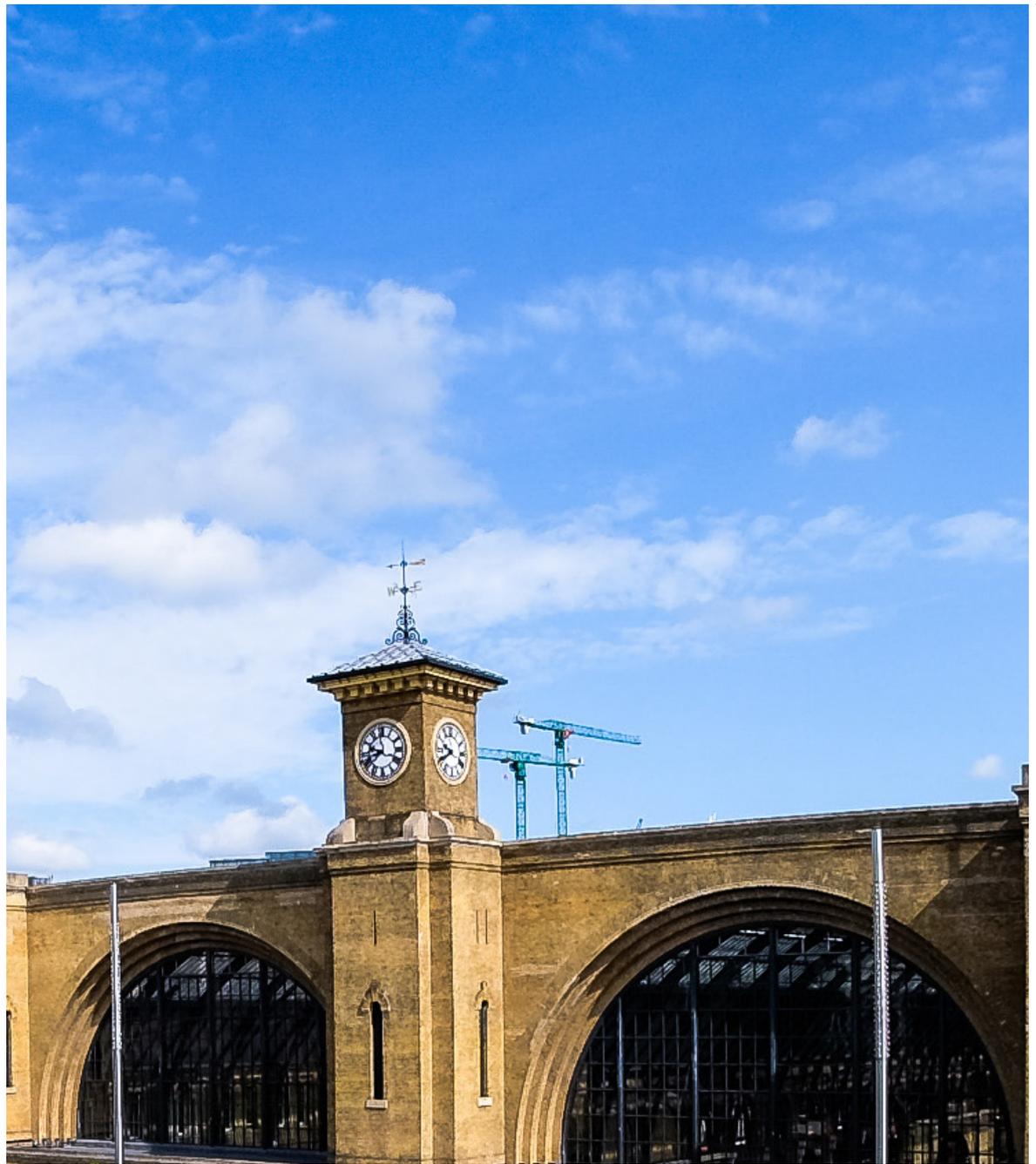


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Fast Trackers Student Workbook B



Welcome

Welcome.

You've completed your research.

You've seen how busy stations and the railway function.

Now it's your turn.

Can you design the best route between Euston and Birmingham? And the best station master plan to replace and enhance the existing Euston Station?

One of the key skills of a good engineer is the ability to work effectively with many people from different backgrounds, and with different skills sets. Therefore, the main aims of today are **COMMUNICATION** and **TEAMWORK**.

Today you will be taking on the role of Project Engineers to produce the new high speed rail route design and the new Euston Station that will receive the trains.

You will be working as one team to produce a joint presentation lasting 10-15 minutes. You will also have to work together to respond to a number of key decisions that will occur throughout the day.



Team Roles

In a big project, no one person can do everything.

Everyone has different interests, strengths, knowledge and skills. For a team to work effectively, there needs to be some structure. This ensures that everyone has a role, and they know what is expected of them.

Spend some time discussing each other's interests and strengths. Then decide what role each team member will undertake and complete your team organogram.

An organogram is a diagram that identifies the various roles in the team and the hierarchy of the team structure. You should draw out your organogram on the following pages.

Tip: You can ask your volunteer for assistance and suggestions for team roles.



Team: Euston Station

Team: High Speed Rail Route





High Speed Rail Route Design

Deliverables

You will need to produce:

- a presentation alongside the stations team.
- provide a marked up map of the new route depicting:
 - stations
 - depots
 - social and environmental areas of concern.

Make sure all questions in this workbook are answered in either the presentation or map.

Make sure you show:

- How each idea was developed.
- How you reached each decision, and
- Why you think your design is best.



The Route

A route needs to be designed, it should start at London Euston and finish in Birmingham. A map has been provided where you can mark up your final route (you have one spare). You will need to justify why you have chosen your route; the points below give some guidance on the key information needed.

- Indicate station stopping points (if any).
- Identify at least two possible routes, explain why one was rejected and the other accepted.
- Show any areas along the route that may cause concern and what will be done to mitigate these.
- Indicate where and why bridges and tunnels will be required on the route.
- Consider the costs of your proposed design for construction as well as ongoing maintenance.



Rolling Stock

Rolling stock refers to vehicles that move on the railways. Based on your passenger demand, you will need to produce suitable trains. The table below provides a range of rolling stock that is available. With this information you should be able to answer the following questions.

- Which train will you be using, and why?
- How many trains will be required, and why?
- Draw a seating plan for the train, including and additional facilities.

Train	Cost per car / cab	Speed (km/h)	Length	Gauge	Seating (seats per row)	Facilities (per train)
A	\$4.0m	250	20-30m / car Max length = 200m	UK	1 + 2 if first class 2 + 2 2 + 3 if no trolley service	4 toilets, 2 trolley service, wifi, PIS, first class seats, 8 luggage racks, 20 tables, all cars meet accessibility requirements & regenerative braking.
B	£3.0m	300	35m / car Max length = 350m	Standard	2 + 2 2 + 3 Standing area	PIS, 10 luggage racks, all cars meet accessibility requirements & regenerative braking.
C	£3.5m	400	40m / car Max length = 400m	Standard	1 + 2 2 + 2 2 + 3	4 toilets, 1 cafe area and 1 trolley service, PIS, first class seats, 6 luggage racks, all cars meet accessibility requirements, regenerative braking & 30 tables
D	£3.8m	350	20m / car Max length = 250m	Broad	Doubler decker 3 + 3 2 + 3 2 + 2 if first class	8 toilets, 2 cafe areas, 2 trolley services, wifi, PIS, first class seats, luggage racks, regenerative braking, screens on seats & 50 tables
E	£3.2m	250	30m / car Max length = 300m	Standard	2 + 2 2 + 3	1 trolley service, PIS, 8 luggage racks, regenerative braking & 20 tables

Rolling Stock Maintenance

What about the maintenance depots that will be required for the rolling stock? Remember that trains can't be in operation 24 hours a day, 365 days a year. Also, the passenger demand won't be the same at 4am as it is during the rush hour. Depots are where the rolling stock are kept when they require maintenance. Your design should answer the following questions - remember to include this information on the map and in your presentation.

- Where will the train depot(s) be located?
- What provisions will there need to be for the depot?
- How many spare trains will you have?
- Why you think your design is best.

Strategic Business Case

To secure funding for the project, a strategic business case is required. This should create a compelling case for why the new infrastructure is required. Consider the questions below - these will enable you to prove a case for change. It is important that you answer all of the questions as the strategic outline business case should give the sponsor of the project the confidence to provide further investment. A cost table for the construction, operation and rolling stock has been provided to help you prepare a cost analysis for your design. You will have to work closely with the Station Master Planning team to develop your strategic business case.

- Calculate an estimated passenger demand.
- What is the expected journey time?
- What are the benefits of the new route?
- How much will the proposed design cost to build and run? When will a profit be delivered?
- What would ticket prices need to be to pay for the running costs of the scheme?
- What will the train timetable look like?
- What are the risks to the project and what contingencies will be put in place?
- How have you made sure you meet public expectations?

A: Track Infrastructure

Item	Cost	Measure	Item Total
Track (for a single line)	£900 / metre	x	= £
Electrification (for a single line)	£1600 / metre	x	= £
Connection to National Grid (every 40km of track)	£20m each	x	= £
Bridge / crossing (25m span under/over 2 tracks)	£5m each	x	= £
Tunnel (Twin track)	£150k / metre	x	= £
Sub-Total for Design and Construction Overheads			= £

Strategic Business Case

B: Depot & Intermediate Station Interface

Item	Cost	Measure	Item Total
Depot within 20 km of London Euston	£400m each	x	= £
Depot within 15km of Birmingham New Street	£300m each	x	= £
Depot in all other locations	£200m each	x	= £
Intermediate Stations	£3k / square metre	x	= £
Sub-Total for Depot & Intermediate Station Interface			= £

C: Rolling Stock Costs

Item	Cost	Measure	Item Total
Final costs of Rolling Stock		x	= £
Sub-Total for Rolling Stock			= £

D: Overhead Costs for Design & Construction

Item	Measure	Item Total
Project Management Costs	= 10% of (A + B + C)	= £
Contractor's Preliminary Costs	= 25% of (A + B + C)	= £
Contractor's Design Costs	= 12% of (A + B + C)	= £
Testing and Commissioning Costs	= 1% of (A + B + C)	= £
Clients Costs	= 7.5% of (A + B + C)	= £
Sub-Total for Design and Construction Overheads		= £

Overall Capital Expenditure (CAPEX) for Proposed Project (A + B + C + D) =

Strategic Business Case

E: Operational Expenditure (OPEX)

Item	Cost	Measure	Item Total
Operational & Maintenance of track and infrastructure	£200k / km of railway	x	= £
Rolling Stock Operation and Maintenance	£5 / km travelled	x	= £
Driver Cost (per train)	£0.75 / km travelled	x	= £
Conductor Cost (per train)	£0.50 / km travelled	x	= £
Sub-Total for Operational Expenditure			= £

Tip: Calculate your OPEX costs on an annual basis to help calculate how long it will take you to break even and start making a profit on your design.

Technology

Technology

Technology can be used to optimise the new railway and reduce its cost. To ensure this is a world renowned high speed rail route you should incorporate the answers to the questions below into your design.

- How can technology optimise the capacity of the railway?
- How can technology optimise the maintenance of the railway?
- What additional features can we offer to passengers through technology?
- What tools will you use to help optimise the design and minimise the cost of infrastructure?



Notes

Notes



The background features a large, abstract purple graphic. It consists of several curved, overlapping shapes that create a sense of depth and movement. The shapes are solid purple and set against a white background. The overall composition is clean and modern.

Euston Station Master Plan

Deliverables

You will need to produce a presentation alongside the route design team and provide a marked up map of your proposed station master plan. Make sure all of the questions that follow are answered in either the presentation or map. Make sure you show how each idea was developed, how you reached each decision, and why you think your design is best.

As well as producing a short presentation in collaboration with your colleagues designing the route, we would like you to produce a map of your master plan detailing your proposals for the station redevelopment. You should demonstrate how you have addressed the design objectives that were detailed in Workbook A.

Areas to include:

- The station building and how it connects into the route proposals
- Building use around the station including residential, commercial, retail, education and leisure
- Areas of communal space
- Integration with local sustainable travel options.



Existing Station Design

Through a series of public engagement workshops held prior to this project, key themes were identified that are important to those who use the station, and those who live and work in the surrounding area. Consider these themes below to help generate ideas about what to include in your station masterplan that will keep any interested parties on board with your ideas.

1. Urban Design

The current Euston Station building and tracks form a barrier between Somers Town and King's Cross to the east and Regent's Park Estate and Park to the west. Local communities have expressed an interest in being able to integrate better between the two areas.

The existing station and surrounding public realm is dated and in need of investment. Users of the station have commented on the inconvenience of having to change levels to access the plaza, existing bus station and Euston Road and the signage around the station is poor. Accessibility is restricted and this creates a poor impression and user experience.

The quality of Euston Square Gardens is compromised by the layout of the existing bus station and dominated by Euston Road Traffic. A local charity encouraging urban gardening have commented that it would be good to have a more inviting and multi-use garden space that is separated from the traffic. They want to see the inclusion of more green infrastructure in the area.

2. Heritage

The station sits within three conservation areas, has over 50 listed buildings and assets which are protected for their value to the historic environment. There are also five designated London Squares. A local heritage organisation have commented that it would be nice to see the areas history reflected in the station designs and existing assets protected.

3. Land Use

There is a significant need for new housing in Camden, especially affordable homes. Housing is therefore Camden's priority land use. The Council have requested that this is considered in the station masterplan.

Consultation responses generally indicated a lack of support for chain shops and large corporations in favour of support for local businesses and training. Local businesses have asked for ideas as to how they can integrate into the station masterplan.

The redevelopment of Euston Station offers the opportunity to introduce new uses and development into the area, therefore opening up new training and job opportunities to the local community. Local colleges have said they want to see further job and training opportunities for their students in the Euston Station Area.

Existing Station Design

4. Social and Community Infrastructure

Deprivation, unemployment, education attainment and poor health are significant issues for communities to the north of Euston Road. Welfare organisations and a local health and wellbeing charity want to see an increase in community facilities and services in and around the station area, including education and health facilities, community centres and libraries and open spaces.

5. Transport and Public Realm

Euston is extremely well connected with National Rail, London Underground and bus routes, as well as proximity to key destinations such as Central London, the West End and Camden Town.

Pedestrian movement is currently restricted between the north and south of the station due to the layout of the tracks and station building. Those who live local to the station complain of long pedestrian journey times to get to places within relatively close distance.

Collisions occur along the entire length of Euston Road, particularly at pedestrian crossings. Local police forces want to improve pedestrian safety in the area and discourage use of vehicles along Euston Road to improve collision rates.

There are a high volume of taxis from Euston Station which currently stop in a poor quality basement taxi standing area. There is a lack of cycle infrastructure in and around the station which local cycling groups have said they would like to see improved.



6. Environment and Open Space

The Euston Road corridor is identified as having strong potential to deliver a new decentralised energy network to help Camden achieve its challenging borough-wide CO2 reduction targets to 2050. Euston Station and the surrounding area is within Camden Air Quality Management Area which was declared in 2002. Euston Road experiences significant problems with air quality and noise as a result of heavy vehicle movements.

Large corporations and energy companies in London want to offer their support in achieving these targets and have suggested to use the redevelopment of Euston Station as a campaign to raise awareness of air quality and carbon emission issues in the area. Consultation results revealed air pollution and the impact of buses and taxis are a concern to local people.

A significant number of mature trees in open spaces and trees lining streets are likely to be lost as a result of the development. Consultation results revealed open spaces, parks and trees were highly valued, particularly for peoples health and wellbeing.

There are many sensitive receptors within the area of the station including schools, hospitals, churches, residences and businesses who have the potential to be impacted by nuisance as a result of your proposals. They would like to know how they will be kept informed of the proposed works and what is being done to address their concerns.

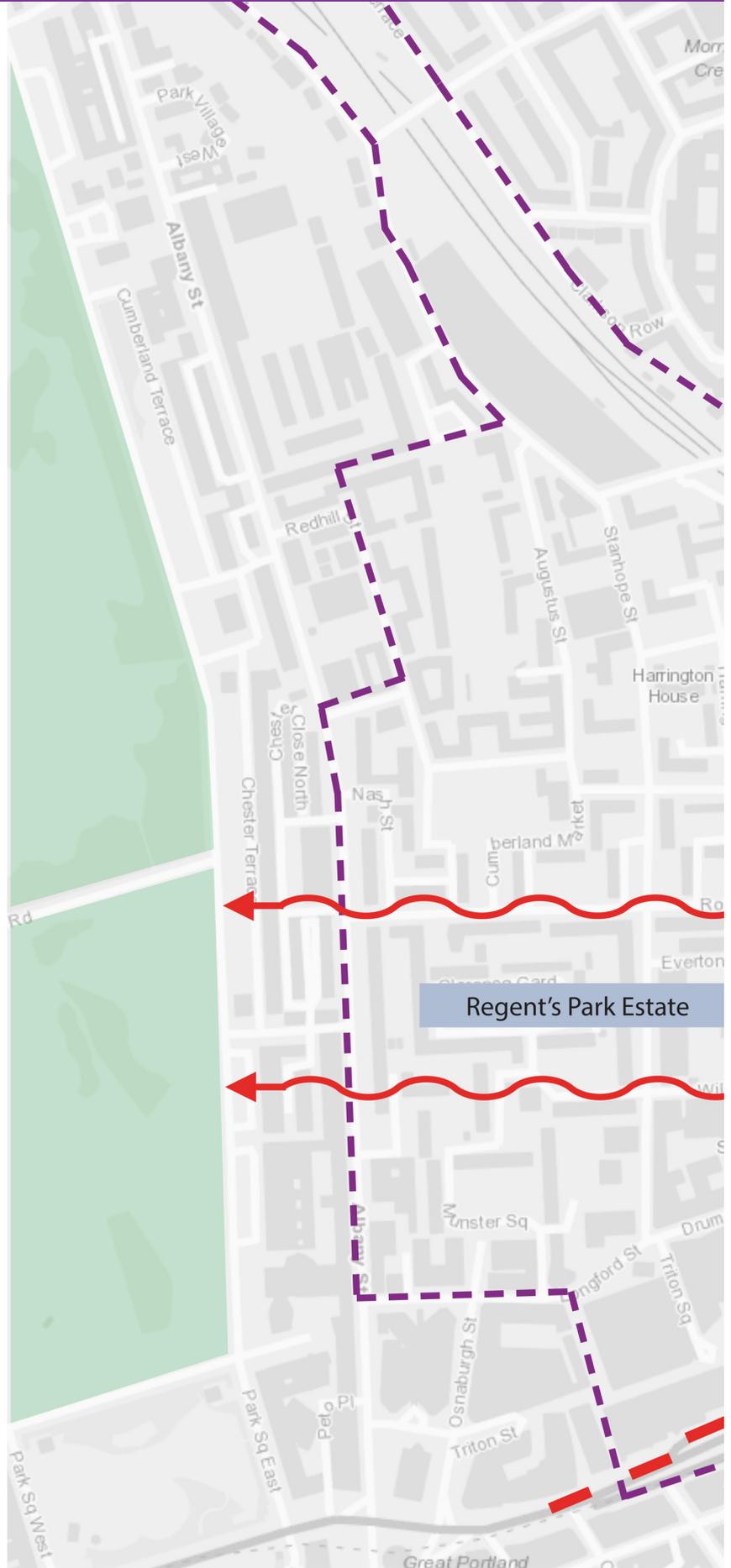
Some of the issues with the existing station design are on the next page. You should consider if you can accommodate any of the issues in your station master plan and improve on the original.

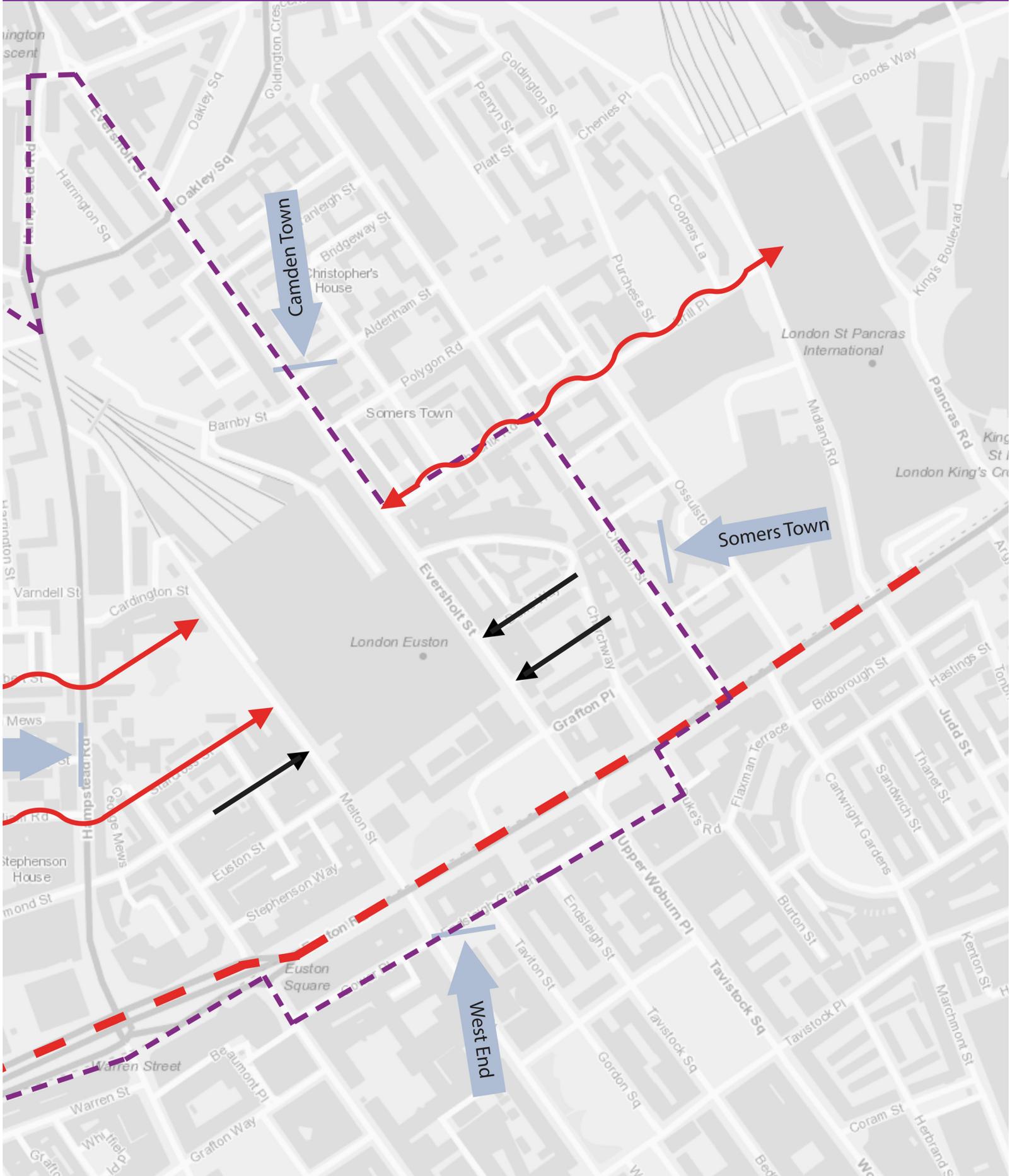


Existing Station Design

Key

-  Local connections broken by existing station.
-  Longer distance connections broken by existing station
-  Planning boundary for Station Master Plan development
-  Poor way finding to Regent's Park
-  Station area impermeable to neighbouring communities





Energy Provision

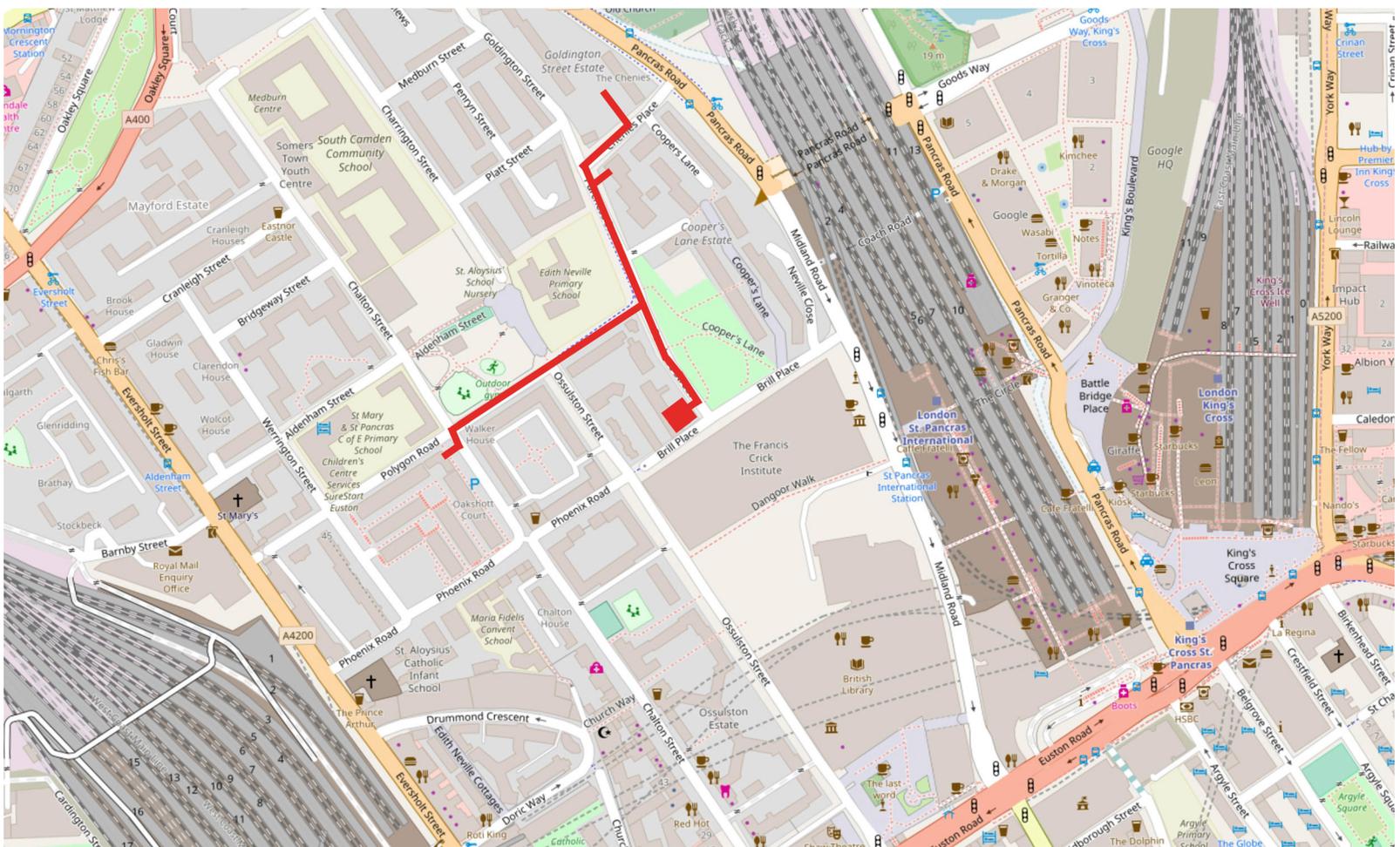
Energy provision for the Euston Station masterplan is of significant importance. The production of energy using traditional methods generates large quantities of carbon emissions. In keeping with the design objectives, it has been brought to your attention that adjacent to the Euston Station boundary, there is an existing Combined Heat and Power (CHP) scheme in operation (Phoenix Court).

You should give consideration to how you provide energy to your proposed development. The three options for providing energy are as follows.

- Gas boilers
- New Gas Fired CHP Scheme
- Extension of existing CHP scheme

You should also consider what other alternative methods are available to provide energy and how you might incorporate them into your master plan.

Energy provision for the Euston Station masterplan is of significant importance. The production of The image below show the location and distribution network for the existing Phoenix Court scheme adjacent tot he Euston Station Development area. The red square shows the location of the existing CHP energy scheme, with the current pipe network represented with red lines.



You should determine the number of CHP and gas boilers that you will need to provide energy to your master plan. To help you with this, the following assumptions have been provided.

- Housing developments require 50,000 kWh per annum (for every 10 houses of average size).
- Non-domestic spaces (retail spaces) require 700,000 kWh per annum per 1,000 square metres
- Non-domestic spaces (food court/waiting areas) require 1,330,000 kWh per annum per 2,000 square metres.

Item	Quantity	Measure	Total
10 houses	x	50,000 kWh / year	= £
Retail Spaces 1,000 sq m2	x	700,000 kWh / year	= £
Food court/waiting areas 2,000 sq m2	x	1,330,000 kWh / year	= £
Sub-Total for Energy Required for Station Master Plan			= £

Convert to Power

The power P in watts (W) is equal to 1000 times the energy E in kilowatt-hours (kWh), divided by the consumption time period t in hours (hr):

$$P(W) = 1000 \times E(kWh) / t(hr)$$

Item	Power required	Measure	Quantity Required
1 MW Gas Fired CHP	/	1,000,000 W	=
4 MW Gas Boiler	/	4,000,000W	=

By providing an energy centre with the number of boilers calculated above, you will need to connect the centre to the various areas of your master plan. This is done via an underground network of pipes. Typically there are two sizes of pipes as follows.

Item	Value	Units	Notes
Pipe Network	3,000	£ / m	Assumes 350mm transmission pipe under hard urban ground conditions
	2,000	£ each	Assumes 100mm individual building connection pipe diameter under hard urban ground conditions

Sustainable Travel

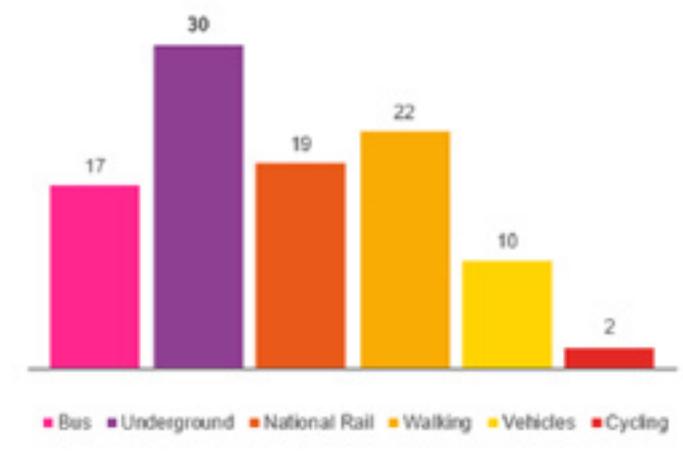
The Mayor's Transport Strategy for London was published in March 2018. There are several challenges the strategy aims to address, including:

- Tackling physical inactivity
- Reducing traffic on London's streets
- Improving air quality and aiming towards becoming a zero carbon city
- Having a reliable public transport system that can cope with increased future passenger numbers
- Providing a safe, accessible and affordable public transport network
- Investing in transport that supports the creation of new jobs and homes.

The strategy has a large focus on using a Healthy Streets Approach ensuring that health and personal experience in the city is a key priority. Measures to create Healthy Streets include removing traffic from key pedestrian routes, creating ultra low emission zones and creating a city wide network of cycle routes.

How can you adopt a Healthy Streets approach to your development proposals?

The travel choice within the station area reflects the area's high accessibility to public transport. Two thirds of the trips from or to the area are taken during the AM peak (between 07:30 and 09:30). The percentage mode share is described in the graph below.



Can you identify ways that you could encourage greater cycling within the area?

What do you think the current reasons are to why cycling is the lowest mode of public mode of transport currently used in this area?

Notes

Strategic Business Case

To secure funding for the project, a strategic business case is required. This should create a compelling case for why the new infrastructure is required. Consider the questions below - these will enable you to prove a case for change. It is important that you answer all of the questions as the strategic outline business case should give the sponsor of the project the confidence to provide further investment. A cost table for the demolition, construction, energy provision has been provided to help you prepare a cost analysis for your design. You will have to work closely with the Route team to prepare an overall cost estimation for the entire project.

- Calculate an estimate passenger demand.
- What are the benefits of the new station master plan?
- How much will the proposed design cost to build and run? When will a profit be delivered?
- What would ticket prices need to be to pay for the running costs of the scheme?
- What are the risks to the project and what contingencies will be put in place?
- How have you made sure you meet public expectations?

A: Euston Station Energy Plan

Item	Cost	Measure	Item Total
Gas Fired CHP	£800 / kW	x	= £
Gas Boilers	£75 / kW	x	= £
Pipe Network - 350mm transmission pipe	£3,000 / m	x	= £
Pipe Network - 100mm individual connections	£2,000 each	x	= £
Sub-Total for Euston Station Energy Plan			= £

B: Euston Station Master Plan

Item	Cost	Measure	Item Total
Demolition / site clearance of existing buildings	£50 / m2	x	= £
Demolition / site clearance of existing rail corridor	£20 / m2	x	= £
Demolition / site clearance of existing highway sections	£25 / m2	x	= £
Paving - Block	£75 / m2	x	= £
Paving - Granite Setts	£130 / m2	x	= £
Paving - Imprinted Concrete	£90 / m2	x	= £
Asphalt Surfacing	£75 / m2	x	= £
Concrete Surfacing	£90 / m2	x	= £
Electrical Substation	£20m each	x	= £
Station Platform - Facing	£275k each	x	= £
Station Platform - Island	£225k each	x	= £
New Station Building	£2,000 / m2	x	= £
Pedestrian Crossing (road)	£4,000 each	x	= £
Street lighting	£130 / m run of street	x	= £
New Car Parking	£115 / m2	x	= £
Gates and Barriers	£40k each	x	= £
Landscaping	£50k / m2	x	= £
New Affordable Housing	£40k / m2	x	= £
New Retail Spaces	£65k / m2	x	= £
Cost for closure of the existing track into Euston Station	£100k / hour / track	x	= £
Sub-Total for Euston Station Energy Plan			= £

Overall Capital Expenditure (CAPEX) for Proposed Project
(A + B)

=

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