Unit 30: Public Health Engineering

Delivery guidance

This unit focuses on developing the knowledge and skills that will enable learners to understand the principles, methods and processes of public health engineering.

Approaching the unit

Utility records, drawings, illustrations, images, animations and video clips are all useful resources to explain how drinking water is produced and distributed. Such resources are freely available online and can be easily incorporated into any presentations.

In addition to this, site visits would be beneficial and could possibly include a water treatment plant, landfill sites and a sewerage treatment plant. It would also be helpful to involve local professionals and experts from the public health engineering organisations (e.g. utilities providers, consultants and suppliers) as guest speakers, as this will be interesting for learners and will give them an insight into the current practices within the industry.

You could also use simple laboratory experiments to demonstrate, e.g. the purification of water. Develop a number of activity sheets, including practice questions, to support learners in developing the skills required to carry out design calculations for below ground drainage systems.

Delivering the learning aims

The content of this unit relates to a number of other units in this qualification, which will help to motivate learners as it can be related to other areas of learning.

Learning aim A is about understanding below ground drainage systems and sewerage treatment methods. An important element of this learning aim is for learners to develop an understanding of the sustainable urban drainage system (SUDS). Focus on the design, installation and testing of drainage systems, as well as the ways to treat sewerage.

Site visits are key to engaging learners and this learning aim would benefit from an early visit to a site where drainage systems are being installed or tested. The site visit will reinforce learning about types of pipes, cover required and bedding details. Learners will experience first-hand knowledge of access points, gradients and health and safety requirements in such environments.

Produce activity sheets that require learners to carry out design calculations for below ground drainage. Ensure that they understand the importance of assessing the practical and functional uses of the system and are able to demonstrate their problem-solving skills.

Support and challenge learners throughout the unit using a variety of means, such as knowledge quizzes, paired or small group activities and group discussions, which will provide learners with opportunities for peer learning.

Learning aim B focuses on the different types of solid waste, disposal methods and the legislation relating to waste disposal. Introduce the different types using pictures and illustrations or short video clips. It will be beneficial for the content to

be reinforced using visits, such as to a landfill site and/or a recycling centre, as this will ensure that learners can see how and why solid waste is segregated. On the visit, introduce the relevant legislation and explain why it is implemented, which will help learners to appreciate the rationale of the regulations. Alternatively, introduce them to some examples of site waste management plans (SWMP) to explain and reinforce learning if visits are not possible.

In **learning aim C**, learners will develop an understanding of the sources and treatment of drinking water. A variety of animations and videos to explain different sources of water is available online. Engage learners using knowledge quizzes, group-based research activities and presentations. Basic laboratory and/or field kits could also be used to help learners understand the characteristics of drinking water. Arrange a visit to a local water treatment facility.

It is important to have access to drawings and utility records relating to drainage systems and water distribution networks. Ensure that learners also have access to copies of legislation, standards, design charts and tables.

Finally, where possible, invite a guest speaker from a utility company, a design consultancy, a supplier or a manufacturer. This will allow the guest speaker to share with learners the current approaches and design practices in industry, as well as ensuring efficiency and environmental sustainability.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Understand below ground drainage systems and methods for treating sewerage	**A1** Introduction to below ground drainage systems **A2** Installation, testing and maintenance of below ground drainage systems **A3** Methods of treating domestic sewerage	A report that investigates below ground drainage systems and methods of treating domestic sewerage.
B Examine methods for disposing of solid domestic waste	**B1** Types and forms of solid domestic waste **B2** Methods of disposal of solid waste **B3** Requirements and constraints relating to the disposal of solid waste	A report that investigates and evaluates the disposal of solid domestic waste produced within a given domestic development.
C Examine the processes used to produce and distribute drinking water	**C1** Sources of drinking water **C2** Treatment of drinking water **C3** Storage and distribution of drinking water	A report that examines a range of sources of drinking water, methods used to purify water and the subsequent storage and distribution of drinking water.

Assessment guidance

There is a maximum number of three summative assignments for this unit. The assignment briefs should be set within the context of a small development, such as a housing or commercial development. The brief should be developed in a way that all three assignments can be set against it. Assessment evidence may take the form of written reports, which will need to include sketches, illustrations and a list of the information sources used.

For **learning aim A**, provide adequate details about the design requirements, pipe materials and disposal issues so that learners can compare, justify and suggest alternatives to treat sewerage and dispose of sludge. Learners should include calculations and consider the issues relating to cost and health and safety while justifying the design choices made.

The assessment of **learning aim B** could be contextualised using the same development as the first assignment. Learners evaluate disposal methods with reference to the solid waste materials and legal constraints. Their evaluation should include their rationale for sorting materials and due consideration of legal, environmental and health and safety issues.

For **learning aim C**, the housing or commercial development could be located somewhere where learners should consider storing and distributing water to the consumers. Learners can then evaluate various approaches in their responses. Ensure that you provide client requirements so that learners can carry out suitable evaluation.

Getting started

This gives you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 30: Public Health Engineering

Introduction

Introduce learners to the unit using utility records, animations, DVDs, pictures, illustrations or web-based videos relating to drainage and drinking water for a small development.

Well-organised site visits are invaluable to the delivery of this unit. Ensure that learners can see below ground drainage, waste management and water treatment and/or distribution as part of these visits. Visits will need to be timetabled carefully to ensure that learners have sufficient knowledge of the relevant learning aim to fully benefit from the experience. The site visits for this unit could also be done in conjunction with visits from other units. It is critical to coordinate with the site staff in advance to confirm:

- the health and safety requirements of the project
- the type of project (e.g. domestic, commercial or industrial)
- the construction stage (i.e. what learners could see during the visit)
- the extent to which site staff could engage with learners (e.g. giving a presentation about the project or allowing learners access to project drawings, design and treatment data).

Direct learners to prepare checklists before the visits so that they can record details of materials, jointing methods and types of systems, as well as installation, treatment and disposal processes. If finding appropriate sites to visit proves difficult, DVDs or other project data can illustrate project examples to help learners understand.

Other ways in which you can engage learners throughout the unit include using guest speakers, knowledge quizzes, paired and/or group activities, group discussions and presentations.

Learning aim A – Understand below ground drainage systems and methods for treating sewerage

- The delivery of this learning aim would benefit from a site visit so that learners can examine both below ground drainage and sewerage treatment. If a visit is not possible, targeted use of online resources and videos clips can enhance your presentations and classroom-based activities.
- Begin **learning aim A1** by delivering a presentation that explains how a below ground drainage system works, using animations, DVDs, pictures, illustrations or web-based videos to illustrate. Introduce an example to learners, showing the design requirements and associated calculations relating to the systems.
- Facilitate a group discussion by asking learners to consider the principles and applications of combined, totally separate, partially separate and grey water systems. This could be followed by a question and answer (Q&A) session, drawing upon the key points and summarising the discussion.
- In the following session, present learners with more detail by explaining the types of systems, design requirements and factors. Introduce the sustainable urban drainage system (SUDS) at this point. Use drawings, DVD or web-based video resources as appropriate, as well as informal Q&A sessions to check understanding.

- Organise learners into small groups to investigate suitable systems for different scenarios. For example, one group could be given the task of investigating systems that could be used for an industrial estate, while another group could consider a small housing development. Observe the groups as they work and give guidance where necessary. All groups then share their findings. Collate group notes and upload them to a shared access folder.
- Extend the small group activity by including suitable SUDS structures. Each group could be allocated a specific structure. For example, one group could work on swales, while another could focus on wet ponds. Ask learners to discuss their findings about their given structure, drawing upon key points. Summarise and add their findings to a shared access folder.
- Give a presentation to introduce the design requirements for below ground water drainage. Facilitate a Q&A session to engage learners.
- Organise learners into small groups and give each group a set of example project documents, including design requirements and the final design. For each group, assign a specific topic from the unit content for this learning aim. For example, one group will identify how access requirements have been satisfied while another group could investigate ventilation stacks. Observe the groups as they work and give guidance where necessary. All groups then share their findings. Collate group notes for the whole group and upload them to a shared access folder.
- Use a knowledge quiz to check learner knowledge before they start the design calculations. Use the same example project data from the previous activity. Once learners have completed this quiz, provide model answers. Ask learners to do a self-assessment, then give them constructive and developmental feedback.
- Demonstrate how to complete the Chezy, Chezy-Manning and continuity equations, then hand out activity sheets that require learners to practise completing these equations. Support them as they work towards solving the calculations. (This activity could also be conducted in small groups.) Conclude this activity with learner feedback and summarise the key factors for consideration.
- Demonstrate how to complete design calculations, including drain size, loadings, depth of flow and self-cleansing velocity, then hand out activity sheets that require learners to practise completing these equations . Support them as they work towards solving the calculations. (This could also be conducted in small groups.) Conclude this activity with learner feedback and summarise the key factors for consideration.
- Introduce **learning aim A2** by delivering a presentation containing animations, videos and drawings for use in this learning aim. Introduce installation and jointing techniques for a variety of pipes. Engage learners using a Q&A session, drawing upon and summarising the key points from the presentation.
- Ask learners to carry out research into the various testing methods available in small groups. Assign each group a specific type of testing method. For example, one group could work on CCTV inspection, while another group could investigate air tests. All groups share their findings. Pick out and summarise the key points, then add learners' findings to a shared access folder.
- Ask learners to form small groups and give them an example design project. Ask each group to justify access and maintenance requirements of a specific aspect of this topic that you allocate to them. For example, one group could justify the access points provided while another group could identify tools and equipment required for maintenance and servicing. All groups share their

findings. Pick out and summarise the key points, then add learners' findings to a shared access folder.

- Arrange a guest speaker to visit the centre and present to the group. They could be from either a utility company or design background. Ideally, they can present learners with some real-life examples of drainage systems in terms of their design, installation and testing. Prior to the guest speaker's arrival, prepare learners to ask questions to ensure that they can take full advantage of this opportunity.
- As part of **learning aim A3**, consider arranging a visit to a sewerage treatment facility where learners can observe the techniques used for treatment. This would give them the opportunity to experience state-of-the-art equipment first-hand. Encourage learners to prepare checklists based upon the unit content, so that they can record and note down relevant details during the visit. If it is possible to arrange such a visit, it could form part of the assessment for this learning aim.
- If a visit cannot be arranged, use animations, videos and group discussions for the delivery of the learning aim. Engage learners by providing small group research activities, the findings of which must be presented to the rest of the group.
- To review the content covered in this learning aim, facilitate a whole group discussion in which learners justify the suitability of approaches to designing below ground drainage systems. Summarise learners' feedback and expand on the key points where necessary.

Learning aim B – Examine methods for disposing of solid domestic waste

- The delivery of this learning aim would benefit from a site visit so that learners can examine how solid waste is segregated and disposed of. If a visit is not possible, use online resources and videos clips to enhance your presentations and classroom-based activities.
- For the delivery of **learning aims B1 and B2**, deliver a presentation to show how solid waste is disposed of. You could use animations, DVDs, pictures, illustrations or web-based videos.
- Lead a discussion to introduce the characteristics of various solid waste types and explain how these can help to determine the disposal method. Engage learners through question and answer (Q&A) sessions to recap and summarise key points.
- Use a knowledge quiz to check learning. This could be based on the waste data from your centre, data from local recycling companies or online data. Once they have completed the quiz, give them model answers. Ask learners to complete a self-assessment and give them constructive and developmental feedback.
- Deliver a presentation about disposal methods. Use DVD and/or web-based video resources as appropriate. Use informal Q&A sessions to check learners' understanding and engage their interest.
- Organise learners into small groups to investigate suitable systems for different scenarios. For example, one group could investigate systems that could be used for an industrial estate, while another group could consider systems suitable for a small housing development. All groups share their findings. Emphasise and summarise the key points, then add learners' findings to a shared access folder.
- For **learning aim B3**, learners need to know about the regulations relating to solid waste disposal. Deliver a presentation introducing relevant regulations, including those relating to health, safety and welfare. Use the data used in previous activities to give examples of compliance, rather than

reviewing extracts from specific regulations. You could also give learners summary handouts with key features of regulations, to which learners could refer during group discussions.

- Organise learners into small groups to carry out research on the disposal of solid waste, considering regulatory, health and safety and environmental considerations. All groups share their findings. Emphasise and summarise the key points, then add learners' findings to a shared access folder.
- Arrange for a guest speaker with an environmental management background to visit the centre and present to the group. Ideally, their talk could cover some real-life examples of the types of solid waste, how it is disposed and any associated regulatory or other challenges (e.g. cost implications). Prior to this guest speaker's visit, ask learners to prepare questions to ensure that they take advantage of this opportunity.
- Facilitate a group discussion to review this learning aim. Learners evaluate the requirements and constraints on the disposal of solid waste and how this could impact on the sorting and disposal of solids.

Learning aim C – Examine the processes used to produce and distribute drinking water

- The delivery of this learning aim would benefit from a site visit so that learners can see first-hand how water is treated, stored and distributed. If a visit is not possible, use online resources and videos clips to enhance your presentations and classroom-based activities.
- To begin **learning aim C1**, deliver a presentation showing the variety of sources of drinking water, such as rainfall, rivers, wells and boreholes. Make use of illustrations, animations and video resources and engage learners through an informal Q&A session.
- Organise learners into small groups. Learners carry out research into the different sources of water and how river management helps to maintain these sources. All groups share their findings. Emphasise and summarise the key points, then add their findings to a shared access folder.
- Introduce **learning aim C2** by delivering a presentation about the treatment approaches and processes. Build upon the previous activity by asking learners to relate the characteristics of the water obtained from various resources to the possible treatment processes.
- Arrange a visit to a water treatment facility where learners can observe the techniques used for water treatment and purification. Encourage learners to prepare checklists based upon the unit content so that they can record and note relevant details during the visit. If it can be arranged, this visit could form part of the assessment for this learning aim.
- If a visit cannot be arranged, use animations, videos and group discussion for the delivery of learning aim C2. Engage learners by setting small group research activities that require them to present their findings to the rest of the group. Emphasise and summarise the key points.
- Demonstrate using some basic lab and/or field kits to test the quality of water obtained from various sources. Working in small groups, learners could use the data from the demonstration to evaluate relevant treatment and purification processes.
- Introduce **learning aim C3** by delivering a presentation to introduce how water is stored and distributed. Engage learners using animations, videos and whole group discussion. Follow this by

leading a discussion on the topic, then give learners some utility records, layout drawings or illustrations, showing the storage and distribution arrangements.

- Organise learners into small groups and allocate each group a specific aspect of water storage and distribution. For example, one group could work on isolation arrangements, while another group could investigate pumping station arrangements.
- Arrange a visit to a reservoir or pumping station to reinforce the delivery of the content of this learning aim. This would allow learners to observe first-hand the storage and distribution arrangements. Learners could prepare checklists in advance that are based on the unit content so that they can record and note relevant details during the visit. If it can be arranged, this visit could form part of the assessment for this learning aim.
- Arrange for a guest speaker, either from a utility company, or with an environmental management background, to present to the whole group. Ideally, the guest speaker's talk can cover some real-life examples of water treatment, storage and distribution. Prior to their visit, ask learners to prepare questions to ensure that they can take advantage of this opportunity.
- Review this learning aim by facilitating a whole group discussion, evaluating how water sources, treatment methods and distribution and storage influence the supply of drinking water for a given scenario.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- *Unit 1: Construction Technology*
- *Unit 7: Graphical Detailing*
- *Unit 23: Construction in Civil Engineering*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Internationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Afullo, A., *Integrated Solid Waste Management Handbook: For Engineers, Planners, Environmentalists, Students and Policy Makers*, WAMRA TECHNOPRISES, 2014,
ISBN 9789966720535

This handbook provides a comprehensive guide to managing solid waste and covers a wide range of perspectives.

Spellman, F., *Handbook of Water and Wastewater Treatment Plant Operations* (3rd edition), CRC Press, 2017, ISBN 9781466553378

A useful text to understand variety of treatment processes.

Journals

SoPHE Journal – the journal of the Society of Public Health Engineers, which contains useful research and industry reports relevant to all aspects of public health engineering.

Videos

Search YouTube™ for the following videos:

- 'Drinking Water Treatment Plant' by City of Winnipeg – this video explains the working of a drinking water treatment plant
- 'The sewage treatment process' by Unitywater – this video shows the sewerage treatment process
- 'Wastewater Treatment Plant Tour – Flush to Finish' by City of Grand Island – this video shows how wastewater is treated.

Websites

Society of Public Health Engineers (SoPHE) under the 'Chartered Institute of Building (CIBSE)' – this website gives useful information about various aspects of public health engineering.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.