Thames Tideway Case Study

Each case study starts with an introduction, designed to help introduce the concept of the case study and encourage students to start to explore more about the project.

There then follows a Topic Lesson Plan. Each Topic Lesson Plan introduces the topic within the concept of the case study and includes 3 or 4 activities that are designed to support the teaching the learning of the topic to your students.

The Thames Tideway Case Study covers the following topics from the Core Component:

- Construction Maths and Science
- Design
- Law
- CBE Industry Relationship Management / Commercial Business
- Project Management

Additional topics from the Core Component are embedded within the Topic Lesson Plan. These embedded topics are:

- Health and Safety
- Sustainability
- Measurement
- Information and Data
- Building Technology
- Digital Technology

The case study and associated Topic Lesson Plans should be used in conjunction with the following documents:

- Thames Tideway Introduction PowerPoint
- Thames Tideway Industry Links
- Links to Assessment

Thames Tideway: Case Study

Introduce the Case Study
The Thames Tideway Tunnel is one of the largest civil engineering projects in the United Kingdom. A 25km tunnel is being constructed under London that aims to provide extra capacity to the existing London sewer system that was designed in 1858. Since then the population of London has grown from 2 million people to nearly 9 million. At the same time, the amount of open spaces has reduced which reduces the ability of rainwater to soak in to the ground.

The Thames Tideway Tunnel is designed to intercept sewerage and transport it from west London eastwards at depths of up to 60m below the ground using only gravity to move the waste.

Once completed, the Thames Tideway Tunnel will reduce the amount of waste flowing in to the River Thames during times of heavy rainfall, which in turn will improve the quality of river water for wildlife.

In this case study you will learn all about infrastructure projects. You will have the opportunity to investigate factors that impact on improving infrastructure such as project constraints, planning requirements and site conditions. You will also look at the outcomes for an infrastructure project and what would need to be included in tender documentation.

You will learn about approaches to surveying and site investigation, including the use of modern approaches such as drones and 3D scanning.

To achieve this, it is intended that you will work sequentially through a series of topics and activities with your tutor. Each topic will broaden your knowledge and understanding and is designed to build upon what you have previously learned.

Thames Tideway: Topic Lesson Plan

Topic: Construction and the built environment industry and Construction Maths	
Infrastructure projects	
Aim and objective	The aim of this topic is for students to learn about types of infrastructure project that are carried out by the construction industry. The objective of this topic is for students to develop an understanding of different types of work carried out by the construction sector. Students will develop an understanding of how infrastructure projects can benefit local communities, such as providing employment or leisure facilities in addition to the principle aims of the project. Students will consider how statistics can be used when determining if an infrastructure project is going to be beneficial to the local community, for example considering how much time could be saved by a new bridge, or traffic flow increased by improving existing road infrastructure. Tutors should allocate their students with a familiar local site, upon which they can consider an appropriate infrastructure project which would offer some benefits for the local community. Projects could be linked to highways, bridges, rail or water management.
How long will this Topic take to deliver?	The total time that it might take to deliver this topic is 8 hours.
What knowledge and understanding will students develop?	This topic has been designed to deliver the following knowledge and understanding from the Core Component content: • 7.3.1 - students will learn how statistics, including averages and central tendency are used in a construction context • 9.1.1 - students will develop an understanding of the types of activity undertaken by sectors in the construction

	industry, with a focus on infrastructure. • 9.2.2 - students will investigate contributions to infrastructure, such as transport networks, provision of services, water management and renewable energy projects. • 9.2.3 - students will investigate the contribution of the construction industry to the community, including employment and transport • 9.2.4 - students will also learn about the benefits to the local community of the redevelopment of brownfield sites There is also opportunity to cover sub-topic 4.2.6 'Infrastructure' within the Building Technology Topic, through this activity.
Self-study activities	Students could use: The social benefits of infrastructure investment report for the Civil Engineering Contractors Association to gain a deeper understanding of the social benefits of infrastructure. https://www.ceca.co.uk/wp-content/uploads/2018/12/Cebr-CECA-report-The-Social-Benefits-of-Infrastructure-Investment-FINAL-December-2018-compressed-2.pdf
Activity 1	
Title	**Investigating an infrastructure project**
How long will this activity take to deliver?	It is anticipated that this activity will take 8 hours.
Instructions	**Tutor Instructions** In this activity your students will investigate how an infrastructure project can be beneficial for a wide range of parties. You should introduce the concept of infrastructure projects by walking through the Thames Tideway project with students. Using the Thames Tideway website you can demonstrate to students the benefits associated with the project overall, such as

	the provision of new public spaces where land is reclaimed from the River Thames, or the reduction in pollution as less sewerage will be released in to waterways. You will then introduce students to a local context where an infrastructure project is required. This could be a real project that is in the planning stage, such as a local highways project, or something which is required on your campus, for example improved drainage for an area of the site which has a history of flooding. First your students should research the area where the infrastructure project will be completed and examine the potential benefits that could be brought to the locality. You could also use one of the fly-through demonstrations of one of the locations, for example Earl Pumping Station. Show students the information that is available for each of the sites of the Thames Tideway project and the benefits envisaged for each of these. Once the students have investigated the area of the proposed infrastructure project they could complete a basic statistical analysis linked to the proposed project. This could consider traffic levels, journey times, frequency of flooding etc, but should be sufficient to allow students to produce some statistical data from which baseline information could be derived such as mean values. **Student Instructions** You have been asked to investigate proposals for a new xxxxx project at xxxxxxx.

	You are to: Using their research, students to then prepare a report or presentation for contrasting aspects of the project. Students should then investigate the same aspects of the project they have previously. For each of the sites they need to investigate how these will affect the economy. (a) Research the proposed project including the size and scope of the works involved. You also need to investigate which sectors of the construction industry would likely be involved during the delivery of the project. (b) Investigate what benefits the project would be expected to bring to the community as a whole. You should consider: i. Employment ii. Transport iii. Security iv. Leisure/recreation (c) Produce some sketches of the local area in which the proposed project will be located. Indicate on the sketches what surrounding land is used for and indicate whether any open spaces are brownfield or greenfield. (d) For the proposed project, collect some statistical information that could be used as baseline data for comparisons after the completion of the project. This will depend on the nature of the infrastructure project, and your tutor will give you guidance as to what data needs to be collected. (e) Use the data you have collected to produce charts and/or graphs to present the information, and also calculate values such as the mean, that could be used to make judgements.

	Having completed your research and investigation you should present your findings as a short report. Your report should cover: i. Proposed project outcomes ii. Site information, including land use and iii. Benefits the project will bring to the community
Worksheets / templates	NA
English, maths and digital skills	There will be an opportunity for students to practice: • E1 Convey technical information to different audiences • M5 Processing data • M7 Interpret and represent with mathematical diagrams • M8 Communicate using mathematics • D1 Use digital technology and media effectively.
Industry Links	To support this activity the following Industry Resources Links could be used: • Thames Tideway • Introduction to the UK Construction industry • Earl Pumping Station

Topic: Construction Science and Law	
Site Investigations	
Aim and objective	In this topic students will be introduced to the science embedded within the context of surveying a site for a proposed development Students will learn about the approaches that can be used for surveying along with the underpinning knowledge of physical geography, hydrology and geology which will impact on the design of the project. Student will then focus on the legal requirements that need to be met when completing site investigations, including the permissions which might need to be granted. Students will also suggest methods that could be used to survey the site.
How long will this Topic take to deliver	The total time that it might take to deliver this topic is 10 hours.
What knowledge, understanding and skills will students develop?	This topic has been designed to deliver the following knowledge and understanding from the Core Component content: • 2.8.1 - students will develop an understanding of physical geography that will affect the design of infrastructure projects.– groundwork, water levels, investigation methods, contaminated land, land use. • 2.8.2 – Students will acquire an understanding of hydrology • 2.8.3 – Students will acquire an understanding of geology, including ground conditions and methods of site investigation • 14.3.1 - Students will also learn about the persons and organisations from which permission to carry out surveys may be required
Self-study activities	Students could watch online videos linked to geotechinical engineering, site investigations and the use of modern surveying techniques such as drones and 3D scanning.

Activity 1:	
Title	Desktop survey
How long will this activity take to deliver?	It is anticipated that this activity will take 6 hours.
Instructions	**Tutor Instructions** In this activity you will support students to gain an understanding of the approaches that will be needed to complete a survey of the site for the proposed infrastructure project. Due to the nature of site investigations, you can link this aspect of the case study with topics from Information and Data, Digital Technology and Sustainability (specifically 5.3.1, 5.3.2, 5.3.5, 6.2.4, 6.3.2, 6.3.3 and 10.3.2) It is intended that students will learn firstly about the physical geography that will impact on the design of the infrastructure project, such as existing land use. You might approach this by site visit for the given site and discuss features linked to physical geography during this visit. During a visit students are more likely to become aware of the concepts that are being investigated. Once familiar with physical geography you should work with students to understand the concepts of geology and hydrology. Explain that there are connections between the two with respect to water on and in the ground. Discuss with students their prior knowledge of the water cycle and the effects of hydrology and geology on construction activities and the links between hydrology, geology and physical geography. You then should demonstrate to students how to interpret site investigation reports, such as boreholes and trial pits to complete the initial stages of a site survey.

	Student Instruction You have been asked to carry out a desktop survey for the infrastructure project on the site located at [XXX insert site location XXX]. You are to prepare an initial site report which: a) Defines the physical geography of the site, including: i. Existing land use ii. Topological features (level of the land, waterways etc) iii. Groundworks b) Examines existing information (from the BGS website) from borehole and trial pit reports. This information should be used to determine the structure of the ground including types of ground (made ground, soils, clays and rocks) and the level at which each is found. c) Details the level of the water table on the site and any hydrological features which might affect the design of the infrastructure. d) Details potential sources of ground contamination through the use historical land use maps for the location of the project. Having completed the desktop survey, make recommendations related to further information that will need to be investigated during the on-site survey.
Worksheets / templates	Site investigation worksheet
English, maths and digital skills	There will be an opportunity for students to practice: • E3 Create texts for different purposes and audiences • E4 Summarising information/ideas
Industry Links	To support this activity the following Industry Resources Links could be used: • British Geographical Survey Borehole Reports

	• Historic land use maps
Activity 2:	
Title	Planning an on-site survey
How long will this activity take to deliver?	It is anticipated that this activity will take 4 hours.
Instructions	**Tutor Instructions** In this activity your students will plan an on-site survey for the proposed infrastructure project. To start this exercise, you will need to provide the students with information about the site that will allow them to investigate information such whom permissions would need to be obtained to complete a survey. Once ownership is established and restrictions that might apply have been identified, students will need to suggest approaches for completing a site survey that would allow a design team to produce suitable designs for the project. You should support your students when they are determining survey methods and provide advice and guidance regarding which would be more suitable for the given location. **Student Instruction** You have been asked by a member of the project team to produce a plan for surveying the site. This plan will need to provide information about the persons that they surveyor will need to gain permission from to be able to carry out the survey and also methods that could be used to complete a survey of the project site. The survey will include both a topological survey and also surveying for ground contamination. The outcomes of the site survey will be used, along with the

	desktop study you have already completed, by the design team. Your plan needs to include: (a) Information about who permissions need to be obtained from to complete the survey. (b) Information about approaches that can be used to survey the site, including data that would need to be collected. (c) Opportunities to use modern surveying methods, such as drones and laser scanning, You should include a brief summary that justifies your selection of survey methods.
Worksheets / templates	Site plan showing location of the proposed infrastructure project and surrounding properties.
English, maths and digital skills	There will be an opportunity for students to practice: • E2 Present information and ideas • D1 Use digital technology and media effectively • D2 Design, create and edit documents and digital media • D3 Communicate and collaborate
Industry Links	To support this activity the following Industry Resources Links could be used: • RICS - what surveyors do • Regulations relating to the commercial use of small drones

Topics: Design and Law	
Legal compliance	
Aim and objective	The aim of this topic is to introduce students to constraints which apply to construction projects, including those set out in legislation and regulations. Students will understand the need to take in to account information identified during site investigations. Students will investigate planning factors which might be applicable for the infrastructure project they are investigating along with social, budget and economic constraints. They will also consider the ownership of land which will be affected by the infrastructure project.
How long will this Topic take to deliver	The total time that it might take to deliver this topic is 6 hours.
What knowledge, understanding and skills will students develop?	This topic has been designed to deliver the following knowledge and understanding from the Core Component content: • 8.3.2 – Students will gain an understanding of site information factors that will affect the given infrastructure project. • 8.3.3 – Students will gain an understanding of planning factors that would impact on the infrastructure project • 8.3.4 – Students will gain an understanding of statutory constraints and their requirements and impacts on inclusivity • 8.3.6 – Students will gain an understanding of social constraints including neighbours' rights, local community objections, green space requirements and environmental requirements • 8.3.7 – Students will gain an understanding of project budget and economic constraints • 14.2.1 - students will learn about different types of land

	ownership
Self-study activities	Students could review the 'Building Regulations Planning Portal' to determine what happens if you fail to comply with planning approvals.
Activity 1	
Title	Project constraints
How long will this activity take to deliver?	It is anticipated that this activity will take 6 hours.
Instructions	**Tutor Instructions** You will introduce students to the legal, statutory and regulatory constraints that would apply to construction projects of all types and in particular infrastructure projects such as the Thames Tideway. Students will also consider the social and economic constraints that impact on construction projects and sources of funding that are available for completing construction tasks and also investing in property. You also need to make sure students understand the statutory constraints that impact on design. Outline the coverage of the Equality Act and revisit Building Regulations that might be applicable for some infrastructure projects. Explain to students situations where there may be restrictive covenants on land or property use which would limit development opportunities. Introduce students to the financial and budgetary constraints that need to be considered when working on construction projects. Discuss with students how projects can be funded and how costs can be considered over the life of a project. Explain the concept of cost/benefit analysis with respect to the construction of

	infrastructure projects. **Student Instruction** You have been asked to work with a small group of colleagues to produce a report which examines the constraints of the given infrastructure project. You are to: (a) Provide information about site constraints, including: i. site features (based on your desktop survey) ii. borehole information iii. possibility of contaminated land iv. existing buildings/structures v. restrictions that might apply to the site. vi. Ownership of the land which will be affected by the project (private, public, council or government) (b) Identify planning factors which might affect the construction of the project, including listed buildings which might be affected and environmental factors related to the location of the project (c) Explain how statutory constraints might affect the development of the project, including (as appropriate) the Equality Act and any restrictive covenants that might apply to the site. You then need to examine project budgets and economic constraints that apply to infrastructure projects. This should include sources of funding for the project and an appreciation of life cycle costs for the project. You should outline how a cost/benefit analysis report would be used to determine whether to proceed with the project or not.
Worksheets / templates	Site investigation worksheet
English, maths and digital skills	There will be an opportunity for students to practice: • E1 – Convey technical information to different audiences

	• E4 - Summarise information/ideas • E5 - Synthesise information • M6 - Understand data and risk • D1 – Design, create and edit documents and digital media.
Industry Links	To support this activity the following Industry Resources Links could be used: • Building Regulations 2010 • Equality Act 2010 • Restrictive Covenants, Wayleaves and Easements

Topic: Construction Science, Design, CBE Industry, Relationship Management, Commercial Business	
Planning the outcomes	
Aim / objective	The aim of this topic is to introduce students to factors that need to be considered when designing and planning the infrastructure project. This will cover two aspects; one - the intended life cycle of the project and the selection of materials which will allow the project to meet its required outcomes. The second aspect is the route by which the project will be procured The objective is that students will focus on the project they are considering and how the selection of materials should be such that they are able to perform as expected depending on the environment they are exposed to. You should introduce students to procurement routes to enable students to acquire an appreciation of how different approaches are used for different types of project and the documentation associated with procurement. Students also develop an understanding of the features of an effective team, the characteristics of effective team members and how teamworking is important for successful project delivery.
How long will this Topic take to deliver?	The total time that it might take to deliver this topic section is 12 hours.
What knowledge, understanding and skills will students develop?	This topic has been designed to deliver the following knowledge and understanding from the Core Component content: • 2.1.1 - Students will gain an understanding of how different materials behave, their properties, composition and causes of failure and degradation when used for infrastructure projects • 8.4.1 - Students will gain an understanding of the stages of life cycle assessments in construction and infrastructure projects.

	• 9.4.1, 9.4.2, 13.4.1, 13.4.2 and 13.4.3 – Students will acquire an appreciation of procurement, including documentation and types of procurement. • 11.4.1 - Students will learn about the positive effects of good teamwork in delivering infrastructure projects. • 11.12.1 – Students will consider how products and services can be promoted through social media and advertisements. • 13.1.1 – Students will learn about common roles and responsibilities of stakeholders within project teams.
Self-study activities	Students could read texts related to life cycle assessments, such as Life Cycle Assessment (LCA): A Guide to Best Practice by Walter Klöpffer, Birgit Grahl
Activity 1	
Title	Life cycle assessment for an infrastructure project
How long will this activity take to deliver?	It is anticipated that this activity will take 8 hours.
Instructions	**Tutor Instructions** You will introduce students to the links between material properties and the reasons why specific materials are used in construction projects. Explain to students that materials need to have specific properties to be suitable for the environment in which they are expected to function, for example those which will be used in the tunnels for the Thames Tideway will need to be resistant to degradation caused by chemical and other substances that will be in the sewerage. You can use specific examples, such as why reinforced concrete is used for applications where there is exposure to water and steel is used for structural frameworks. You should then develop this by considering modes of degradation and failure for materials, and approaches to prevent or reduce

	degradation. This could be exemplified by showing students videos of failure of structures caused by exposure, poor design or material failure. Introduce students to the stages of a life cycle assessment Consider what is involved at each stage of the assessment and the benefits of completing a LCA for a construction project. Introduce students to the Dover Western Docks Revival project (or one of the other case studies), explaining the relevance of the project in a wider construction context. **Student Instructions** You have been asked to work with other members of your group to investigate possible materials that could be used for your infrastructure project at XXXX. No decisions have been made yet about the design for the infrastructure, but you have been asked to consider materials that could be used in its construction. You have been asked to produce a short presentation for the design team that will consider: i. Materials that could be used for the project ii. Properties and composition of these materials iii. modes of failure that could be associated with the project, taking into account environmental conditions. iv. ways of preventing failure of materials. As a part of the project there will be an environmental statement

	that considers the environmental impact of the materials used for the infrastructure. Your tutor will provide you with some information about the expected lifespan of the infrastructure, including desired levels of maintenance. Next, you need to select one of the materials that could be used for the construction of you project and carry out a life cycle assessment on it. The life cycle assessment should cover: i. raw material or recycled material supply ii. manufacture of construction products iii. the construction process stage iv. occupation, use and maintenance stage v. demolition vi. material disposal or recycling.
Worksheets / templates	Life cycle assessment template.
English, maths and digital skills	There will be an opportunity for students to practice: • E1 Convey technical information to different audiences • E2 Present information and ideas • E3 Create texts for different purposes and audiences • D1 Use digital technology and media effectively. • D3 Communicate and collaborate.
Industry Links	To support this activity the following Industry Resources Links could be used: • The Constructor - Properties of Building Materials • Construction materials • Life cycle assessments
Activity 2	

Title	Procurement routes for an infrastructure project
How long will this activity take to deliver?	It is anticipated that this activity will take 4 hours.
Instructions	**Tutor Instructions** You will support students to acquire an understanding of the stages of an infrastructure project. Students will gain an understanding of the roles of individuals within a construction project team delivering an infrastructure project as well as the importance of good teamwork within that team. Students will learn about the roles fulfilled by different team members, before going on to consider ways in which the project might be procured. You will then support them to understand the key principles of project management and how the client and contractors would interact during the project delivery phase. You should introduce the students to the documentation that would be included within documents used for tendering for the infrastructure project. **Student Instructions** You have been asked to complete some work for the client that will investigate the procurement and delivery of the infrastructure project. As part of this work, you need to examine procurement routes, documentation and project teams. You will need to produce a short presentation that shares this information with colleagues. You are to: a) Research the roles and responsibilities of the main stakeholders in the infrastructure project. You need to think about how these roles change during different stages of the project

	b) Research how and why stakeholders, including contractors, will need to collaborate during the construction phase of the project. You need to also consider how good teamwork will have a positive effect on the outcomes of the project. You then need to examine how the principles of project management, such as goals, objectives and milestones, could be used effectively during the delivery of the infrastructure project. Next, you need to investigate types of procurement that could be used for the project. You then need to produce a report which provides a rationale for one procurement route that is appropriate for your given infrastructure project. You need to justify your choice and explain the documentation that would be required during the tendering stage of the project.
Worksheets / templates	NA
English, maths and digital skills	There will be an opportunity for students to practice: • E2 Present information and ideas. • E6 Take part in/lead discussions • D1 Use digital technology and media effectively. • D3 Communicate and collaborate.
Industry Links	To support this activity the following Industry Resources Links could be used: • Introduction to Project Management • Procurement routes