and compaction labor and effort. A very narrow trench will render laying, handling and joining of pipes, as well as compaction of side backfill difficult. The minimum recommended trench width is given in figure 1.

Notes:

1. In poor native soil conditions and depending on pipe stiffness and burial depth, a wide trench (up to 4 X DN (Diameter Nominal)) might be required. During trench excavation, a pipe bedding thickness of at least 150 mm must be provided. In case of very poor native soils (silt, clay or mud) additional 150 mm thick foundation layer must be provided below the bedding. Selected backfill material should be placed at the foundation and bedding levels and thoroughly compacted by plate vibrators or by hand tamping. Wetting of sand bedding/foundation material prior to compaction will improve and facilitate the achievement of the degree of compaction required.
2. The distance between the pipe and the trench wall should be at least 10cm wider than the width of the equipment used for compaction of the backfill material.

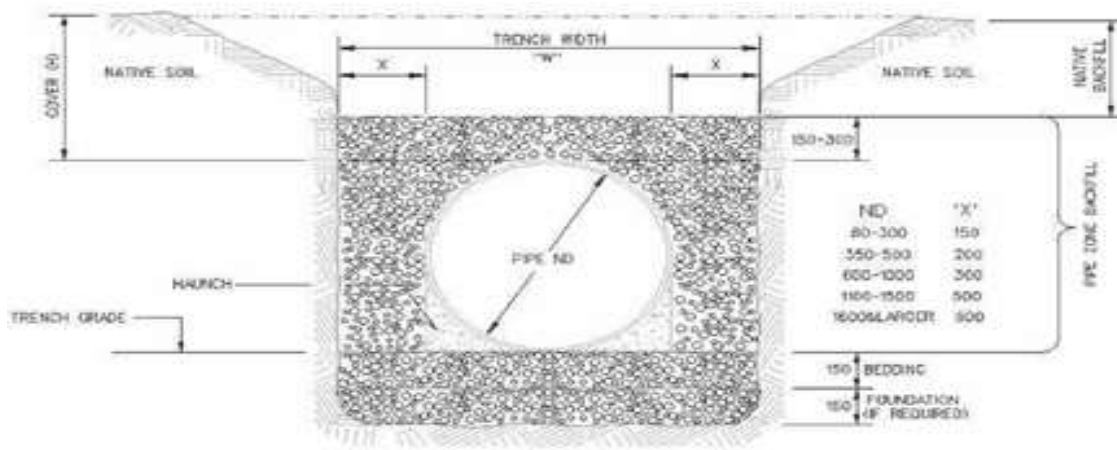


Figure 1: Minimum Trench Width

1.1.2 Trench Depth

Generally the cover depth of pipe is specified by the design Engineer. When there is no traffic load over the pipe, the minimum burial depth is 0.6m. In the presence of traffic loads, a minimum cover above the pipes shall always be maintained as follows for all stiffness classes.

Load Type	Traffic (wheel Load)		Minimum Burial Depth
	Kn	Lbs	
AASHTO H20 (C)	72	16,000	1
BS 153 HA (C)	90	20,000	1.5
ATV LKW 12 (C)	40	9,000	1
ATV SLW 30 (C)	50	11,000	1
ATV SLW 60 (C)	100	22,000	1.5

Table 1 - Minimum Cover Depth

In case of high ground water table, a minimum cover depth equal to 0.75 times the pipe diameter of granular soil (minimum dry density of 1900 Kg/m³) must be provided to prevent WAVISTRONG® (H2O) WATER SERIES pipes from floating. Always insure that this minimum cover is available before turning off dewatering systems.

1.1.3 Cover Height

The maximum cover height depends on the type of installation, backfill material and its compaction, as well as native soil conditions.

Self-Check -1	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are factors that determine trench Depth? (5pts)

Note: Satisfactory rating 10 points

Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet-2	Setting out and marking Trench location
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2.1 Setting out and marking Trench location

A trench is a long and narrow ditch dug in the ground, usually deeper than it is wide. They have many practical uses, such as installing pipelines, irrigating land, and gardening. The layout of trenches establishes the excavation size, shape and direction, as well as the width and position of walls. Trenches are excavated once the building outline has been set out. The width is often marked with a line of dots of dry lime powder for accurate excavation by hand, whereas the center line is marked for accurate machine excavation.

Outline profile boards are often used to control trench positioning, width and depth. In order that they do not obstruct the excavation work, profile boards should be set up at least 2m clear of the trench positions. The level of the profile cross board should be related to the site datum and fixed at a convenient height above ground level, often with cords strung between two profiles at either end of the trench. Bands can be painted on the cross board for identification purposes.

Pegs are often driven into the bottom of the trench to mark the top of the concrete strip that is subsequently poured. The corners of walls are transferred from intersecting cord lines to mortar spots on the concrete foundations, using a spirit level for accuracy. The cutting of trenches needs to be undertaken with great care, especially if they are to be left open for an extended period as there is the possibility of the sides caving in.

Steps to marking trench locations are:-

Step 1 - Measure dimensions

Step 2 - Mark points

Step 3 - Set up batter-boards

Step 4 - Suspend brick lines (external)

Step 5 - Check alignment

Step 6 - Suspend brick lines (internal)

Step 7 - Dig trench

Step 8 - Back fill the trench

These steps involve the following actions:-

1. Determine location based on purpose
2. Determine the trench dimensions
 - ✓ Knowing the depth, width, and length of your trench will help you save effort and keep your trench the shape you desire. It may help you to mark widths, lengths and route of your trench using stakes and string. If available, you can use sandbags or other markers to outline the path of your trench.
 - ✓ If you are using the trench to install or replace electrical utilities or pipelines, you will want to dig at least 2.5 feet deep in order to protect the pipes from frost, but no deeper than 4 feet. The width of your trench will depend on your pipes, but will likely be narrow.
 - ✓ If you are digging a trench for a sprinkler system, you may only need to dig 9-12 inches deep depending on the height of the sprinkler, and 5 inches wide depending, again, depending on your sprinkler system. Consult the instructions that came with your sprinkler system before installation.
3. Purchase supplies
 - ✓ You'll need a D-handle sharp shooter shovel and a trenching or clean-out shovel. These can be purchased at any hardware or gardening store. For clearing roots, pruning shear or a Pulaski digging tool can help you quickly remove this obstruction. Wearing gloves will protect your hand from blisters and splinters, and comfortable work boots will provide foot protection and traction.
4. Avoid obstructions.
 - ✓ Be careful when you dig around trees or other pipes. Roots can add a significant time to your excavation, and a ruptured gas line will require you to call your gas provider immediately. Severed utility lines could also leave you without power until your electric company can fix the problem.
 - ✓ If you're digging near trees, make sure that your trench will not invade the tree's protected root zone (usually the part of the roots that lie directly below its branches).
 - ✓ If you're digging near pipes, try to determine where any other pipes may be. New pipes should be at least 1.5 feet away from another.
5. Break up the dirt.
 - ✓ Use the D-handle shovel to loosen the dirt along both sides of the soon-to-be trench. This will make it easier to dig out the dirt in the middle while physically establishing your dig line alongside the guideline you laid.^[4] Cut both sides of the hole with your shovel, break up the topsoil, and then work both sides of your trench until you have loosened enough soil to merit clearing.

6. Dig out the trench middle.

- ✓ Once you have accumulated enough loose soil, use the trenching shovel to remove it out of your way. This may be a pile off to the side, or it may be a location you choose prior specifically for backfill.

7. Continue loosening and clearing the soil.

- ✓ Depending on the depth and length of your trench, this could take a considerable amount of time and effort. Use your D-handle shovel to break up the soil and the trench shovel to clean it out until your trench is the desired length and depth.
- ✓ Running into roots might require you to place the pointed end of your shovel on the root and stomp, which should sever most small-medium sized roots. More developed root systems might require a Pulaski digging tool. Pruning shears are another good option, if your shovel fails and you do not have a Pulaski digging tool on hand.

8. Take safety measures with deep trenches.

- ✓ An unsupported trench can be extremely dangerous, as collapsing soil can kill someone standing in the trench. Any trench 3 feet (0.91 m) (0.9m) deep, and some shallower trenches in soft soil, should be supported by side walls (such as timber posts and panels) before digging any deeper. You can increase safety by "benching" (digging in tiered levels), or by digging the walls at a slope instead of vertically.
- ✓ An experienced trench excavator may choose to keep the trench unsupported at depths up to 5 ft (1.5 m), but only under stable soil conditions.[8] Follow the 3 ft (0.9 m) rule if you do not have expert supervision.

Self-Check - 2	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain Steps to marking trench locations(5pts)

Note: Satisfactory rating 5 points

Unsatisfactory - below 5 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

3.1 cleaning out Trenches

After the construction, you should clear all trenches corner and all associated pipe and drainage work before backfilling, to ensure all components are correctly positioned and installed accordingly.

You should inspect the final installation to ensure it complies with all conditions of consent before issuing an approval to install the system and clear all unwanted wastes/debris. During clearance you should comply with occupational safety standards.

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Why you clear the trenches? (5pts.)

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Operation Sheet -1	Setting out, marking location and digging out Trench
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Steps to do make a trench:

Step 1 - Measure dimensions

Step 2 - Mark points

Step 3 - Set up batter-boards

Step 4 - Suspend brick lines (external)

Step 5 - Check alignment

Step 6 - Suspend brick lines (internal)

Step 7 - Dig trench

Step 8 – Back fill the trench

Operation Sheet -2	Cleaning out Trenches
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Techniques for Cleaning out Trenches:

Step 1- wear PPE.

Step 2- Identifies tools and equipment.

Steps 3- Clean the trench.

Step 4- clean each tools and equipment.

LAP Test	Practical Demonstration
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Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3:30 hour.

Task 1. Setting out and marking Trench location

Task 2. Dig out Trench

Task 3. Store tools and equipment depends 5s standard.

Reference

1. [https://media.toro.com › documents › irrigation › sprinkler-pig](https://media.toro.com/documents/irrigation/sprinkler-pig)
2. [www.turfcare.ca › documents › manuals › Other › Installing an Irrigation ...](http://www.turfcare.ca/documents/manuals/Other/Installing%20an%20Irrigation%20System.pdf)
3. [www.skatom.pl › dapqk › irrigation-pipe-puller](http://www.skatom.pl/dapqk/irrigation-pipe-puller)
4. [www.irrigationbc.com › assets › client › File › Documents › StandardsFor...](http://www.irrigationbc.com/assets/client/File/Documents/StandardsFor...)