AGRICULTURAL TVET COLLEGE

SMALL SCALE IRRIGATION DEVELOPMENT LEVEL-II

MODEL TTLM

Learning Guide #1

Unit of Competence: Lay micro irrigation systems

Module Title: Laying micro irrigation systems

LG Code: AGR SSI2 M01 LO1- LO4

TTLM Code: SSI2 TTLM 1218V2

Nominal Duration: 34 Hours

Instruction Sheet	Learning Guide 01

This learning guide is developed to provide trainees the necessary information regarding the following content coverage and topic:

- Prepare tools and materials for installation work.
- Set out and prepare site
- Install irrigation components
- Complete installation work

This guide will assist trainees to attain the learning outcome stated in the curriculum guide. Specifically, upon completion of this Learning Guide, trainees will be able to:

- Identify the required materials, tools, and equipment
- Identify site for installation of the micro-irrigation system
- Check delivery system of water supply systems
- Check water supply systems compatible to the specification
- Undertake measurement and marking out of irrigation lines
- Identify OHS hazards related to equipment operation and work practices
- Check tools, accessories relating to Pre-operational activities
- Select and checking Suitable personal protective equipment (PPE).
- Undertake work according to plan and supervisors instructions
- Test components are assembled and connected according to plan, joints
- Maintain A clean and safe work area while installation work is carried out.
- chose appropriate tools to undertake work
- undertake finale earth work activities

Learning Activities

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the "Information Sheets"
3. Accomplish the "Self-check" questions
4. If you earned a satisfactory evaluation, you will proceed to the next "Information Sheet." However, if your rating is unsatisfactory, see your teacher for further instructions.

5. Submit your accomplished Self-check.
6. Follow the steps and procedure list on the operation sheet
7. Do the "LAP test" and Request your teacher to evaluate your performance

InformationSheet-1	Prepare tools and materials for installation work

1.1 Preparing tools materials and accessories according to irrigation design requirements

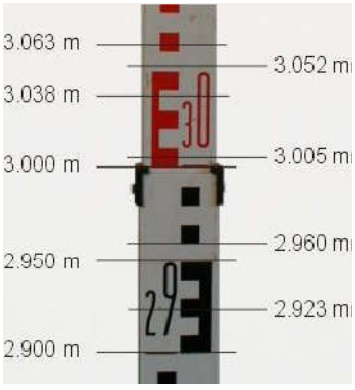
Micro-irrigation: refers to low-pressure irrigation systems that spray, mist, sprinkle or drip. The water discharge patterns differ because emission devices are designed for specific applications due to agronomic or horticultural requirements. Micro-irrigation components include pipes, tubes, water emitting devices, flow control equipment, installation tools, fittings and accessories

Surveying and leveling equipment

Automatic Level: Automatic levels are electronic surveying instruments that contain optical compensators. This self-leveling feature enables it to maintain a level line of sight even though the instrument is slightly tilted. After the bubble was manually centered, the automatic compensator takes over and levels the line of sight.

An automatic level is a special leveling instrument used in surveying which contains an optical compensator which maintains line of sight or line of collimation even though instrument is slightly tilted.

The leveling staff: is a graduated rod of rectangular section. It is usually made of thick wood. It may be of fiberglass or metal.



Figer1.1 graduated staff

Figer1.2 reading the stuff

- ✓ **laser level:** In surveying and construction, the **laser level** is a control tool consisting of a laser beam projector that can be affixed to a tripod. The tool is leveled according to the accuracy of the device and projects a fixed red or green beam about the horizontal and/or vertical axis.[1]

Figer1.3Laser level

- ✓ **Cowley level:** 'In appearance this level does not look like an ordinary level but resembles a small amateur's cine camera. It is particularly suitable in building and engineering work for setting our [sic.]foundations, gradients, etc., and, although it can be used for running short lines of levels from point to point, it is not so suitable as an ordinary level for carrying forward long lines of levels. It has the advantage of being very simple and quick to use and it is very cheap considering the degree of accuracy obtainable with it. It has also the advantage of not requiring a skilled surveyor to manipulate it(D. Clark, J., 1963).

Figer1.4Cowley level

- ✓ **Boning rod:** boning rods consist of a set of 3 T shaped staffs of identical size, one is a different color. The basic idea is that once two fixed levels are established, any level between them can be established by a line of sight.

Figer1.5Boning rod

- ✓ **Dumpy level** is commonly used leveling instrument to locate the points in same horizontal plane. It is also called as automatic level or builder's level. Elevations of different points and distance between the points of same elevation can be determined by dumpy level.

Figer1.6dumpy level

- ✓ **Pegs:** Pegs are used when certain points on the field require more permanent marking. Pegs are generally made of wood; sometimes pieces of tree-branches, properly sharpened, are good enough. The size of the pegs (40 to 60 cm) depends on the type of survey work they are used for and the type of soil they have to be driven in. The pegs should be driven vertically into the soil and the top should be clearly visible.

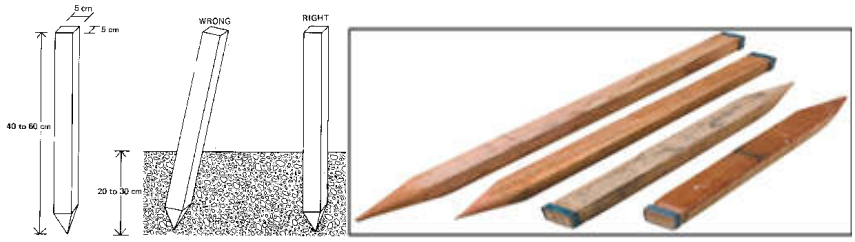


Figure 1.7 pegs

- ✓ **Notebook:** A notebook (notepad, writing pad, drawing pad, legal pad) is a book or binder of paper pages, often ruled, used for purposes such as recording notes or memoranda, writing, drawing or scrapbooking.

Figure 1.8 pegs

- ✓ **Scientific calculator** is a type of electronic calculator, usually but not always handheld, designed to calculate problems in science, engineering, and mathematics. They have almost completely replaced slide rules in traditional applications, and are widely used in both education and professional settings.

Figure 1.9 scientific calculator

- ✓ **Pencil:** is an implement for writing or drawing constructed of a narrow, solid pigment core inside a protective casing which prevents the core from being broken and/or from leavingmarks on the user's hand during use.

Figure 1.10Pencil

- **Hand tools**

A. Spade

A spade is a tool designed primarily for the purpose of digging or removing earth.

With a metal tip, a spade can both break and move the earth in most situations, increasing efficiency. Small spade for clay soil; the other one for sandy soil and loamy soil

Figure 1.11 pegs

B. Rake

A rake is a tool used to gather or loosen material or to grade or level a surface.

There are two major kinds of rakes: an attachment for a tractor and a hand tool.

Figure 1.12Rake

C. Shovels

A shovel is a tool for digging, lifting, and moving bulk materials, such as soil, coal, gravel, snow, sand, or ore.

Figure 1.13Shovels

D. **Wheel barrow-** for transporting all kinds of materials in the nursery: potting soil, seedling ready for delivery…etc.

Figure 1.14Wheel barrow

E. **Roller**: The **roller** is an agricultural tool used for flattening land or breaking up large clumps of soil, especially after ploughing or disc harrowing. Typically, rollers are pulled by tractors or, prior to mechanization, a team of animals such as horses or oxen.

Figure 1.15 Roller

F. **Hoses:** A **hose** is a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a circular cross section).

Figure 1.16Hoses

- **Delivery equipment (accessories)**
  - ✓ **Pipe:** hollow cylinder of metal, wood, or other material, used for the conve yance ofwater

Figure 1.17Pipe

- ✓ **Fitting:** A fitting is used in pipe systems to connect the straight pipe or tubing sections, adapt to different sizes or shapes and for other purposes, such as regulating fluid flow.

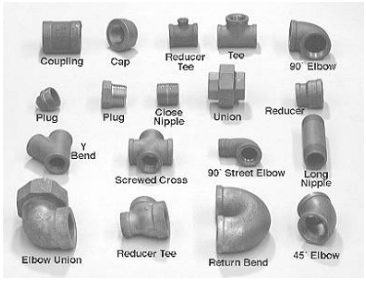


Figure 1.18Pipe

- ✓ **Drip emitters:** are the devices that connect to the drip line or hose. They are the small pieces of equipment that disperse the water onto the plants. Drip emitters are essentially small, plastic nozzles that can be

punched through the wall of a main water line. They are the small pieces of equipment that disperse the water onto the plants.

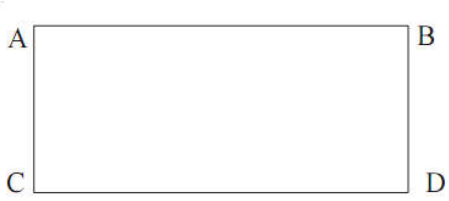
- ✓ **Sprinkler nozzles:** also referred to as spray nozzles, are an important, but often overlooked component of well-designed irrigation systems. The proper nozzle ensures accurate, even delivery of water in the pattern you need.

Figure 1.19Sprinkler Nozzle

- ✓ **Valve:** should be installed at the closest point possible to your water source, that is, the location where you tap in for the irrigation system. Without this valve you will need to shut off the water to the entire house when you want to work on the mainline or irrigation valves. The most commonly used valves for this purpose are **"gate valves"** because they are inexpensive.

1.2. Identifying the site for installation of the micro-irrigation system

Survey: The following survey inputs are required to prepare an accurate layout of any area (size, shape and slope) for design of micro irrigation system:



1. Straight distance between points at the corners (e.g. AB, BC, CD & DA). It can be measured with a tape in a straight line with corner points duly identified by setting down stones or sticks.

2. Angle at the corner: For a three-cornered area, distances of three of the sides are sufficient to make the layout. For a four-cornered area, any one angle has to be measured along with distances of all sides. For a five-cornered figure, two consecutive angles are required and so on for multiple sides. A distance of 10 meters is marked from the corner on each line, forming the angle, and then a tie length is measured between these points. To determine the corner angle, use the following equation.

Tan (angle) = Length of opposite side / Length of adjacent side

3. Elevation: Slope of the ground surface may be judged with the naked eye for small plots wherever possible and taken into consideration while designing the drip system. If the ground surface is too undulating and the slope is difficult to judge, levels should be taken with a leveling instrument and contours drawn on the map to make a proper design of the drip system.

4. **Water Source**: Position of water source (tank, well, reservoir, pond, river, stream, existing pump, pipeline, etc.) should be marked on the map and the following details noted.

a) **Size, volume, flow rate**, and height above ground level or depth from ground surface or water source.

b) **Pump** details for the existing pump including suction, delivery, actual discharge & head, operating time, pump HP, expected discharge & head.

c) **Quality of water**, impurities in water (algae, sand /silt, etc.) If a water analysis report is available, it should be enclosed with the survey report or if possible the farmer should try to have it analyzed at a local laboratory.

5. **Agro-climatic details**: The details of existing or future crops should be noted including specific areas, crop spacing (plant to plant distance x row to row distance), number of plants and number of rows, crop duration, expected canopy, rainfall, evapo transpiration, etc.

6. **Soil details**: The details of soil quality visible to the naked eye should be noted including heavy soil or light soil depending on soil texture (proportion of clay, silt & sand.) If a soil analysis report is available it should be enclosed with the survey report or the farmer should try to have it analyzed at a local laboratory.

7. **Permanent details of the land**: Location of farm house, large trees, rocks, etc. should be marked by taking angular measurements from a minimum of two points so that they can be plotted accurately on the survey plan.

Survey Plan: From the above information, a plan of the area surveyed can be prepared on a 1:1000 scale. For smaller areas, an appropriate scale can be used depending on the size of the area. The drip system layout can be prepared on this plan and then it can be used for installation.

1.3. Checking Parts and equipment according to system drawings and specifications.

Irrigation problems are not always apparent during the cooler times of year, but once summer heat arrives, your system will be providing a lifeline to your plants. Here's a checklist for some routine maintenance:

- ✓ Inspect all components of your watering system, from the backflow preventer to the valves, for standing water, soggy ground, or eroded soil. If you have a controller, check that the programs are correct. If the controller has battery backup power, replace the battery at least yearly.
- ✓ Sprinklers should be checked frequently since they are above ground and can easily get damaged or misdirected. Check the irrigation line from the valve to the spray heads for leaks. Replace spray heads if necessary, and be sure to replace with the proper spray head. Check that sprinkler heads are flush with the soil surface and straight, not tilted. Clear grass, plants and other obstructions that block sprinkler spray. Finally, adjust sprinkler heads so they don't spray walls, driveways, or sidewalks.
- ✓ For drip irrigation, turn on the system 20-30 minutes before the inspection to allow enough time for emitter wetting patterns to show. Check from the valve to the end of the irrigation line for leaks or clogged emitters. Check for proper emitter placement on plants as they grow. You may need to move emitters out to the drip line of the plant each season. Do this by purchasing some extra micro tubing and connectors.

1.4. Checking Water supply according to system specifications.

Measure water flow: You need to determine the available water flow for your sprinkler system so you'll know how many sprinkler heads or drip emitters can run at one time.

The movement of water through pipe, fittings, valves and generally measured in Gallons per Minute (GPM) and Gallons per Hour (GPH). You will need to know the flow rate when planning an irrigation system. It is the key factor when determining the maximum number of zones or emitters per zone. Once you know your flow rate, you know the maximum amount of water

available for your system. Keep that in mind when adding up the output (flow) of sprinklers or drip emitters that you are considering for your system.

- **Hydraulic pressure test procedure of water supply systems**

1. Start to fill the piping and then 'walk' the route of the piping under test, continuously visually checking for leaks and by listening for the sound of escaping air.

2. Release air from all the high points systematically through the system to completely fill it with water.

3. Once the system is full, raise the pressure to the test pressure and, if a plastics piping system, continue

4. If the pressure falls, check that stop valves are not letting by, then walk the system again for leaks.

5. Once the system is proven sound, have the test witnessed if necessary and obtain a signature on the test certificate.

6. After testing release the pressure. If necessary, ensure that any vents on cylinders, tanks, and pressure-vessels are opened to atmosphere before draining down and refitting vulnerable items.

Self-Check 1	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List the types of hand tools used to lay micro irrigation? (5 points)
2. List the types of surveying and leveling equipment used to lay micro irrigation? (5 points)
3. List the types of delivery equipment used to lay micro irrigation? (5 points)
4. List the method of checking water delivery system? (5 points)

Note: Satisfactory rating - 10 points and above Unsatisfactory - below 10 points

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

Operation sheet-1	Investigate surveying tools, material and equipment

Objectives: To know the functions of the tools and equipment in surveying.

Procedure:

1. Identify surveying tools used for leveling, hand tool and accessories
2. List out the surveying tools used for leveling, hand tool and accessories
3. Giving the name of the surveying tools and equipment, hand tool and accessories.

LAP Test1	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

1. You are required to perform any of the following:

1.1 Request your teacher to arrange for you to visit the nearby lay micro irrigation. You should identify important surveying leveling equipment, hand tools and delivery equipment (accessories). Submit your report to your teacher for evaluation.

1.2 Request a set of micro irrigation equipment, then perform the following tasks in front of your teacher

- Name of the tool and
- Its application

1.3 Request your teacher for evaluation and feedback

Information Sheet-2	Set out and prepare site.

2.1 Cleaning up the site

- Clearing is the process of removing trees, stumps, brush, stones and other obstacles from an area as required to increase the size of the an existing farm or to provide land for a new farm operation. The newly cleared land must be ready for cultivation, including liming and leveling to meet acceptable installation and operation goals.

- **How Site Clearing Prepares a Construction Site**

We remove all rocks, roots, and trees before we begin to level out the ground. Before creating a brand new parking lot or road, we first have to clear the site. Site clearing is the process of clearing away the vegetation and surface soil of the construction site. There are several steps involved in a successful site clearing. Here is what we do when site clearing to ensure that we get a project set up for success.

- ***Clearing vegetation***

After designating the area to be cleared, the first step is to remove vegetation. This begins with undergrowth. After the undergrowth is cleared away, only large vegetation, such as trees and shrubs, is left to be cleared. Clearing the undergrowth first creates a safer, easier space to do the labor or tree removal. then focus on removing the roots, stumps and roots. We also remove large stones and dig out animal burrows and fill them with clay. Vegetation within a surrounding designated workspace area should be cleared.

- **Clearing equipment**

Proper and well maintained industrial cleaning equipment and skilled operators shall be used for land clearing. The primary land clearing equipment shall be one of the following: Crawler tractors with piling blades, cutting blades or earth blades. Cutting blades shall be used only for cutting and piling method. Earth blades shall only be used for walking-down standing timber. Excavator with piling rake. Generally, auxiliary land clearing equipment shall be breaking discs and breaking plows pulled by crawler tractors. Generally land clearing equipment used for debris cleanup operations shall be wheel rakes, power drum rakes, specialized reel head rock pickers and debris pickers powered by farm tractors. Brush cutters (rotary brush mowers) powered by farm tractors, may be used for clearing light growth and ground brush, if normal cultivation can proceed after brush cutting.

Making the site good

- ✓ Irrigation work sites are expected to be clean, tidy, comfortable and good to create conducive environment for work. Cleanliness is the most essential elements in maintaining a healthy and safe work environment. Not only does a clean workplace reflect the professionalism of a business or facility and help motivate employees, it also promotes a healthy workforce as a clean environment prevents accidents and the spread of germs.

- ✓ Working together we can all contribute to creating a safe and healthy workplace and a professional looking facility for employees, visitors and customers.

Site maintenance

1) The job site shall be kept in a neat, clean, and orderly condition at all times during the installation process.

2) All scrap and excess materials are to be regularly removed from the site and not buried in trenches.

3) Trenching, laying pipe and backfilling shall be continuous so that the amount of open trench at the end of each work day is minimized. Any open trench or other excavations shall be barricaded and marked with high visibility flagging tape.

2.2 Undertaking measurement and marking out of irrigation lines

The steps of undertaking irrigation site measurements here as follows

1. Interpreting an Irrigation Design Plan

The foundation of a reliable irrigation system is based on adequate data on the crop, soil and root system being incorporated in a good irrigation design plan. The irrigation system is usually designed by a qualified irrigation consultant.

- ➢ **Laying Out the Irrigation System**

Now that we have developed an understanding of the irrigation design plan, the blocks can be pegged out in the field. The assumption is made that the land has been cleared and soil preparation has been done, and that other infrastructure items, such as roads and waterways, has

already been demarcated. Care must be taken when laying out the irrigation blocks that it is done correctly and precisely. It may take a day or two longer to get it right, but remember that the result will be visible for the lifespan of the orchard.

- **Marking the Corners of the Blocks**

The corners of the blocks are first pegged out roughly to see the relation of the blocks to one another. The lengths of the sides of the blocks are now measured on the irrigation design plan, and the scale of the plan is used to calculate the actual length. The scale is a ratio that shows the relation between the measurement on the plan and the actual distance on the ground

- **Marking the Rows**

Start by measuring the rows on the side of the block with the mother line, using a measuring tape. Remember that poor-quality measuring tapes can stretch and expand. Use a good quality measuring tape made of fiber.

- **Marking the Plant Positions**

Set up the dumpy at the end of a row and look at the other end. Use the tape measure to measure the inter-plant spaces. If the plant spacing is 6x2m, this would be 2m. Plant pegs at every spot where a tree must be planted. Check the pegs visually to see that they are in line. Check them also at an angle, meaning from one corner to the corner diagonally opposite, to see if they are aligned.

- **Conveyance System Trenches**

Conveyance system trenches are the trenches into which the pipelines are buried. Before the trenches are dug, they must first be pegged out. The centre of the trench can be pegged with pegs about 50m to 100m apart. Tie a wire or a rope to the pegs to mark out line between them, and use ordinary lime to mark out the line of the trench. When the trenches are dug, the chalk line must be in the center of the trench. Trenches are dug depending on the size of the pipe. Trenches for pipes that go through lands and roads, such as mainlines and sub-mainlines, should

be 1,000mm deep. Trenches for mother lines can be a bit shallower, at about 400mm. Trenches must be free of protruding rocks on the bed since these rocks can break the pipes. Trenches can be dug by either using manual labor or a back-end loader, also called an excavator. Manual labor may be cheaper, but will take longer, while using a back-end loader will be faster but more expensive. Keep in mind that back-end loaders are also more suited for rocky terrain. The choice will depend on the budget.

2. 3 Conforming equipment operation and work practices

Only machinery and tools that comply with the relevant requirements and are suitable for the job at hand may be used at work. The manufacturer's instructions must always be followed when operating machinery or using tools. Machinery and tools must be kept in good order throughout their useful life. The operating of machinery must also be safe for employees.

The Act on the Conformity of Certain Technical Devices to Relevant Requirements regulates the design and manufacture of some machinery and the requirements they must comply with. In addition to the relevant requirements, the safety of all machinery and tools used at the workplace must be at least at the level specified in the Occupational Safety and Health Act and the Government Decree on the Safe Use and Inspection of Work Equipment, regardless of how old the machine or tool is. Old machines must be upgraded to improve their safety as technology evolves. Compliance with legislative requirements in fact mandates that many machines currently in use must be restructured to make them safer.

The employer must ensure that employees are given tools that are safe and suitable for the job and work circumstances at hand. The selection of tools must also take into account the demands of the location and ergonomic requirements. The use of machinery and tools at the workplace is provided for in the Occupational Safety and Health Act and the Government Decree on the Safe Use and Inspection of Work Equipment (the 'Safe Use Decree').

Machinery must be serviced regularly

The employer must ensure that the machinery and tools in use are serviced and maintained regularly in order to keep them in good and safe working order throughout their useful life. There must be procedures in place at the workplace to fulfill this requirement.

The condition of machinery and tools must be continuously monitored through inspections, testing, measurement and other appropriate means. The employer must employ a competent person for managing these duties or outsource this function to an outside expert.

The employer determines the means to be used for hazard investigation and assessment from time to time. For instance, if lifting equipment is used at a workplace, the intervals for regular inspections of that equipment must be based on how much of a strain use puts on each particular device. If someone at a workplace notices that the using of a particular tool creates a hazard or causes harm to any employee, the employer must take immediate action to remove the hazard.

Machinery and equipment must be provided with operating instructions

The seller of a Machinery and equipment is responsible for ensuring that operating instructions and any other instructions are supplied with the Machinery and equipment. The seller of a used machine must also supply its operating instructions to the buyer.

Requirements concerning the content of operating instructions for machines may be found for instance in the **Operating instructions must include for instance the following items:**

- instructions on how to introduce and use the machine and, if necessary, how to train its operators
- information on any personal protective equipment required
- information on maintenance measures to be performed by the user
- Instructions for installing, assembling and disassembling the machine.

2.4. Carrying out pre-operational and safety checks on tools and accessories

Before operation carried out on tools, equipment and machinery we checks safety with great treat care. Always read

- ✓ Manufacturers' instructions before operating or making adjustments.
- ✓ Never make adjustments or carry out servicing while in use.

- ✓ Keep well clear on them operation. Check to see all parts are tightened securely before starting.
- ✓ Manufacturer's technical literature as appropriate.
- ✓ For other than common accessories, where no manufacturer literature is available, a precise and concise description of the operation procedure.

• Safe starting, running, operating and shutting-down procedures for the equipment installed including a logical step-by step sequence of instructions for each procedure.

• Control sequences and flow diagrams for the systems installed.

• A legend for color-coded services. A legend of the symbols used on the drawings, unless included on the drawings.

• Schedules of the parameter settings of each protective device, including fixed and adjustable circuit breakers, protective relays, adjustable photoelectric switches, pressure switches, and any other control and monitoring device, as established during commissioning and maintenance.

- ➢ **Irrigation Equipment Safety**

- ✓ The following suggestions are aimed at ensuring the safety of the irrigator as well as preventing damage to the equipment.

- ✓ Read and follow directions in the owner's manual for each piece of equipment, paying particular attention to the safety precautions and features listed. Make sure that all employees also read and understand all directions and precautions.

- ✓ When setting valve openers onto field irrigation hydrants make sure the valve opener locking lever is swiveled far enough clock wise to lock it onto the hydrant ears. Always do a quick visual check to make sure the valve opener is locked onto the hydrant ears before turning the water on or off. Stay out of the way of high-pressure water streams, such as end guns.

- ✓ Be sure all pumps are equipped with devices that will shut off the electric motor or engine if there is a break in the suction or loss of pressure in the main pipe line. To

perform overhead maintenance, use a ladder that is sufficiently tall as well as stable .Have qualified service personnel perform any hazardous repair or maintenance. Keep all guards and shields in place, especially those covering power-take-off units. Make sure that service or auxiliary equipment is not in the path of the irrigation system.

- ✓ Bury all power lines around the equipment, and clearly mark where they are buried. Keep away from moving parts when equipment is in operation. If fuses or circuit breakers keep blowing, don't "correct" by over-fusing. Find the cause.
- ✓ If chemicals have been added to the irrigation water, avoid exposure to spray drift; and make sure that the spray does not blow past the area of intended operation.

2.5 Identifying OHS hazards, assessing risks, implementing and reporting controls

➢ Identifying hazards in the workplace

- Workplace injury is a major cause of concern for all involved in occupational health and safety.
- The factors which cause workplace accidents and occupational illnesses are called hazards. The need for systematic management of OHS hazards and their attendant risks applies to all organizations and all activities and functions within an organization.
- Risk management is a four step process:

1. Identify the hazard

2. Assess the risk associated with the hazard

3. Control the risk

4. Review the process.

The first and most important step in reducing the likelihood of an accident is hazard identification. This means identifying all workplace situations or events that could cause injury or illness.

The second step is an assessment of the level of risk of the hazards you have identified. This step involves collecting information and making decisions. It is important you consider the extent of the harm or consequence from a hazard and the likelihood of harm occurring. If your assessment is that an unacceptable risk to health and safety exists, you must introduce controls to reduce the risk to an acceptable level.

There are three categories of control measures you might take. You can

- eliminate the hazard
- minimize the risk
- introduce 'back-up' controls

The third step in effective risk management is to establish and maintain systems which give opportunity for regular evaluation and review procedures (i.e. PPE)

Implement additional risk controls

Having identified the hazards in your workplace, assessed their risks and reviewed the existing controls, all hazards must be managed before people are hurt, become ill or there is damage to plant, property or the environment. The management of risks in the workplace requires eliminating risks so far as reasonably practicable in the first instance. Where elimination is not possible, then risks should be minimized, so far as reasonably practicable.

All hazards that have been assessed should be dealt with in order of priority. The most effective control option/s should be selected to eliminate or minimize risks. The Hierarchy of Controls (see diagram below) ranks control options from highest level of protection and reliability to lowest. This should be used to determine the most effective control/s.

2.6 Selecting, using and maintaining suitable safety and personal protective equipment (PPE)

Personal protective equipment is to include that prescribed under legislation, regulations and enterprise policies and practices. Face masks are available for rubbing back and painting.

- **Selecting personal protective clothing and equipment**

Suitable personal protective clothing and equipments selected, used, maintained and stored in accordance with Occupational Health and Safety requirements.

- **Select PPE based on the PPE Hazard Assessment**

Consider these factors when selecting PPE:

- Type of hazardous materials, processes, and equipment involved
- Routes of potential exposure (ingestion, inhalation, injection, or dermal contact)
- Correct size for maximum protection
- Minimal interference with movement

- **Personal protective clothing and equipment may include:**

  - ✓ hat/hard hat
  - ✓ boots
  - ✓ overalls
  - ✓ gloves
  - ✓ goggles
  - ✓ protective eyewear
  - ✓ hearing protection]
  - ✓ respirator or face mask
  - ✓ sun protection, e.g., sun hat, sunscreen

- **Different types of PPE are described below**

Foot protection Workers must wear closed-toe shoes at all times to protect feet from chemical spills and sharp objects. Steel-toed footwear and puncture-resistant soles. Slip-resistant shoes for anyone who works in wet environments.

Figure .2.1 boots

- **Eye protection:** Use safety glasses for minor splash hazards, goggles for moderate hazards, and goggles combined with a face shield for severe hazards.

Figure .2.2 Eye protection

- **Hand protection:** Hand protection is indicated for the possibility of severe cuts, lacerations, or abrasions, punctures, temperature extremes, and chemical hazards. (Nit rile loves are usually a good choice for general use.) Use heavy-duty gloves for non-incidental contact and gross contamination.

Figure .2.3 hand protection

- **Body protection:** Protective clothing includes lab coats, smocks, scrub suits, gowns, rubber or coated aprons, coveralls, uniforms, and pierce-resistant jackets and vests.

Figure .2.4 body protection

- **Head protection:** Hard hats must be worn by electricians, construction workers, and any other workers when there is a danger of objects falling from above.

Figure .2.5 Hard hat

- Respiratory protection

Figure .2.6 respiratory protection

SELF-CHECK #2

Self-Check 1	**Written Test**

Name: _____ **Date:** _____

Directions: **Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers**

1. Write the under taking irrigation measurement work steps ?(5pt)
2. List Operating instructions must include for instance the following items?(5)
3. List Risk management step process?(5pt)
4. List Personal protective clothing and equipment may include?(5)

5. ***Note:*** **Satisfactory rating –10points and above Unsatisfactory - below 10 points**

6. You can ask your teacher for the copy of the correct answer.

Information sheet -3	**Install irrigation components**

3.1 Undertaking installation work

The purpose of professionally installed irrigation system is to provide supplemental water when rainfall is not sufficient to maintain the turf and landscape for its intended purpose. A quality irrigation system and its proper management are required to distribute supplemental water in a way that adequately maintain plant health while conserving and protecting water resources and the environment. In the pre-construction period the work of an irrigation installer is primarily in planning. Most irrigation installations start with an irrigation design. This is a plan of the layout, identifying all the components and where they are to be placed in relation to each other.

Design for domestic backyard systems may be relatively uncomplicated whereas designs for major agricultural developments or urban commercial layouts will be large and contain a lot of detail. The irrigation installer must interpret the design to establish the scope of work. It will define the size of the task and its complexity. Installation of Ideal Micro Irrigation Systems is a very simple process. It can be divided in to three stages:

- Installing water source (bucket, barrel, tank, pump, etc.).
- Laying of pipes and emitters / micro-tubes / setting up sprinklers.
- Commissioning

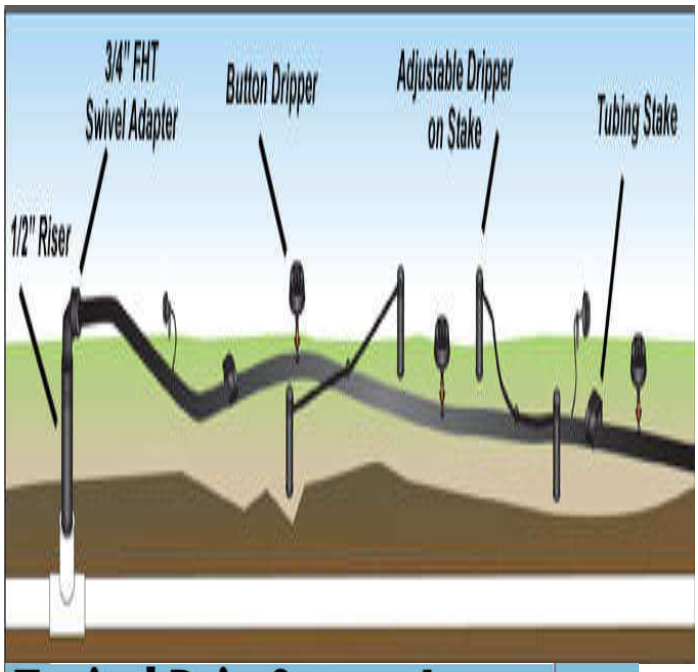
I. If there is no overhead tank then a water source must be created (i.e. a bucket, barrel, tank, etc.) It has to be installed above ground level on a stable support platform at the required height to achieve minimum pressure requirements for the system (minimum 1 meter). The system then can be connected to the water source. Micro-sprinkler and overhead sprinkler kits can be directly connected with the equivalent discharge outlet of a pump or water supply system. Make sure that the control valve and filter are connected to the system through the main line.

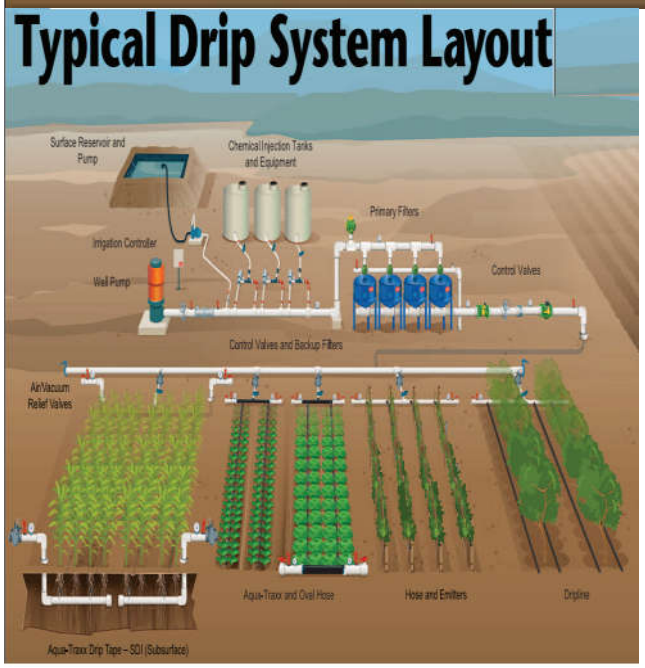
II. For drip systems, lateral pipes are laid on the ground in a straight line or along the plant rows. Emitters / micro tubes are pre-fixed on the lateral. They are placed at equal spacing so that plants receive a uniform amount of water. For sprinklers, stakes are used to place them properly. Care should be taken so that dirt, sand etc. does not enter into the pipes while making connections.

Before operating the system, end caps at the end of the laterals and sub-main are released so that if there is dirt in the pipes it is washed away and air is also driven out. Open the control valve and let the water flow freely through the pipes for some time (flush the system). Then close the end caps and ensure that water is coming out from each emitter.

Drip and Sprinkler irrigation systems installation guide

- Marking pipe lines and intersections
- Main lines ditches excavation
- Assembling irrigation control and distribution heads.
- Main lines piping placement and union.
- Connections between main lines with control and distribution heads.
- Main lines ends and intersections and anchoring.
- Covering main lines ditches
- Manifold lines, ditches excavation
- Manifold lines, pipes placement, union and lateral outlets preparation.
- Drip irrigation (mini sprinklers) laterals distribution.
- Covering manifold lines ditches
- Main lines flushing and testing.
- Manifold lines flushing and testing.
- Emitters/sprinkler head insertion and placement.
- Laterals flushing and testing, emitters inspection.
- Irrigation shifts flow rates measurement inspection.


3/4" FHT
Swivel Adapter
Button Dripper
Adjustable Dripper
on Stake
Tubing Stake
1/2" Riser


Typical Drip System Layout
Surface Reservoir and Pump
Chemical Injection Tanks and Equipment
Primary Filters
Irrigation Controller
Well Pump
Control Valves
Control Valves and Backup Filters
Air/Vacuum Relief Valves
Aqua-Traxx and Oval Hose
Hose and Emitters
Dripline
Aqua-Traxx Drip Tape – SDI (Subsurface)

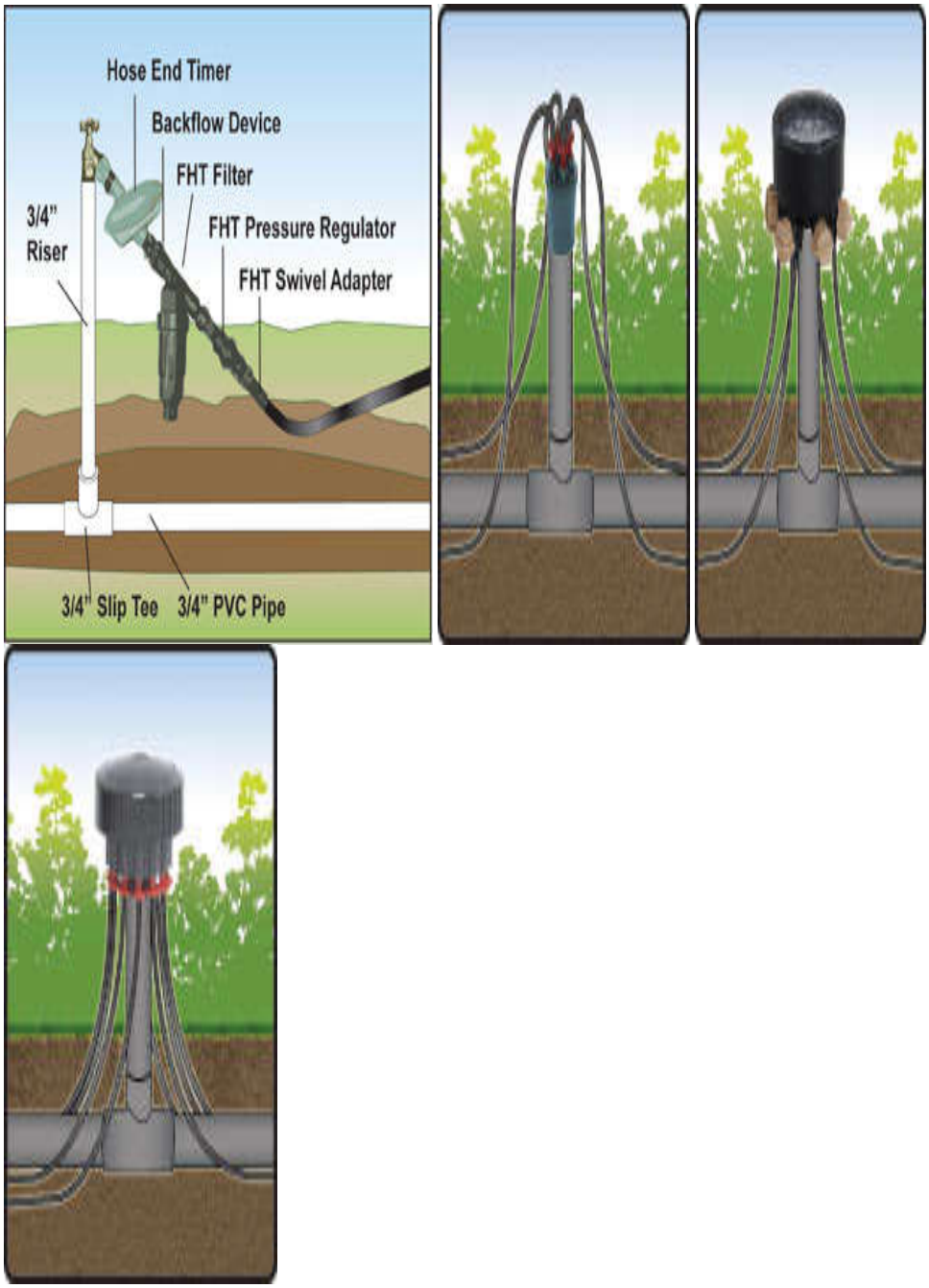


Fig 3.1 layout of drip and sprinkler irrigation components

3.2. Assembling, connecting, testing, completing and testing components

- **Installing Irrigation Equipment**

The installation of your irrigation system begins at the control valve assembly. It consists of the control valve, the filter and the pressure regulator respectively.

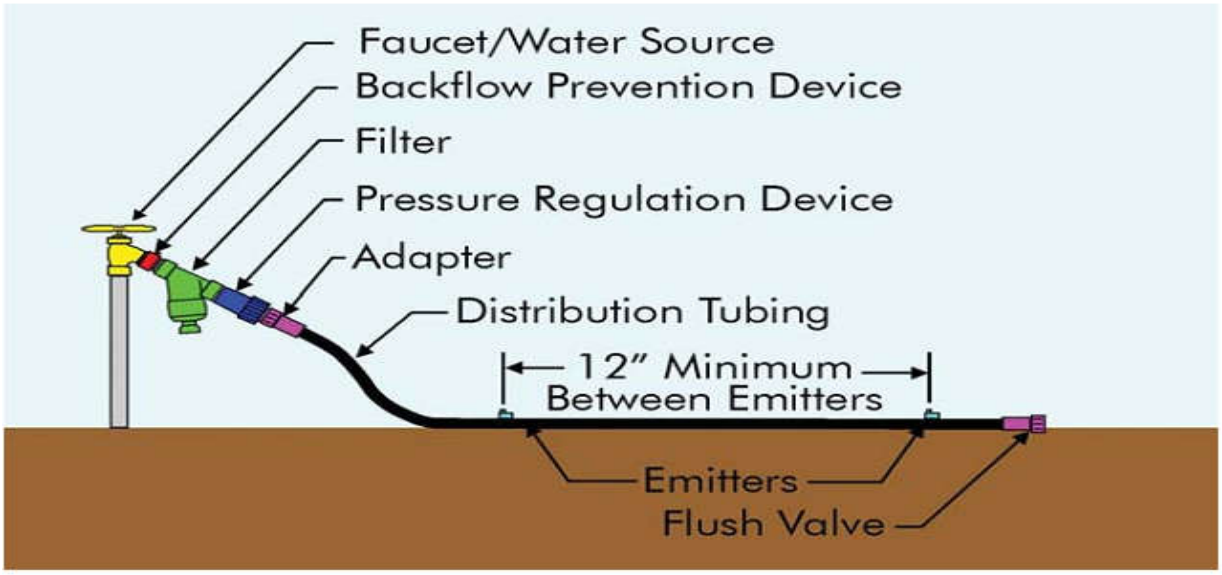


Figure: 3.2 hose-end system components

- **Installing Pipes**

Pipes are installed in trenches as follows:

Before installing pipes in trenches, ensure that

- The trenches are free of stones and sharp edges.
- Asbestos cement pipes and large PVC pipes must be laid down on a bed of sand.
- Place the first pipe into the trench and secure it by backfilling the trench near the ends of the pipes.
- Place a collar over the end of the pipe. Make sure the collar and the end of the next pipe is clean
- Lubricate the inside of the collar and the end of the next pipe with pipe lubricant or soap water.
- Do not use oil because this will cause the rubbers to perish.
- Insert the end of the second pipe into the collar.
- Place a wooden block over the other end of the second pipe and tap the block with a hammer to force the pipe into the collar. The force that is required depends on the size of the pipe.
- Drive the pipe in up to the depth marked on the pipe. Take care not to pinch the rubbers

- If the pipe refuses to go into the collar, remove the pipe and inspect the collar, as the rubbers may have shifted.
- Ensure that there are no foreign objects inside the pipes that can cause blockages in the irrigation system
- As the pipes are laid they can be backfilled near the edges. Joints must be left open to check for leaks.

Where bends or end caps are fitted there is always the possibility that the joints can kick out, except in the case of steel joints. Bends and end caps must be anchored either by driving Y-standards in and tying them down, or by casting trust blocks. Trust blocks can be 600x600x300 and cast in ordinary concrete.

It is good practice to flush the pipes as the work continues. First flush the mainline before the valves are fitted. Then flush the mother lines before the laterals are fitted. Next, the laterals can be flushed before emitters are fitted.

Considerations during installation of pipes

- Sun burnt pipe and fittings should not be used.
- Pipe should not be dropped.
- Pipe cuts should be straight.
- Burrs from cutting should be removed before gluing.
- Pipe and fittings should be clean before gluing.
- Pipe and fittings should be primed PVC primer before gluing.
- Glue type should match the manufacturer's recommendations for pipe size.
- Old, jellified glue should not be used.
- A light, even coat of glue should be applied to both the pipe and fitting.
- Fittings should be held in place until the glue forms an adequate bond.
- Any excess glue on the connection should be wiped off immediately.
- Glued fitting should be left to cure for at least 24 hours before the system is pressurized.

➢ **Installing Filters and Valve Clusters**

Pump and filter bank installation is a specialized job that should be carried out by a competent contractor.

Inline filters can however be installed very easily. The filter is attached to risers so that it is above ground. At the bottom end of the risers are riser outlet bends, which are spigot to slide over the pipe. At the back of each riser leg, a Y-standard is hammered in and tied down to the riser to keep the leg from popping out. The valve clusters are installed in the same way.

- **Installing Infield Fittings**

Grommets are installed by sawing a hole in the mother line, and inserting a rubber ring into the hole. The ring has a groove that fits into the sides of the pipe. The coupling is inserted into the lateral and then pushed into the rubber ring. There is also another type of grommet that is pushed into the hole and the retaining nut on the grommet is tightened.

Nylon couplings and reducers are pushed into the poly-pipe. No clamps are needed as long as the working pressure is within limits.

Micros have a tube that is fitted with a barb and drippers have the barb molded onto them. A hole is punched in to the poly-pipe and the barb inserted into the hole.

- **Emitter and Tubing Installation**
    - Emitters and tubing should be installed in a way that reduces damage due to vandalism, insects, animals, and landscape maintenance
    - Emitters installed on the soil surface are more vulnerable to damage and calcification.
    - With emitters installed at the end of the line, tubing is under pressure and may flow out large quantities of water if damaged.
    - Emitter tubing length should not exceed 10 feet from the point of emission.
    - Lengths of less than 5 feet are highly recommended.
    - Long tubing lengths are difficult to service.
    - Emitters or connector barbs should be installed into the polyethylene tube with holes made by hollow point punches of the correct size.
    - Solid point punches can tear the tube and cause a leaky fit.
    - Nails, ice pick, and other pointed devices are not properly sized or designed to ensure a proper fit.
    - Emitter tubing outlets should be exposed between 1" and 3" above the ground surface

- **Pressure Testing**

Before backfilling, all pipes and connections should be pressure tested for leakage.

Air must be bled out of the system before testing.

Follow manufacturer's recommendation for glue curing time before the system is pressurized (usually 24 hours).

- **Flushing**
  - Flush backflow preventer before installing valves.
  - Flush valves before installing laterals.
  - Debris needs to be flushed out of the lines so the equipment does not clog.
  - Flush laterals before installing drip emitters.
  - Tubing outlets should be placed above ground so that their discharge can be observed.
  - Outlets placed above ground reduce the potential of dirt being drawn back into the tubing.
- **Backfill**
  - Trenches must be backfilled with soil free of large rocks and sharp objects.
  - Rocks and sharp objects can crack or break the pipe.
  - Backfill must be compacted enough to avoid settling within the trench

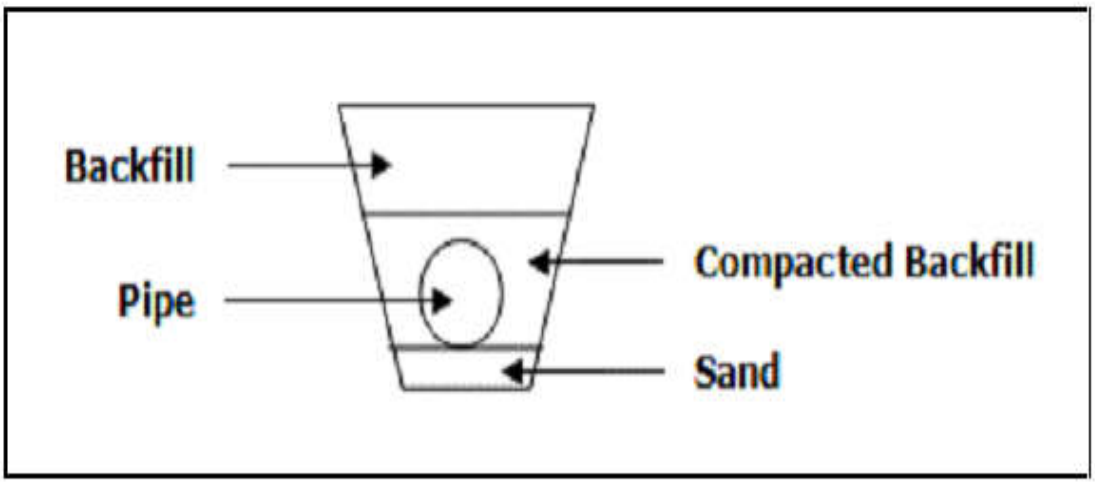


Figure: 3.2 Trench back filling

3.3. Maintaining a clean and safe work area

Next to tidiness, cleanliness is one of the most essential elements in maintaining a healthy, safe work environment. Not only does a clean workplace reflect the professionalism of a company and help motivate employees, it also promotes healthy workers as a clean environment prevents accidents and the spread of illnesses. Although we are talking simple matters of common sense here, it might be worthwhile pointing out some of the salient reasons why cleanliness is a major factor when it comes to providing a safe work area. A place for everything and everything in its place, or so the saying goes. One of the first principles of a tidy workplace is to make sure that tools are kept in their place at all times. This alleviates the problem of losing bits and pieces and cluttering up walkways. Work practices which were developed in factories over many decades concluded that it was not only safer to keep everything in its place were not being used, but it also contributed to high rates of efficiency.

As dirt, dust and grime accumulate bacteria start to breed and this can be catastrophic in any enclosed working space such as an office. Bacterial infections can lead to illness, a major contributor to staff absentee rates so; once again, a clean environment contributes to greater workplace safety.

Hazardous materials are commonly used in some workplaces. The very nature of these products means that they are dangerous to human health and pose a risk unless properly handled. By keeping it in special containers/safe place, and out of the workspace when not being used, risk is minimized and a clean environment is maintained.

Site maintenance

- The job site shall be kept in a neat, clean, and orderly condition at all times during the installation process.
- All scrap and excess materials are to be regularly removed from the site and not buried in trenches.
- Trenching, laying pipe and backfilling shall be continuous so that the amount of open trench at the end of each work day is minimized. Any open trench or other excavations shall be barricaded and marked with high visibility flagging tape.
- Disabling unused tools, equipment and machinery and storing neatly out of the way of installation activities;
- safely storing materials on site;

- Using signage and safety barriers during and removing after construction activitiesare completed; and swiftly and efficiently removing and processing debris andwaste from the work area.

During the site maintenance activity we are expected to remove/dispose Waste material may include

- Unused construction and excavated materials,
- plant debris,
- Litter and broken components.

Waste may be removed to designated areas for

- Recycling,
- Reuse, and
- Return to the manufacturer or disposal.

Plant-based material may be mulched or composted, plastic, metal, paper based materials may be recycled, re-used, returned to the manufacturer, or disposed of according to enterprise work procedures

3.4. Choosing tools appropriate to the task

During installation of irrigation components firstly we are expected to choose and prepare appropriate tools for the appropriate tasks. The following tools and equipments are required for pegging out the blocks in addition to those mentioned in section.

- Pegs (one per tree in the block)
- Hammer
- Measuring tape
- Wire or rope
- Surveying and leveling equipment such as
- Automatic level,
- Laser level,
- Dumpy level,
- Cowley level,
- Staff,
- Boning rods,

- Pegs,
- Notebook,
- Pencil and calculator;
- Hand tools such as
- Hakes,
- Shovels,
- Spades,
- Rollers,
- Wheelbarrows,
- Hoses and hose fittings;
- Pumps and pump fittings; and fitting and
- Welding tools appropriate to the irrigation system

Safe working practices must be employed

During installation work safe lifting and material handling means keeping your back aligned and balanced when lifting. With a little practice, precautionary methods outlined below can become good daily habits that could help prevent back injuries both on and off the job. Before, excavating, lifting and installing take a moment to think about what you're about to do.

OHS requirements include identifying hazards; assessing risks and implementing controls; cleaning, maintaining and storing tools, equipment and machinery; appropriate use of PPE including sun

Personal Protective Equipment-Workers should use appropriate protective equipment as necessary to help reduce accident potential. In order to control hazards related with installation of micro irrigation by using PPES like

- boots,
- overalls,
- gloves,
- goggles,
- respirator or face mask,
- face guard,
- hearing protection,

- Sunscreen lotion and hard hat.

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below accordingly.

1. Write the basic stages of Installation of Ideal Micro Irrigation Systems. (10 pts)
2. Write the factors that we are expected to considerations during installation of pipe in micro irrigation. (5pts)
3. Write types pipe for micro irrigation. (5pts)

Note: Satisfactory rating - 10 points and above Unsatisfactory - below 10 points

You can ask your teacher for the copy of the correct answers

Operation sheet	Installation of micro irrigation

Installation of micro irrigation

Purpose: - Micro-irrigation refers to low-pressure irrigation systems that spray, mist, sprinkle or drip. The water discharge patterns differ because emission devices are designed for specific applications due to agronomic or horticultural requirements. Micro-irrigation components include pipes, tubes, water emitting devices, flow control equipment, installation tools, fittings and accessories

Equipment, Tools and Materials:

Pipes, tubes, water emitting devices, flow control equipment, installation tools, fittings and accessories

Conditions: If there is no overhead tank then a water source must be created (i.e. a bucket, barrel, tank, etc.) It has to be installed above ground level on a stable support platform at the required height to achieve minimum pressure requirements for the system (minimum 1 meter).

Procedure:

- Study installation sketch

- Give layout for water tank / filter platform and trenches for pipes if required
- Check components in the kit / material at site as per the list of materials in the user manual
- Install water storage tank and filter on the platform
- Connect filter to the water source / pump and the main line
- Lay out the main line, sub-main and lateral pipes
- Cover the pipe trenches if required
- Place / fix the emitters / sprinklers (if micro tubes require inflated lateral pipes then fill the pipes with water then punch holes and fix micro tubes)
- Start the pump / Open the valve and fill the pipes with water
- Release all end caps / flush valves to clean the system of dirt
- Check pressure and discharge and ensure all emitters are working
- Precaution: Care should be taken so that dirt, sand etc. does not enter into the pipes while making connections. Before operating the system, end caps at the end of the laterals and sub-main are released so that if there is dirt in the pipes it is washed away and air is also driven out. Workers must all be aware of safety regulations

Quality Criteria:

At the completion of the project, should inspect for leaks in irrigation pipes and connections ensure that all emitters are operating at their proper flow rate, and ensure all trenches have been properly covered. The backflow preventer should be tested by a certified tester. Backflow preventer testing is mandatory for commercial installations.

LAP Test/ Job Sheet	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

You are required to perform the following:

Request a set of different activities in of installing micro irrigation systems and then perform the following task in front of your trainer:

- List the component parts of drip and sprinkler
- Install drip and sprinklerirrigation systems

InformationSheet-4	Complete installation work

4.1 Finishing of earth work activities

- **Earthworks** are engineering works created through the processing of parts of the earth's surface involving quantities of soil or unformed rock.
  - Excavation may be classified by type of material (Frederick.S. et al, 1995)
    - ✓ Topsoil excavation
    - ✓ Earth excavation
    - ✓ Rock excavation
    - ✓ Muck excavation – this usually contains excess water and unsuitable soil
    - ✓ Unclassified excavation – this is any combination of material types
- Backfill is used to fill trenches for pipe structures, culverts, utility cuts and other work extending under pavement locations, to fill cavities beneath slope walls and other locations which are excavated during micro irrigation work.
- Unbalanced backfill is not allowed until the concrete required to resist the backfill is at least 10 days old or a flexural strength of 440 lb/in2 for third point loading has been attained. The unbalanced height may not exceed 10 ft until the concrete is at least 15 days old or a flexural strength of 480 lb/in2 for third point loading has been attained.
- Protect earthworks and in particular road formations from the effects of erosion and deposition. Grade earth works and particularly sub grades to drain at all stages without ponding. Where run-off must cross the formation, ensure that the stream is a broad sheet flow which crosses roughly at right angles to the alignment and minimizes the likelihood of sub grade softening. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimize ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material

placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface. Should insitu or stockpiled material become over wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

- Final trimming and cleaning consists of trimming and cleaning the otherwise completed micro irrigation for the entire contract specification. At the time of acceptance of the contract, the following conditions are required for the entire length and right-of-way width of the contract.
    - ✓ All debris and rubbish removed and properly disposed off.
    - ✓ All cut and fill slopes and any other areas that were disturbed left reasonably smooth and uniform
    - ✓ Any loose and overhanging rock removed
    - ✓ Weeds, brush, and stumps cut close to the ground and properly disposed of as directed
    - ✓ Waterways left unobstructed
    - ✓ Bridges cleaned of all rubbish, sand, stone, gravel, and dirt including the floors, roadways, railings, bottom chords, shoes, and seats
    - ✓ Culverts and other drainage structures left clean for their entire length

Self-Check 4	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What does mean earth work? (5 points)
2. List the types of excavation depending on the types of material? (5 points)
3. What does mean backfill? (5 points)
4. What activities will be done after finishing of earth work? (5 points)

Note: Satisfactory rating - 10 points and above Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answer

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