Ethiopian TVET-System

Irrigation and Drainage Design and Construction Supervision

Level IV

Based on, March 2017G.C. Occupational Standard

Module Title: Coordinating and Monitoring Asset Construction and Maintenance

TTLM Code: EIS IDS4 TTLM 0620v1

This module includes the following Learning Guides

LG 64: Plan and Prepare for Asset Construction & Maintenance

LG Code: EIS IDS4 M14 0920 LO1-64

LG 65: Undertake Work Site Maintenance

LG Code: EIS IDS4 M14 0920 LO2-65

LG 66: Test and Commission Work

LG Code: EIS IDS4 M14 0920 LO3-66

LG 67: Conduct Post-Maintenance Activities

LG Code: EIS IDS4 M14 0920 LO4-67

Instruction sheet	Learning Guide 64: Plan & prepare for asset construction &maintenance

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

- Determining Work requirement
- Confirming maintenance plan, prioritizing and scheduling work
- Confirming Authorizations and communication with stakeholders
- Identifying and addressing Stakeholders impacting Issue
- Conducting site inspection as per requirement

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 Work requirement
- Confirm maintenance plan, prioritizing and scheduling work
- Confirm authorizations and communication with stakeholders
- Identify and address stakeholders impacting Issue
- Conducting site inspection as per requirement

Learning Instructions:

1. Read the specific objectives of this learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets 1- 5”. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1,2, 3, 4 and 5 ” in each information sheets on pages 7,10,15,19 and 24.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets 1, and 2 on pages 25 and 26 and do the LAP Test on page 27”.

Information Sheet-1	Determining Work requirement

1.1. Introduction

One of the key objectives in the management of an irrigation and drainage system is to provide levels of service as agreed with Government/Project Manager and consumers at minimum achievable cost.

To meet that objective, and assure the ongoing integrity of the asset embodied in an irrigation project calls for management skills of a high order. Those skills are required to coordinate effectively the elements of staff, equipment, and the physical and financial resources involved in the project. A Plan for Operations and Maintenance is required to establish a strategy for the achievement of these objectives.

1.2. Work requirement concept in asset construction and maintenance

Table 1:Some the scopes in work requirement(source .EOS, March 2017

• Purpose and history of site and its assets • Maintenance plans and specifications Site location and conditions • Risk and hazard management procedures • Communication methods and equipment • Authorizations, permits and restrictions • Environmental and heritage conditions • Recording and reporting asset condition and maintenance	• Preparing and coordinating the availability and transporting of: ✓ Maintenance and construction support Equipment and tools ✓ Replacement assets ✓ Safety and protective equipment ✓ Communication equipment ✓ Technical expertise ✓ Surveying equipment ✓ Camping and survival resources ✓ Rescue and retrieval resources

1.2. Work requirement preparation process

1.2.1 Working knowledge

Proper maintenance of an irrigation system involves having a working knowledge of the functionality of the basic components that are common in all systems. This knowledge can be directed toward detecting and preventing problems associated with improperly functioning systems, thus preventing deterioration of the system asset.

1.2.2 Scope of work requirement

Work involves the maintenance and repair of all the components of the irrigation system. The scope of work includes, but is not limited to, the point of connection, piping system, electrical system and the sprinkler heads that apply water to the landscape area.

1.3. Planning and preparing for logistic requirements

1.3.1Duties and responsibility in wok requirement

Contractors are responsible for bringing the irrigation up to specifications within thirty (30) days of the contracts Notice to Proceed date.
If you are unable to bring the project up to specifications within thirty (30) days, you shall request a time extension from the Engineer.

- Failure to bring the project up to specifications or to request a time extension may result in an unsatisfactory rating for this period (and a deduction in pay).
- It is your responsibility to ensure that adequate labor, equipment and tools are provided for irrigation maintenance. Contractors are required to provide

1.3.2 Reuse asset Confirmation

Contractors and asset maintenance personnel involved in irrigation maintenance are responsible for ordering all replacement parts. The Engineer must approve the ordered

parts before they are bought, and determine whether maintenance personnel or the contractor will pay. In addition note that:

- The reuse of salvageable material, wherever feasible, is authorized if it is accepted by the Site inspector.
- The reuse of materials is authorized for the purpose of maintaining the same product type on the site/ system.

1.3.3 Planning for Replacement of system components

Replacement of irrigation system components must be made with materials of the same manufacturer and model as the original equipment. Substitutions of materials other than the original equipment brand will be approved only when the original equipment has been discontinued and is no longer available for purchase at any location. The substituted component must be completely compatible with the original and must be approved in advance by the Engineer. All repairs to the system shall be identical to the original installation unless otherwise approved in advance by the Engineer.

In your plan and prepare task for asset. Construction and maintenance you are expected to ensure all replacement parts must have the same output and coverage specifications as the previous equipment.

Self-Check-1	Written test

Directions: For the question below write True if the given statement is true and write False if the given Statement is False. Each question has equal 2 point. For your answer use the space provided.

1. A plan for operations and maintenance is required to establish a strategy for the achievement of asset objectives.
2. Proper maintenance of an irrigation system involves having a working knowledge of the functionality of scheme.
3. Work requirement involves the maintenance and repair of all the components of the irrigation system.
4. Contractors are responsible for bringing the irrigation up to specifications within twenty (20) days.
5. As supervisor it is your responsibility to ensure that adequate labor, equipment and tools are provided for irrigation maintenance.
6. The reuse of salvageable material, wherever feasible, is authorized if it is accepted by the Site inspector.

Note: Satisfactory rating -6 points and above **Unsatisfactory - below 6 points**

Name: _____ **Date:** _____

Score = _____

Rating: _____

Answer Sheet

1		**4**		**6**	
2		**5**			

Information Sheet-2	Confirming Maintenance Plan, Prioritizing and Scheduling Work

2.1 Introduction

One of the key objectives in the management of an irrigation and drainage system is to provide levels of service as agreed with Government/Project Manager and consumers at minimum achievable cost. To meet that objective, and assure the ongoing integrity of the asset embodied in an irrigation project calls for management skills of a high order. Those skills are required to coordinate effectively the elements of staff, equipment, and the physical and financial resources involved in the project.

2.2 Set of coordination and management plan

Table 2: Typical set of management plan as compared with maintenance plan

No	Type	Description and key features of planning
1.	Development Plan	• new services to be provided • new facilities, programs or activities • major modernization of existing facilities
2	Plan for Operations and Maintenance	• a permanent set of documents and instructions, work procedures, programs and schedules
3	Management Support Plan	• development and review of organizational structure • development of management reformation systems
4	Human Resources Plan	• categories and levels of resources to carry out specific tasks • skills required, or not required, to address future activities • special programs to meet specific needs
5	Financial Plan	• indicating sources of funds and cost recovery policies and targets

2.3. Confirmation and work schedule process of maintenance plan

2.3.1. Operation and maintenance plan

The POM is a permanent set of documents and instructions, organization charts, work programs and schedules, updated when changes are made, so that it comprises a complete statement for reference and guidance at every level in the project organization.

2.3.2. Prioritize and schedule Maintenance work

Wherever an irrigation system has been installed, you must maintain it in good working order. Repairs must start within 48 hours of detecting damage, or from the time of notification by the Engineer. Normal work shall be performed during daylight hours, Monday through Friday (except State holidays).

Self-Check-2	Written test

Directions: For the question below write True if the given statement is true and write False if the given Statement is False. Each question has equal 2 point. For your answer use the space provided.

1. In development Plan new services to be provided
2. Management Support Plan indicating sources of funds and cost.
3. Human resources plan is about management reformation systems
4. Wherever an irrigation system has been installed, it must maintain it in good working order.
5. The elements of staff and, equipment involved in the project monitored well.
6. The POM will form one of the set of management plans
7. Operation maintenance plan is a permanent set of documents and instructions.

Note: Satisfactory rating -7 points and above **Unsatisfactory - below 7 points**

Name: _____ **Date:** _____

Score = _____

Rating: _____

Answer Sheet

1		**4**		**6**	
2		**5**		**7**	

Information Sheet-3	Confirming Authorization and Communication with Stakeholders

3.1. Introduction

To make possible the flow of information required for operation within the system and between the project and the users, an efficient system of communication is necessary. A full management information system is usually desirable, and this can be used by other authorities responsible for different aspects of an irrigation scheme, such as the extent and rate of planting and. harvesting, and occurrence of pests and diseases. Clear instructions should be provided to operating staff on timing and nature of data to be exchanged.

3.2. Authorizations and Stakeholder in asset management

3.2.1. Stakeholders

In coordinate and monitor asset construction and maintenance stakeholders include (it may not be limited):-

- Contractors
- Government and regulatory authorities
- Property owners
- Utility organizations
- Specialized work teams
- General public and Asset users

3.2.2. Authorization in coordinating and monitoring of asset

Authorizations in coordinate and. monitor asset construction and maintenance include:-

- Federal, state and local government
- Quarantine controls
- Legal access
- Traffic management

3.3. Confirmation process of Authorization

3.3.1. Work instruction document

The work instruction document will provide specific, concise but detailed instructions for the operation of the irrigation system.

- It is to be used predominantly by operators in the field, and their supervisors and managers. It will provide a formal documentation of operational procedures to assist in effective day-to-day operation,
- As well as providing a basis for longer term review and evaluation of policy and operational practices in the light of operational experience.

Two fundamental factors will influence the content of these instructions:

- the method of water allocation and distribution adopted for the system;
- The technology adopted for water control within the distribution system.

3.3.2. System stakeholders operating rules

There are a number of activities to be addressed in the formulation of System Operation rules, which could be grouped under the following headings:

- Detailed Operational Rules and Specifications;
- Irrigation Plan (Seasonal and Annual Operating Plan);
- Operational Procedures
- Emergency Procedures
- Operations below Farm Outlets

3.3.3. Authorization statement

The Authorization statement document Comprise the essential specific policy guidelines and general operating criteria which system operators must take into account in determining detailed operational procedures. These will be extracted and expanded, where necessary for operational purposes.

In confirming authorization statement document communication with the relevant stakeholders required and it should be checked the in minim in the following contents are well included.

3.3.4. Organizational duties and responsibilities

Based on relevant information that are contained in information sheet#1 and information sheet #2 Organization Management and Responsibilities, and Project Description respectively.

Table 3: Example of how key aspect are considered in organizational

No	Key area	Issue to be considered
1.	Water sources	any legal limits to water availability for project purposes any water sharing agreements with external bodies or organizations
2	Priorities for delivery	normal availability from sources restricted availability from sources
3	Categories of demand to be supplied	project requirements municipal and industrial (M&I),environmental flows
4	Requirements for "passed-down-river' flows to meet riparian entitlements, or entitlements of downstream projects or water users, in terms of either flow rate or water levels to be maintained.	

3.4. Communication

To make possible the flow of information required for operation within the system and between the project and the users, an efficient system of communication is necessary. A full management information system is usually desirable, and this can be used by other authorities responsible for different aspects of an irrigation scheme, such as the extent and rate of planting and harvesting, and occurrence of pests and diseases. Clear instructions should be provided to operating staff on timing and nature of data to be exchanged.

- Every month contractors will be required to report on the water consumption for irrigation, the time spent doing irrigation maintenance work, and the detection, repair and replacement costs of broken components.
- Every month the inspector will check to ensure that the various components and functions of the irrigation system, including but not limited to dry spots, leaking valves, stuck valves and broken risers, laterals or mains, are functioning properly.
- You will also be required to accompany the Engineer to perform a comprehensive annual inspection of the irrigation system.

Self-Check-3	Written test

Directions: For the question below write True if the given statement is true and write False if the given Statement is False. Each question has equal 2 point. For your answer use the space provided.

1. The work instruction document will provide specific, concise but detailed instructions for the operation of the irrigation system.
2. Clear instructions should be provided to operating staff on timing and nature of data to be exchanged.
3. In operating rule preparation the method of water allocation and distribution adopted for the system is include.
4. Detailed operational rules and specifications are parts of operating rule.
5. In communication a full management information system is usually desirable
6. Clear instructions should be provided to operating staff on timing and nature of data to be exchanged.

Note: Satisfactory rating -7 points and above **Unsatisfactory - below 7 points**

Name: _____ **Date:** _____

Score = _____

Rating: _____

Answer Sheet

1		**4**		**6**	
2		**5**		**7**	

Information Sheet-4	Identifying and addressing stakeholders impacting issue

4.1. Introduction

Not all stakeholders need or want to be involved in all tasks associated with the process. One purpose of stakeholder analysis is to ensure that the Team, and others involved in managing the planning process, adequately understands the stakes of different interest groups, where they wish to participate, and what their expectations and skills are.

4.2. Stakeholders participation and involvement

4.2.2. Aspect of stakeholder participation

A core principle approach to water management is stakeholder participation. Water is everyone's business and for the success of water sector reforms it is important to know what the views and interests are of the stakeholders. The importance of stakeholder participation should be recognized in a number of aspects of project preparation and implementation. These aspects include:

- The identification of stakeholders' interests in, importance to, and influence over the proposed project;
- The identification of local institutions or processes upon which to build support for the project; and
- The provision of a foundation and strategy for involving the stakeholders in the various stages of preparing and implementing the IWRM plan.
- The last point shows that the stakeholder engagement strategy runs right
- The last point shows that the stakeholder engagement strategy runs right through the planning process as an integral component and is not a one off event.

4.2.3. Benefit of stakeholder involvement

It can lead to informed decision-making as stakeholders often possess a wealth of information which can benefit the project maintenance and construction. In addition the involvement of stakeholder:-

- Stakeholders are the most affected by lack of water resources or poor management of water resources;
- Consensus at early stages of the project can reduce the likelihood of conflicts which can harm the implementation and success of the project;
- Stakeholder involvement contributes to the transparency of public and private actions, as these actions are monitored by the different stakeholders that are involved;
- The involvement of stakeholders can build trust between the government and civil society, which can possibly lead to lead to long-term collaborative relationships

4.3. Consideration in stakeholders impacting issue assessment

4.3.1. Stakeholder interests

Not all stakeholders need or want to be involved in all tasks associated with the process. One purpose of stakeholder analysis is to ensure that the Team, and others involved in managing the planning process, adequately understand the stakes of different interest groups, where they wish to participate, and what their expectations and skills are.

So it is important to clarify early on the roles of the key participants in strategic planning processes and relationships between them, as defined in the formal roles and mandates of institutions and organizations in the process, and as promoted by the different policy communities.

4.3.2. Stakeholder potential impact

Once the key stakeholders have been identified, the possible interest that these groups or individuals may have in the project can be considered. Questions that you should try to answer in order to assess the interests of different stakeholders include:

- What are the stakeholder expectations of the plan?
- What benefits are likely to result from the project for the stakeholder?
- What resources might the stakeholder be able and willing to mobilize?
- What stakeholder interests conflict with Project goals?

Self-Check-4	Written test

Directions: Write short answer for the question given below. Each question has equal 2 point. For your answer use the space provided.

1. What are the key stake holder's asset construction and maintenance?
2. Write the two fundamental factors that influence the content of operating rule.
3. Write how effective communication can be done with stakeholders?
4. What are the duties and responsibility of stakeholders in assets construction planning
5. How Authorization and communication can be confirmed?

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1. ----------
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3. ----------
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4. ----------
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5. ----------

Information Sheet-5	Conducting Site inspection as per requirement

5.1. Introduction

Major irrigation system checks and repairs are performed on an annual basis, normally during the winter when irrigation is required less often.

5.2. Site inspections activities in asset construction and maintenance

Site inspections activities in asset construction and maintenance may include, but not limited to:

- Confirmation of:
  - ✓ Plans
  - ✓ Contracts
  - ✓ Purpose
  - ✓ Asset history
  - ✓ Fault reports
  - ✓ Components
  - ✓ Risk factors
  - ✓ Inspection of preparation work
- Assessment of compliance with specifications and manufacturers' guidelines
- Assessment of compliance with procedures and legislation including:
  - ✓ Occupational health and safety requirements
  - ✓ Environmental
  - ✓ Natural resource management
  - ✓ Water quality

5.3. Irrigation system inspecting checklist

An inspection checklist is established according to the irrigation maintenance program.

- System is regularly inspected according to the checklist.
- Remedial action and repairs are identified and undertaken to restore system to full effectiveness.

- Servicing of mechanical equipment is undertaken according to the irrigation maintenance program.
- servicing of mechanical equipment include periodical maintenance for pumping unit may include changing engine oil, replacing the oil filter, replacing the air cleaner, checking battery water level, pre-cleaner, gear box oil, cooling system/water, fuel, battery charge and fuel tank, greasing the pump jack shaft and bearings, and flushing (de-silting) the pump.

Centre control tower maintenance may include greasing head of pivot and all gearboxes, checking tire pressure, and cleaning electrical controls of authorized components.

5.4. Pump station and filters inspection consideration

5.4.1. Pre-start-up inspections guide line

Pre-start-up inspections must be performed every time before the pump is started, and start-up and shut-down procedures must be strictly followed. The pump installation is equipped with an amp meter, volt meter, pressure gauge and flow meter. Readings from these meters are used to determine the working characteristics of the pump and pump-motor. The normal pump-motor working characteristics are determined by the irrigation manager and based on the irrigation design.

5.4.2. Guide line for flushing and cleaning filters

Primary filters are usually in banks and can be either sand or disc filters. Filters in banks are back-flushed using hydraulic valves. In a sand filter, water enters through the inlet and is filtered through the sand during normal operation with back flush valves closed. The clean water exit through the outlet and the dirt and impurities stay trapped in the sand. The more the filter is used, the dirtier the sand will become.

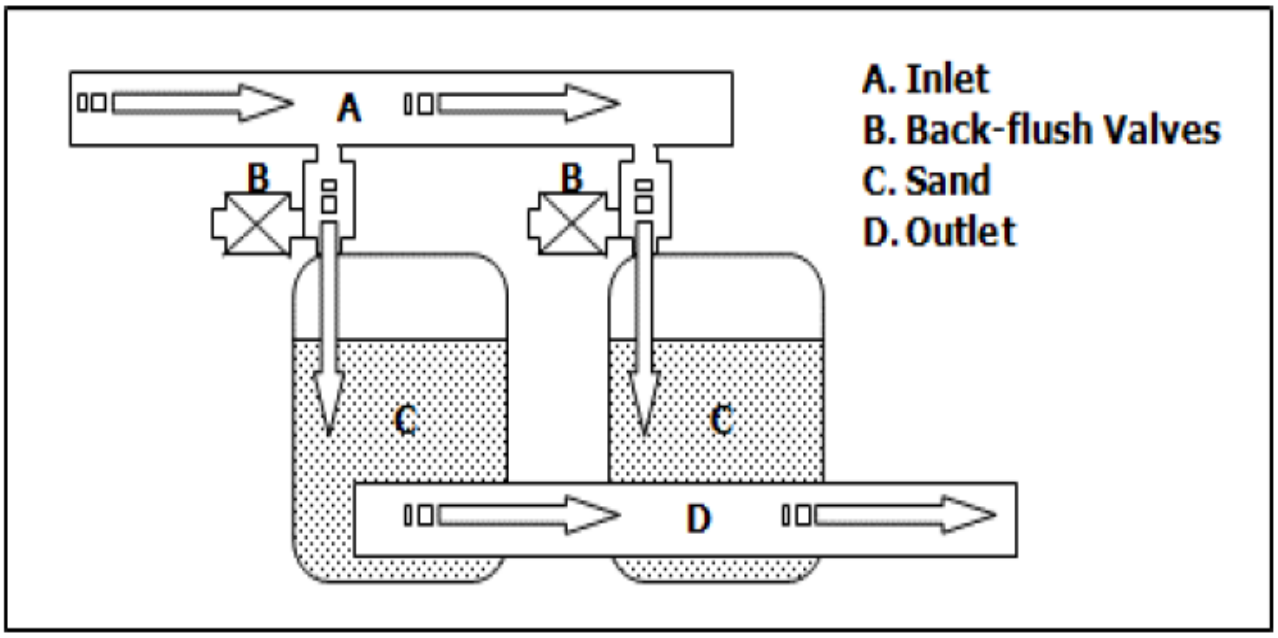

Figure 1: Normal Filtration in Sand Filter

5.4.3. Risk management guide line

If the sand has become dirty to a point where water cannot pass through it easily any longer, a pressure differential between the in- and outlet of greater than 0.5bar occur. The filter needs to be back-flushed.

If filters are not back-flushed regularly in the prescribed manner, dirt will accumulate in the filter, causing holes in the sand. The accumulated dirt cause irregular flow inside the filter. This irregular flow blow holes inside the sand. The water will move through the holes and not the sand, meaning that the water will not be filtered properly.

Self-Check-5	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What does site inspection means?
2. How site inspection is conducted?
3. What are the components of organizational procedure to conduct site inspection
4. What does irrigation maintenance and repair involve?
5. How do you receive replacement parts/components?

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1. ---
2. ---
3. ---
4. ---
5. ---

Operation sheet-1	Techniques of Assessing and Identifying Stakeholder Issue

OPERATION TITLE: Assessment and Identification of stakeholders issue

PURPOSE: To Conduct assessment and identify stakeholders issue impacting asset construction and maintenance.

EQUIPMENT, TOOLS AND MATERIAL: TTLM/Operation sheet, pen, pencil, Checklist

PROCEDURE:

In conducting Assessment and Identification of stakeholders issue use the following steps:-

Step-1: Identify the key stakeholders from the large array of groups and individuals that could potentially affect or be affected by changes in water management.

Step-2: Assess stakeholder interests & the potential impact of the irrigation plan on these interests.

Step-3: Assess the influence and importance of the identified stakeholders.

Step-3: Outline a stakeholder participation strategy

Step-4: In identifying the key stakeholders, you should consider the following questions:

A. Who are the potential beneficiaries?
B. Who might be adversely impacted?
C. Have vulnerable groups who may be impacted by the plan been identified?
D. Have supporters and opponents of changes to water management systems been identified?
E. Are gender interests adequately identified and represented?
F. What are the relationships among the stakeholders?

Answering these question will lead to a simple list, which forms the basis of the stakeholder analysis.

PRECUATIONS:

- Don’t talk too much and avoid using harsh words in data collection
- Important to realize when assessing the interests of the different stakeholders is that some stakeholders may have hidden, multiple or contradictory aims and interests.

Operation sheet-2	Steps in Inspecting Pump Station and Filters

OPERATION TITLE: Pump station and filters inspection

PURPOSE: Conducting inspection check at pump station and filters as per organizational procedure and risk management guideline

EQUIPMENT, TOOLS AND MATERIAL: Simulated area, TTLM/Operation sheet, pen, pencil, Checklist

PROCEDURE:

The following checks are made on the pump system:

1. Pressure readings
2. Pipe work
3. Pump and motor coupling
4. Mounting bolts
5. Electrical panels
6. Be attentive to noise and vibration from the pump whenever it is working.

The following checks are made on filters:

1. Filtering material (sand, discs, screens, etc.)
2. Hydraulic valves
3. Lid seals and rubber tubing
4. In the infield irrigation system, the valves, emitters and pipes must be checked regularly.

PRECUATIONS:

Ensure surroundings are tidied and materials and equipment cleared from the site on completion of maintenance works

QUALITY CRITERIA: Developed action plan for post maintenance activities.

Lap Test -1	Practical Demonstration

Ensure surroundings are tidied and materials and equipment cleared from the site on completion of maintenance works

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 7 hour

Task-1: Assess and identify stake holder issue

Task-2: Inspect Pump station and filters

Instruction sheet	Learning Guide 65: Undertake work site maintenance

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

- Monitoring material handling procedure
- Monitoring Construction activities
- Confirming maintenance requirements
- Carrying out maintenance work
- Using equipment, tools and technology

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**:

- Monitor materials handling procedure
- Monitor construction activities
- Confirm maintenance requirement
- Carry out maintenance work
- Use equipment, tools and technology

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets 1- 4”. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1, 2, 3 and 4 ” in each information sheets on pages 32, 36, 39 and 55.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets 1, and 2 on pages 58 and 59 and do the LAP Test on page 60”.
7. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.

Information Sheet-1	Monitoring material handling procedures

1.1. Introduction

A well-designed irrigation system that have been installed correctly and that are operated within the set parameters never requires major maintenance under normal circumstances, meaning circumstances that do not include for instance a flood or a fire. A sound preventative maintenance plan ensures that minor problems do not turn into major problems, and constant evaluation and monitoring of the system ensures that the system operates within the required parameters, and that problems are identified and dealt with when they occur.

1.2. The lifespan of irrigation equipment

The lifespan of irrigation equipment is determined by the quality of the equipment that was originally installed and the ongoing maintenance of the irrigation system
Good quality and well-maintained lateral lines should have a life-expectancy of around seven years, at which time drippers should also be replaced. Micro-jets should last for the lifespan of the orchard, but may deteriorate sooner if water quality is poor.

- A long-term maintenance plan describes the tasks that should be performed on a monthly, yearly, 5 yearly and 5-7 yearly bases.
- Contingency plans should be in place to deal with emergency situations such as floods, fire, pump breakdowns, pipe bursts, and chemical spills.
- In case of floods, pumps must be removed from vulnerable positions as soon as possible. The electricity must be shut down and not be switched on again before the system has been inspected by a qualified electrician.
- The risk of fire must be limited as far as possible, and a fire fighting unit must be kept at hand and in good working condition.
- When pump breakdown occurs, high-value crops must receive priority for the available water and the pump must be repaired as soon as possible.
- Equipment must be kept on had to repair pipe burst as soon as possible.
- If the irrigation water has been contaminated as a result of a chemical spill, all irrigation must be halted immediately and the irrigation manager must be informed.

- A monthly budget can be developed from the list of irrigation equipment requirements.
- Irrigation equipment should be bought from dependable suppliers that provide good quality equipment.

1.3. Guide line in monitoring Material handling

Use the following as a guideline:

- If the physical water quality is poor, increase the frequency of flushing and cleaning for laterals, mother lines, filters and filter rings.
- Discharge tests can be performed less often if critical points are checked more often.
- The frequency of the inspection for air leaks can be decreased on new suction pipe work.
- Replace bearings and wearing parts as soon as the pump does not deliver the original capacity.
- Replace diaphragms when valves do not close properly.
- Replace poly pipe when the pipes become brittle and burst easily.
- Replace emitters as soon as the discharge test shows a deviation form the design specifications and the flow rate per block increase.

Self-Check-1	Written test

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. Write two advantage of materials handling
2. Write how the life irrigation system equipment so fixed.
3. Write three points you can consider during material handling.

Note: Satisfactory rating - 6 points and above **Unsatisfactory - below 6 points**

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1. ----------
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2. ----------

   ----
3. ----------

Information Sheet-2	Monitoring Construction Activities

2.1. Introduction

Irrigation as part of agriculture also involves a wide range of different types of machinery, animals, plants and products, working in both indoor and outdoor environments under widely varying geographic and climatic conditions. While agricultural enterprises in many developed countries are highly mechanized and operate on a large scale, in many developing countries labor-intensive farming is much more common.

2.2. Monitor installation of irrigation Asset

2.2.1. Interpreting an irrigation Design Plan

The foundation of a high quality irrigation system is a good irrigation design plan. The irrigation system should be designed by a qualified irrigation designer. The SA Irrigation Institute (SABI) has a specific designer membership which is attainable by passing an exam. Below is an example of an irrigation design plan for three adjacent blocks of a micro sprayer irrigation system for a fruit orchard.

2.2.2. Reading installed system Orientation

When reading an irrigation design plan, the first step is to get the orientation right. The plan must be turned so that landmarks on the plan agree with the actual landmarks, such as dams, canals, copies (hillock), or any other distinguishable features that is shown on the map. Familiarize yourself with the block and pipe layout on the plan and compare it with the actual block and pipe layout (if it is an existing system).

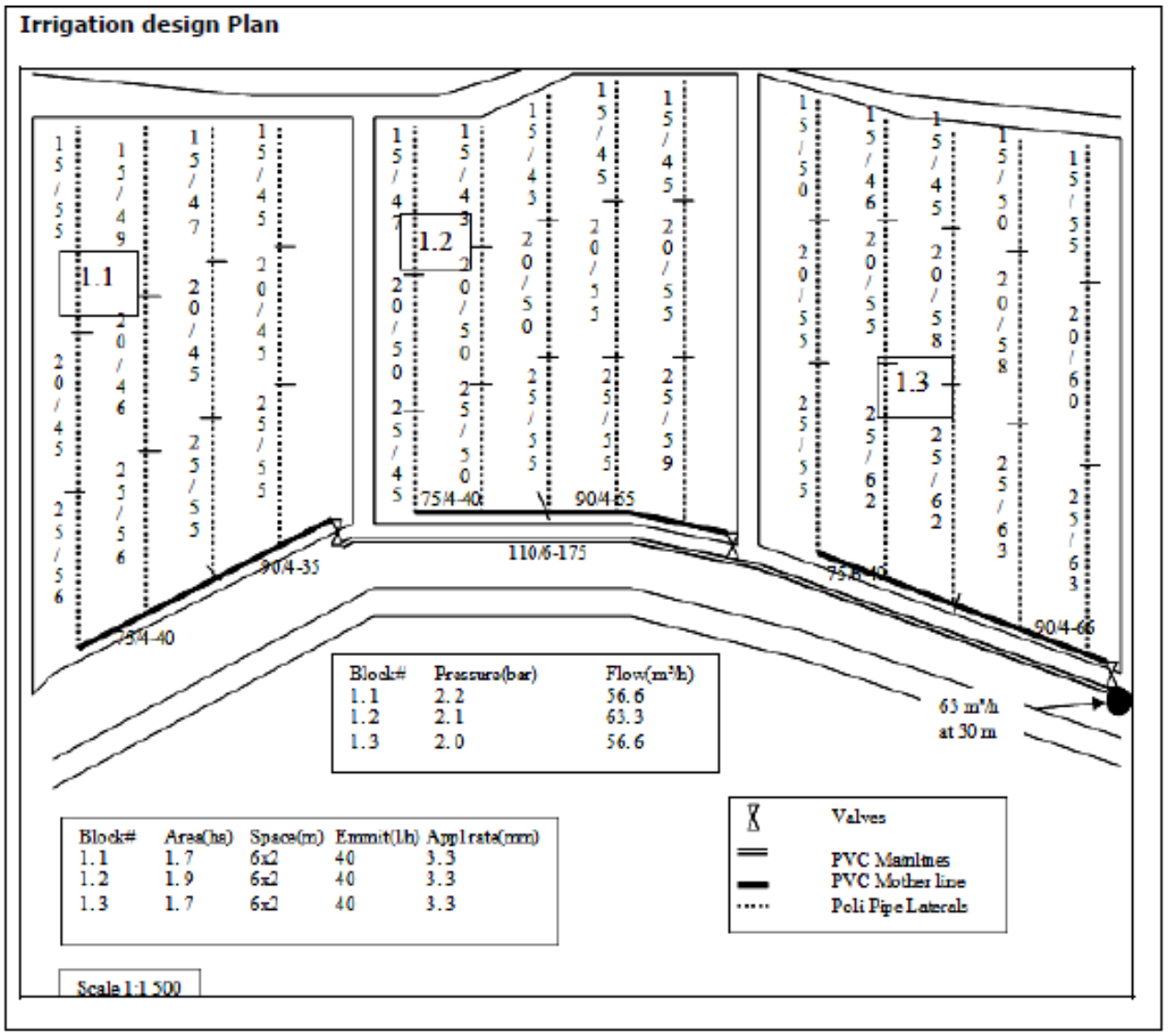
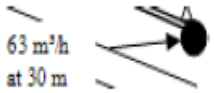
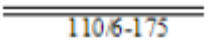
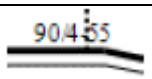
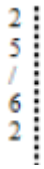


Figure 2: Handling and interpreting drawing and specification document

2.2.3. Identification of symbol and notation

On an irrigation design plan symbols or different colors are used to depict the various pipes, valves and other features. Usually, a key is provided with the symbols and their meaning. In the table below, the symbols and keys that are shown on the irrigation design plan above are explained further.

Table 4: Symbol Identification Example

Symbol	Description	Example of Use	Details
●	Pump		The best place to start on an irrigation plan is at the pump station or the beginning of the mainline. The pump station is marked on the plan with a dot and the pump duty point is noted (63m3/h at 30m in this case).
═	Mainline		The mainline can be traced from the pump station. On some plans there may also be sub mainlines, which are pipes that branches off from the mainline to take water to blocks that are further off the mainline.
⧖	Valve		Every block has a valve on the mainline and sub mainline that feeds directly into the mother line.
▬	Sub main Line		There is a sub main line for each block. The lateral lines branches off from the sub main lines.
.....	Lateral line		Lateral lines run from the mother line along the tree rows. The emitters are located on the laterals.

The notations next to the different sections of pipes indicate the pipe size and class for that particular section of pipe, and the length of the pipe. Using the notation of 110/6-175 for the mainline in the table above as an example, the 110/6 indicates the pipe size and class, meaning the pipe will have a nominal diameter of 110mm and will be up class 6 pipes. The second part of the notation indicates the length of the pipe in meters, meaning that this pipe will be 175m long. Note that this is the total length and includes the bends in the pipe.

2.3. OHS, environmental and organizational requirement

2.3.1. OHS and Environmental requirements

In coordinating and monitoring asset construction and maintenance the occupational health and safety and environmental requirement may include as indicated in **Table 5** below.

Table 5 :OHS and Environmental Requirements in coordination and monitoring of irrigation asset construction and maintenance

• Working with, near and in:
  ➢ Confined spaces
  ➢ Heights
  ➢ Water
  ➢ Forests
• Equipment operation
• Plant operation
• Contamination issues
• Weather exposure
• Herbicides
• Pesticides
• Solvents
• Fuels
• PPE requirements
	• Onsite communication and procedures for working remotely.
	• Equipment:
	  ➢ Ladders
	  ➢ Harness
	  ➢ Trailer
	• Personnel safety:
	  ➢ Medical constraints and conditions
	  ➢ CPR
	  ➢ First Aid
	  ➢ Water survival
	  ➢ Bush survival
	  ➢ Self-rescue
	  ➢ Traffic management authority

2.3.2. OSH in system monitoring

The positive impact of introducing OSH management systems at the enterprise level, on the recognition and elimination of hazards, the prevention and reduction of risks and the enhancement of productivity, is now recognized internationally by governments, employers and workers. In particular, it helps to promote positive attitudes towards OSH and also a preventive OSH culture, both at the enterprise level and more widely.

Typically, an OSH management system should contain the following main elements:

- OSH policy

- OSH organization and arrangements for establishing responsibility and accountability, competence requirements and training, documentation and record keeping, communication and information, etc.
- hazard identification and risk assessment;
- planning and implementation of controls; and
- Monitoring, evaluation and improvement of OSH performance.

2.3.4. Environmental consideration

There may be environmental considerations relating to the servicing of mechanical equipment such as disposal of oils/grease and used parts. Results of maintenance works are assessed and recorded to ensure repairs or maintenance standards have been achieved according to the irrigation maintenance program.

2.4. Quality assurance in construction industry

2.4.1. Quality Concept in construction sector

Quality in construction is defined as 'meeting or exceeding the requirement of client/owners. In construction industry, quality is used in different every than the product industry. The common way of controlling quality is the inspection of finished parts of a product.

Quality control in construction means making sure that things are done according to the plans, specifications and permit requirements. The quality assurance process checks the quality plan and quality control process to confirm that quality standards are implemented on the project site.

2.4.2. Quality assurance requirements

Quality assurance makes sure that you are doing the right things in the appropriate way while quality control is making sure that the results of what is done to meet the set standards. Quality assurance is connected to a working interaction between each contractor on site while quality control deals with the inspection of the outcome of this

work. The two operations are closely linked because monitoring your quality levels through the project guarantee high quality results at the end.

2.4.3. Specification of constructed works

Construction specifications, also called specs, are the details for the work that needs to be completed in a construction project. These details include information such as materials, the scope of work, installation process, and quality of work.

Purpose of specification is to highlight the necessary information which cannot be obtained from drawing. In addition, it is used to show the strength of construction material or construction work. During construction, specifics are everything and failure to communicate specifically could create massive change orders, cost overruns and schedule delays, which can negatively impact your bottom line. In fact, specifics are such a key element of construction that there is an entire formal process dedicated to them; enter construction specifications.

Although blueprints and certain documents can illustrate what a building should look like visually, an in-depth written explanation is needed to describe the construction process. Simply put, construction specifications are documents prepared ahead of construction to describe how building should be carried out by contractors and subcontractors.

2.4.3. Main types of construction specifications

Each project is unique and will need a different set of specifications and most likely corresponding packages. However, there are three main types of construction specifications commonly used on projects.

- Prescriptive: Provides details on the types of materials and installations needed to complete a project. Additionally, prescriptive specifications also describe how to measure installations to ensure that they were up to project quality and standards.
- Performance: Describes the operational requirements. Fundamentally, the performance specifications should describe to the contractor what is needed for the final product and how it should essentially function once completed.

- Proprietary: Although not as common as prescriptive and performance, proprietary specifications are used if only one specific product can be used for an installation.

2.5. Quality control of construction works

The common way of controlling quality of construction works is the inspection of finished parts of a product. The quality control engineers' main purpose is to minimize the chance of defects before the project delivery to the owner. Controlling quality means monitoring if the work practices are going as planned or not, examining the quality of the current construction tasks, and provide reports daily for any unsatisfactory work output.

Self-Check-2	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the benefit of irrigation systems plan?
2. Write the use of orientation plan.
3. Write four OHS requirement in confirming maintenance plan.
4. How you manage OHS system?

Note: Satisfactory rating - 8 points and above **Unsatisfactory - below 8 points**

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

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Information Sheet-3	Confirming maintenance requirement

3.1. Introduction

The regular expenditure of a small amount of maintenance funds is much better for a building, and more cost effective, than large injections of capital every 20 years or so. People often think that once a building has been 'restored' it doesn't need to be looked at again for many years. But many major repairs to historic buildings could have been prevented if simple things like leaking down-pipes and gutters had been cleaned out or repaired quickly.

3.2. Concept and Categories of maintenance

Maintenance is as the continuous protective care of the fabric, contents and setting of a place. Maintenance can be categorized according to why and when it happens, as indicated Table 6 below.

Table 6: Common categories of Maintenance

No	Descriptions	Example of Maintenance Type
1	**corrective maintenance**	work necessary to bring a building to an acceptable standard (often as recommended by a conservation plan) such as treatment for rising damp; or planned maintenance work to prevent failure which recurs predictably within the life of a building, such as cleaning gutters or painting;
2	**Emergency corrective maintenance**	work that must be initiated immediately for health, safety, security reasons or that may result in the rapid deterioration of the structure or fabric if not undertaken (for example, roof repairs after storm damage, graffiti removal or repairing broken glass). A daily response system detailing who is responsible for urgent repairs should be prepared.
3	**Planned maintenance**	work to prevent failure which recurs predictably within the life of a building, such as cleaning gutters or painting; or

3.3. Maintenance requirement

3.3.1. Maintenance activity

Maintenance activities include:

- Inspection
- Testing
- Measurement
- Replacement
- Adjustment
- Repair
- Upkeep
- Fault detection
- Replacement of parts
- Servicing
- Lubrication, cleaning

Maintenance is critical to ensure continuous productivity, to produce products of high quality and to keep companies competitiveness. But it also has an impact on occupational safety and health. Firstly, good maintenance is essential to keep machines and work environment safe and reliable. Secondly, maintenance itself is a high-risk activity and it has to be performed in a safe way, with appropriate protection of maintenance workers and other people present in the workplace.

3.3.2. Maintenance period

Major irrigation system checks and repairs are performed on an annual basis, normally during the winter when irrigation is required less often. Wherever an irrigation system has been installed, you must maintain it in good working order. Repairs must start within 48 hours of detecting damage, or from the time of notification by the Engineer. Normal work shall be performed during daylight hours, Monday through Friday (except State holidays).

3.3.3. Frequency of maintenance work

Frequency of maintenance works is determined and implemented according to the irrigation maintenance program. Irrigation maintenance standards are established in line with the irrigation maintenance program.

- Maintenance works are planned and prepared.
- OHS requirements are identified, associated hazards and risks assessed, and suitable controls implemented.
- Environmental considerations of irrigation maintenance activities are identified.
- Environmental considerations may include efficient operation of the system to conserve water by identifying and repairing leaks, avoidance of over watering, and even distribution of water to targeted areas with minimal wastage and run-off.

3.3.4. Organizational requirement of maintenance

The main reason for a maintenance plan is that it is the most cost-effective way to maintain the value of an asset. The advantages of a plan are: the property is organized and maintained in a systematic rather than ad-hoc way; building services can be monitored to assist their efficient use;

- the standard and presentation of the property can be maintained;
- Subjective decision making and emergency corrective maintenance are minimized.
- When buildings are neglected, defects can occur which may result in extensive and avoidable damage to the building fabric or equipment.

Neglect of maintenance can also give rise to fire and safety hazards, which could result in building owners being found legally liable for any injuries

3.4. Example of maintenance planning

Table 7: Example for operation and Maintenance plan

Frequency	Item	Task and Action
Daily	Pressures	Check that pump and block pressures are
	Emitter operation	Check for clogged, broken or misplaced
	Leaks	Check for water wastage and leaks in pipes and
	Primary filter	Flush primary filters as prescribed.
	Fertigation application	Check that fertigation applications are within
Weekly	Lateral lines	Flush lateral lines as prescribed.
	Exposed joints	Check and repair if needed, e.g. quick coupling
	Secondary filters	Flush secondary filters as prescribed
	System pressure and	Check that system pressure and flow are as per
	Pump operation	Check that pump operation is within prescribed
	Block pressures for	Check that block pressures are as prescribed
	Pump oil levels	Check pump oil levels as prescribed.
	Fertigation plant	Inspect fertigation plant.
	Pipes (above and below	Check for leaks and repair
Monthly	Valves, water meters,	Visually check valves, water meters and gauges
	Filters	Open and inspect filters as prescribed.
	Pump pipe work	Check for leaks at pump station that causes
	Pump motor	Pump motor must be greased as prescribed.
Annually	Valves	Service valves and physically check correct
	Filters	Clean filters thoroughly and replace sand in
	Pump	Change oil in pump.
	Water sampling	Take a water sample at the end of lateral lines
	Emitter delivery tests	Test specific emitters for discharge and
	Sprinkler parts	Replace nozzles annually and other parts when
2-10 years	Pump	Replace bearings and other wearing parts on
	Hydraulic valves	Replace diaphragms on hydraulic valves every
	Poly pipe and emitters	Replace poly pipe and emitters every seven to

Self-Check-3	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. Write the definition of maintenance.
2. Write four activities to be performed in maintenance job.
3. Which time is suitable for maintenance work?
4. Write the three type of maintenance.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

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Information Sheet-4	Carrying out maintenance work

4.1. Introduction

Major irrigation system checks and repairs are performed on an annual basis, normally during the winter when irrigation is required less often.

4.2. Carry out System maintenance work

4.2.1. Maintenance of pressurized systems

Scope of maintenance works is determined according to the irrigation maintenance program. Irrigation maintenance work on pressurized systems may range from manual operation and monitoring to fully automated with computer control and monitoring. They may include micro-irrigation systems and spray irrigation systems. Micro-irrigation systems may be mains pressure, low pressure, below or above -ground, sprays systems, drip emitter trickle, t-tape, mini-sprinklers, and capillary.

4.2.2. Gravity-fed systems maintenance

Irrigation maintenance work on gravity-fed systems may range from manual operation and monitoring to fully automated with computer control and monitoring. Flood irrigation systems may include border check, contour irrigation, furrow irrigation, hillside flooding, and basin irrigation. Border check systems may be either permanent or temporary earth, plastic or concrete devices for insertion in a drain for reticulating water, contour banks used to collect and distribute water along the perimeter of an irrigation plot, contour banks within a plot to collect/distribute water, or larger scale systems to stop water exiting one area to another.

4.2.3. Pipeline maintenance

Leaks in pipes, connections and flanges must be repaired as soon as they are detected. Basic repair and replacement items must be kept on the farm for this

purpose. It is important to flush the mother-lines and lateral lines regularly. The intervals between flushing vary depending on the season, being weekly in mid-summer and monthly in winter. Proper flushing reduces emitter blockage and forms an essential part of the maintenance program. The supervisor or manager will prescribe the appropriate flushing interval.

4.3. Supervise and carryout routines maintenance

4.3.1. Supervising irrigation activities schedule

Supervising the implementation of an irrigation schedule is easiest done by compiling a work program for the field workers and monitoring them.

The irrigation schedule is adapted to ambient weather conditions by using information from scheduling equipment.

The operation of the irrigation system is monitored through keeping records of readings when the pump system is started up.

- Workers must all be aware of safety regulations.
- Irregular problems must be reported to the irrigation manager immediately.

4.3.2. Routine maintenance checks

Service technicians perform routine maintenance checks on diesel engines and on fuel, brake, and transmission systems to ensure peak performance, safety, and longevity of the equipment. Occasionally, the equipment requires extensive repairs, as when a defective hydraulic pump needs replacing. In addition to conducting routine maintenance checks, service technicians perform a variety of other repairs.

- They diagnose electrical problems and adjust or replace defective components.
- They also disassemble and repair undercarriages and track assemblies.
- They weld broken equipment frames and structural parts, using electric or gas welders.

4.3.3. Staff Safety Organizational and Manufactures requirement

The following safety regulations must be adhered to:

- Treat pumps and motors with respect.

- Stay clear from moving parts as this can result in serious injury.
- Do not open electrical panels or distribution boxes.
- Never enter the restricted area around transformers even if the gate is open.
- Report damaged pumps, motors and electrical gear.
- Where chemicals are used, for instance in fustigation, wear the prescribed protective clothing. Wear a clean overall every day.
- Where chemicals such as phosphoric acid and chlorine are used, staff must be trained to comply with regulations.

Self-Check-4	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. Write the two key points in irrigation system maintenance.
2. What are the activities performed in pipe line maintenance?
3. Write three staff safely requirements.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Answer Sheet

Score = _____

Rating: _____

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Information sheet-5	Using equipment, tools and technology

5.1. Tools for basic maintenance of irrigation systems

The appropriate tools for basic maintenance of irrigation systems, and what they are used for shall be identified at maintenance task requirement identification phase.

- The appropriate clothing to wear when performing maintenance on an irrigation system.
- Using, maintaining, cleaning and storing of tools.
- Reporting problems of faulty tools and equipment.
- Dealing with problems that might be encountered during maintenance of an irrigation system.

Figure 3: Example tools that are used during maintenance of irrigation systems.

5.2. Workplace safety regulations

All workers must be fully trained in workplace safety regulations and these regulations should be enforced at all times. The regulations must include:

- Regulations regarding the conduct of personnel when handling samples and chemicals, being:

- No smoking, drinking or eating is allowed in the vicinity of where chemicals are mixed, applied or stored.
- No person that is under the influence of alcohol or other drugs is allowed to handle chemicals for whatever purpose under any circumstances.
- Safety regulations regarding the use of chemical application equipment.
- Regulations regarding proper utilization of protective clothing and equipment.
- Regulations on how to handle chemicals safely.
- Prescriptive regulations on how chemical spills, leakages and other emergencies should be handled.
- Instructions concerning the chemical to be used, the concentration to be used, the area to be sampled and type of sample coverage required must be given in writing on a daily basis and signed by the supervisor.
- In the interest of safety, under no circumstances are any non-authorized workers allowed to handle or be associated with handling or application of chemicals.

5.3. Worksite Maintenance tools and Equipment

Proper care and maintenance of tools prolongs their lifespan, and will help to ensure that they work properly. Follow these guidelines:

A. Hand Tools

Hand Tools includes pliers, spanners, screwdrivers, spades and any other hand tools. After use, wash, clean and dry the tools if required, otherwise wipe them with a rag. Regularly following this procedure will prevent rusting. When tools are dry and clean, store them in the proper place that prevents theft and accidents.

B. Pressure Gauge

Keep gauges away from high temperatures, and protect them from bumps and shocks. If the gauge is filled with fluid, keep it ¾ full with glycerin. Never use a low pressure gauge to measure high pressure as this will damage the gauge and make it inaccurate.

C. Grease guns and oil Cans

Keep grease guns and oil cans free of sand and grit. Always wipe the tip of the grease gun before use to remove any sand or grit. Wipe off excess grease and oil after use, and after filling the cans. Tools must be stored in a shed or an enclosed area that can be locked. This prevents theft of tools. A system must be in place to ensure that tools

are returned after being used. It is helpful to have designated areas for the different tools marked on a board, to which the tools can be returned.

5.4. Worksite maintenance tools and equipment

5.4.1. Personal protective and safety tools

It is important to remember that some of the sampling chemicals might require the workers to wear respiratory gear and safety clothing. In this section, we will look at the manner in which protective gear and clothing must be maintained and how it is correctly utilized.

- The use of protective clothing must be strictly enforced at all times. Each individual should have his or her own protective clothing and equipment that fits well and is properly maintained.
- Safety precautions do not end when the sampling application is complete. All equipment has to be cleaned, maintained and stored in good condition in preparation for future use. Operators should change out of working clothes and bathe once spraying is complete. Work clothes should be washed.

5.4.2. Work site maintenance Tools and equipment's

All protective clothing and safety equipment must be in good condition at all times. Before protective clothing is utilized, the user must ensure that: All items are free of holes and tears to prevent penetration of the chemical onto undergarments or onto the skin.

- All items have been washed properly after previous use.
- All buttons, zippers or other fastenings are working well.
- Elastic used in clothing and facemasks are not perished or stretched out.

Self-Check-5	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. Write three work place requirements.
2. Write two work site maintenance tools and equipment.
3. How you use tools, material and technology effectively?

Note: Satisfactory rating - 6 points and above **Unsatisfactory - below 6 points**

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

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Instruction sheet	Learning Guide 66: Test and Commission work

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

- Conducting test and defining commissioning program
- Monitoring test result
- Conducting and recording inspection

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**:

- Conduct test and define commissioning program
- Monitor test result
- Conduct and record inspection

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets 1- 4”. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1,2, 3 and 4 ” in each information sheets on pages 32,36,39 and 55.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets 1, and 2 on pages 58 and 59 and do the LAP Test on page 60”.
7. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.

1.1. Opening and closing pressure control valves

Pressure control valves are hydraulic valves fitted with a pilot valve and is used to regulate pressure and flow. The pilot valve is a device that regulates the pressure inside the hydraulic valves. To open a gate valve, turn the wheel anticlockwise and to close the valve, turn the wheel clockwise.

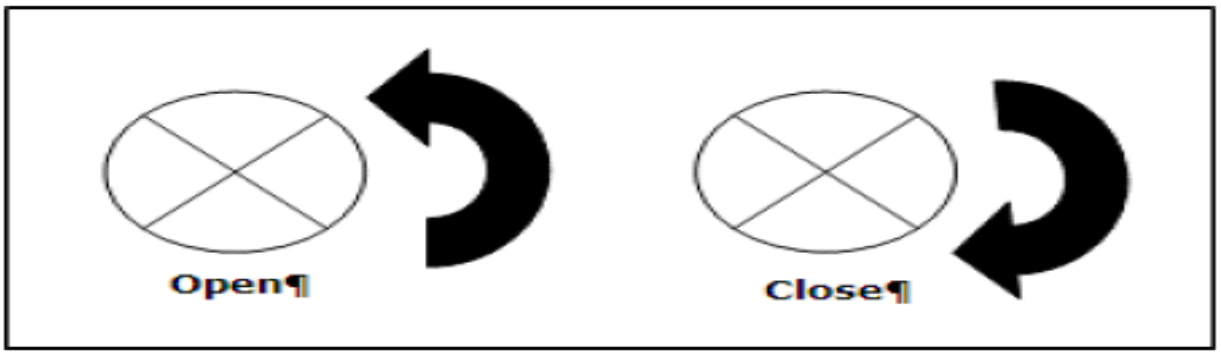

Figure 4: Opening and Closing Direction for Gate Valves

Butterfly valves are equipped with a handle. To open the valve, turn the handle until it is in line with the pipe. To close the valve, turn the handle until it is perpendicular to the pipe. Some butterfly valves are equipped with a wheel and dial. When the wheel is turned, the dial indicates if it is opening or closing.

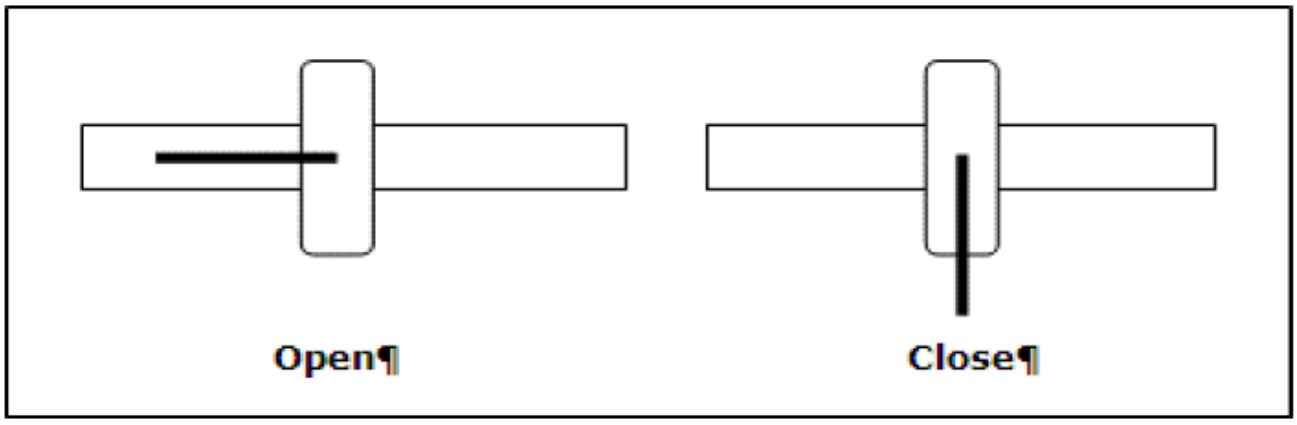

Figure 5: Opening and Closing Positions for Butterfly Valves

To set the flow rate for an irrigation block, the pressure needs to be adjusted by opening or closing the valve. To reduce the pressure, close the valve more, and to increase the pressure, open the valve more. All valves under water pressure must

always be opened and closed very slowly to prevent water hammer and the resulting damage. See section 6 for the measuring and regulating of the pressure.

1.2. Monitoring the operation of valves

These valves are controlled by a 3-way valve. The 3-way valve is marked Open, Close and Auto. To open the pressure, simply turn the dial to open and to close the valve, turn the dial to close. Keep in mind that turning the dial to open could burst a pipe because of high pressure. The pilot should be adjusted by the supervisor or manager. Some valves are fitted with pressure points. See section 6 of this chapter for more information on the use of these pressure points.

1.2.1. Identify and rectify possible problems

After a pump is started in the morning, it must be monitored during the day to ensure that it is running smoothly. Always check the perimeter and working characteristics of the pump as described in previous sections. Also pay attention to vibration, noise, leaks, burst pipes, smoke, sparks, fire, etc. Switch off the pump immediately if any of this should occur and report it to the supervisor or manager

Self-Check-1	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. How do you now the opening and closing direction of valves?
2. What is the unique characteristic of three way valves?
3. Explain commissioning.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____Date: _____

Score = _____

Rating: _____

Answer Sheet

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Information Sheet -2	Monitoring test result

2.1. Introduction

The various components of the irrigation system are tested as they are installed and the performance of the entire system is tested once the installation is complete.

2.2. Testing the irrigation system

The various components of the irrigation system are tested as they are installed and the performance of the entire system is tested once the installation is complete. As the pipes are laid and flushed, joints are inspected for leaks. Once the pipes are partially backfilled with the joints exposed, the system is brought up to working pressure.

- The blocks that are grouped in operations are opened. Pressure readings are taken in front of and after the valves.
- These are compared with the values noted on the irrigation design plan in the Pressure and Flow at Nodes table. If the readings are not correct, it may be an indication of wrong pipe size, incorrect hydraulic valve settings, or pump or filter malfunction.
- Hydraulic valves are calibrated at this time. The pressure gauge is inserted downstream, after the valve, and the valve is opened. Note the pressure reading. Test and commission work

Once the block is filled, the valve is switched to automatic. If the pressure reading drops, the screw on the pilot is turned slowly in a clockwise direction. If the pressure rises, the screw on the pilot is turned anticlockwise. The process is repeated by adjusting the pilot, checking the pressure again after a while, and adjusting the pilot again if necessary.

2.3. Evaluating the Functioning of Irrigation System

Evaluating the functioning of the irrigation system is important in that it ensures that the system operates within the set parameters which protect the components of the system. This is essential for ensuring that the correct amount of water is delivered to

the crop. All the data required to monitor and evaluate the operation of the irrigation system is provided on the irrigation design plan, including the list of operations, a table with pressures and flows at valves and at nodes, and a table with the plant spacing and precipitation for each block.

2.4. Work program development for monitoring

The implementation of irrigation scheduling was described in the previous sessions. A supervisor ensures that workers open and close the right valves at the right time, in line with the requirements of the schedule. It is thus important that workers have a thorough understanding of the schedule. The best way to manage workers around scheduling is to use a work program. In a work program the names of the workers are listed, with their task description for each day. A column can be added for notes about the execution of the task.

Table 8: Example how Developing work requirement to look 9916 page

Name	Task					
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Gudeta	Irrigate Section-1	Irrigate Section-1	Irrigate Section-1	Irrigate Section-1	Irrigate Section-1	Irrigate Section-1
Comment						
Getachew	Irrigate Section-2	Irrigate Section-2	Irrigate Section-2	Irrigate Section-2	Irrigate Section-2	Irrigate Section-2
Comment						

When the schedule is implemented, the supervisor controls the process. Control measures range from physically checking the workers and the opening and closing of valves, taking measurements with scheduling equipment, to scouting irrigation blocks for signs of over- and under-irrigation.

2.4.2. Monitoring the Operation of irrigation System

The monitoring of the irrigation system is discussed at length in session 4, as well as understanding the operational parameters. The irrigation supervisor is responsible for ensuring that the irrigation system is operated within the desired parameters. The most efficient way to accomplish this is by ensuring that records are kept by the workers that are responsible for starting up and shutting down the pump system. The person starting the pump must keep record of the volts, amps, pressure and flow-rate of the pump every day when the pump is started. Workers operating the infield irrigation must also keep records of infield pressures and flow-rates where applicable. The supervisor evaluates the recorded parameters daily or a few times a week.

Table 9: Example Irrigation system monitoring Data (**Source:** Irrigation System agriSETA)

Date	Volts	Amps	Pump	Flow
Parameters	400V	120A	8.5bar	210m^3/hr
01/09/2008	402	125	8.0	220
02/09/2008	405	125	8.0	220
03/09/2008	402	118	8.7	205
04/09/2008	402	122	8.1	218
05/09/2008	402	120	8.4	215

Self-Check-2	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the value of testing in commissioning program?
2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

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Information Sheet -3	Conducting and recording inspection

3.1. Care in data collection

3.1.1 Soil and water contamination

Care should be taken when compiling data so that spray drift does not contaminate water sources, such as dams, streams, springs, etc, as this might contaminate samples and distort the data. Filling points where chemicals are mixed and spray machine tanks filled should be situated at least 50m from any water source, including boreholes, and have a suitable drainage system, such as a French drain, that can safely drain away spilt chemicals and excess water.

3.1.2. Climatic Conditions

The supervisor should take cognizance of the expected weather conditions for the day of the planned sampling application, using various media that are available, such as radio, television, websites, etc. This will assist in the planning for resource allocation for the following day. If rain is expected, delay the planned sampling until such time as the weather clears

3.1.3 Recording designated areas

Adequate signage (approved by the authorities) that is easily observable should be placed in locations designated for a specific purpose. These signs must give a bold, concise message such as:

- Danger.
- No Entry.
- No smoking.
- No drinking and eating.
- Fire-extinguisher location.
- First Aid Equipment location.
- Emergency Exit.

These signs are either informative in nature or give a clear instruction in a manner that is understandable to all irrespective of their language. Chemicals should only be mixed in areas designated for the purpose, such as at filling points. These areas should be clearly marked and unauthorized personnel should not be allowed into these areas while chemicals are being handled.

The main reason of collecting this data as irrigation and drainage operation and maintenance asses monitoring person is This will influence all our decisions in terms of crop planning, cash-flow and help us to plan strategically for our planting, pruning, harvesting and transportation / distribution actions.

3.2. Inspect Irrigation System

Regular maintenance is essential to keep equipment, machines and the work environment safe and reliable. Lack of maintenance or inadequate maintenance can lead to dangerous situations, accidents and health problems. Maintenance is a generic term for variety of tasks in very different types of sectors and all kinds of working environments.

3.2.1. Preventive Maintenance

Preventive maintenance (PM) is the practice of maintaining equipment on a regular schedule based on elapsed time or meter readings. The intent of PM is to “prevent” maintenance problems or failures before they take place by following routine and comprehensive maintenance procedures. The goal is to achieve fewer, shorter, and more predictable outages.

Some advantages of PM are:

- It is predictable, making budgeting, planning, and resource leveling possible.
- When properly practiced, it generally prevents most major problems, thus reducing forced outages, “reactive maintenance,” and maintenance costs in general.
- It assures managers that equipment is being maintained.
- It is easily understood and justified.

PM does have some drawbacks:

- It is time consuming and resource intensive.
- It does not consider actual equipment condition when scheduling or performing the maintenance.
- It can cause problems in equipment in addition to solving them (e.g., damaging seals, stripping threads).

3.2.2. Reliability-Centered Maintenance

Programs are gaining in popularity and have been piloted in a few Reclamation power facilities with good results. The goal of these programs is to provide the appropriate amount of maintenance at the right time to prevent forced outages while at the same time eliminating unnecessary maintenance.

Implemented properly, RCM can eliminate some of the drawbacks of PM and may result in a more streamlined, efficient maintenance program. RCM seems very attractive in times of diminishing funding, scarcity of skilled maintenance staff, and the pressure to "stay online" due to electric utility industry deregulation.
Some features of RCM are:

- It may be labor intensive and time consuming to set up initially.
- It may require additional monitoring of quantities, like temperature and vibration, to be effective.

Self-Check-3	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the value of testing in commissioning program?
2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1. ---

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2. ---

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Instruction sheet	Learning Guide 67: Conduct Post Maintenance activities

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

- Coordinating work site inspection and rehabilitation
- Undertaking review of construction or installation asset performance
- Identifying defects and making arrangements to rectify them
- Completing reports and documentation
- Storing and securing reports

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**:

- Coordinate work site inspection and rehabilitation
- undertake review of construction or installation asset performance
- identify defects and make arrangements to rectify them
- complete reports and documentation
- Store and secure reports

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets 1- 4”. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1,2, 3 and 4 ” in each information sheets on pages 32,36,39 and 55.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets 1, and 2 on pages 58 and 59 and do the LAP Test on page 60”.

1.1. Interpret an irrigation maintenance program

Before you begin irrigating each year, you should prepare your irrigation system for the new season. Many temporary repairs made last year will probably need attention. Irrigation systems are more than just a method to deliver water to the crop. They are becoming a management tool. A properly designed and maintained system allows the grower to supply precise amounts of water, nutrients, and other materials to the crop.

1.2. Flushing/Draining the System

1.2.1. Flush the main line.

Depending on the system and pump capabilities, it may be a good idea to close a portion of the system to increase the pressure and velocity. Find out what the safe maximum operating pressure is before flushing.

1.2.2. Flush tubing in the field

Hose ends are now opened and again, a portion of the laterals may be closed to ensure good pressure and velocity for a thorough flushing of the drip tubing. After the entire system has been flushed, the system needs to be checked line by line. One of the most efficient methods utilizes an irrigator walking and checking every row, wearing a cloth pouch like you would find in a lumber store. In it are emitters, couplings, punch, plugs, and hose ends to make the necessary repairs.

1.3. Filters

Several items need to be checked on both screen and media filters prior to start-up. On filters that flush automatically, the controller and valves should be checked for proper operation. If the controller is equipped with a pressure differential switch, the setting should be checked against the manufacturer's specifications. Once the equipment that

filters and delivers the water to the field has been checked and repaired, the drip lines, emitters, and peripheral equipment need to be inspected.

1.4. Visual Inspection

Make a visual check of all bolts in the System making sure something has not become loose during the idle period. One loose bolt may cause serious structural damages. Check the electrical boxes and wiring of the System to make sure the Ground Wires are secured and rodents or insects have not damaged the Systems' mechanisms.

1.5. Lubrication

Grease fittings are located on the Power Tower Cart (Lateral Move only), Pivot Point, at any optional Steel U-joints (1 each), and on any Towable Gearboxes (2 each). These fittings should be greased with good quality grease. Check the oil level in the center Drive and Wheel Gearboxes. Do not overfill any of these Gearboxes! Overfilling may result in seal damage.

1.5.1. Tires

Tire pressure should be maintained according to the chart in the owner's manual. Also, inspect the Tires for impending problems (cuts, breaks, etc.)

1.5.2. Cleaning Water Lines

If there is heavy scaling on the collector and/or blocked water passages, consult for cleaning recommendations. Chlorine present in tap water is harmful to the klystron water passages. Thorough flushing with de ionized water will remove all traces of chlorine. Never use tap water for final refill or for makeup water.

1.5.3 Other cleanliness issues

The sight glass and float of the water-flow indicators must also be kept clean to achieve efficient system operation. The water-flow indicators usually become contaminated

during use, and this contamination collects on the sight glass and float, making the readouts difficult to see. If too much contamination is present on the glass and float, they may stick and produce an erroneous reading. The detergent and cleaning solutions may not remove all of this contamination. If this is the case, the flow meter must be removed and cleaned and the glass surface brushed.

1.6. Flushing the Klystron Water Lines

It is good engineering practice to flush all cooling passages before installing the device. Contaminated water also contributes to dirty water lines. The following back flushing procedure is suggested for units having contaminated water lines, corrosion, scale, or blocked passages

Self-Check-1	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the value of testing in commissioning program?
2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme

Note: Satisfactory rating - 6 points and above **Unsatisfactory - below 6 points**

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1. ---

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2. ---

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3. ---

Information Sheet -2	Undertaking review of construction or installation asset performance

2.1. Interpret an irrigation maintenance program

Before you begin irrigating each year, you should prepare your irrigation system for the new season. Many temporary repairs made last year will probably need attention. Irrigation systems are more than just a method to deliver water to the crop. They are becoming a management tool. A properly designed and maintained system allows the grower to supply precise amounts of water, nutrients, and other materials to the crop.

2.2 checking and reviewing Monitoring and maintenance records

A poorly maintained irrigation system means that much of this water never reaches its intended source and is lost to runoff, evaporation and deep watering below the root zone.

Maintaining irrigation systems is one most effective ways to reduce wasted water, reduce pollution from run-off and over-irrigation, and improve plant health by applying the correct amount of water where it can be utilized by the landscape.

At a minimum, a check of the irrigation system should be performed twice seasonally. Once at the beginning of the season when the system is first turned on and again halfway through the season. Ideally, the system should be checked on a monthly basis. The basics of irrigation maintenance are:

- Inspect the controller and make sure it's plugged in and functioning:
- Update the time and date
- Check the connection on all of the wires – make sure that rain, wind, or soil moisture sensors are connected
- Replace the back-up battery
- Change the schedule to reflect the current season and irrigation needs of the landscape
- Turn on each zone and look for system damage

- Carrying out Operational tests in accordance with system specifications, technical manuals and OHS requirements.

2.3. Conducting Operational test

Once the faulty components have been replaced, the system needs to be tested to ensure that the system is operating correctly. Your supervisor will show you how to replace faulty components in the irrigation system(s) used in your enterprise.1.4 identifying and documenting Faulty components and blockages according to enterprise policy and procedures.

Recording and reporting damage or faulty pumps, valves, electrical components and computer systems Damaged or faulty pumps, valves, electrical components, etc. in irrigation systems should be recorded and reported to the supervisor. Maintenance and repair to these damaged parts should also be carried as soon as possible to avoid leakage and water losses.

The record of damaged or faulty pumps, valves, electrical components may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures.

The reports on damaged or faulty pumps, valves, electrical components shall include:

- specification of the quantity of each of the principal damage and blockage
- specification of the quantity of each of the principal location and the section of the system affected
- a summary of maintenance activities,
- a summary, by waste class, of activities and quantities disposed of,
- any instances in which observed site characteristics were significantly different from those described in the application for a license; and
- any other information the Commission may require

2.4. Site inspection requirements

Major irrigation system checks and repairs are performed on an annual basis, normally during the winter when irrigation is required less often in order to prevent major problems such as leakages and destruction of embankments, the canal system should be regularly inspected throughout the irrigation season.

Rat holes in canal banks, small leakages, erosion of canals and cracks in linings can cause severe problems. They must to be noticed and repaired as soon as possible. Such quick responses will only occur if the system is inspected frequently. Inspection can be done easily and quickly if the canals are easily accessible. This means that the canal banks should have good pathways, and not be covered with plant growth.

Figure 6: Heavy plant growth makes inspection difficult

2.5. Ownership and involvement of user

Small irrigation systems are usually operated and managed by the farmers themselves through their own irrigation committees. They can take care of daily inspections of the canal system while passing the canals on their way to and from the fields. In larger schemes, inspection of the smaller tertiary canals can be done every day by the farmers

using the canal. Inspection of the secondary and primary canals in these larger schemes needs to be systematically organized by the irrigation committee. Whoever inspects a canal and finds a shortcoming in the system should inform the irrigation committee as quickly as possible. The irrigation committee should then take action for immediate repair.

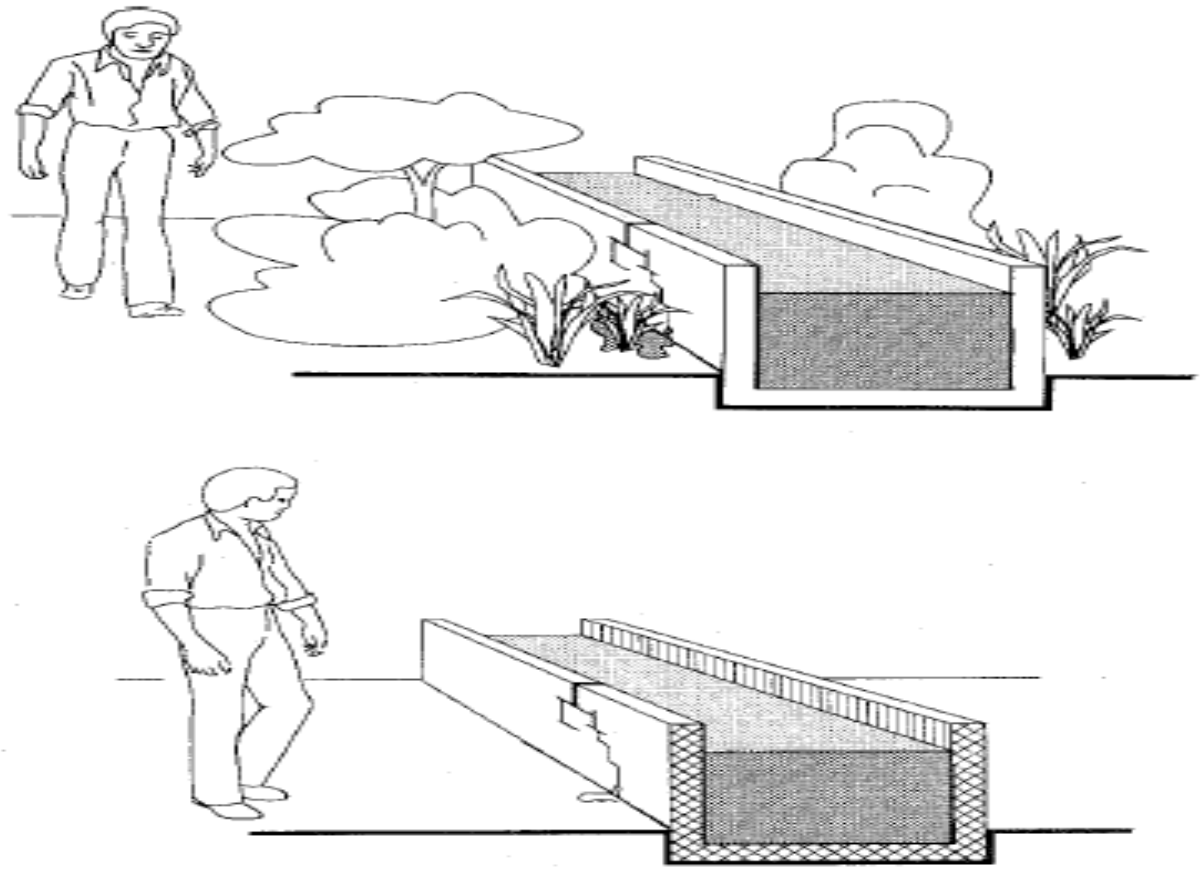


Figure 7: Clean canal embankments are conditional for rapid inspection

2.6. Plan commissioning of Irrigation and drainage sites and facilities

In a drainage monitoring programme, the items to be considered are:

- Crop production
- Drainage water quantity and quality.
- Groundwater quality and level.
- Soil salinity.

Once an irrigation system has been installed, arrangements have to be made to ensure that it will function properly for a long time to come.

For this, a good plan for its operation and maintenance is needed. In this plan, the following issues have to be addressed:

- Why and when is maintenance necessary?
- What are the objectives?
- What will be the frequency?
- What are the costs and benefits?
- . Who is responsible for the planning, execution, control, and financing?
- . How is it to be done and by whom: the government, the farmers, or contractors?
- . How are the costs to be financed? Who will pay and how is the money to be collected?

Commission Irrigation and drainage sites, stations and ancillary facilities

Maintaining a technically sound drainage system requires maintaining a good drainage base, making regular inspections of the system, and repairing and cleaning it when necessary. The agency responsible for the operation and maintenance should have available the "as -built" data on the drainage works (i.e. as they were built). These include:-

- an accurate map of all the main components such as field drains,
- collectors,
- connections, and
- outlet structures

In addition, the agency should know the elevations of collector points (outlet, inflow and outflow levels in manholes, longitudinal sections), of field drain outlets, and of reference points on major structures like manholes. Most of the required data will be found in the design specifications, but they may need to be updated, because the actual construction may have deviated from the design.

Self-Check-2	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the value of testing in commissioning program?
2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ ID_____Date: _____

Score = _____

Rating: _____

Answer Sheet

1----------

2----------

3. ----------

Information Sheet -3	Identifying defects and making arrangements to rectify them

3.1 Defect identification and rectify Arrangements

Many problems could occur that are not described in these sessions. An example is where the soil water balance is correct according to scheduling equipment, but the trees show signs of stress.

- A problem like this must be reported to the irrigation manager. It is possible that scheduling equipment can give an incorrect reading because of incorrect calibration or a malfunction.
- Tensiometers especially are unreliable if not maintained properly and probes can become damaged by shocks. If a problem occurs and you are not confident in dealing with it must be reported to the irrigation manager.

3.2 Identify and rectify possible problems

After a pump is started in the morning, it must be monitored during the day to ensure that it is running smoothly. Always check the perimeter and working characteristics of the pump as described in previous sections. Also pay attention to vibration, noise, leaks, burst pipes, smoke, sparks, fire, etc. Switch off the pump immediately if any of this should occur and report it to the supervisor or manager.

3.3 Conduct system performance Check

There are three kinds of checks to be made after a drainage system has been installed: a post construction check, routine checks, and thorough checking.

- A post-construction check is done to find out whether the construction was done to an acceptable standard, and whether the drainage works have been delivered in good functional order.
- Routine checks Routine checks are simple operation-and-maintenance inspections to verify whether the system is functioning properly, and to see whether there is any need for repairs or cleaning.

- Simple routine inspections can be done according to a locally suitable checklist. Important points to include in such a list are:
- Check the drainage base, which means checking whether the pipe and open drains have free outflow, especially in a period when drainage is most needed.
- Note, however, that an occasional, very brief submergence of the outlets is normally accepted. A good drainage base is the first and foremost condition for a drainage system to function satisfactorily. If the drainage base is found to be unsatisfactory, the main drainage system should be maintained or improved.
- . Check that drains are discharging during and shortly after rain or irrigation.

Figure 8: A drain should be discharging shortly after rain or irrigation

Monitor Water Levels in the filed

Monitor water levels in field and collector drains. High water levels indicate an obstruction in the drain. When high water levels are found, the water levels along a drain should be compared, which may give a clue as to where the problem lies.

Check Segment deposition and Drain

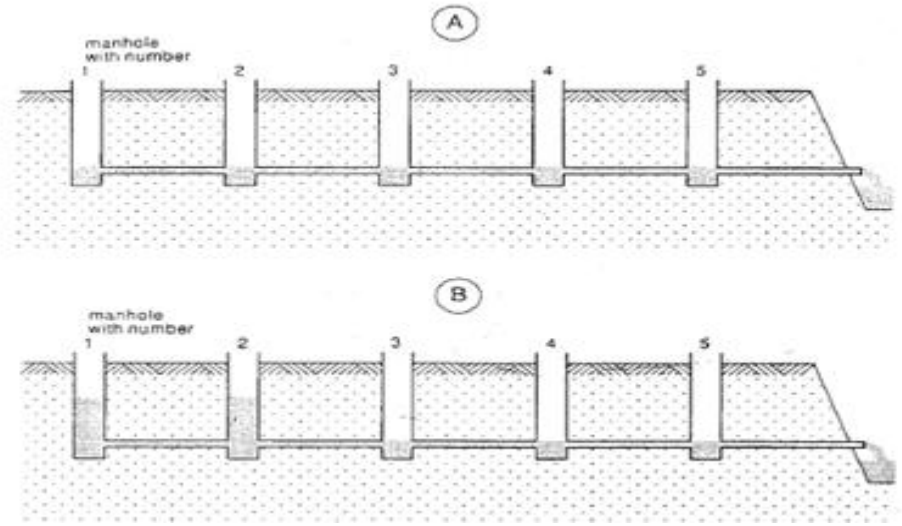


Figure 9: Checking drain system

Testing the performance of collector drain by comparing the water level in manholes:(A) collector is functioning according to design(=no overpressure):(B) Overpressure in manholes 1 and 2 indicates obstruction between manholes 2 and 3

Check whether sediments or other pollutants have accumulated in the drain, structures, or outlets. Look at the land surface for wet spots, as signs of water logging, a few days after rain or irrigation

Figure 10: Wet spots on the land surface are sign of water logging

Check the death of water Table

Check the depth of the water table, especially where wet conditions are found. The water table can be measured in a auger hole or observation well. Look for any damage to pipe outlets and structures: a damaged outlet restricts the functioning of a drain.

Observe Drain outflow

Note that the observations on drain outflow, water levels, and wet field spots should, of course, concern the same drainage event and the same drain. A suitable time schedule for the above routine inspections would be to start with a first inspection shortly after the system has been installed, during the first or second drainage event when the drains should be running. Further inspections could follow about once a year, a frequency which, after a few years without problems, could possibly be reduced to once every two years. In an irrigation-drainage project, storage of these data in the operating agency's computer data bank is highly recommended.

Check proper functioning of the system

Thorough checking A thorough check of the functioning of the system may follow after a routine inspection has revealed significant problems. Such a check may also be intended as a monitoring programme, aimed at improving the design of future drainage projects in the region. Beside these checks on the physical performance of a drainage system, the effectiveness of the investment in drainage should also be assessed; in other words: "Is the drainage system working as designed?". A monitoring and evaluation (M & E) programme could make such an assessment and could be used to check the criteria used for the design. Monitoring and evaluation should usually be considered from a long-term viewpoint, and should be based on factors that are relatively easy to evaluate. Consideration should be given to the proper collection, storage and retrieval of data. This is of the utmost importance for the subsequent physical and economic analysis of the project.

Figure 11: In monitoring and Evaluation programme, data on crop yield are collected

3.4. Maintain Open Drain

The benefits derived from land forming will often depend on good maintenance in the subsequent years. A bedding system requires regular maintenance. Care should be taken to eliminate any obstructions to flow or low points in the drains because they will cause standing water and loss of crops.

Major problems in maintaining open drains may be due to erosion, settlement, silting, vegetation and seepage. Before the drainage season, drains should be cleaned (e.g. with a shovel or a V-drag); all vegetation should be removed, and side slopes and banks should be repaired when necessary. Siltation should be monitored and removed when required. The frequency depends on the local situation and no hard and fast rules can be given.

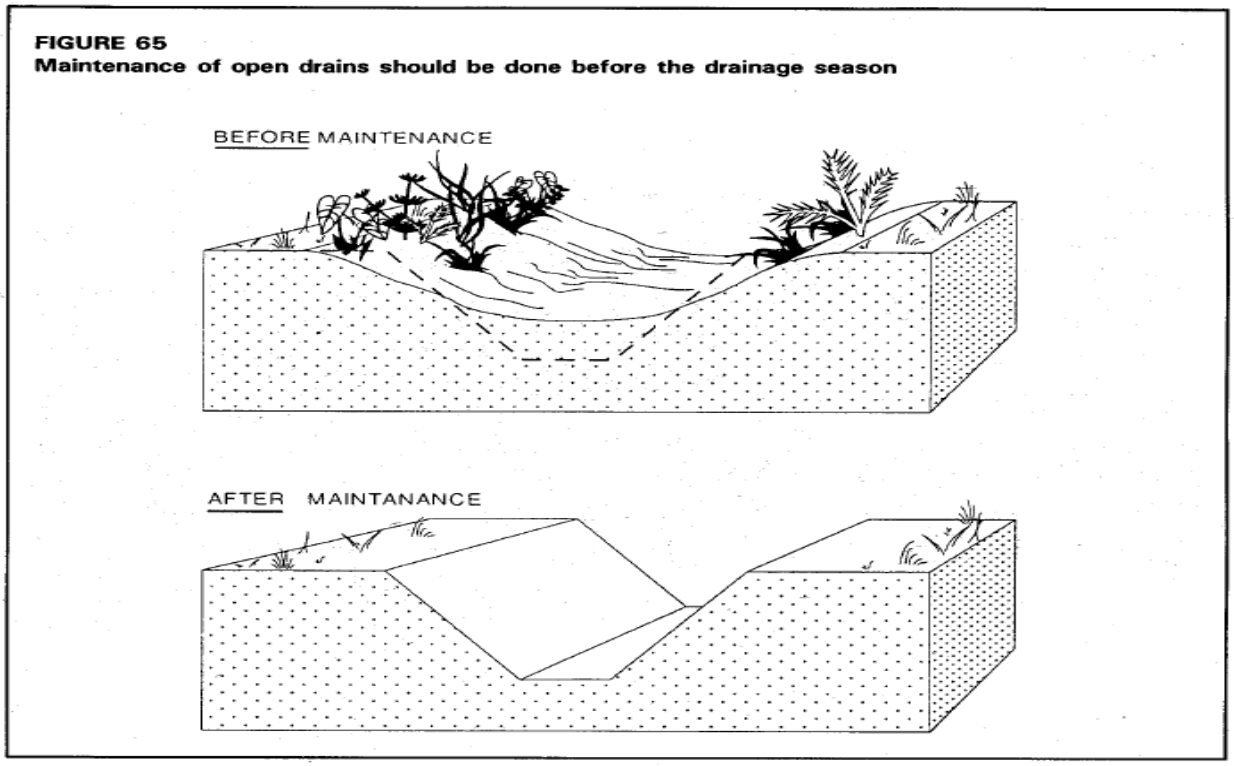
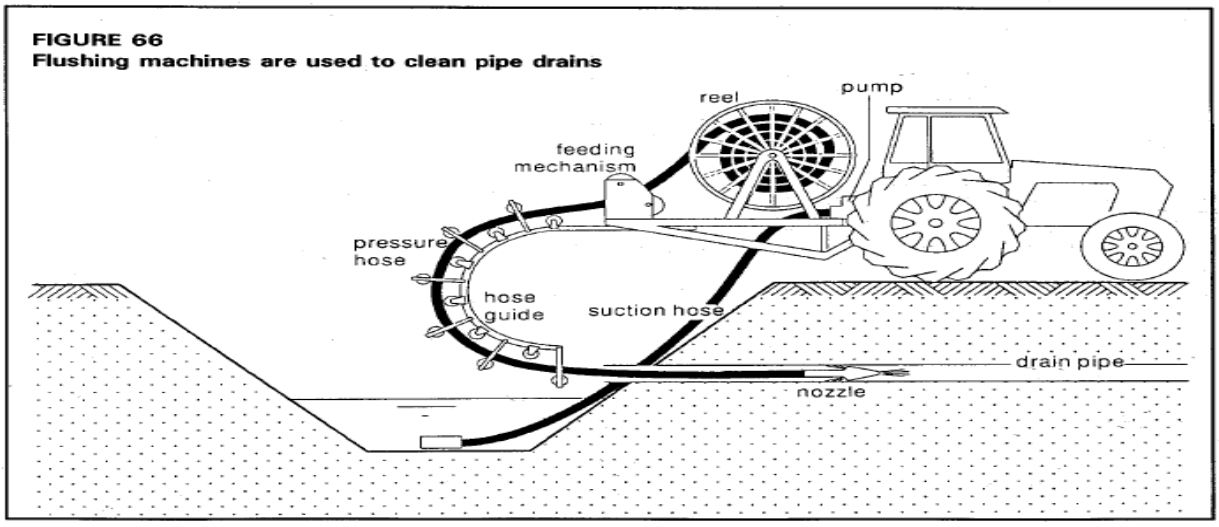


Figure: Maintenance of open drains

Pipe drains

For the maintenance of pipe drains, the problems may be **physical blockages, organic and biological blockages, chemical or mineral sealing,** and outlet restrictions.

Before the drainage season, a visual inspection of all outlets should be done, and water levels in manholes should be monitored to check for obstructions or siltation in the pipe sections. Pipe lines can be cleaned with specialized **flushing machines** which remove sediment from the pipes.



Structures

Structures normally have a higher safety factor than the drains, and in **general need less maintenance.** Nevertheless, regular and timely inspection is required to identify problems and maintenance needs. This concerns visual inspection as well as regular hydraulic surveys.

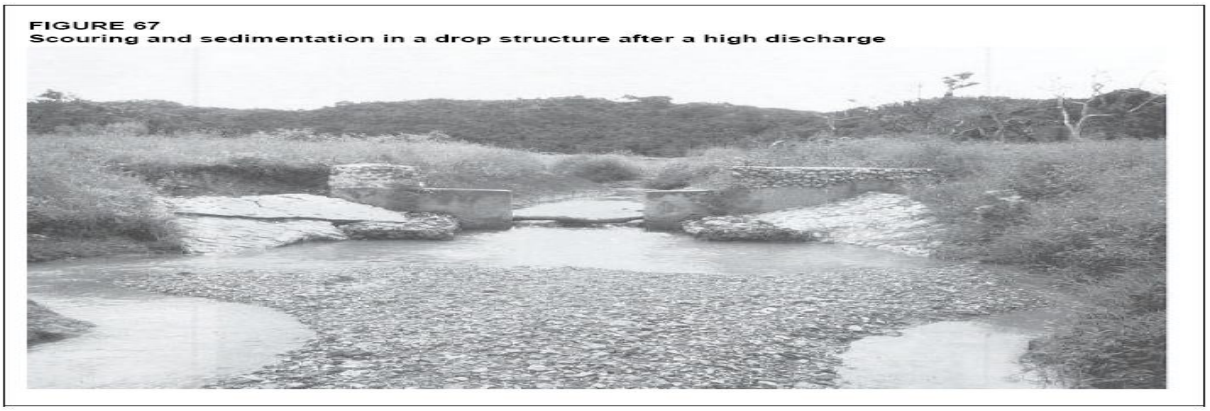


Figure 12:

FIGURE –Scouring and sedimentation in a drop structure after a high discharge

Moving parts in doors and gates should be checked for wear and tear, and inflow and outflow openings should be cleaned of debris and checked for scouring and damage to banks and the structure itself. Without maintenance, a drainage system will not function properly and no sustainable agriculture can be achieved .

3.5. Requirement for Well Designed Scheme

A well designed and constructed canal system transports water from the source to the farmers fields with a minimum amount of water loss. However, water losses will occur and can seriously reduce the efficiency of water delivery. Water may be lost by seepage, leakage, or both.

Water that seeps through the bed and sides of a canal will be lost for irrigation. This so-called '**seepage loss'** can be significant where a canal is constructed from material which has a high permeability: water seeps quickly through a sandy soil and slowly through a clay soil, and so canals constructed in sandy soils will have more seepage losses than canals in clay soils.

The results of seepage through the sides of a canal can sometimes be very obvious, such as when fields adjacent to a canal become very wet, and even have standing water.

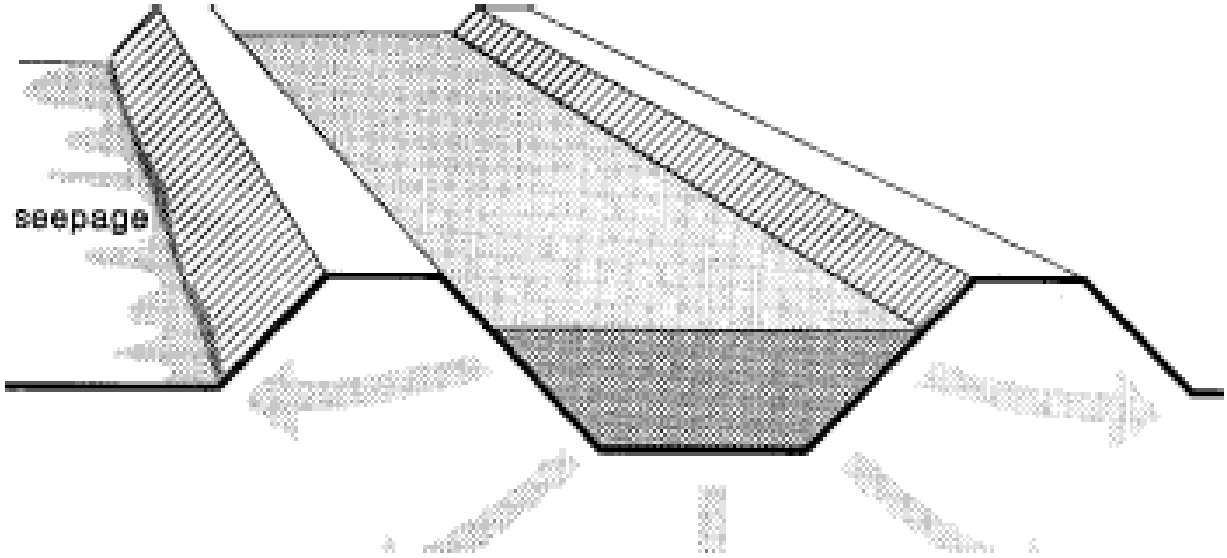


Figure 13: seepage in canal

Leakage

Water may also be lost for irrigation by **leakage.** This water does not seep, but flows through larger openings in the canal bed or sides. Leaks can develop in several ways:

- By rat or termite holes in a canal bed or sides;
- eroded and washed canal bank;

- Small tunnels started by seepage water in a badly compacted or sandy section of a canal bank;
- Seepage around structures, leading to severe leakages;
- Gates which are not tightly sealed;
- cracked concrete canal linings, or joints that are not tightly sealed; or
- torn asphalt or plastic lining.

Canal Overtopping

Water in a canal may rise unexpectedly due to several reasons:

- The incoming flow through the canal off take may be much greater than the canal capacity;
- Obstacles such as stones, blocks or plant growth in the canal may dam up the water;
- Outlets from a canal may be closed which should be open;
- Rain or other water may be draining into the irrigation canal; or
- Farmers may make temporary weirs to raise the water level.

Canal erosion

The sides and bed of an unlined canal are sometimes badly attacked by scouring water. This process is called erosion. Canal bends and sections downstream of structures in particular are susceptible to erosion, since local flow velocities can be very high and the direction of flow changes suddenly, causing turbulence. The inner side slopes of a canal which are too steep or which are not well compacted, may slide.

The soil will be washed away by the flowing water and the canal will erode if the flow velocity is excessively high. The original and the actual cross-section can be clearly seen. The embankments have collapsed and the cross-section no longer has its original shape: it has become irregular. The canal banks have become smaller and the bed is wider than before. As a consequence, more water is needed to fill the canal and to attain the water level required, and there is more danger of a breakdown of the narrowed banks. When the embankments of a canal are not very solid, erosion can result in leakage.

Figure 14: eroded canal

Siltation

Another problem is that the eroded soil will be deposited, known as siltation, in structures downstream of the eroded canal section. This may cause a malfunctioning of the structures. Eroded soil could also be deposited in canal sections, thus reducing the capacity and causing the flow to overtop the bank.

- Safety of hand tools
- Hammerheads should firmly secure to the handle.
- Trowel, saws, chisels, and other tools should not be left lying on scaffolds, when not used.
- All ropes and chains for lifting should be inspected before use they should not be loaded beyond the limit recommended by the manufacturer.
- Nails or bolts used in construction scaffold should be of adequate size of sufficient number at each connection to develop the designed strength of structure.

Safety rule in setting out and excavation

The preliminary site works for construction project usually begin after the site facilities are set up. Clearing the site is essential. First, all Vegetation such as bushes and scrub should be removed. The roots of trees and bushes must be dug out and cleared away.

The building site and surrounding areas should be inspected for termites as part of the process of clearing the site.

A constructor will dug trial holes as part of the preliminary site works.

These holes provide information about the best methods of excavation.

Irrigation system components

The irrigation system component consists of a (main) intake structure or (main) pumping station, a conveyance system, a distribution system, a field application system and a drainage system.

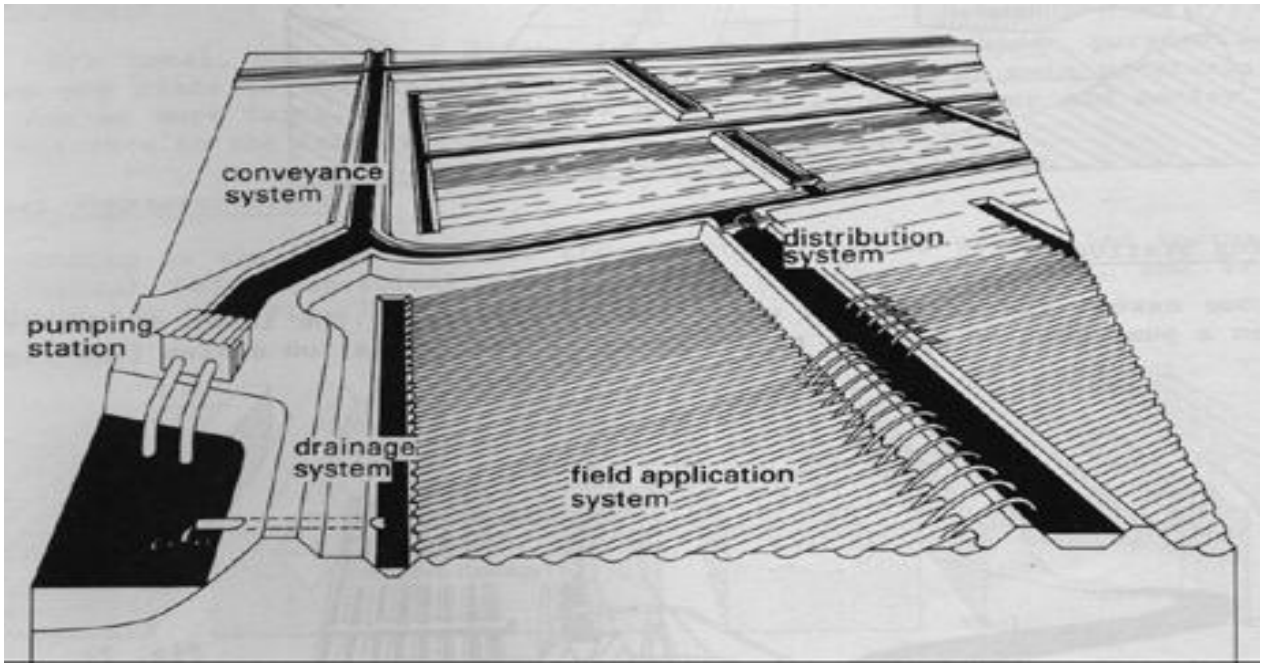


Figure:

- The (main) intake structure, or (main) pumping station, directs water from the source of supply, such as a reservoir or river, into the irrigation system.
- The conveyance system assures the transport of water from the main intake structure or main pumping station up to the field ditches.
- The distribution system assures the transport of water through field ditches to the irrigated fields.
- The field application system assures the transport of water within the fields.
- The drainage system removes the excess water (caused by rainfall and /or irrigation) from the fields.

Operational tests

Once the faulty components have been replaced, the system needs to be tested to ensure that the system is operating correctly. Your supervisor will show you how to replace faulty components in the irrigation system(s) used in your enterprise.

Recording and reporting damage or faulty pumps, valves, electrical components and computer systems

Damaged or faulty pumps, valves, electrical components, etc in irrigation systems should be recorded and reported to the supervisor. Maintenance and repair to these damaged parts should also be carried as soon as possible to avoid leakage and water losses.

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- a summary of maintenance activities,
- a summary, by waste class, of activities and quantities disposed of,
- any instances in which observed site characteristics were significantly different from those described in the application for a license; and
- any other information the Commission may require

Self-Check-3	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

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2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1----------

2----------

3. ----------

Information Sheet -4	Completing reports and documentation

4.1. Session Introduction

In the previous information sheet of learning guide 67 (information sheet #14, 15,16) you have covered the important points that has to be followed in conducting post maintenance activities.

Here in Information sheet#17 you will covers also two important points. Firstly, identify reports and documentation that are required in conducting post maintenance activities of asset construction and maintenance. The second important point you will cover in this information sheet is how they can be completed as per organizational requirement secondly.

4.2. Requirements in documentation

The aim of documentation is to give those carrying out the works the information they need. Documents are also used to prepare and implement the coordination and monitoring asset construction and maintenance activities effectively.

Documentation should be prepared by qualified specialists. The key to good documentation is to correctly identify the problem to be solved, and hence to specify an appropriate solution. The nature and extent of the work must then be clearly conveyed to those who will do it.

4.3. Types of documentation

4.3.1. Contract conditions

If the works are being carried out by a contractor, some kind of contract will be necessary. There are several standard forms of contract available. Make sure that the contract gives you and the building adequate protection if something goes wrong.

Thus during post maintenance inspection even the irrigation and drainage system seems well operating, there will always be unforeseen problems and extra works in repairs to a asset. Thus as per the contract document you are expected to coordinate maintenance requirement and the contract should allow for further inspections to confirm the extent of work.

In reading an irrigation design plan, the first step is to get the orientation right. The plan must be turned so that landmarks on the plan agree with the actual landmarks, such as dams, canals, copies (hillock), or any other distinguishable features that is shown on the map. You are also expected to familiarize yourself with the block and pipe layout on the plan and compare it with the actual block and pipe layout (if it is an existing system).

4.3.2. Specifications

A specification is a written description of the materials and techniques to be used in the work. Most project specifications incorporate references to standard specifications. In conducting post maintenance activities the project asset specification documents shall be well reference and reported as per organizational requirements. A basic rule for good documentation is that the specification describes what needs to be done and the drawing shows where.

4.3.3. Schedules

Most documents contain lists (known as schedules) of components and for conservation work; schedules of repairs are commonly prepared for each part of the system. Schedules are an effective way to summaries the works to be done.

4.4. Document with care

Poorly documented repair works could result in the work making matters worse rather than better. Documents should include a description of site conditions, such as potential noise problems, access times and work areas for the contractor and special protection of heritage fabric. Generally, the requirements of the occupants and the

users of the building should be documented where they conflict with the contractors work. Note that some work may need to be done “out of work hours”.

4.5. Document with care

Poorly documented repair works could result in the work making matters worse rather than better. Documents should include a description of site conditions, such as potential noise problems, access times and work areas for the contractor and special protection of heritage fabric. Generally, the requirements of the occupants and the users of the building should be documented where they conflict with the contractor’s work. Note that some work may need to be done “out of work hours”.

Self-Check-4	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the value of testing in commissioning program?
2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1----------

2----------

3. ----------

Information Sheet -5	Storing And Securing Reports

5.1. Introduction

Information sheet#18 provides you will covers also two important points. Firstly, identify reports and documentation that are required in conducting post maintenance activities of asset construction and maintenance. The second important point you will cover in this information sheet is how they can be completed as per organizational requirement secondly.

5.2. Reporting Requirement

5.2.1. Maintaining accuracy and integrity of data

The accuracy and integrity of data should be maintained. This means that data should be correct and updated at the prescribed and scheduled dates and in some cases specific time of day. Should the data not be collected and recorded correctly, the integrity of the data is corrupted. Data should be reported on by using required reporting formats. This should be available at the farm. Basic deviances in data should be recorded and reported on. (Please refer to the Unit).

5.2.2 Kind of Data to be reported

Example the following are some of the information that should be reported in Coordination and monitoring asset of construction and maintenance in irrigation system

- Occurrence of pest and disease infestations.
- Weather and climatic information – year on year.
- Rainfall.
- Costs of agricultural inputs.
- Prevailing economic conditions in the sector, country and internationally.
- Production costs per crop.
- Soil and fertilization costs and applications.
- Pest and Weed Control application programs and statistics.
- Profit margins per cultivar / per crop / per block / per orchard / per Hectare.

5.2.3. Purpose of reporting and collecting data

The three main reasons why we would collect irrigation system data;
Patterns of the environment include rainfall, climate, dry cycles, original vegetation, seasons, movement patterns of animals, etc.

- Processes of the biophysical environment include the interaction and the relationship between food webs, human activities, soil, climate, water, plants, animals and solar energy.
- It is always useful to have detailed records and data in order to ensure that we make optimum decisions in order to maximize profits, production and quality, whilst keeping risks and problems to a minimum

5.3. Data and Information management requirement

5.3.1. Requirement for Data and Information

Data and information are needed to assure affectivity and efficiency. In each level, therefore, a management information system (MIS) has to be developed. The activities in those different levels affect the same irrigation area and farmers.

The MIS for each level is interdependent for they make use of the same set of raw data and information. These sets, when processed and analyzed, provide a new set of data and information for making decisions and undertaking action.

To be effective in managing activities at their own level, IA officers, TSA (or Sector) leaders, and members must have a good understanding of these management information systems.

5.3.2 Management Information System (MIS) in an Irrigation System

The management information system (MIS) in irrigation as shown in Figure VI-1 has two complementing components:

- Irrigation Management Information System (IMIS) -which is at the level of the NIA organization. This MIS has sub-levels that use similar information but for a different kind
- Irrigators Association's Management Information System (IAMIS)

5.5. Record and report maintenance activities

Damage and blockage caused by pests and animals are recorded by damage type, location and the section of the system affected. Damage or faulty pumps, valves, electrical components and computer systems are recorded and reported, and action taken to effect repairs. Routine and preventative maintenance activities are recorded and reported in accordance with enterprise standards.

- **Record and report maintenance activities**

Each irrigation worker shall maintain any records and make any reports in connection with the activities as may be required by the conditions or by the rules, regulations, and orders of the enterprise. Records which are required by the regulations in this part or by license conditions must be maintained for a period specified by the appropriate regulations or by license condition.

Records which must be maintained pursuant may be the original or a reproduced copy or a microform if this reproduced copy or microform is capable of producing copy that is clear and legible at the end of the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures.

Damaged or faulty pumps, valves, electrical components, etc in irrigation systems should be recorded and reported to the supervisor. Maintenance and repair to these damaged parts should also be carried as soon as possible to avoid leakage and water losses.

The record of damaged or faulty pumps, valves, electrical components may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures.

The reports on damaged or faulty pumps, valves, electrical components shall include: specification of the quantity of each of the principal damage and blockage specification of the quantity of each of the principal location and the section of the system affected summary of maintenance activities, a summary, by waste class, of activities and quantities disposed of, any instances in which observed site characteristics were significantly different from those described in the application for a license; and any other information the Commission may require

- **Record and report maintenance activities**
  - ✓ Damage and blockage caused by pests and animals are recorded by damage type, location and the section of the system affected.
  - ✓ Damage or faulty pumps, valves, electrical components and computer systems are recorded and reported, and action taken to effect repairs.
  - ✓ Routine and preventative maintenance activities are recorded and reported in accordance with enterprise standards.

Self-Check-5	Written

Directions: Write short answer for the question given below. Each question has equal 4 point. For your answer use the space provided.

1. What is the value of testing in commissioning program?
2. How you test the working pressure?
3. Write two basic points to keep in evaluating functionality of scheme.

Note: Satisfactory rating - 5 points and above Unsatisfactory - below 5points

Name: _____ Date: _____

Score = _____

Rating: _____

Answer Sheet

1----------

2----------

3. ----------

REFERENCE

Federal Democratic Republc Of Ethiopia, Occupational Standandrd, Irrigation And Drainage Design And Construction Supervision Ntqf Iv, Ministry Of Education, March 2017

Federal Democratic Republic Of Ethiopia, Occupational Standandrd, Irrigation And Drainage Design And Construction Supervision Ntqf Iv,Minstry Of Education ,March 2017

Federal Tvet Agency,Ethiopian Water Technology Institute And Jphiego Ethiopia (Hedar 2010) Adama, Model Curriculum, Irrigation And Drainage Design And Construction Supervision Iv

Irrigation And Hydrower Engineering,S.K.Gararg 10th Edition

Irrigation And Water Resource Engineering,G.L Asawa

Irrigation System,Design,Planning And Construction

Water Resource Engineering,Design And.Construction,Arora,2015

PREPARED BY

No	Name	Level	Region	College	Email	Mobile
1	Mesay	B	Oromia	Woliso	Mesayh20@gmail.com	0911923394
2	Mulken	B	Amhar	Kombolcha	eliyaspappet@gmail.com	0910199733

Listofparticipantandthierrespectiveparticipationinproductionofthelearningguide.

PreparedBy							
No	**Name**	**EducationalBackground**	**LEVEL**	**Region**	**College**	**Email**	**PhoneNumber**
1	GetachewLegese	Waterresourceandirrigationengineer	B	Oromia	WalisoPTC	getahewlegese45@gmail.com	0913980196
2	ChalaBekele	Constructionmanagement	A	oromia	WalisoPTC	Chalabekele2020cb@gmai.com	0913333737
	DinkuBacha	Waterconstruction	B	oromia	WalisoPTC	dinkuwater@gamil.com	0917114953
3	MesayAklilu	Irrigationengineer	B	oromia	WalisoPTC	Mesayh2o@gmail.com	0911923394
4	MulkenTilahun			Amhara	kombolchaPTC		
5	TigistKebede	FTAExpert					