

Unit 12: Manage Soil Water

Unit code:	F/600/9844
QCF Level 3:	BTEC National
Credit value:	5
Guided learning hours:	30

● Aim and purpose

This unit aims to provide learners with an understanding of how to manage soil water and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

● Unit introduction

With water conservation a primary thought among many people, ensuring the correct irrigation level and not wasting water is very important to many horticulturalists. Irrigation water management needs the horticulturalist to apply the right amount of water at the right time. Cost and concern for the environment makes the use of irrigation very important to the industry. To manage water use, soil moisture should be measured and an irrigation regime maintained. Water is vital because with water shortages comes a reduction of yield and over-watering can lead to water logging, mineral loss and rot. Luckily, even amateur gardeners have access to a number of high tech, low-cost maintenance systems that allow the gardener to plan and manage water use. If too much water is the problem then this can also be resolved as drainage systems can be installed ranging from highly engineered tiling systems to simple dug out gravel drainage channels.

In this unit learners will study what can affect the moisture level of soil and the irrigation options that are available for the horticulturalist, as well as the drainage options that can be installed in an area. The unit will cover the legal requirements involved when dealing with drainage. It will also allow the opportunity to install, maintain and fault find in irrigation systems and drainage systems that can be built and set up by the learner.

● Learning outcomes

On completion of this unit a learner should:

- 1 Understand the requirements of soil water management for horticultural use
- 2 Be able to maintain irrigation systems
- 3 Be able to install and maintain drainage systems
- 4 Know the legal requirements applicable to irrigation and drainage of horticultural facilities.

Unit content

1 Understand the requirements of soil water management for horticultural use

Factors affecting soil moisture: rainfall; evaporation; transpiration; effect of soil structure and texture; field capacity; wilting point; soil moisture deficit; irrigation sources eg rainwater, rivers and lakes; seasonal factors.

Calculating water use: use of water balance sheets including use of evapotranspiration data, computer programmes, weather forecasts, soil moisture data; drainage calculations using standard formulae; calculations for a specific site eg soil water-holding capacity, root zone, crop growth stages, available water.

2 Be able to maintain irrigation systems

Maintenance: inspection of automatic systems; inspection of mobile systems; nozzle repair and replacement; fault finding; routine and annual maintenance of automatic irrigation systems; routine and annual maintenance of mobile irrigation systems; relevant current legislation and codes of practice including health and safety considerations.

3 Be able to install and maintain drainage systems

Drainage systems: open ditch; mole; pipe; sand slit/sand injection; drainage carpet; describe component parts of pipe drainage eg mains, laterals, catch water drains, silt traps, outfalls; installation of pipe drainage systems; achieving desired flow rates; suitable backfill materials for pipe drains; sand infiltration systems to improve existing irrigation.

Maintenance: inspection of drainage systems; fault finding; carry out routine repairs; carry out routine maintenance; annual maintenance considerations with drainage systems; carry out annual maintenance.

4 Know the legal requirements applicable to irrigation and drainage of horticultural facilities

Relevant legislation: current legislation covering irrigation; current legislation covering drainage; record keeping for water abstraction; record keeping of drainage activities; use of grey water; water use and the water act 2003

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 analyse factors affecting water infiltration, penetration and drainage	M1 compare water use data from different sites and suggest improvements in water conservation	D1 evaluate available irrigation systems used in the horticulture industry
P2 analyse factors affecting loss of water from sites and soil		
P3 prepare and use a soil water balance sheet		
P4 calculate the drainage and irrigation requirements of horticultural sites		
P5 diagnose faults and problems with installed irrigation systems	M2 explain the benefits of automatic irrigation systems	
P6 safely isolate irrigation systems prior to repair or maintenance		
P7 carry out routine maintenance and repair to irrigation systems		
P8 carry out the seasonal shut-down and starting of irrigation systems safely		
P9 describe systems of drainage suitable for a range of horticultural sites and uses	M3 explain the benefits of pipe drainage systems.	D2 evaluate the condition of an existing irrigation system and an existing drainage system.
P10 install pipe drainage according to specification		
P11 diagnose faults and problems with installed drainage systems		
P12 carry out routine maintenance and repair to drainage systems		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P13 describe the records required for water abstraction and drainage activities		
P14 describe the legal requirements of irrigation and drainage of horticultural sites and facilities.		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable sites and will possibly involve developing links with industry for site visits and guest expert speakers who may be able to talk about specific locations where irrigation and drainage have been vital to creating land suitable for horticultural use; and will possibly link to industrial experience placements. If land is available to the provider then drainage and irrigation systems can be set up and maintained, but if space is limited then the unit can be delivered by use of site visits, guest speakers and organised visits for practical work. Some of the material can however be delivered by a wide range of techniques including lectures, discussions, seminar presentations, supervised practicals and research using the internet and/or library resources. Delivery should stimulate, motivate, educate and enthuse learners.

Any site visits should be checked for suitability and a risk assessment of activities carried out. Companies can often offer site visits with support and provide expert guidance on the specific location as well as sometimes being able to tailor-make sessions and practical work. It would be beneficial if learners and supervisors of sites were made aware of the requirements of this unit prior to any activities so that evidence can be collected at the time. For example, learners may have the opportunity to use computer systems that would otherwise be too expensive for a college or school but that show large-scale irrigation in the horticulture industry. Learners should be encouraged to ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Guest speakers would also be useful to provide background information to legal requirements and health and safety considerations when recording and dealing with drainage and irrigation water.

Some of the techniques can be carried out by setting up a scenario in a small open space if suitable equipment is available. Samples of drainage systems can be collected and shown. Land can then be identified for the learner to establish or maintain an irrigation and drainage system.

Whichever delivery methods are used, it is essential that tutors stress the importance of water conservation, sound environment management and the need to manage the resource using legal methods.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: The Struggling Garden (P1, P2).
Introduction to assignment.
Supervised practical work, lectures, calculations, site visits, workshop diary, presentations.

Topic and suggested assignments/activities and/assessment

Assignment 2: How much? (P3, P4, M1, D1).

Introduction to assignment.

Supervised practical work, lectures, calculations, site visits, workshop diary, presentations.

Assignment 3: Watering made easy (P5, P6, P7, P8, M2)

Introduction to assignment.

Supervised practical work, site visits, workshop diary, presentations.

Assignment 4: Another problem (P9, P10, P11, P12, M3, D2)

Introduction to assignment.

Supervised practical work, site visits, workshop diary, presentations.

Assignment 5: Helping others (P13, P14)

Introduction to the assignment.

Internet research, lectures, Supervised practical work, site visits, presentations.

Unit review.

Assessment

To gain a pass grade learners must achieve the fourteen pass criteria listed on the grading grid provided.

P1 requires learners to analyse factors affecting water infiltration, penetration and drainage. Evidence for this can be in the form of a set of detailed notes, presentation, leaflet, poster, web page or blog.

P2 requires the learner to analyse factors affecting loss of water from sites and soil. This can be assessed in a similar way to P1.

For P3 and P4, learners are involved in calculating water use. The evidence for this could take the form of written examples of calculations, a leaflet describing how to complete a water balance sheet or a demonstration to others on how to calculate water use.

P5, P6, P7 and P8 all involve practical work on irrigation systems. Evidence for these criteria can be from assessed practical work, learner diaries, a work diary if a site visit or placement is used, annotated photographic diary, witness statements or observation records. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

For P9, learners must describe systems of drainage suitable for a range of horticultural sites and uses. Evidence for this could take the form of a feedback presentation, a guide leaflet for student landscape gardeners, a web page or a mock new staff recruitment training session.

P10, P11 and P12 all involve practical work on drainage systems. These can be assessed in a similar way to P5.

P13 and P14 require learners to describe the records required for water abstraction and drainage activities and to describe the legal requirements of irrigation and drainage of horticultural sites and facilities. Evidence for this could be a guide to land owners/surveyors, a leaflet for new landscape gardeners, a mock trial of someone who has broken the law when building a site, a news report on someone who has been arrested, or a newspaper story.

To achieve a merit grade, learners must fulfil all of the pass grade criteria and the three merit grade criteria.

M1 requires learners to compare water use data from different sites and suggest improvements in water conservation. This can be assessed as a piece of written work, a presentation, a leaflet, web page or magazine article for a specialist magazine, for example the Wildlife Trust.

For M2, learners must explain the benefits of automatic irrigation systems. Learners could provide research notes or other forms of written assessment as evidence. Alternatively a presentation, leaflet, section of a website, section from a book or similar can be completed.

For M3, learners must explain the benefits of pipe drainage systems. This can be assessed in a similar way to M2.

For a distinction grade learners must achieve all of the pass and merit grade criteria and the two distinction grade criteria.

D1 and D2 require the learner to evaluate available irrigation systems used in the horticulture industry and to evaluate the condition of an existing irrigation system and an existing drainage system. Evidence can be in the form of written notes based on a work diary, lecture, poster, leaflet, PowerPoint/slideshow.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2	The Struggling Garden	You are an employee of the RHS and have recently changed sections. You are now working on a large area of land in one of the main gardens. There have been some problems in the area and certain plants have been struggling to develop even though pH etc seem fine. You have been asked to complete soil analysis for the area, focusing on water as this may be the problem.	Written report. Presentation to your superiors.
P3, P4, M1, D1	How much?	The water does seem to be an issue so you start to see just how much is needed in the garden and how you can conserve water at other times. You have been asked to construct a water balance sheet for the garden.	Report. Calculations. Talk on conservation of water.
P5, P6, P7, P8, M2	Watering made easy	After looking at your calculations your boss thinks an irrigation system would be great and asks you to select, install and maintain a suitable irrigation system for the site.	Practical notes. Witness statements. Annotated photographs.
P9, P10, P11, P12, M3, D2	Another problem	One area seems to retain water and remain quite boggy. You have decided that a drainage system is required. You must research then select a suitable system as well as fitting it and maintaining it. You must justify your choices and reasons to your boss as they will have to finance the operation.	Practical notes. Witness statements. Annotated photographs.

Criteria covered	Assignment title	Scenario	Assessment method
PI3, PI4	Helping others	The RHS also offers a free consultation service for people to ask questions about plants and gardening. You are the expert at an open day for members and have been asked about the legal requirements of installing irrigation and drainage at home or in a small business such as a nursery. You must give as much good advice as possible and be prepared.	Research notes. Presentation. Letter to member.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Land-based sector suite. This unit has particular links with:

Level 2	Level 3
Establish and Maintain Plants Outdoors	L21.1 and L21.2 Maintain drainage and irrigation systems L15.1 (part) Install and maintain drainage systems
	Undertake an Investigative Project in the Land-based Sector
	Establish and Manage Exterior Plant Displays

Essential resources

There are many opportunities for practical and experimental work in this unit. Therefore there should be access to adequate field and laboratory facilities for the installation and maintenance of irrigation and drainage systems, preferably of different varieties. A suitable range of drainage systems should be available for learners to study.

There should be access to soil analysis kits and soil water testing equipment. Learners should have access to current health and safety regulations and equipment. Links with, for example, farmers and growers will enable access to a range of irrigation and drainage regimes.

Learners should be given access to computers for research and presentation of assignments.

Employer engagement and vocational contexts

Learners would benefit from having access to expert speakers or guides. Often this can be achieved by creating links with local businesses, specialist plant nurseries, farms or charitable organisations who may even benefit from taking on students. Local charities are often keen to provide information and produce a number of useful resources that will help students in identification, installation and maintenance of irrigation and drainage systems. Local authorities can be a useful source of information, as can business education alliances. Charitable and government organisations can often provide guest speakers to attend and give lectures as well as demonstrations, normally for a minimal cost.

Indicative reading for learners

Textbooks

Bardgett R – *The Biology of Soil: A community and ecosystem approach (Biology of Habitats)* (John Wiley & Sons; 4th Edition, 2005)

Mazumdar B C – *Orchard Irrigation and Soil Management Practices* (Daya Publishing House, 2005)

Schwab Y G O, Fangmeier D, and Elliot W J – *Soil and Water Management Systems* (OUP Oxford, 1995)

Websites

www.ehow.co.uk/video

e how videos

www.onlinegardener.com

Soil drainage report

schools-wikipedia.org/wp/i/

Irrigation.htm wikipedia

www.self-sufficient.co.uk

Irrigation-Options.htm self-sufficient

www.soilandwater.co.uk

Ron Allen's rough guide to soil

www.ukia.org

UK irrigation association

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	carrying out internet research and library research, questioning experts
Creative thinkers	suggesting improvements to practical work
Reflective learners	evaluating work completed
Team workers	participating in group tasks for analysis
Self-managers	meeting deadlines
Effective participators	completing group tasks.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Creative thinkers	applying techniques studied to the working environment
Reflective learners	suggesting improvements to techniques
Team workers	practising techniques
Self-managers	producing written work on time
Effective participators	participating in team activities.

● Functional Skills — Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	carrying out internet research writing presentations
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching mineral deficiency comparing data from logging practical work
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records 	presenting written work and data
Bring together information to suit content and purpose	displaying data from practical work
Present information in ways that are fit for purpose and audience	giving presentations
Mathematics	
Identify the situation or problem and the mathematical methods needed to tackle it	producing calculations and water balance sheets
Select and apply a range of skills to find solutions	producing calculations and water balance sheets
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	producing presentations, video, and blogs
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading information as part of internet and library research
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	completing reports, diaries and other assessments.