

# HS2

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## **HS2 labour and skills demand and supply forecasting and analysis**

July 2021

This report was commissioned by, and prepared for, High Speed Two (HS2) Ltd by a consortium of Whole Life Consultants Ltd, CITB, NSAR Ltd and Experian ('The Consortium'). The findings and conclusions set forth in this report represent the best professional judgment of The Consortium based on information made available to it at a point in time. The Consortium has relied on, and not independently verified, data provided to it by such sources and secondary sources of information cited in the report. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. We accept no responsibility to third parties to whom this report, or any part thereof, is made available. Any such party relies upon the report at their own risk.

Approved by: Doug Forbes

Date: April 2021

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# 1. Introduction

## 1.1. Context

High Speed Two (HS2) is one of the largest and most complex infrastructure projects ever undertaken in the UK. It will be a new high-speed railway, forming the spine of our rail system, with 25 stops from Scotland to the South East, connecting 30 million people and eight of our largest cities. When completed, 345 miles of brand-new high-speed track will run between Birmingham, Manchester, Leeds and London. HS2 trains will also run on the existing network serving towns and cities in the North West, North East and Scotland.

HS2 will provide more capacity, cut carbon and deliver better connectivity. HS2 is designed to address three key problems facing the nation:

1. Our railways are overcrowded and desperately need more capacity. Demand for rail travel in the UK more than doubled between 2000 and 2020. HS2 will add vital capacity to the existing rail network by taking long-distance trains off it, creating thousands of extra seats and space for more local, commuter, and freight services.
2. Our economy is unbalanced, with more focus needed in the Midlands and the North. HS2 is the most important social and economic regeneration project in decades. It will act as a catalyst for growth and help level-up the country, boosting growth in the Midlands and North and opening up new employment and leisure opportunities for millions of people.
3. Our climate is changing and a huge part of creating a zero-carbon economy is decarbonising our transport network – the UK's number one carbon producer. HS2 will be the UK's low-carbon alternative for long distance travel, reducing the need for car and plane journeys and playing a vital role in delivering the Government's ambitious goal of Britain becoming net zero carbon by 2050.

At the time of writing, the construction of the new railway is split into three phases – Phase One linking West Midlands and London; Phase 2a continuing the line from the West Midlands to the North via Crewe; and Phase 2b completing the railway to Manchester and Leeds.

### **Phase One**

When complete, high-speed trains will travel between Birmingham and London on 140 miles of dedicated track. They will pass through more than 32 miles of tunnels, over 10 miles of viaducts and four high-speed stations, delivering quicker journeys on more trains with more seats.

### **Phase 2a**

Phase 2a will extend the line from Fradley in the West Midlands to Crewe in Cheshire. We'll be laying 35 miles of new high-speed track, creating 42 bridges and building 5.5km of viaducts. Services will travel onward to places like Manchester, Glasgow, Liverpool, Preston and Wigan.

## Phase 2b

The Phase 2b line forms a Y shape, split into an eastern and a western leg. The western leg will connect to the high-speed lines at Crewe and run through to Manchester. The eastern leg will connect to high-speed lines in the West Midlands and run through to Leeds. Services will also travel on to places like Glasgow, Liverpool, Preston and Wigan. This report refers to Phase 2bWL as the western leg and 2bEL as the eastern leg.

Figure 1 shows the route of the new HS2 high-speed infrastructure and the regions through which it passes.

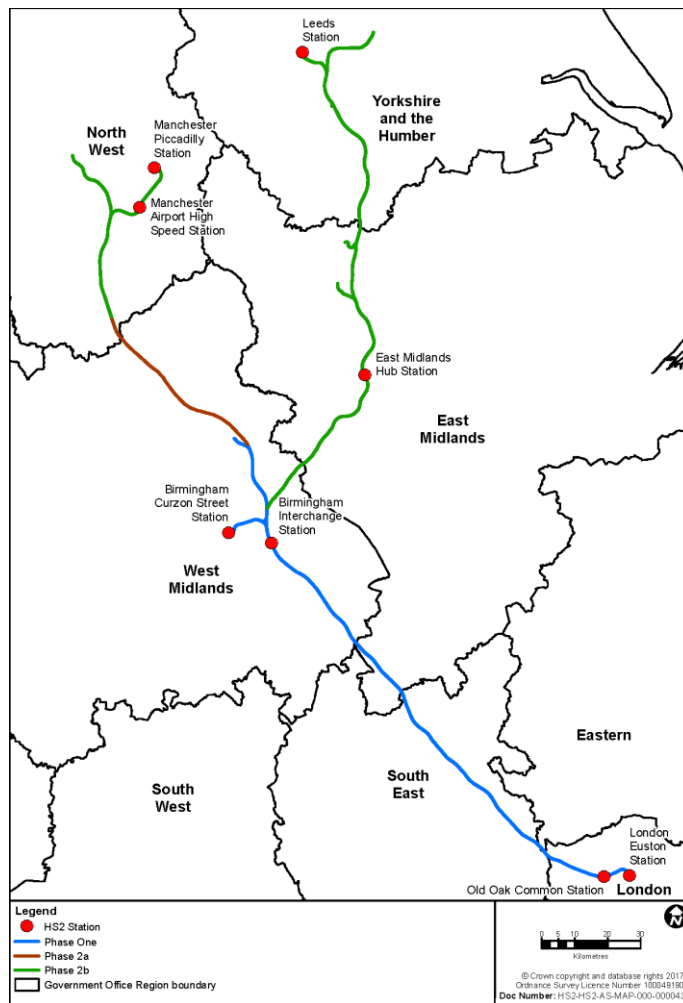


Figure 1: HS2 route with regions and phases

## 1.2. Purpose of the report

Increasing Britain's skills, employment and education is one of HS2 Ltd's seven strategic objectives and is crucial in achieving the vision of HS2 as a catalyst for growth across Britain. HS2 Ltd's focus is on securing the skills and labour required to build the HS2 railway and leaving a legacy of a highly skilled and diverse workforce for the UK. HS2 Ltd's Skills,

Employment and Education Strategy<sup>1</sup> sets out how it will achieve this aspiration and encompasses the design, planning and construction of the HS2 programme.

This report has been prepared to update the forecasts published in 2018. It will allow HS2 Ltd to use an evidence base that provides the best available insight around the programme's labour and skills requirements in terms of volume, occupation, qualification, timing, geographic area and duration. This will ensure HS2 Ltd's Skills, Employment, and Education Strategy continues to focus on areas which are likely to yield the greatest benefit.

The data contained in this report supports HS2 Ltd in meeting the objectives of their strategy in a number of ways. These include:

- understanding HS2's impact on the economy and regional economies through the overall labour demand required to deliver the programme;
- analysing skills mismatches to understand where pressures on skills may arise, taking into account the workforce required to deliver HS2 and the wider workforce requirements; and
- identifying the interaction of labour demand, and how it might transition, between phases.

The analysis in this report has been undertaken on the basis of Baseline 7.1 costs for Phase One, Baseline 2 costs for Phase 2a and Baseline 2 costs for Phase 2bWL. This provides preliminary, top-down estimates of HS2 labour and skills requirements.

As the HS2 programme develops and contractors are mobilised, bottom-up evidence on labour and skills requirements can be collected and used to supplement and refine the preliminary top-down estimates provided in this report. The labour and skills that will be required to operate HS2 services are not assessed in this report.

### **1.3. Overall approach**

This report distinguishes between construction and rail engineering work required to deliver HS2. For both types of work the report does the following:

- determines the demand for labour and skills arising from the HS2 programme to estimate the volume of workers required to deliver it;
- assesses the future national demand for, and available supply of, labour and skills arising from the overall construction and rail engineering sectors; and
- overlays the sector-wide labour and skills demand with supply to determine potential mismatches, and their potential impact on the HS2 programme.

The overall approach is illustrated in Figure 2.

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<sup>1</sup> <https://assets.hs2.org.uk/wp-content/uploads/2018/09/26114402/CS962-HS2-Skills-Education-Employment-Strategy-210x2101.pdf>

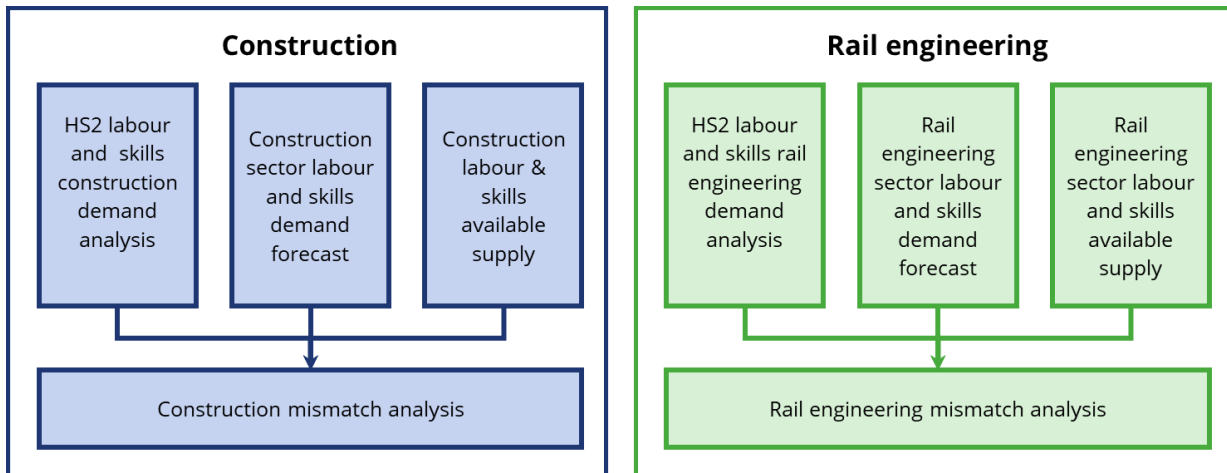


Figure 2: The relationship between demand, supply and mismatch analyses

## 1.4. Structure of the report

Following this first section, the report is structured as follows.

- Section 2 provides an overview of total labour and skills required to deliver construction and rail engineering activities across all phases of HS2. It also provides an assessment of the number of apprenticeships which may be realised from the HS2 programme.
- Section 3 outlines the approach to understanding the labour market trends.
- Section 4 provides forecasts of overall requirements for labour and skills in the UK construction sector, and their available supply, in order to assess labour market conditions during the construction of HS2.
- Section 5 provides forecasts of overall requirements for labour and skills in the UK rail engineering sector, and their available supply, in order to assess labour market conditions during the delivery of the HS2 rail engineering programme.
- Section 6 outlines the approach to the mismatch analyses.
- Section 7 provides an assessment of the mismatches for construction roles for Phases One and 2a and also Phase 2bWL.
- Section 8 provides an assessment of the mismatches for rail engineering roles for Phases One and 2a and also Phase 2bWL.

## 2. Labour demand generated by High Speed Two

### 2.1. Introduction

This report estimates the High Speed Two (HS2) programme requirements for labour and skills from two sectors: construction and rail engineering. Labour demand for the HS2 programme was estimated using data, provided by HS2 Ltd, on the location and forecast cost of HS2 construction and rail engineering activities. Cost data were provided at point estimate alongside estimates of the risk and contingency less any allowance for efficiency gains. The forecast demand for both construction and rail engineering labour and skills is generated using CITB's Labour Forecasting Tool.

Planning for Phases One and 2a of HS2 is more advanced than for Phase 2b. The hybrid bill for Phase One of HS2 secured Royal Assent in February 2017 and activity started in the same year. The Phase 2a hybrid bill secured Royal Assent in February 2021 and activity is due to start this year. Following the conclusion of the Oakervee Review into HS2, the government has decided to proceed with legislation for the Western Leg of Phase 2b as a priority. A hybrid bill for the Western Leg (WL) is due to be submitted in 2022.

Reflecting the differing levels of maturity in planning, Phase 2bWL is treated differently from Phases One and 2a. The Phase 2b work presented in this report focusses exclusively on Phase 2bWL to allow it to feed into the Phase 2bWL Outline Business Case (OBC).

### 2.2. Methodology

To produce a profile for the labour and skills required to deliver HS2, it is necessary to know the type and schedule of work taking place. HS2 Ltd has provided data indicating the annual spend by cost pillar. The underlying models are based on a series of labour coefficients representing the number of person-years required to produce £1 million of output. The labour coefficients are different for each measured occupation and type of project. The tool can forecast the labour requirements month-by-month and occupation-by-occupation, given the value or leading characteristic (e.g. floor area) of a project, together with its start and end dates and location.

The following cost pillars have been allocated to construction work:

- tunnels;
- civil engineering;
- stations; and
- depots and sidings.

The following cost pillars have been allocated to rail engineering and are dealt with separately from construction work:

- railway systems;
- on-network costs (works relating to existing infrastructure);
- operations and maintenance (O&M) set up; and
- traction and rolling stock.

The following general assumptions have been made:

- all modelling uses point estimate costs plus an allowance for risk and contingency, less any forecast efficiency gains;
- where a spend is given for a specific calendar year, it has been allocated to the start of the financial year (for example, 2021 is allocated to April 2021/22);
- the price base is 2015Q1<sup>2</sup>; and
- costs exclude VAT.

For most asset types, work has been allocated to a particular geographical region. It should be noted that the regional analysis refers to the region in which labour demand is generated. It may not necessarily be the case that this work is delivered by workers based in the same region. Some occupations do not need to be based on site and can deliver work remotely. Traction and rolling stock work has not been assigned to a specific region. The labour and skills that will be required to operate HS2 services are not assessed in this report.

### 2.2.1 Construction labour demand forecasting

It is necessary to allocate work to one of the project types built into the Labour Forecasting Tool. The labour coefficients for each project type are based on detailed analyses of historic data from the Office for National Statistics and data collected from historic site records. Each of the activities within the analysis has been assigned to the most appropriate model from the project types. These project types cover non-housing new-build buildings, stations and infrastructure. Infrastructure is further broken into 12 models which include roads, utilities, tunnels, bridges embankments and portals.

The construction results are presented for 28 occupational groups and eight skills levels. The construction occupational aggregates have been derived by CITB from the 166 relevant job titles that appear in the Office for National Statistics' Standard Occupational Classifications (2010). Aggregation of job titles is necessary because analysing data at the job title level would result in samples that were too small to allow robust statistical analysis. Full details of the construction occupations can be found in Appendix A.

For the construction forecasts, three models have been developed for each work package or activity. The three stages address:

- **design services**, encompassing those involved in the design process, including senior managers and support staff within design organisations;
- **management of construction**, encompassing those staff involved with the management of the delivery of the construction or installation and including the

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<sup>2</sup> This price base aligns to the upcoming Phase 2b Western Leg Outline Business Case

- professionals employed for the construction stage of a project (e.g. architects employed to supervise the work); and
- **construction operatives**, encompassing those operatives involved with the delivery of the construction or installation at all levels of the construction supply chain.

The forecasts do not include roles generally within HS2 Ltd, or roles in materials production and supply, or manufacturing.

The construction forecasts assume that productivity growth in the construction sector will be 0.5% per year. This assumption is consistent with the long-term average growth rate for output per hour worked in the UK construction sector between 1978 and 2014.<sup>3</sup>

### 2.2.2 Rail engineering labour demand forecasting

Rail engineering forecasting models exist by asset types. These have been allocated to cost pillars as follows:

- track – included within railway systems and on-network cost pillars;
- signalling, systems and telecommunications (SS&T) – included within railway systems cost pillar;
- electrification and plant (E&P) – included within railway systems cost pillar;
- civils and structures<sup>4</sup> – rail elements only;
- property, stations and depots – rail elements only;
- operations (which includes operations and maintenance set up); and
- traction and rolling stock.

In the modelling of rail engineering labour and skills demand we have not differentiated between design, management or construction/delivery activities. We have also made no assumptions regarding future productivity

growth, since there is no historic data on which to base a calculation.

The rail engineering occupations have been derived from roles identified by the National Skills Academy for Rail (NSAR) surveys of the rail engineering sector. This latest survey was carried out in 2019 and gathered data from over 240,000 responses from individuals working in the rail sector. Respondents were asked to provide details of job role, age, gender, location and the type of work that they deliver. This data was then used to assess the numbers employed at each qualification level and occupation for each asset type.

Within the modelling there are no specific high-speed rail occupations, as the UK has not built a high-speed railway for 15 years or so, and there is a lack of available data. As such there would need to be a degree of high-speed 'conversion or familiarisation' in terms of the characteristics of each of the roles.

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<sup>3</sup> [https://www.citb.co.uk/documents/research/productivity%20report%20final%2011\\_03\\_16.pdf](https://www.citb.co.uk/documents/research/productivity%20report%20final%2011_03_16.pdf)

<sup>4</sup> Phase 1 only. These did not feature in previous version of this analysis because the level of detail was not available to disaggregate this asset type.



There are multiple occupations for each of the asset types (track, electrification and power; SS&T; and traction and rolling stock) split into seven qualification levels. We have forecast at asset level (in accordance with investment levels) and then disaggregated into individual occupations (each of which is mapped to a qualification level).

The rail engineering labour demand is presented in two broad groups.

1. Rail systems: those involved in track, SS&T, electrification and power. This also includes those working on network works, which includes rail-specific roles in civils and structures, and property, stations and depots.
2. Rolling stock assembly and deployment: those involved in the design, assembly and deployment of the rolling stock.

### **2.3. Comparison with previous forecasts**

Forecasts of the labour demand arising from HS2 were previously published in 2018.<sup>5</sup> It is not possible or useful to carry out a like-for-like analysis of the 2018 forecasts and those included in this report due to the following principal features.

- Forecasts in 2018 were made using point estimate costs and did not make any allowance for risk or contingency.
- The forecasts in this report do not include Phase 2bEL. In 2018 Phases 2bEL and 2bWL were considered together and could not be separated.
- There have been changes in costs across the overall programme.

The underlying labour coefficients which are used to produce the forecast have also been updated in line with the latest available data.

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<sup>5</sup> <https://assets.hs2.org.uk/wp-content/uploads/2018/09/13145027/CS1006-HS2-labour-and-skills-demand-and-supply-forecasting-and-analysis.pdf>

## 2.4. Combined labour demand from the HS2 programme

The following measures of workforce numbers are used in this report:

### 1. Total workforce

This is measured in person-years. A person-year is the equivalent of one person working for 12 months. All person-years are measured from 2021/22 onwards and do not take account of any past spend. This figure can be used as a measure of the total labour demand required to deliver HS2.

### 1. Peak workforce

This is the maximum number of people at any point in time. For results presented annually it is the average over a 12-month period. In reality, the actual peak may last only for a single month within that period and may be slightly higher than the average.

### 2. Peak year

We also provide an indication of the timing of the peak to identify the timing of the maximum number of people.

Those working for construction and rail engineering contracting companies, and design and professional services companies are included in the forecasts. The forecasts do not include roles generally within HS2 Ltd, or roles in materials production and supply, or manufacturing.

The combined labour demand from HS2 construction and rail engineering for Phases One, 2a and 2bWL is shown in Figure 3.

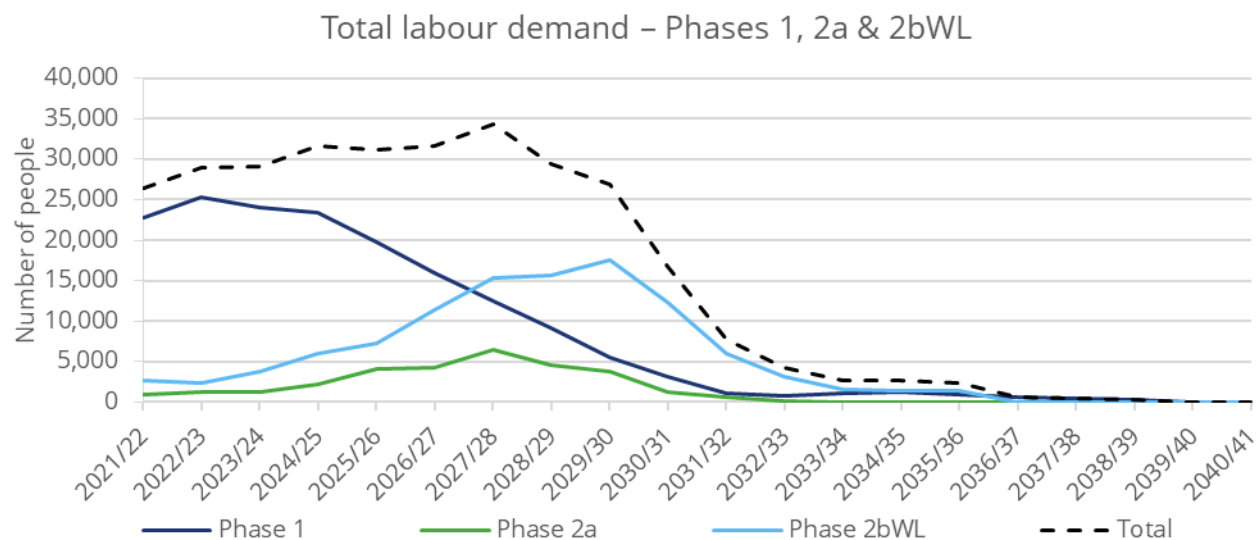


Figure 3: Total labour demand by phase – Phases One, 2a and 2bWL

Table 1 shows the breakdown of the total person-years and peak labour demand arising from each of the three phases.

Phase	Total person-years	Peak workforce	Timing of peak
Phase One	168,000	25,300	2022/23
Phase 2a	30,900	6,500	2027/28
Phase 2bWL	107,900	17,500	2029/30
<b>Total<sup>6</sup></b>	<b>306,800</b>	<b>34,300</b>	<b>2027/28</b>

Table 1: Total labour demand by phase – Phases One, 2a & 2bWL

- Phase One peaks in 2022/23 at 25,000 people before tailing off towards the end of the decade; over 50% of the workforce is working on Phase One.
- Phase 2a peaks in 2027/28 at 6,500 people with just over 10% of the workforce overall.
- Phase 2bWL peaks in 2029/30 at 17,500 people. Overall Phase 2bWL accounts for 35% of the total person-years.
- Between 2021/22 and 2028/29 there is an overall labour demand of between 26,500 and 34,300 people.
- The overall peak of about 34,300 people in 2027/28 is driven by co-incident high activity on Phase 2a and 2bWL.

More detailed analysis of how the workforce is split within regions and types of work follows in sections 2.6.2, 2.6.3.2 and 2.6.4.2.

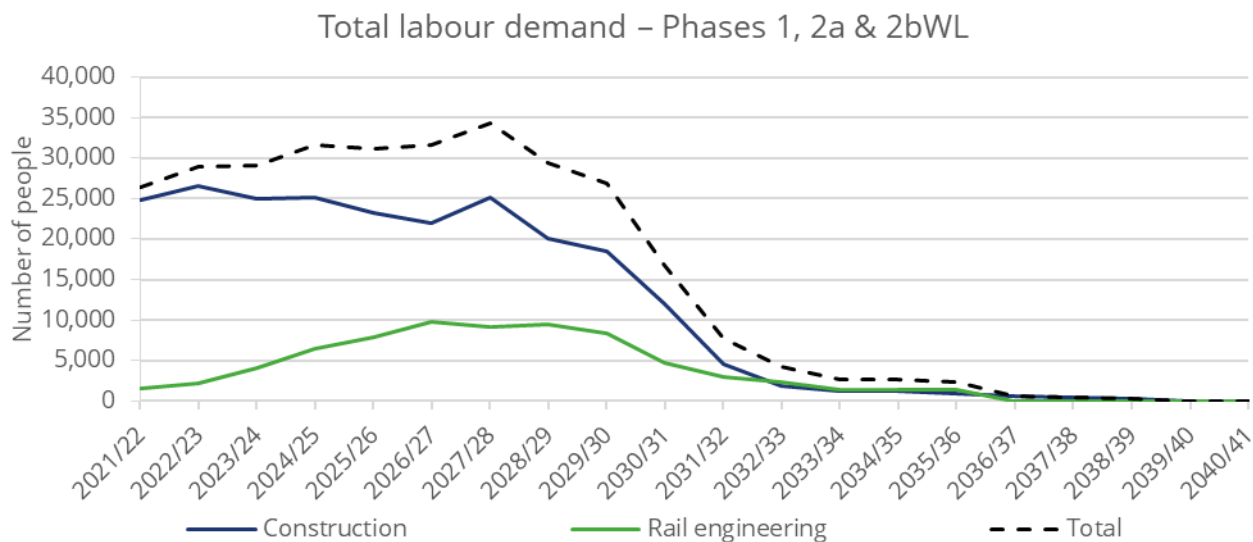


Figure 4: Total labour demand by construction and rail engineering – Phases One, 2a and 2bWL

<sup>6</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

Sector	Total person-years	Peak workforce	Timing of peak
Construction	233,700	26,600	2022/23
Rail engineering	73,100	9,700	2026/27
<b>Total</b>	<b>306,800</b>	<b>34,300</b>	<b>2027/28</b>

Table 2: Total labour demand by construction and rail engineering – Phases One, 2a and 2bWL

Figure 4 and Table 2 show a breakdown of total labour demand across Phases One, 2a and 2bWL split between construction and rail engineering skills.

- More than 75% of the workforce is within the construction sector. The remainder is working in rail engineering.
- The construction workforce peaks at 26,600 people in 2022/23 with rail engineering peaking at 9,700 in 2026/27.
- There is a demand of between 20,000 and 26,600 construction workers from 2021/22 to 2028/29.
- It should be considered that work will be taking place across different regions and roles at different times due to the phasing of the programme.

## 2.5. Phase 2bEL

Since the costs and schedules for Phase 2bEL are under review, we cannot accurately profile the labour demand for this phase. Preliminary analysis of the current scope suggests that the work will require around 151,100 person-years of labour.

- Almost half of that will be required in the East Midlands. There will be around 5% in the West Midlands and the remainder in Yorkshire & the Humber.
- Around 41% of the workforce will be construction operatives and 34% in management of construction roles. Rail systems will account for around 18%, and traction and rolling stock 7%.

## 2.6. Phases One and 2a labour demand

This section now presents a more detailed study of the labour demand arising from Phases One and Two for both construction and rail engineering.

### 2.6.1 Total labour demand by construction and rail engineering

Figure 5 and Table 3 show a breakdown of total labour demand across Phases One and 2a, split between construction and rail engineering skills.

- The total workforce peaks at around 26,500 people in 2022/23
- Overall, there is a constant labour demand of 23,600–26,500 people from now until 2025/26.

- This declines steadily towards the end of the decade and remains under 1,000 throughout the 2030s.
- The peak construction labour demand of 26,500 occurs in 2022/23.
- Rail engineering labour demand steadily increases from its current level of about 1,000 to just under 9,000 people in 2028/29 before tailing off sharply.

Different mixes of occupation and qualification levels will be required at different times. These will be considered in more detail in the mismatch analysis sections later in this report.

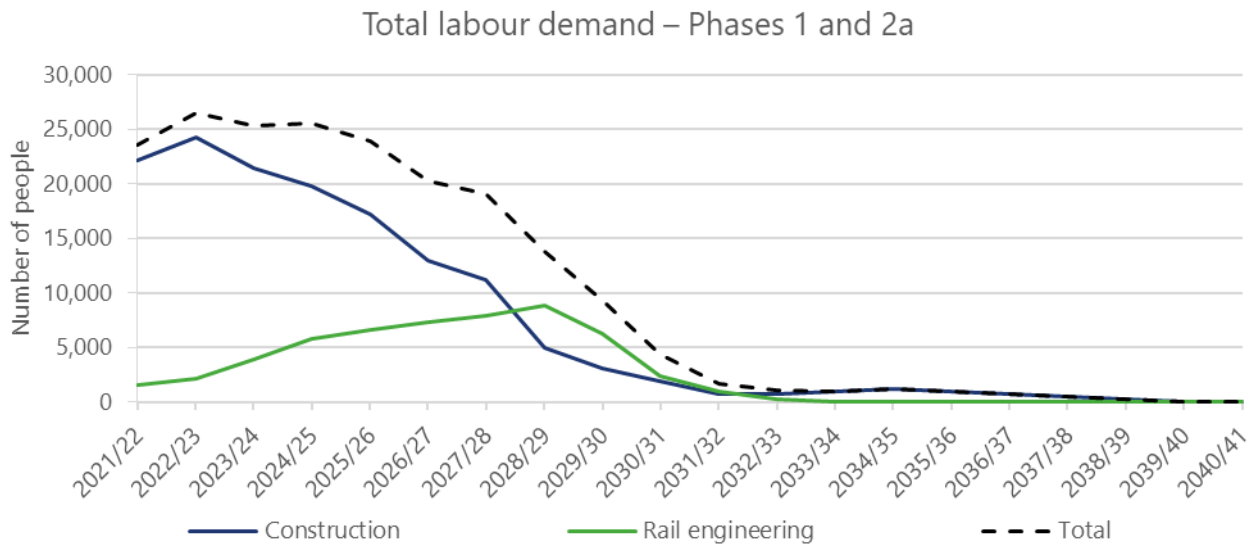


Figure 5: Total labour demand by construction and rail engineering – Phases One and 2a

Phase	Sector	Person years	Peak workforce	Timing of peak
<b>Phase One</b>	Construction	123,600	23,100	2022/23
	Rail engineering	44,500	7,100	2026/27
	<b>Total<sup>7</sup></b>	<b>168,000</b>	<b>25,300</b>	<b>2022/23</b>
<b>Phase 2a</b>	Construction	21,400	5,300	2027/28
	Rail engineering	9,500	3,200	2029/30
	<b>Total<sup>7</sup></b>	<b>30,900</b>	<b>6,500</b>	<b>2027/28</b>
<b>Phase One and 2a</b>	Construction	145,000	24,300	2022/23
	Rail engineering	54,000	8,900	2028/29
	<b>Total<sup>7</sup></b>	<b>199,000</b>	<b>26,500</b>	<b>2022/23</b>

Table 3: Total labour demand by construction and rail engineering – Phases One and 2a

## 2.6.2 Total labour demand by region

Figure 6 and Table 4 (below) show the regional breakdown of workforce for both construction and rail engineering.

- There is a constant workforce of around 10,000 people in the West Midlands between now and 2027/28.
- The workforces in London and the South East are at or around their peaks from 2021/22 to 2024/25, before declining towards the end of this decade.
- The London workforce peaks at around 9,000 people and the South East at around 6,500 people.
- There is a very small workforce in the North West, which accounts for less than 2% of the overall workforce in these phases.

There may also be a small amount of work taking place in the East Midlands during these phases, but it has not been possible to isolate that from the data available. This work is related to 'line of route' work rather than stations.

It should be noted that the regional analysis refers to the region in which the labour demand is generated. It may not necessarily be the case that this work is delivered by workers based in the same region. Some occupations (especially those in professions such as design and management roles) do not need to be based on site and can deliver work remotely. There may also be opportunities to deliver some work through offsite manufacturing. No assumptions have been made in respect to this for this analysis.

<sup>7</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

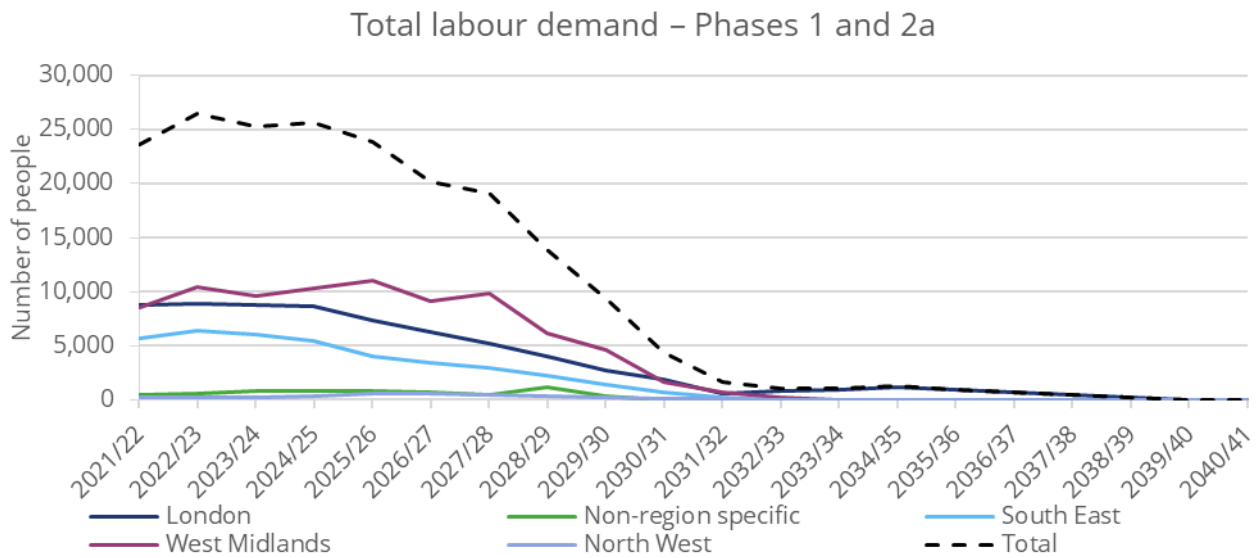


Figure 6: Total labour demand by region – Phases One and 2a

Region	Person-years	Peak workforce	Timing of peak
London	68,500	8,900	2022/23
South East	38,700	6,300	2022/23
West Midlands	82,200	11,000	2025/26
North West	3,500	600	2026/27
Non-region specific	6,200	1,100	2028/29
<b>Total<sup>8</sup></b>	<b>199,000</b>	<b>26,500</b>	<b>2022/23</b>

Table 4: Total labour demand by region – Phases One and 2a

### 2.6.3 Construction

This section contains more detail on the labour demand for construction during Phases One and 2a, disaggregated by stage of work, region, broad occupational groups and qualification level.

#### 2.6.3.1 Stage of work

Figure 7 and Table 5 (below) show the breakdown of labour requirements by construction operatives, management of construction and design services. Full details of the construction occupations can be found in Appendix A.

- The labour demand peaks at around 24,300 people in 2022/23, driven by the construction and management of construction roles.
- The design services labour requirement is relatively constant for the next four years, amounting to 14% of the total construction demand.

<sup>8</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

- Just under 50% of the workforce are construction operatives.

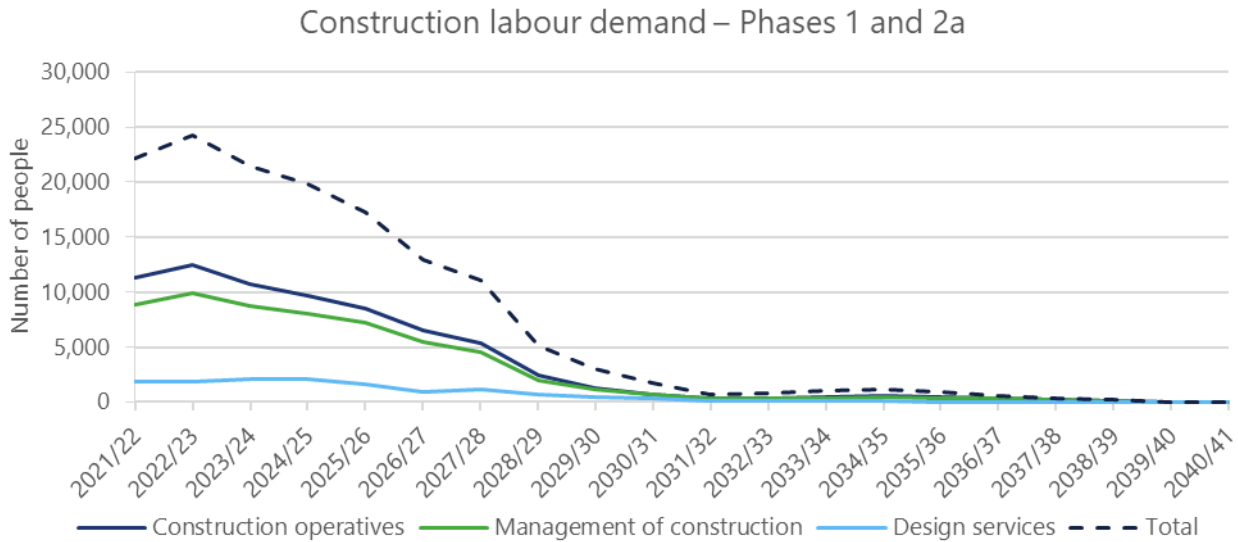


Figure 7: Construction labour demand by stage of work – Phases One and 2a

Phase	Stage of work	Person-years	Peak workforce	Timing of peak
<b>Phase One</b>	Design services	11,000	1,800	2023/24
	Management of construction	50,900	9,500	2022/23
	Construction operatives	61,600	12,000	2022/23
	<b>Total<sup>9</sup></b>	<b>123,500</b>	<b>23,100</b>	<b>2022/23</b>
<b>Phase 2a</b>	Design services	2,700	600	2027/28
	Management of construction	8,200	2,100	2027/28
	Construction operatives	10,300	2,600	2027/28
	<b>Total</b>	<b>21,200<sup>10</sup></b>	<b>5,300</b>	<b>2027/28</b>
<b>Phases One and 2a</b>	Design services	13,700	2,100	2023/24
	Management of construction	59,100	9,900	2022/23
	Construction operatives	71,900	12,500	2022/23
	<b>Total<sup>9</sup></b>	<b>144,500<sup>10</sup></b>	<b>24,300</b>	<b>2022/23</b>

Table 5: Construction labour demand by stage of work – Phases One and 2a

<sup>9</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

<sup>10</sup> The total does not equal the sum of the rows because of rounding.



### 2.6.3.2 Regional breakdown

Figure 8 and Table 6 (below) show the regional breakdown for the construction workforce.

- There is an approximately equal share of the workforce in the West Midlands and London at just over 40% in each region.
- London has a relatively constant demand of around 8,000 people over the next four years.
- The West Midlands has a demand for between 8,000 and 10,000 construction people per year during the next five years before numbers decline towards the end of the decade.

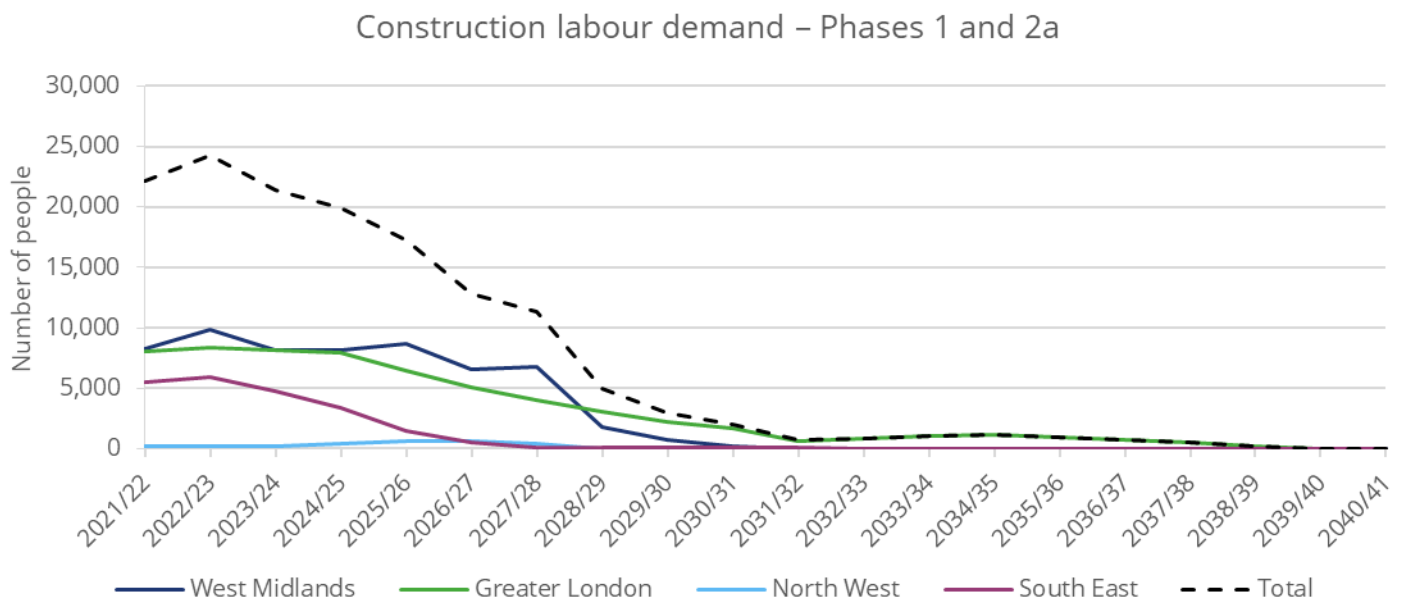


Figure 8: Construction labour demand by region – Phases One and 2a

Region	Person-years	Peak workforce	Timing of peak
London	61,100	8,400	2022/23
South East	22,100	5,900	2022/23
West Midlands	59,300	9,800	2022/23
North West	2,600	600	2025/26
<b>Total<sup>11</sup></b>	<b>145,100<sup>12</sup></b>	<b>24,300</b>	<b>2022/23</b>

Table 6: Construction labour demand by region – Phases One and 2a

<sup>11</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

<sup>12</sup> The total does not equal the sum of the rows because of rounding.

### 2.6.3.3 Broad occupational breakdown

Figure 9 and Table 7 (below) show the regional labour demand broken down by broad occupational groups. These broad occupational groups are outlined in Appendix A. This provides more granularity on the occupations which are forecast.

- The largest trades occupation group is civil engineering operatives and labourers, which accounts for around 15% of all labour.
- Senior management and other office-based staff are the largest single group, accounting for around a fifth of all labour.
- With the exception of building, most broad occupational groups peak in the next two years. Building and mechanical and electrical (M&E) trades peak towards the middle of the decade, driven by work on stations.

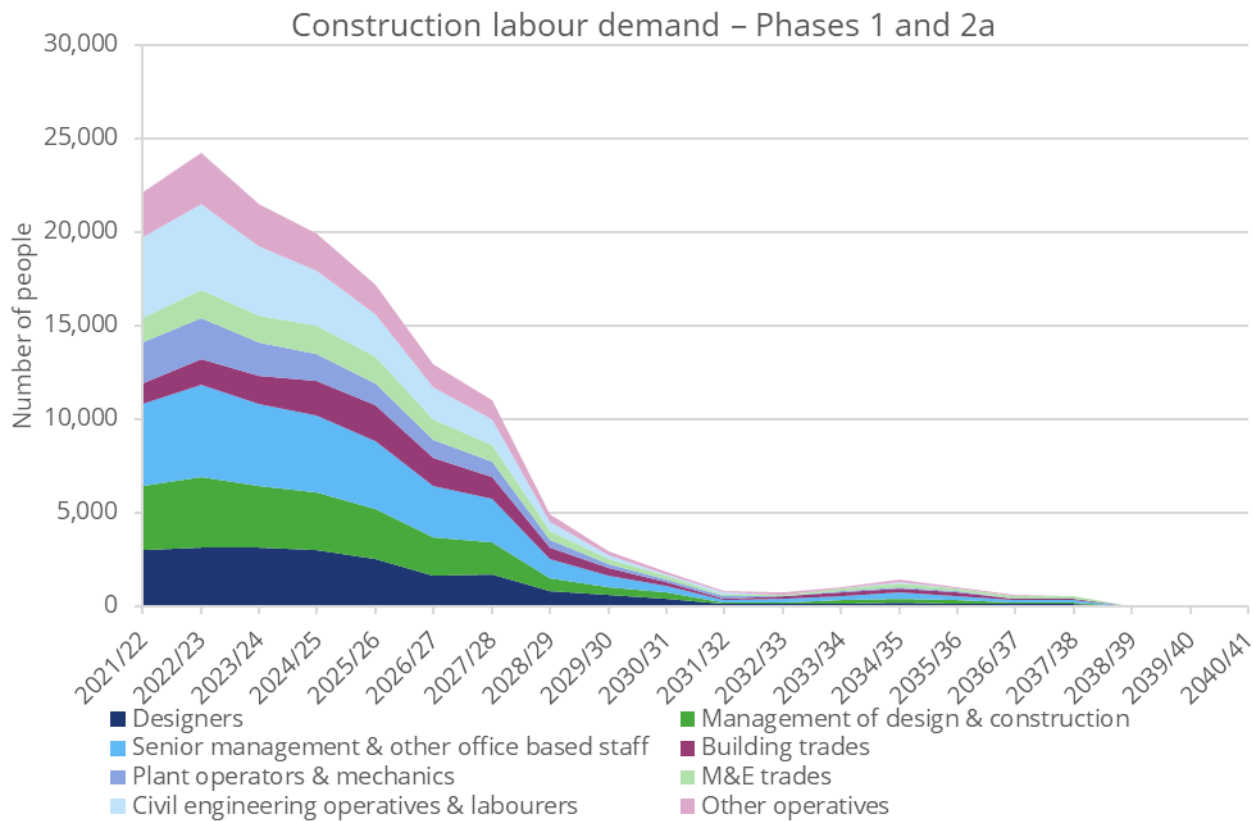


Figure 9: Construction labour demand by broad occupational group – Phases One and 2a

Broad occupational group	Person-years	Peak workforce	Timing of peak
Designers <sup>13</sup>	20,600	3,100	2022/23
Management of design and construction	22,500	3,800	2022/23
Senior management and other office-based staff	29,600	4,900	2022/23
Building trades	12,600	1,900	2025/26
Plant operators and mechanics	11,800	2,200	2021/22
M&E trades	10,900	1,500	2022/23
Civil engineering operatives and labourers	22,000	4,600	2022/23
Other operatives	14,500	2,700	2022/23
<b>Total</b>	<b>144,500<sup>14</sup></b>	<b>24,200</b>	<b>2022/23</b>

Table 7: Construction labour demand by broad occupational group – Phases One and 2a

#### 2.6.3.4 Qualification level

The breakdown of qualification levels used in this report is shown in Table 8. This is also applied to rail engineering.

Level	Further education college/university			Other examples
Level 1	Level 1 diploma; GCSE			Includes Functional Skills level 1 (English, Mathematics and Information & Communication Technology) and vocational qualifications.
Level 2	Level 2 diploma (foundation); GCSE			Includes apprenticeships. For construction, level 2 is a competence requirement for any operative intending to work on a major site, though for trades occupations, a level 3 is generally required.
Level 3	Level 2 diploma (1st diploma); A-Level			
Level 4	HNC	Foundation degree	University degree (BA, BSc)	
Level 5	HND			Includes NVQ at level 4 and vocational qualifications Level 5.
Level 6	Bachelor degree			Includes degree apprenticeships and vocational qualifications level 6
Level 7	Postgraduate (master's degree)			Includes NVQ Level 5, vocational qualifications level 7 and 8, and fellowships.
Level 8	Postgraduate (doctorate)			

Table 8: Examples of qualification levels

<sup>13</sup> The designers broad occupational group is not equivalent to the design services in the previous section.

<sup>14</sup> The total does not equal the sum of the rows because of rounding.

Figure 10 and Table 9 (below) show the breakdown of labour demand on Phase One and 2a by qualification level.

- Around 17% of the workforce are at level 4 and above, excluding a first degree.
- Around 16% have a first degree.
- Around 33% have a at least a level 4 qualification or first degree.
- These proportions are more skewed towards the higher end of the qualification levels than those for the whole industry because infrastructure tends to be more design and management intensive than other sectors of construction.

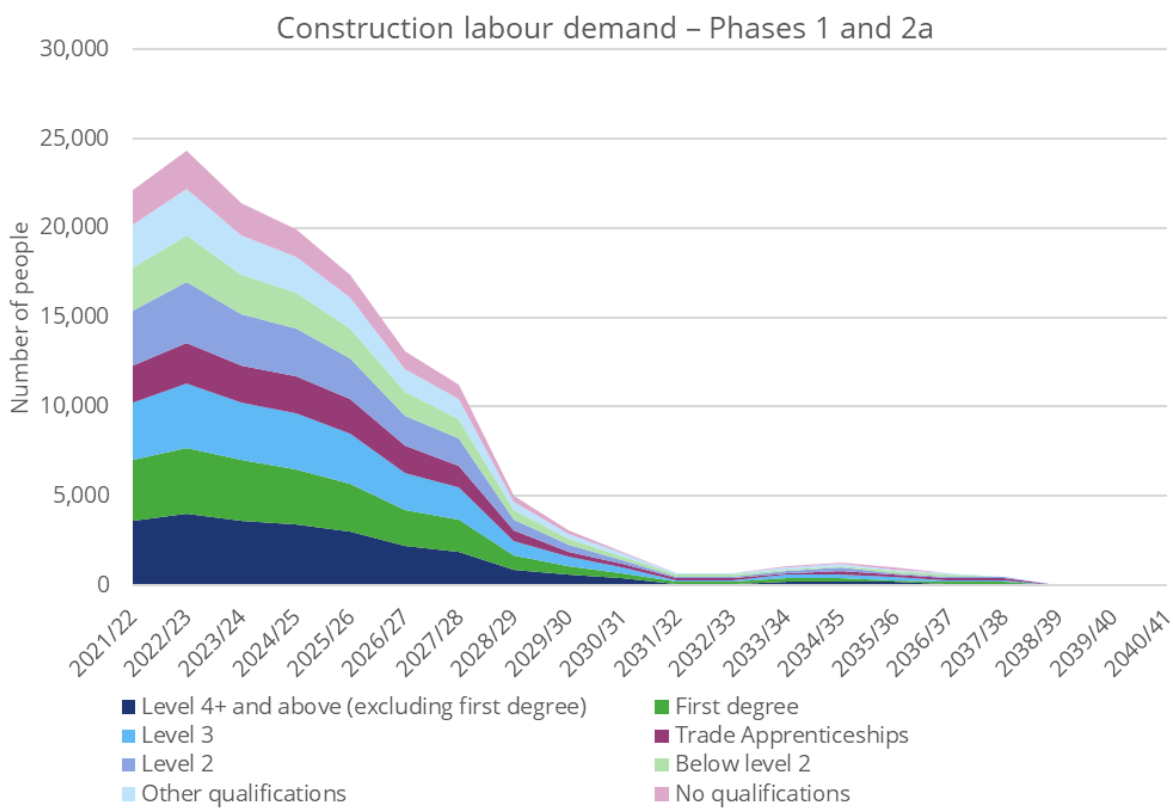


Figure 10: Construction labour demand by qualification level - Phases One and 2a

Qualification	Person-years	Peak workforce	Timing of peak
Level 4+ and above (excluding first degree)	24,600	4,000	2021/22
First degree	22,600	3,700	2021/22
Level 3	22,400	3,600	2021/22
Trade apprenticeships	15,100	2,300	2021/22
Level 2	19,600	3,400	2021/22
Below level 2	14,900	2,600	2021/22
Other qualifications	14,900	2,600	2021/22
No qualifications	11,300	2,100	2021/22
<b>Total</b>	<b>145,400</b>	<b>24,300</b>	<b>2021/22</b>

Table 9: Construction labour demand by qualification level – Phases One and 2a

## 2.6.4 Rail engineering

This section contains more detail on the labour demand for rail engineering during Phases One and 2a, disaggregated by region, asset type and qualification level.

### 2.6.4.1 Asset type

Figure 11 and Table 10 (below) show the breakdown, by asset type, of forecast rail engineering labour demand during Phases One and 2a. This covers all rail-specific infrastructure and includes the track, the signalling and telecommunications, the electrification, some rail-specific civils and property elements, and the traction and rolling stock.

The operations elements cover the activities that will need to be prepared for operating and maintaining once the trains are in service.

- The largest demand for labour and skills occurs in the track asset type with 43% of the total.
- SS&T accounts for around a fifth of total demand.
- Just over 12% of total demand is made up of traction and rolling stock.

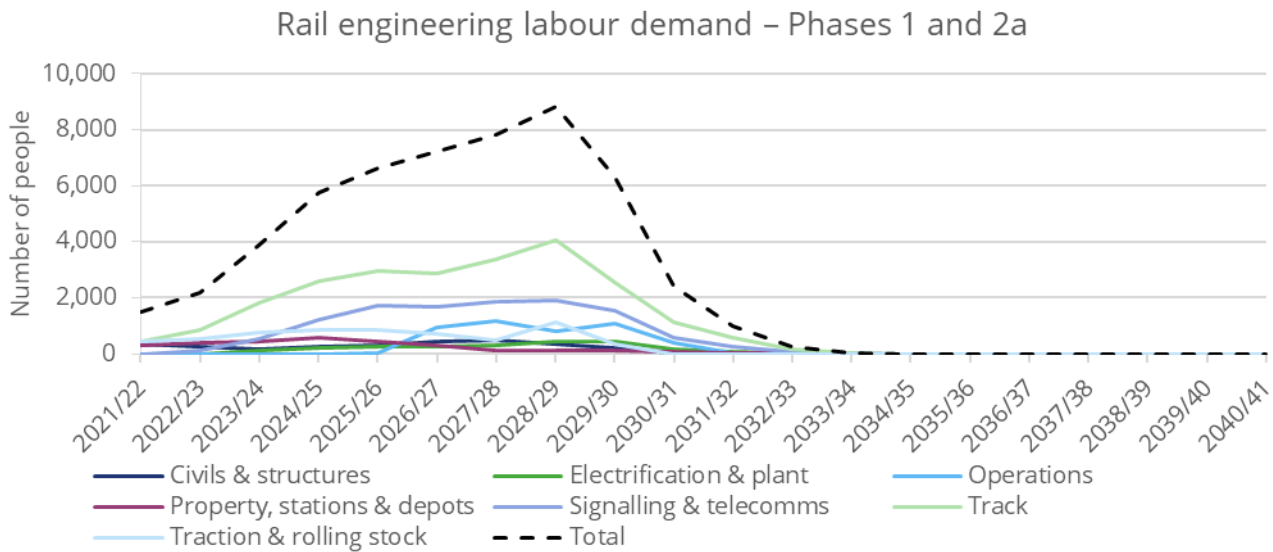


Figure 11: HS2 rail engineering labour demand by asset type – Phases One and 2a

Asset Type	Phases One and 2a person-years	Peak workforce	Timing of peak
Track	23,500	4,050	2028/29
Signalling, systems & telecommunications	11,460	1,890	2028/29
Electrification & plant	2,320	430	2029/30
Operations	4,470	1,180	2027/28
Property, stations & depots	2,980	560	2024/25
Civils & structures	2,880	490	2027/28
Traction & rolling stock	6,190	1,150	2028/29
<b>Total<sup>15</sup></b>	<b>54,000<sup>16</sup></b>	<b>8,900</b>	<b>2028/29</b>

Table 10: Rail engineering labour demand by asset type – Phases One and 2a

### 2.6.4.2 Regional breakdown

Figure 12 and Table 11 (below) show the regional breakdown of forecast rail engineering labour demand during Phases One and 2a.

- The total person-years is approximately 54,000.
- The largest demand for labour and skills occurs in the West Midlands (41% of the total), equating to approximately 23,000 person-years.
- The South East accounts for around a third of total demand.

<sup>15</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

<sup>16</sup> The total does not equal the sum of the rows because of rounding.

- Just over 12% of total demand has not been allocated to a specific region and is made up of traction and rolling stock assembly and deployment activities.
- The activities for the O&M set-up have been assigned to the West Midlands region.
- The forecast peaks at around 4,000 people from 2027/8 to 2029/30 in the West Midlands and is driven by the investment expenditure on track, O&M set-up and on network works.

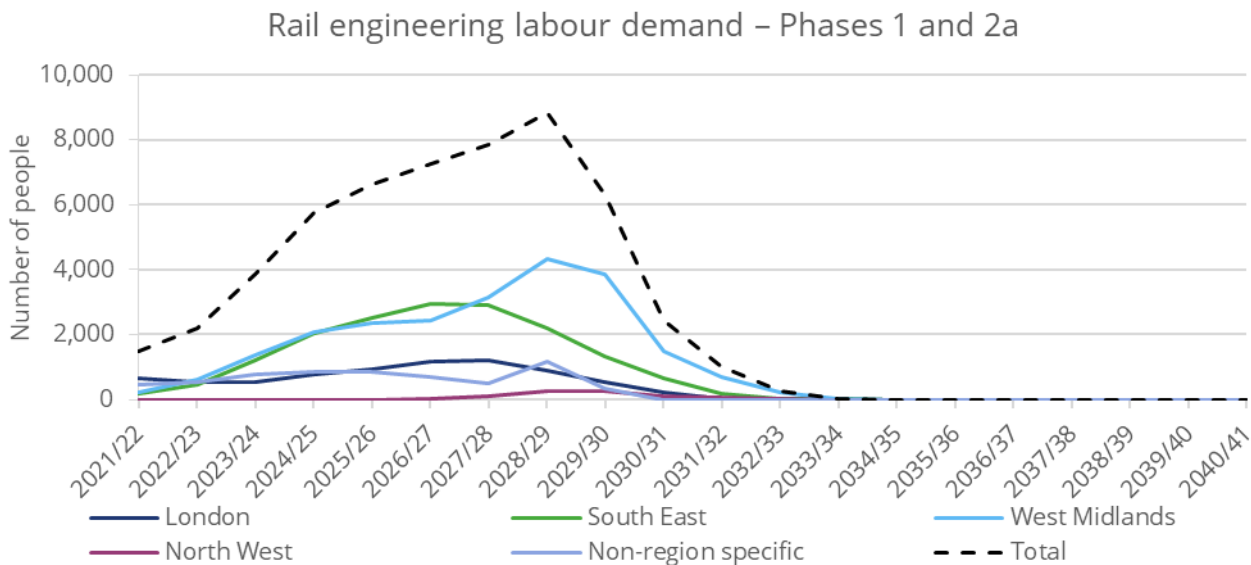


Figure 12: Rail engineering labour demand by region - Phases One and 2a

Region	Total person-years	Peak workforce	Timing of peak
London	7,500	1,210	2027/28
South East	16,680	2,960	2026/27
West Midlands	22,810	4,350	2028/29
North West	780	250	2028/29
Non-region specific	6,200	1,150	2028/29
<b>Total<sup>17</sup></b>	<b>53,970<sup>18</sup></b>	<b>8,850</b>	<b>2028/29</b>

Table 11: Rail engineering labour demand by region - Phases One and 2a

### 2.6.4.3 Qualification level - track

The demand in the rail engineering track asset type is shown in Figure 13 (below).

- Track is the largest workforce within the rail engineering demand forecast and ramps up to a peak in 2028/29.

<sup>17</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

<sup>18</sup> The total does not equal the sum of the rows because of rounding.

- The works reflect the predominance of the on-network works in Phases One and 2a for Network Rail, as well as the track-wide demand for HS2 itself.
- Engineering roles at levels 3 and 5 are in greatest demand.
- Technicians and engineers, both peaking at around 1,600 people in 2028/29, are the most in demand.

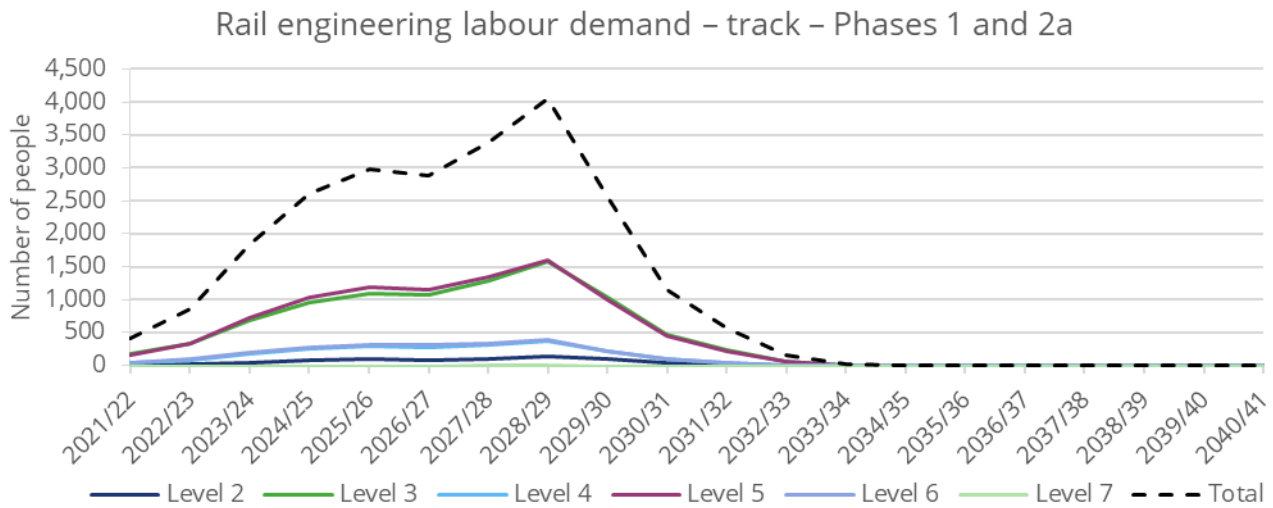


Figure 13: Rail engineering labour demand by qualification level – track – Phases One and 2a

#### 2.6.4.4 Qualification level – signalling, systems and telecommunications

The demand in the rail engineering signalling, systems and telecommunications (SS&T) asset type is shown in Figure 14 (below).

- The labour demand is reasonably constant over a longer five-year period, generally remaining around 1,600 to 1,850 people between 2025/26 and 2029/30.
- Roles at levels 5 and 6 in engineering are in greatest demand.
- Technicians – peaking at around 700 people in 2028/29 – and engineers at around 900 in 2027/28 are those in most demand.



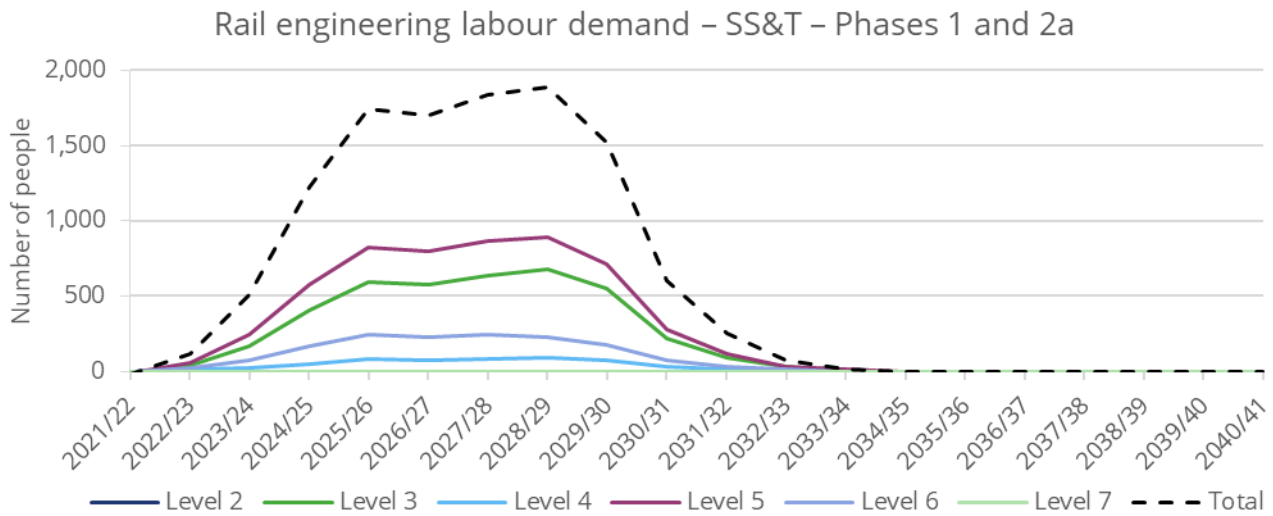


Figure 14: Rail engineering labour demand by qualification level – SS&T – Phases One and 2a

### 2.6.4.5 Qualification level – electrification and plant

The demand in the rail engineering electrification and plant asset type for Phases One and 2a is shown in Figure 15 (below).

- The labour demand is relatively modest, generally remaining below 400 people throughout.
- Roles with levels 3, 5 and 6 are in greatest demand. Typically, they will be project management and engineering roles.
- Assistant/electrification engineers peak at around 100 people in 2028/29.

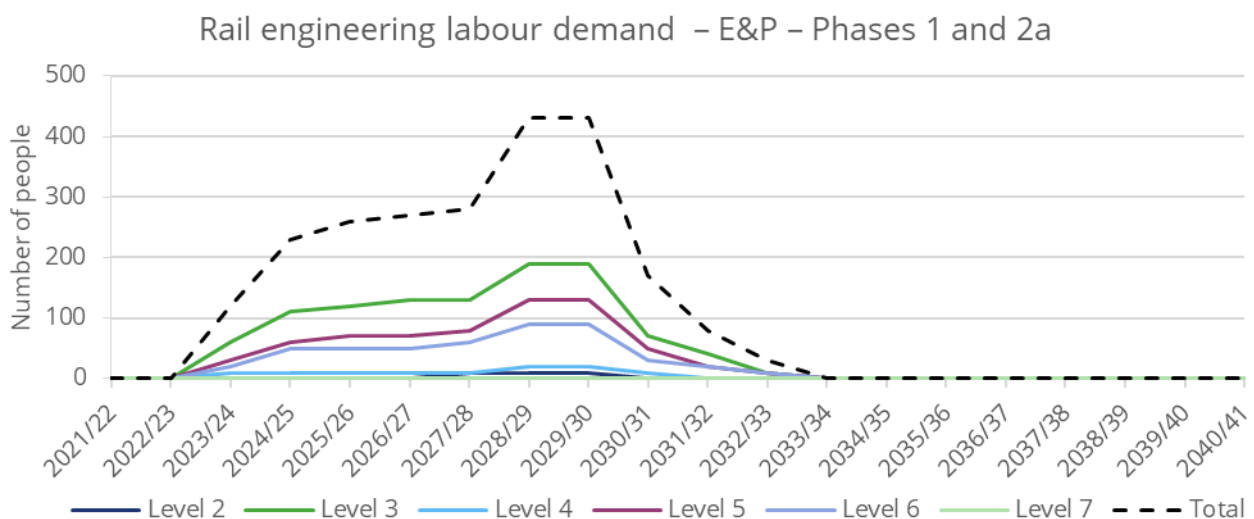


Figure 15: Rail engineering labour demand by qualification level – electrification & plant – Phases One and 2a

### 2.6.4.6 Qualification level – operations

The demand in the rail engineering operations asset type relating to O&M set-up for Phases One and 2a is shown in Figure 16 (below). This demand is driven by the requirement to prepare for the operations and maintenance phases of the railway. It will include a team looking at the operating model of the railway and preparing all the necessary maintenance and operating documentation to meet the requirements of the safety case and the operator. It does not involve actually operating or maintaining the railway but preparing for it.

- Roles with levels 3 and 5 are in greatest demand. Typically, they will be managerial or technician or assistant roles.
- These roles peak towards the end of Phase One in 2029/30 at around 600 people for the technician or assistant roles and 300 for the managerial roles.

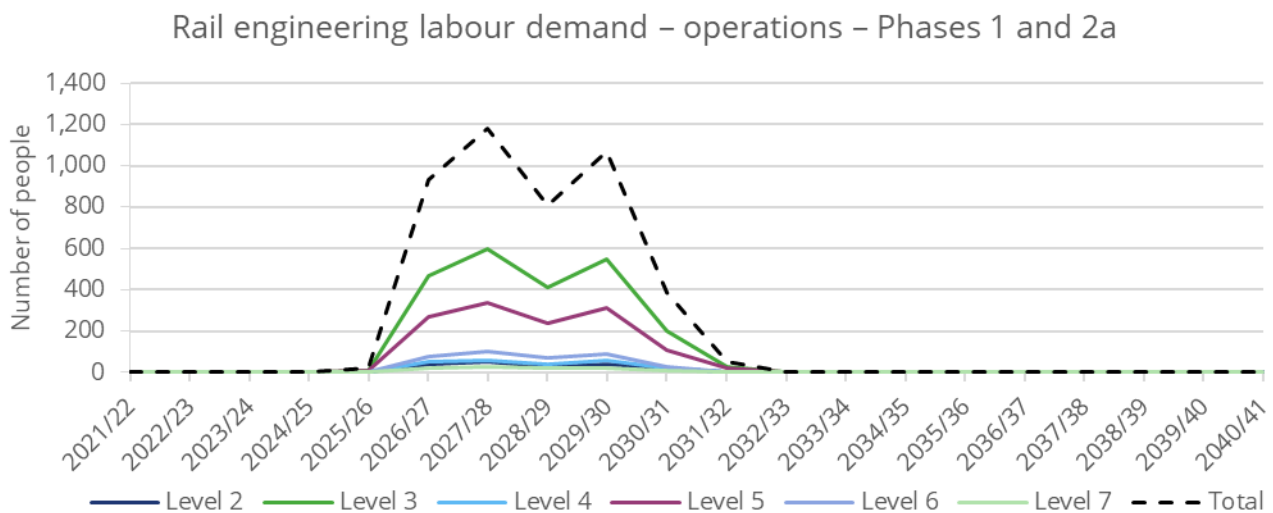


Figure 16: Rail engineering labour demand by qualification level – operations – Phases One and 2a

### 2.6.4.7 Qualification level – property, stations and depots

The demand in the rail-specific property, stations and depots asset type is shown in Figure 17 (below). This asset type did not feature in the previous version of this analysis because data was not available to disaggregate to this level and these roles were previously included within track works.

- Demand is driven by works at Euston and Old Oak Common in the early stages of Phase One, generally remaining below 400 people over the whole of Phases One and 2a.
- Roles with levels 5 and 6 are in greatest demand. Typically, these roles will be in project management and surveying.
- Assistant project managers and project managers peak at around 250 in 2023/24 to 2025/6 and assistant/commercial managers peak at around 200 in 2025/26.

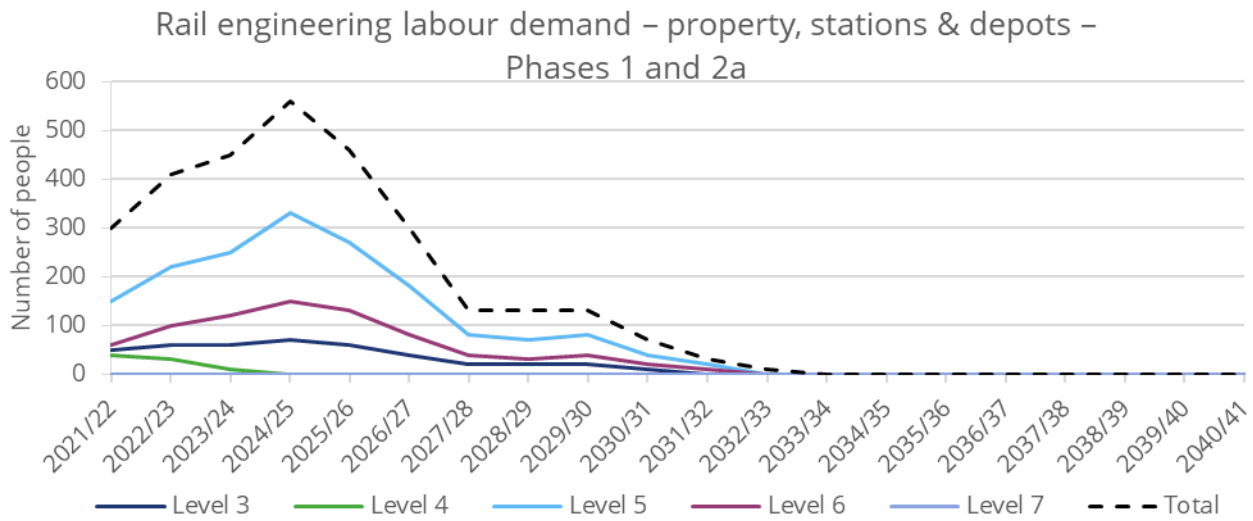


Figure 17: Rail engineering labour demand by qualification level – property, stations and depots – Phases One and 2a

### 2.6.4.8 Qualification level – civils and structures

The demand for rail-specific civils and structures shown in Figure 18 (below) is relatively modest, generally remaining below 500 people over the whole of Phases One and 2a. This asset type did not feature in previous versions of this analysis because the data was not available to disaggregate to this level and these roles were previously included within track works. It features particular elements such as Euston Station and approaches, Stoke Mandeville crossings, East West Rail interfaces, Curborough to Colwich, and Water Orton Corridor works.

- Roles with levels 4 and 5 are those in greatest demand. Typically, these roles will be in project management and engineering, predominantly project managers and assistant project managers peaking at around 120 people in 2026/27 and 2027/28.
- Civil engineers are in highest demand, peaking at around 70 people in 2027/28.

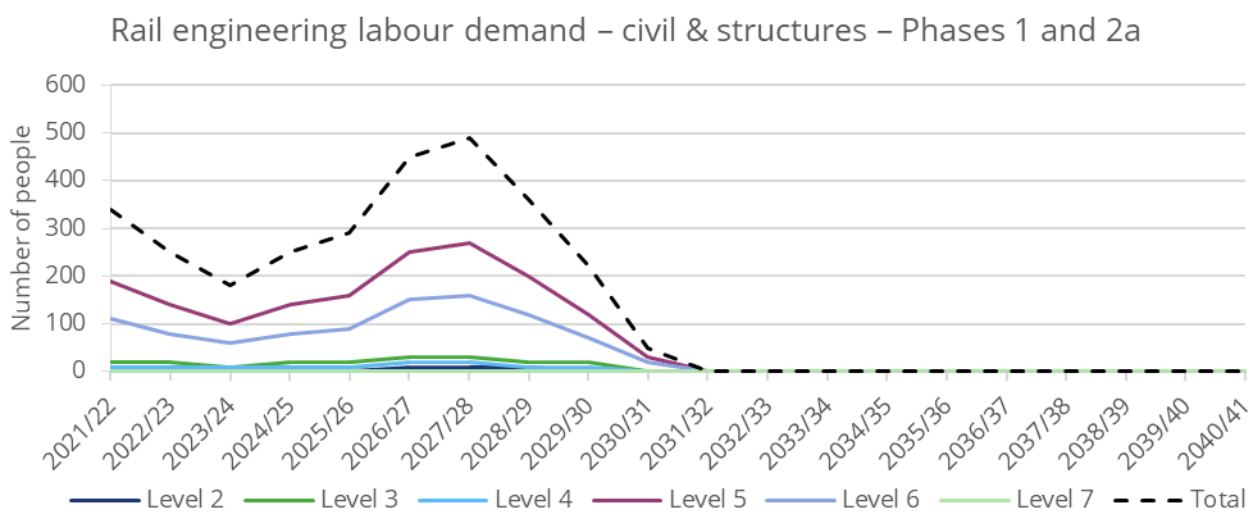


Figure 18: Rail engineering labour demand by qualification level – civil and structures – Phases One and 2a

### 2.6.4.9 Qualification level – traction and rolling stock

Traction and rolling stock is only included for Phase One because Phase 2a of HS2 will be operated using the Phase One traction and rolling stock fleet. Figure 19 (below) presents the forecast labour demand for traction and rolling stock, which includes some elements of design, construction, assembly and testing.

- We forecast these activities to require 6,190 person-years over the period from 2021/22 to 2031/32.
- The predominant skills are forecast to be at Levels 5 and 6 with the remainder at Levels 3 and 4.
- Labour demand is forecast to peak between 2028/29 and 2029/30 because of the need for assembly prior to testing and the railway operations.
- This labour demand has not been assigned to specific regions within the UK because at the time of writing no supplier has been appointed for the traction and rolling stock contract. Therefore it is not realistic to assign the workforce to any particular region at this point.

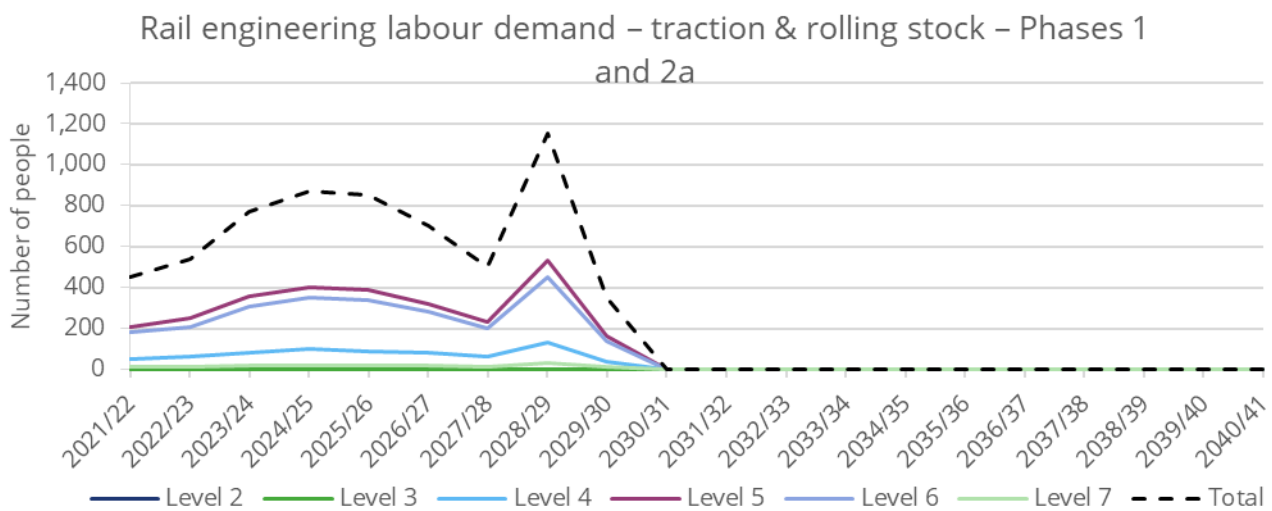


Figure 19: Rail engineering labour demand by qualification level – traction and rolling stock – Phases One and 2a

## 2.7. Phase 2bWL labour demand

### 2.7.1 Combined construction and rail engineering

Figure 20 and Table 12 (below) show a breakdown of total labour demand across Phase 2bWL, split between construction and rail engineering skills. The overall profiles approximately follow the planned spend profile for each asset type.

- The peak requirement is for 17,500 people in 2029/30.
- About 82% of the workforce are in construction roles, with the remainder in rail engineering.
- This workforce level remains above 14,000 people from 2027/28 until 2029/30.

- This peak is principally driven by the construction workforce due to the planned construction investment spend at that time.
- There is a peak in rail engineering of around 2,500 people in 2026/27.

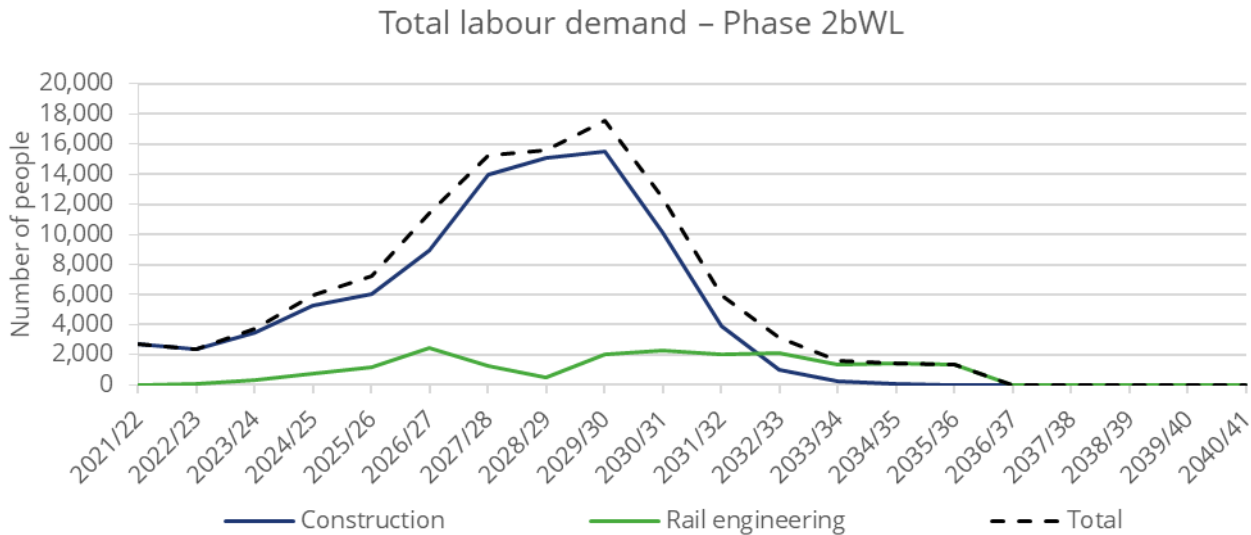


Figure 20: Total labour demand by construction and rail engineering – Phase 2bWL

Stage	Total person-years	Peak workforce	Timing of peak
Construction	88,700	15,400	2029/30
Rail engineering	19,200	2,500	2026/27
<b>Total<sup>19</sup></b>	<b>107,900</b>	<b>17,500</b>	<b>2029/30</b>

Table 12: Total labour demand by construction and rail engineering – Phase 2bWL

All the work on Phase 2bWL takes place in the North West. The exception to this is traction and rolling stock manufacture, which is not assigned to a specific region.

## 2.7.2 Construction

This section contains more detail on the labour demand for construction during Phase 2bWL, disaggregated by stage, occupation and qualification level.

### 2.7.2.1 Stage of work

Figure 21 and Table 13 (below) show a breakdown of construction labour demand across Phase 2bWL split between construction stages of work.

- Construction peaks at around 15,400 people with a relatively constant workforce around that level from 2027/28 to 2029/30.
- Around 48% of the workforce are in construction operative roles and close to 40% in management roles.

<sup>19</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

- Design service roles account for about 13% of the workforce and peak in 2021/22.

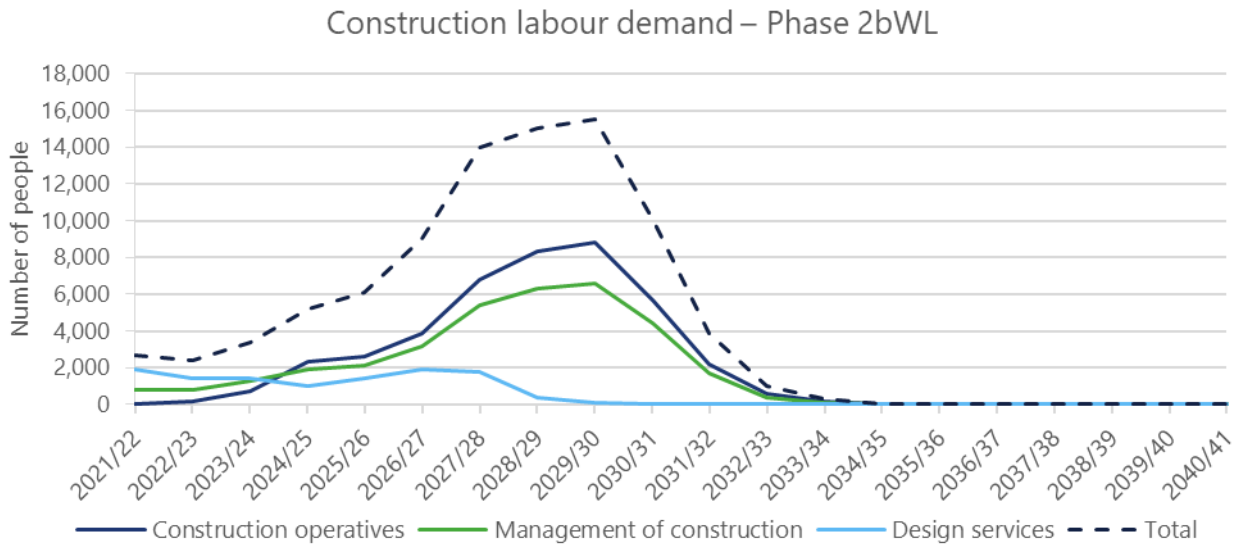


Figure 21: Construction labour demand by stage of work – Phase 2bWL

Stage of work	Person-years	Peak workforce	Timing of peak
Design services	11,300	1,900	2021/22
Management of construction	35,000	6,600	2029/30
Construction operatives	42,300	8,800	2029/30
<b>Total<sup>20</sup></b>	<b>88,300</b>	<b>15,400</b>	<b>2029/30</b>

Table 13: Construction labour demand by stage of work – Phase 2bWL

### 2.7.2.2 Broad occupational breakdown

Figure 22 and Table 14 (below) show the breakdown of Phase 2bWL labour demand by broad construction occupational group.

- Senior management and other office-based staff are in greatest demand, peaking at 3,000 people in 2028/29.
- The largest demand in manual roles is for civil engineering operatives, which account for around about 13% of the workforce.

<sup>20</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

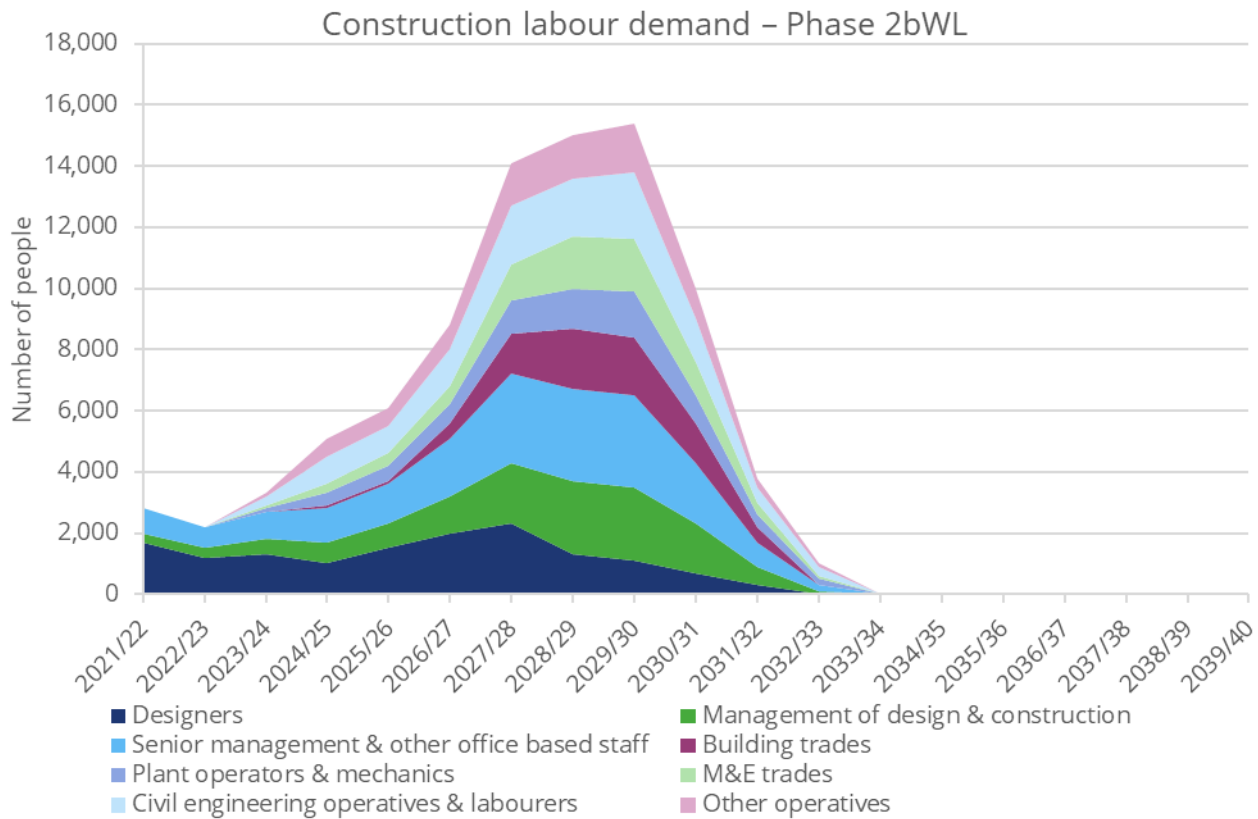


Figure 22: Construction labour demand by broad occupational group – Phase 2bWL

Occupational group	Person-years	Peak workforce	Timing of peak
Designers	14,600	2,300	2027/28
Management of design and construction	13,000	2,500	2028/29
Senior management and other office-based staff	18,800	3,100	2028/29
Building trades	7,800	1,900	2028/29
Plant operators and mechanics	6,900	1,500	2029/30
M&E trades	7,800	1,700	2028/29
Civil engineering operatives and labourers	11,400	2,200	2029/30
Other operatives	8,000	1,600	2029/30
<b>Total<sup>21</sup></b>	<b>88,300</b>	<b>15,400</b>	<b>2029/30</b>

Table 14: Construction labour demand by broad occupational group – Phase 2bWL

<sup>21</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

### 2.7.2.3 Qualification level

Figure 23 and Table 15 (below) show the breakdown by construction qualification level for Phase 2bWL. This shows that some of the more highly qualified roles, which will be more dominant in the design services, peak earlier than the overall peak.

- Occupations requiring either a first degree or level 4 qualifications and above account for around 33% of the total demand.
- Levels 2 and 3 along with trade apprenticeships account for a further 40%.
- The remainder of the roles require qualifications below level 2 or none.

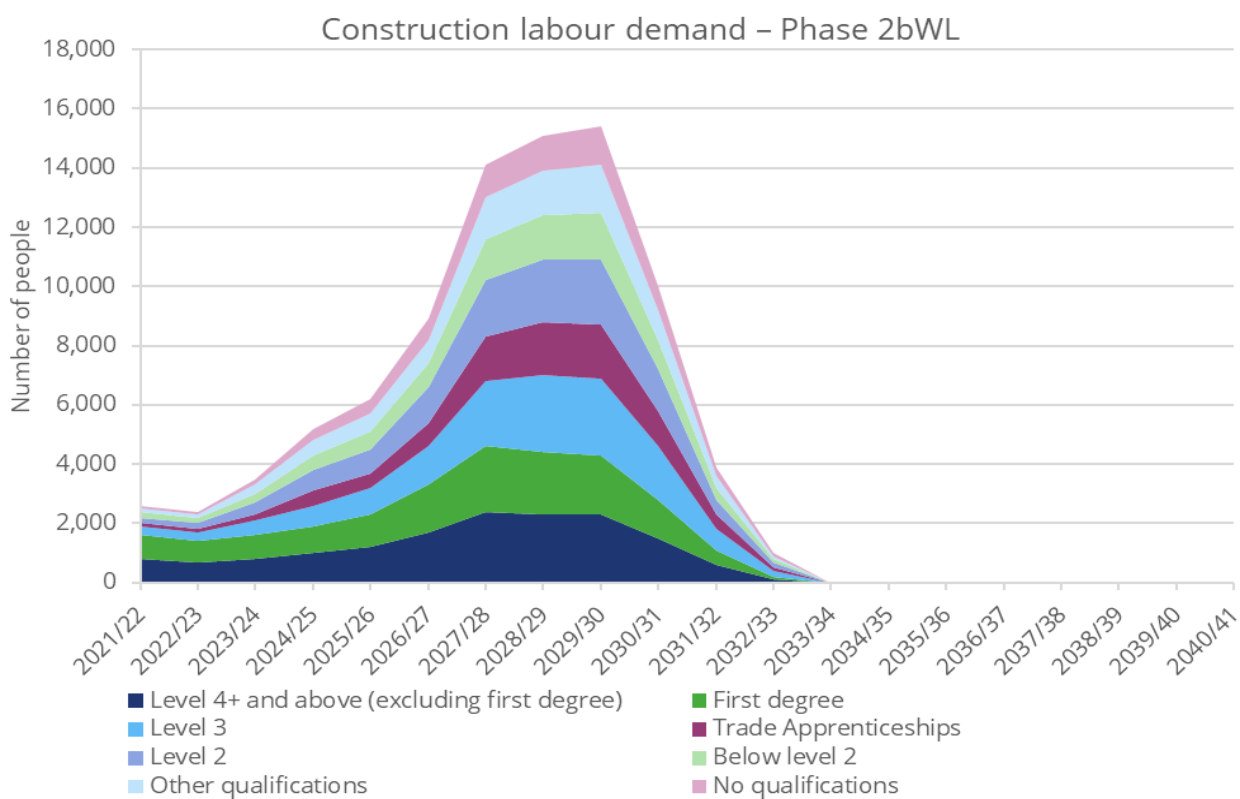


Figure 23: Construction labour demand by qualification level - Phase 2bWL



Occupational group	Person-years	Peak workforce	Timing of peak
Level 4+ and above (excluding first degree)	15,400	2,400	2026/27
First degree	14,100	2,200	2026/27
Level 3	14,100	2,600	2027/28
Trade apprenticeships	9,100	1,800	2027/28
Level 2	11,800	2,200	2028/29
Below level 2	8,600	1,600	2028/29
Other qualifications	8,400	1,600	2028/29
No qualifications	6,800	1,300	2028/29
<b>Total<sup>22</sup></b>	<b>88,300<sup>23</sup></b>	<b>15,400</b>	<b>2028/29</b>

Table 15: Construction labour demand by qualification level – Phase 2bWL

### 2.7.3 Rail engineering

This section contains more detail on the labour demand for rail engineering during Phase 2bWL, disaggregated by asset and qualification level. There is no breakdown by region because all of the work is taking place in the North West.

#### 2.7.3.1 Asset type

Figure 24 and Table 16 (below) show the asset type breakdown of forecast rail engineering labour demand for Phase 2bWL.

- The total person-years is approximately 19,200 compared to 55,600 in Phases One and 2a.
- This phase covers the North West region only.
- The largest demand for labour and skills occurs in the track asset type, followed by traction and rolling stock and then SS&T.
- There is a first peak around 2026/27 and a second starting in 2029/30 and ending in 2032/33. This is driven by the investment expenditure on track, as well as the works associated with traction and rolling stock which is forecast to peak between 2033 and 2035.

<sup>22</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

<sup>23</sup> The total does not equal the sum of the columns because of rounding.

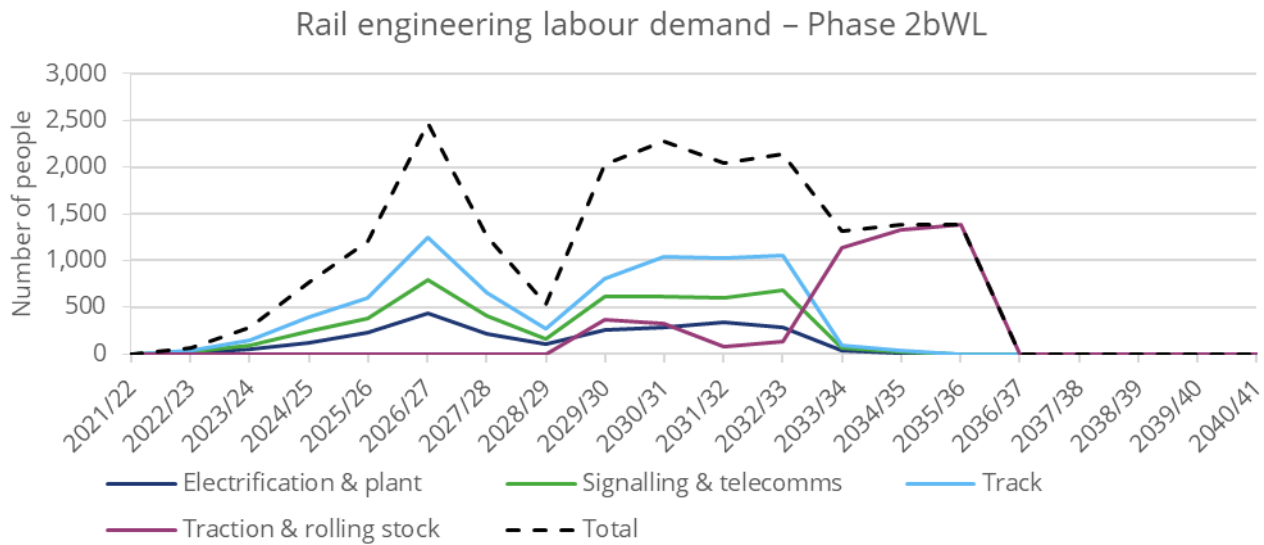


Figure 24: Rail engineering labour demand by asset type – Phase 2bWL

Asset type	Total person-years	Peak workforce	Timing of peak
Track	7,350	1,240	2026/27
Signalling, systems and telecommunications	4,690	790	2026/27
Electrification and plant	2,390	440	2026/27
Traction and rolling stock	4,740	1,380	2035/36
<b>Total<sup>24</sup></b>	<b>19,170</b>	<b>2,470</b>	<b>2026/27</b>

Table 16: Rail engineering labour demand by asset type – Phase 2bWL

### 2.7.3.2 Qualification level – track

Figure 25 (below) presents the demand in the rail engineering track asset type.

- The track asset type contains the largest workforce within the rail engineering demand forecast. It ramps up to a peak in 2027/28, before decreasing and then increasing again through to 2028/29.
- The profile reflects the high levels of on-network works in Phase 2bWL for Network Rail, as well as the trackside demand for HS2 itself.
- Roles at levels 3 and 5 are in greatest demand. Level 3 roles are technicians and level 5 roles are engineers and managerial roles.
- Technicians, peaking at around 500 people in 2026/27, and engineers, peaking at around 500 people in 2026/27, are in greatest demand.

<sup>24</sup> The total peak workforce does not equal the sum of the rows because of differences in the timing of the peaks.

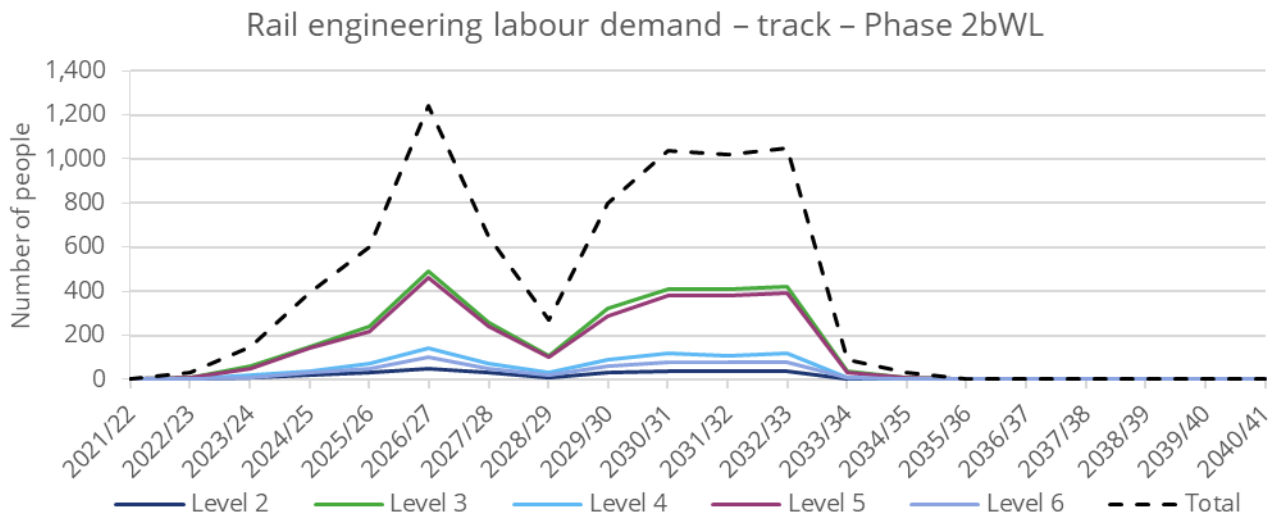


Figure 25: Rail engineering labour demand by qualification level – track – Phase 2bWL

### 2.7.3.3 Qualification level – signalling, systems and telecommunications

Figure 26 (below) shows the demand in the rail engineering signalling, systems & telecommunications (SS&T) asset type.

- There is an initial peak in labour of around 800 people in 2026/27. This is followed by a relatively constant demand of 600 to 700 people from 20230/31 to 2033/34.
- Engineering roles at levels 3, 5 and 6 are in greatest demand.
- Level 3 technicians, peaking at around 350 people in 2027/28, and engineers, peaking at around 300 people in 2027/28, are those in most demand.

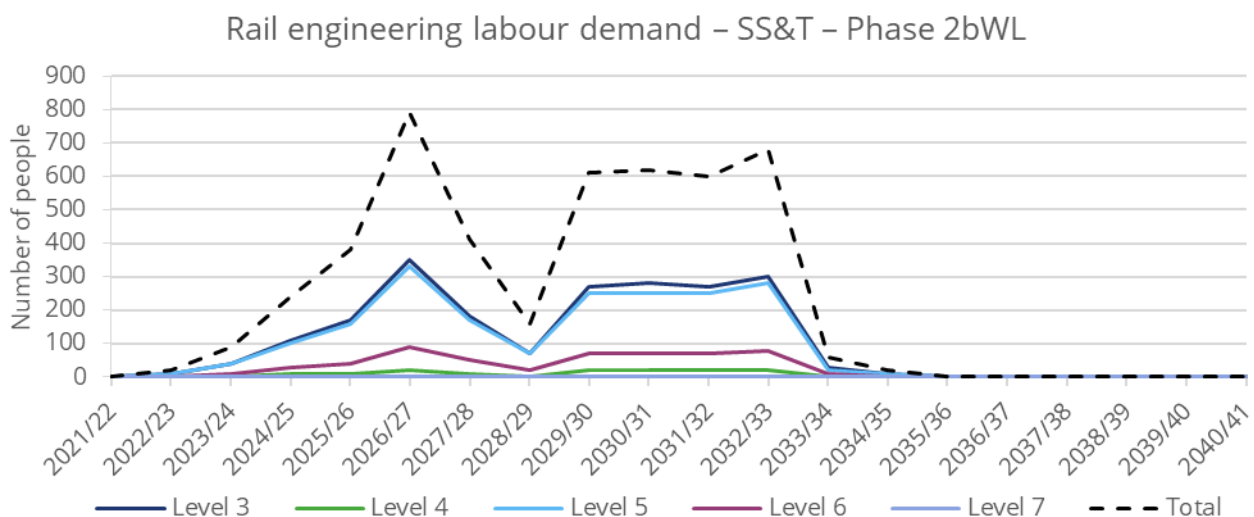


Figure 26: Rail engineering labour demand by qualification level – SS&T – Phase 2bWL

### 2.7.3.4 Qualification level – electrification and plant

Figure 27 (below) shows the labour demand for the rail engineering electrification and plant asset type.

- The overall labour demand is relatively modest, generally remaining below 300 to 400 people over the whole of Phase 2bWL.
- Roles with levels 3, 5 and 6 are in greatest demand – typically, in project management and engineering.
- Assistant project managers and project managers, peaking at around 80 people in 2026/27, and assistant/electrification engineers, peaking at around 100 people in 2026/27, are in greatest demand.

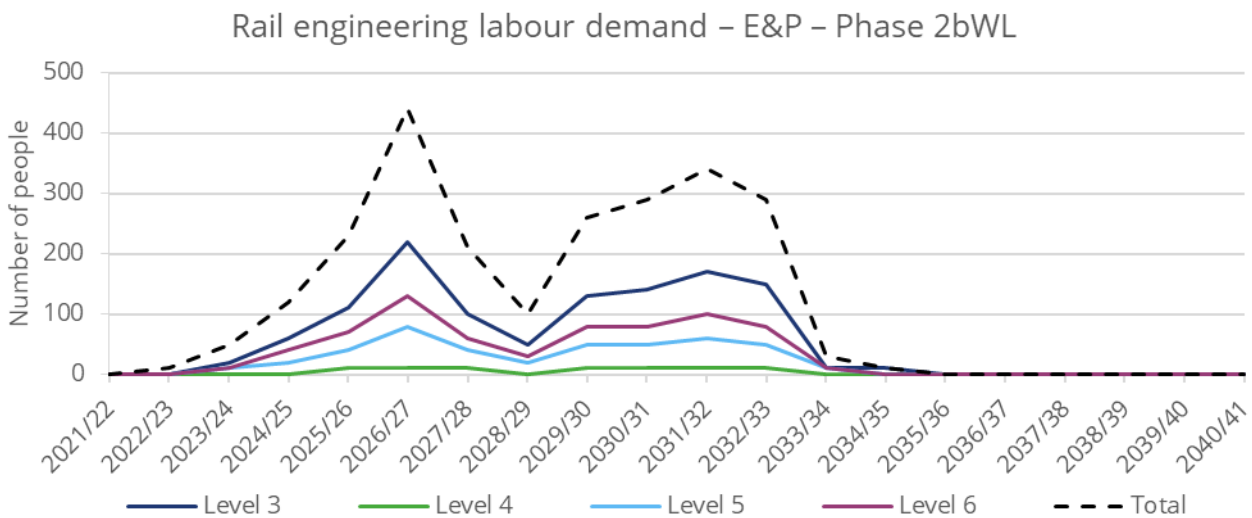


Figure 27: Rail engineering labour demand by qualification level – electrification and plant – Phase 2bWL

### 2.7.3.5 Qualification level – traction and rolling stock

The volume of traction and rolling stock included in Phase 2bWL is a proportional split of the number of trains provided by HS2 Ltd for each Phase 2b leg.

Figure 28 (below) presents the forecast labour demand for the manufacture of traction and rolling stock, which includes design, construction, assembly and testing.

- These activities are forecast to require 4,740 person-years over the period from 2028/29 to 2036/37.
- Most of the roles are forecast to be at levels 5 and 6 with the remainder at levels 3 and 4.
- Labour demand is currently forecast to peak in 2035/36.
- This labour demand has not been assigned to specific regions within the UK.

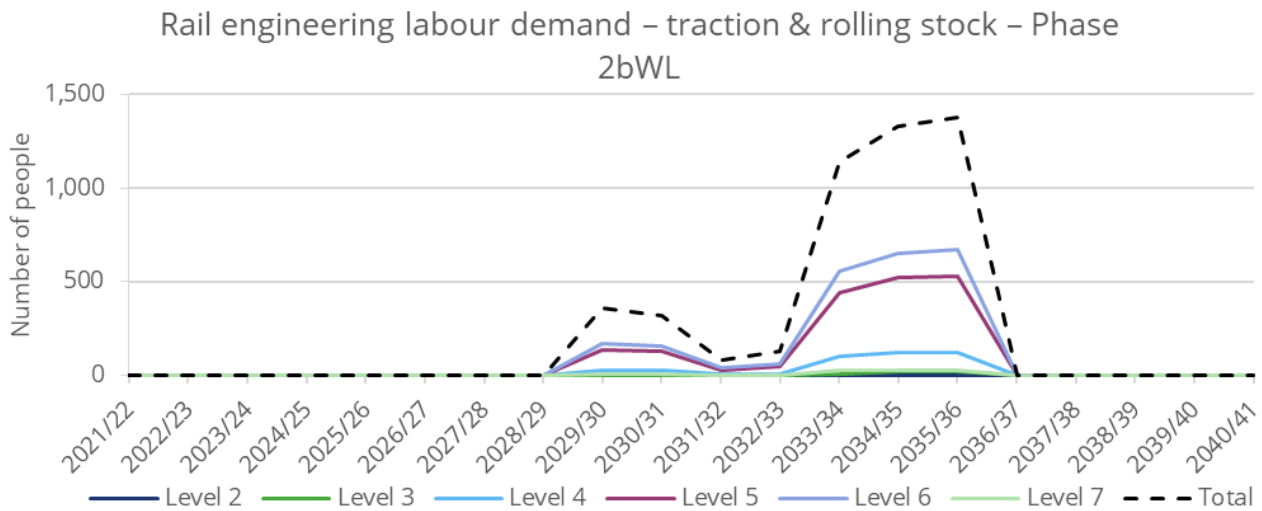


Figure 28: Rail engineering labour demand by qualification level – traction and rolling stock – Phase 2bWL

## 2.8. Apprenticeship forecasts

Potential apprenticeship forecasts for the programme have been developed based on the forecast spend on the programme from 2021/22 onwards. The calculation is based on the likely number of apprentices who will be engaged per £m of spend by HS2 Ltd. Table 17 provides a breakdown by phase. These have been profiled over the duration of the programme using the labour demand profiles prepared in the previous section and shown in Figure 29 (below).

Apprentices	Phase One	Phase 2a	Phase 2bWL	Total
Total	725	375	1,050	2,150

Table 17: Apprenticeships forecast by phase

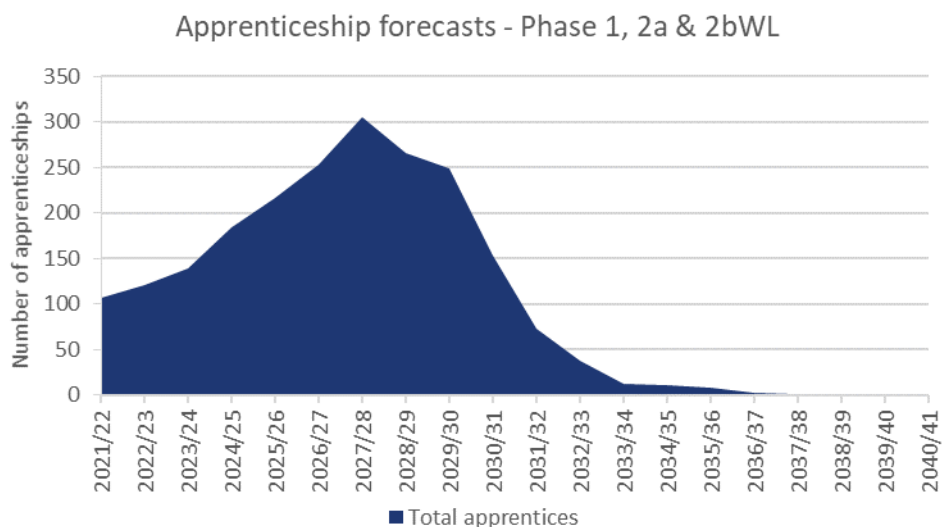


Figure 29: Annual potential apprenticeships forecast

### 3. Labour market trends

The analysis in the following sections provides a picture of the current total labour demand for the distinct construction and rail engineering sectors. The analysis assumes labour supply equals labour demand for the latest available year. The labour outflow rate of people leaving the sector is calculated based on historical averages over 2006–2016.

Two forecasts are then prepared:

1. A forecast future labour demand for construction and rail engineering, based on an understanding of commitments to future spending, historic trends and the economic shocks of Covid-19 and Brexit.
2. A forecast assessment of future labour supply. This is based on the current workforce, the future demand and an assumption that historic outflow rates will continue. These outflow rates take into account those leaving due to retirement, movement into other industries, unemployment or leaving the workforce due to disability, illness, injury or family reasons. These initial supply forecasts do not include inflows into the available supply of construction workers, which are picked up in the mismatch analysis.

This partially complete picture allows us to calculate an annual gross recruitment requirement (GRR). The GRR is the number of people who must be recruited into the sector to meet forecast demand. The mismatch section breaks this down to an occupation level and assesses whether the GRR will be covered by possible inflows.

Similar analyses have been carried out for both the construction and rail engineering sectors. However, there are some differences between the sectors. Rail engineering is much smaller than construction and, as such, the same level of detail of the underlying data is unavailable. Furthermore, the future forecasts of construction sector labour demand are based on future projections of UK-wide macroeconomic indicators whereas the rail engineering sector is based on projections of future investments.

## 4. Construction sector analysis

### 4.1. Introduction

The HS2 programme is one of many planned construction projects to take place over the next two decades. The construction of HS2 will take place alongside UK construction activity that is estimated at about £130 billion<sup>25</sup> in 2020). This construction activity in the wider sector will draw on many of the same labour and skills pools required to construct HS2.

It is important to account for these wider requirements of the UK construction industry, as well as their available supply, to identify occupations and skill sets where the HS2 programme may face recruitment challenges. It should be noted that references to years in this section are to calendar years unless otherwise stated.

Section 4 is broken down into five further sub-sections.

- 4.2 A snapshot of the UK construction sector, which provides a short overview of recent trends in output and employment.
- 4.3 Forecasts of economy-wide demand for the construction sector output and labour. This sub-section presents a baseline forecast and three alternative scenarios.
- 4.4 Outflows from the UK construction sector, which provides a short overview of recent trends in construction sector labour outflows.
- 4.5 Forecasting available supply in the UK construction sector, which outlines the factors that affect available supply and how it is forecast.
- 4.6 A quantitative assessment of the gross recruitment requirement that will have to be met by inflows to satisfy construction sector labour demand.

The implications of the analysis presented in section 4 are investigated in the construction sector mismatch analysis conducted in section 7.

### 4.2. A snapshot of the UK construction sector

The UK construction sector produced output of approximately £175 billion and employed around 2.7 million people in 2019<sup>26</sup>, the latest year for which final data is available. This includes construction trades and operatives, designers and those involved in the management of construction.

The volume of activity in the construction sector is closely related to the performance of the wider economy. Construction output tends to track gross domestic product (GDP) trends, albeit

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<sup>25</sup> Source: Experian

<sup>26</sup> Construction employment is defined by standard industrial classifications (SIC) 41-43, 71.1, and 74.9 – that is contracting and professional services.

with more volatility. Like most output sectors of the economy, construction tends to be pro-cyclical.

There are a number of economic indicators that impact directly on the construction sector.

- Consumer spending – this generates demand for retail and leisure space, building new homes and housing repair and maintenance.
- Business investment – this tends to be concentrated in the industrial and commercial sectors, generating demand for the construction of commercial space such as offices and industrial space.
- Employment growth – this influences the demand for new industrial and commercial space to accommodate the increased numbers of jobs.
- Interest rates – these are used as a proxy for the cost of finance for property developers, which is a factor in determining the profitability of investment in construction activity.

The strength of construction sector output influences demand for labour and skills in the construction sector. When the economy is growing strongly it generates higher demand for the output of the construction sector. This in turn requires higher levels of construction sector employment to deliver that output, all else being equal. The opposite is true when the economy slows or contracts.

#### **4.2.1 Construction output**

Figure 30 (below) shows UK construction output from 2003 to 2019. Output grew by an average of 1.5% per year between 2009 and 2019. This was driven by growth in the second half of the decade. Growth was 0.1% per year between 2009 and 2014 (following the weak recovery from the financial crisis), but 4.3% per year between 2014 and 2019.



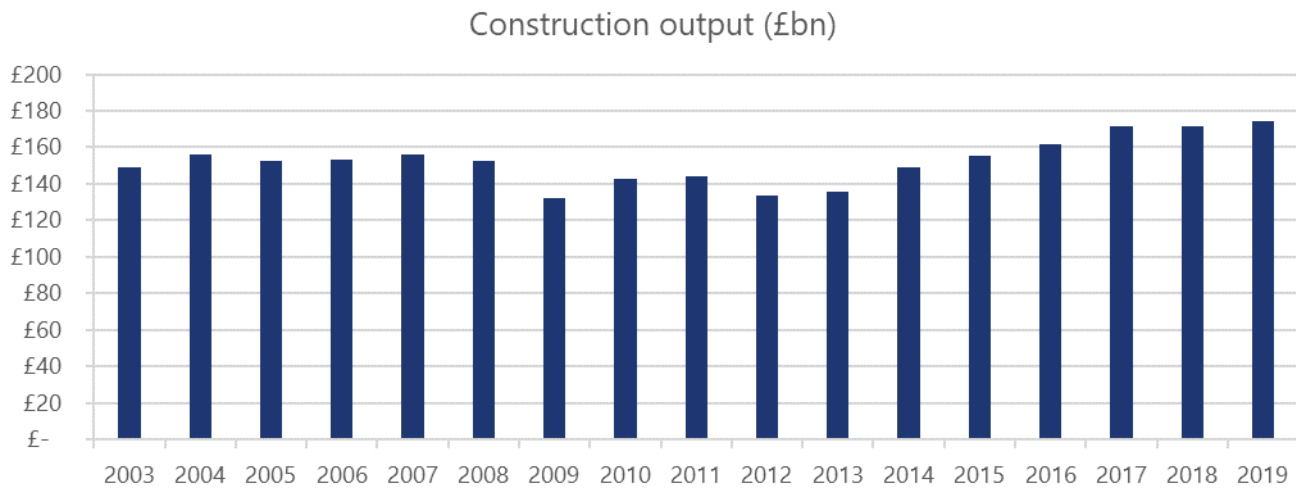


Figure 30: UK construction output<sup>27</sup>, 2003–2019 (source: ONS/NISRA<sup>28</sup>, 2020)

In recording construction output, the Office for National Statistics (ONS) breaks the construction sector down into a number of sub-sectors. Figure 31 (below) shows the share of construction output for each sub-sector from 2003 to 2019.

Private housing and infrastructure were the main drivers of growth in the 2014–19 period, enjoying growth of 6.9% and 11.4% per year, respectively. The private industrial sector grew by 6.5% per year. Growth in this period was underpinned by a strong expansion in warehousing (which grew by 65% between 2017 and 2019 alone).

Growth in the public sector was much weaker, with public non-residential output standing out as the weakest performer, growing by 1.3% per year during the period 2014–19.

<sup>27</sup> Prices are chain linked 2018 prices.

<sup>28</sup> Northern Ireland Statistics and Research Agency

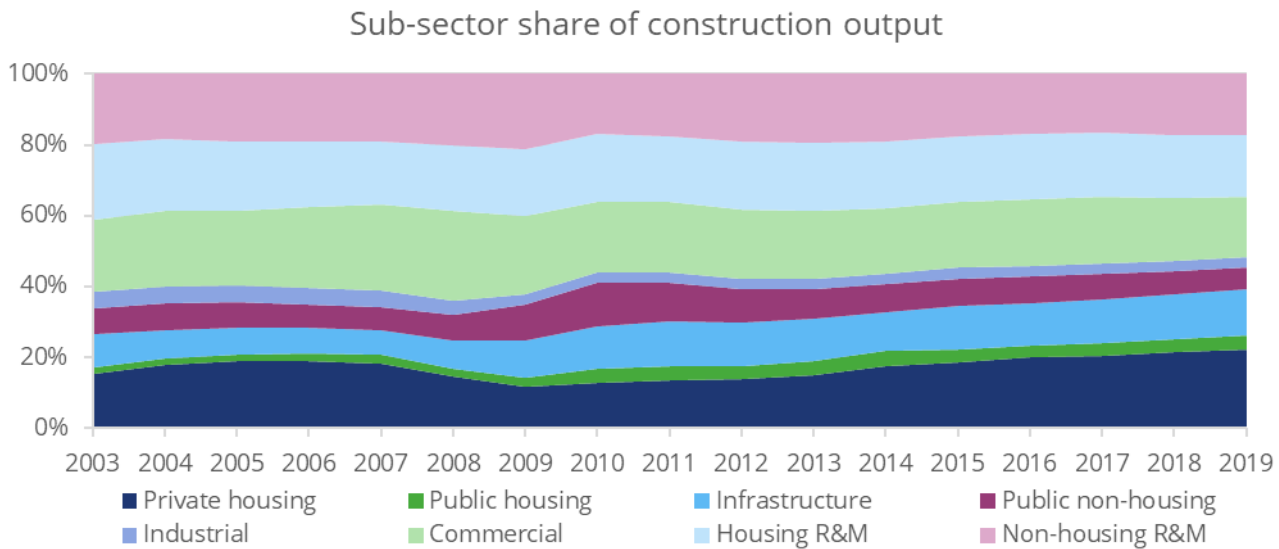


Figure 31: UK construction by construction sub-sector, 2003–2019 (source: ONS/NISRA<sup>29</sup>, 2020)

At a regional level there are substantial variations in construction output year on year. The recovery in construction output since 2008/09 has generally been stronger in the South East, Greater London and the East of England than in other regions of the UK.

#### 4.2.2 Construction employment

Figure 32 (below) shows the total workforce in the UK construction sector from 2003 to 2019. In 2019, there were 2.7 million people employed in the construction sector. However, an estimated 150,000 left the sector in 2020, mostly due to Covid-19. It is reasonable to assume that labour supply for the same period was also 2.7 million.

Despite a healthy rise in output between 2009 and 2014, employment declined at a rate of 1.6% per year between 2009 and 2014 as productivity recovered after the 2008 recession. Between 2014 and 2019, employment rose by 1.4% per year, bolstered by stronger activity.

Construction employment rose in all regions between 2014 and 2019, in line with the national picture, but the degree of employment growth varied among regions.

The strongest per-year growth over 2014–19 was in West Midlands (2.6%), Yorkshire & the Humber (2.4%), East Midlands (1.8%) and Greater London (1.8%). This is due to the predominance of mega projects in these regions, particularly within the infrastructure and private housing sectors.

Conversely, the North West (0.7%) and South East (0.6%) underperformed against the national average employment growth between 2014 and 2019. Historically, construction output and construction employment have shared a small positive relationship.

<sup>29</sup> Northern Ireland Statistics and Research Agency



Figure 32: UK construction workforce, 2003–2019 (source: ONS, CITB/Experian, 2020)

### 4.3. Forecast construction sector labour demand

#### 4.3.1 Purpose and overview

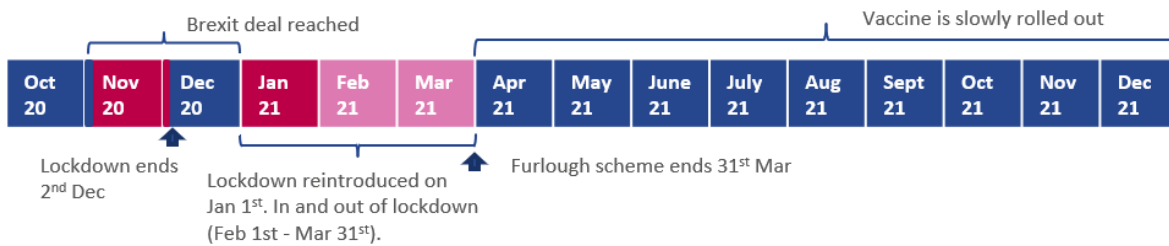
Future construction output and numbers employed in construction by region are derived from the latest CITB Construction Skills Network (CSN) forecast run by Experian (see Appendix B for more detail). The baseline view of construction sector demand has been projected to 2040.

#### 4.3.2 Baseline output and employment methodology

At the time of modelling the baseline scenario (in December 2020), we had assumed a lockdown over January and heightened restrictions during 2021Q1. In reality, the lockdown turned out to last all of 2021Q1 with restrictions expected to be in place well into the second quarter of the year. On the flip side, the vaccine rollout has been faster than assumed in this baseline scenario. In addition, the furlough scheme was extended from April 2021 to October 2021.

We anticipate that these two upsides will largely offset the dampening impact of a longer period of lockdown/restrictions on output growth in 2021. Indeed, our central case view for 2021 had assumed 3% GDP growth in the year, followed by 6.5% growth in 2022. Experian’s view (in March 2021) taking into account the above developments) is for GDP growth of 4.5% in 2021 followed by 6.5% growth in 2022. When this headline GDP growth filters down to the construction sector employment by region, we believe the change will be negligible.

In modelling the various economic scenarios, we have made varying assumptions around the duration of restrictions and the pace of the vaccine rollout, as well as how long the Job Retention Scheme will remain in place. The timeline below highlights the key baseline assumptions at the time of modelling.



Despite the recent success of the vaccination programme, elevated infection levels and new virus variants mean that a strict regime of restrictions will remain in place for some time. The baseline case assumes it will be at least June 2021 before the bulk of restrictions is removed, a position confirmed by the government’s announcement on 22 February 2021.

The modelling assumes a Brexit deal with the European Union similar to that which was agreed in December 2020. There will be a period of adjustment as businesses adapt to a new relationship with their biggest trading partner, accompanied by ongoing uncertainty around the exact nature of agreements around services.

While it is understood the deal includes a tariff and quota-free trading regime for goods, there is little information on arrangements for the more substantive service sector. All of these factors will weigh on business confidence and restrict economic growth for some time.

Our baseline view is that the recovery is likely to take the shape of an elongated tick rather than a V-shape, with real GDP not returning to end-2019 levels until early 2023. This results in the following short-term forecasts.

- GDP growth is approximately 3% in 2021 and 6.5% in 2022.
- By 2023, GDP growth is close to long-term trend levels.
- GDP is 3.7% below the 2019Q4 level by the end 2021 and only reaches the 2019Q4 output level in the second half of 2023.

Over the longer term, the following has been forecast.

- Average annual GDP growth is 1.7% over 2023 to 2040.
- Household spending growth is projected to average 1.8% a year over 2023 to 2040 and total investment growth will average 1.6% in this period.
- Employment (on the workforce jobs measure) is forecast to grow at an average annual rate of 0.6%.
- The forecast assumes that the Bank of England base interest rate will remain at its historically low level of 0.1% until at least 2024 and any subsequent increases will be gradual. Bank rate will remain close to 0.5% up to mid-2026, rising to no more than 1% until the end of the current decade.

In the baseline scenario, no adjustments were made to underlying population projections, due to the continuing uncertainty over future migration policies. The resulting forecasts for the key macroeconomic variables are shown in Appendix C for the baseline scenario.

At the UK level, nearly 17% of construction output is estimated to have been lost as a result of the Covid-19 pandemic in 2020. Under the baseline scenario, the impacts on construction output are as follows.

- Construction output will not return to 2019 levels until mid-2023, slightly quicker than GDP.
- From 2024, construction output is forecast to expand at an average annual rate of 1.7%.
- This compares to a 2.8% average growth rate between 2009 and 2019, although this was bolstered by exceptionally fast growth in 2010.
- Looking over a longer time period, the compound annual growth rate between 2004 and 2015 was 1.1%, with growth impacted by the recession and the period of stagnation that followed the 2008 financial crash.

#### **4.3.2.1 Baseline UK construction sector forecast of labour and skills demand**

As a result of Covid-19 construction employment is estimated to have fallen by 5.6% in 2020 to just under 2.6 million. This represents the first decline in construction jobs since 2013, with employment now 10% lower than its 2008 peak. The decline in employment has been far less pronounced than the 17% fall in construction output.

This is due to a range of factors.

- The output shock will have been somewhat absorbed by a reduction in hours worked rather than jobs, and 'total employment' fails to capture this trend.
- Social distancing measures will have impacted productivity, which affects output more than jobs.
- The government furlough scheme has provided significant support to the construction sector, protecting jobs and preventing steeper falls in employment. ONS data shows that the construction sector was a beneficiary of the Covid-19 Job Retention scheme, with 56% uptake (of all eligible employment) in April 2020 down to 15% by December 2020. Reliance on government to support jobs increases the future risk of significant job losses once support is phased out, particularly if the economy has not recovered sufficiently. This remains a downside risk to the near-term forecast.

Construction employment is projected to return to positive growth of approximately 4% in 2021, reverting to more modest growth from 2022 and then easing further between 2023 and 2025. This reflects a return to stronger productivity and more hours worked from mid-2022.

Further out, the expected average annual expansion in construction output of 1.7% over 2024 to 2040 is forecast to coincide with a 1.1% expansion in UK construction sector labour demand over the same period. This reflects, to some extent, ongoing stronger growth in less labour-intensive sectors such as infrastructure and housing, but is also indicative of a modest improvement in productivity, with an increase of 32,000 people per year expected between 2024 and 2040. The resulting labour demand forecast to 2040 is shown in Figure 33 (below).

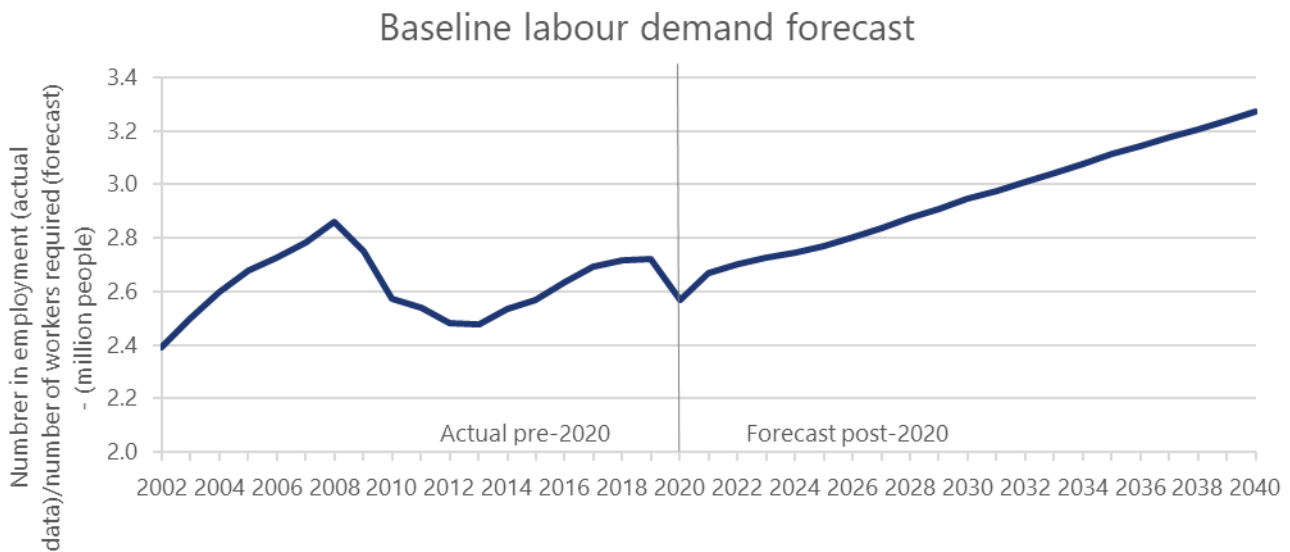


Figure 33: UK baseline scenario forecast for construction sector labour demand (source: CSN, Experian)

Although all regions are forecast to see positive average annual growth between 2020 and 2040, there is some regional variation as shown in Figure 34. The West Midlands, Yorkshire & the Humber, and the East Midlands are forecast to see higher annual average labour demand growth than the UK as a whole. Greater London and the South East are forecast to perform similarly to the national average, while the North West will experience lower growth. Appendix D shows a more detailed breakdown of the labour demand in the regions along the HS2 route by both occupation and region.

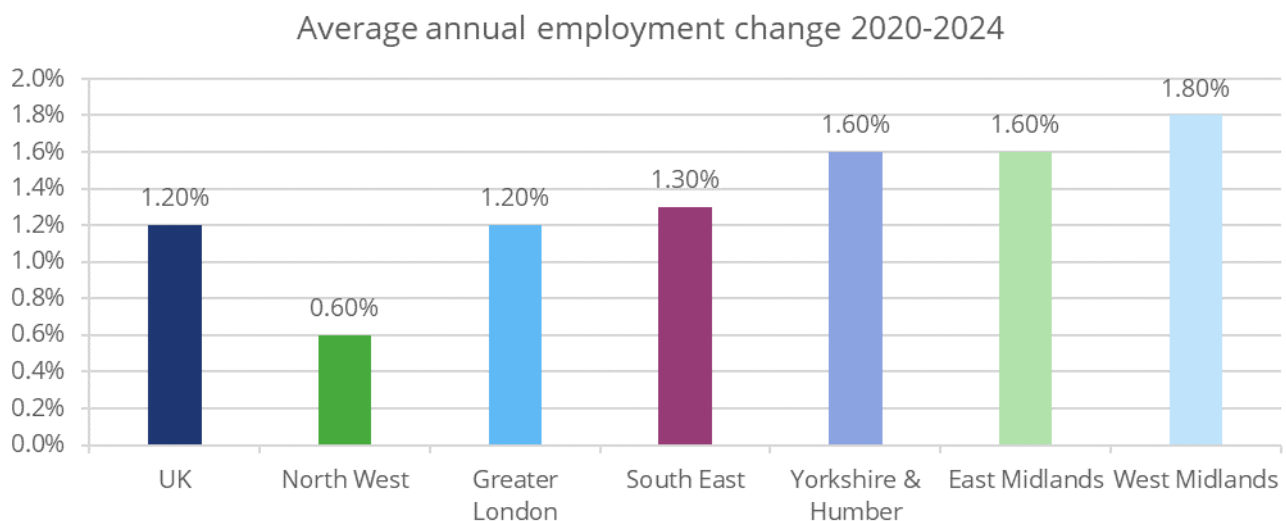


Figure 34: Average annual employment change 2020-2024 for regions on the HS2 route (source: CSN, Experian)

### 4.3.2.2 Alternative scenarios for labour and skills requirements of UK construction sector

The forecasts for the UK macroeconomy – and hence for construction sector output and employment – are subject to a high degree of uncertainty. This risk is particularly elevated at the present time due to Covid-19 and Brexit. To understand how varying economic backdrops might impact output and labour demand in the UK construction sector, three alternative scenarios have been considered:

- mild scenario: a faster-than-expected growth scenario;
- severe scenario: a more prolonged period of economic weakness (seen in a number of key indicators such as GDP, unemployment rates, etc) due to Covid-19; and
- low migration scenario: tighter points-based restrictions.

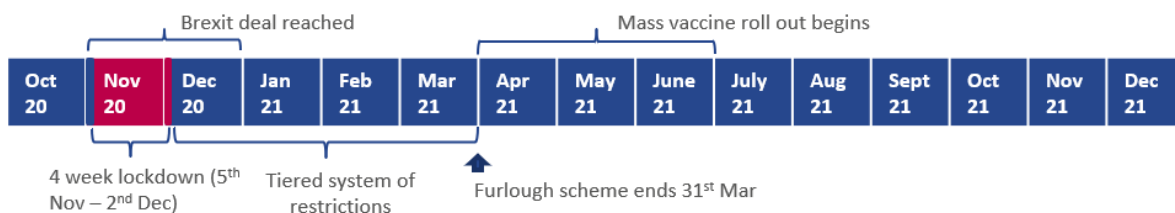
These scenarios have been simulated by shocking the macroeconomic indicators that are judged to be most relevant in determining construction demand. These are GDP, consumer spending, business investment, employment growth and interest rates. The scenarios consider how differing periods of Covid-19 restrictions or lower EU migration due to Brexit would indirectly impact the UK construction sector, by considering the scenario’s impact on demand conditions in the wider economy.

#### Mild scenario assumptions

Both the mild and severe scenarios, constructed around Covid-19, are primarily short-term scenarios with the bulk of impact felt over 2020–2023.

- Faster than baseline employment growth of just under 6% in 2021, almost fully compensating for 2019’s losses.
- Long-term trajectory mirrors that of the baseline case.

Below is a timeline that reflects the assumptions around Brexit and Covid-19 that underpin the mild scenario forecast.

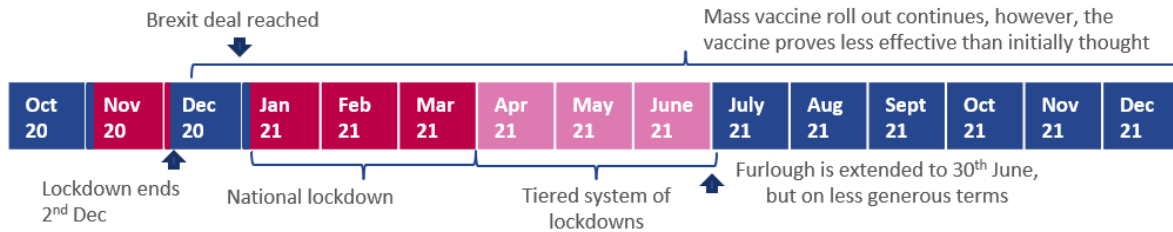


#### Severe scenario assumptions

The profile for labour demand is less positive in the near term, as weaker economic prospects particularly impact private sector activity. Weaker-than-baseline construction output causes:

- lower-than-baseline employment growth of 2.6% in 2021 and 0.5% in 2022; and
- reverts to trend growth from 2024 at a similar level to the baseline scenario (of around 1%).

Below is a timeline that reflects the assumptions around Brexit and Covid-19 that underpin the severe scenario forecast.

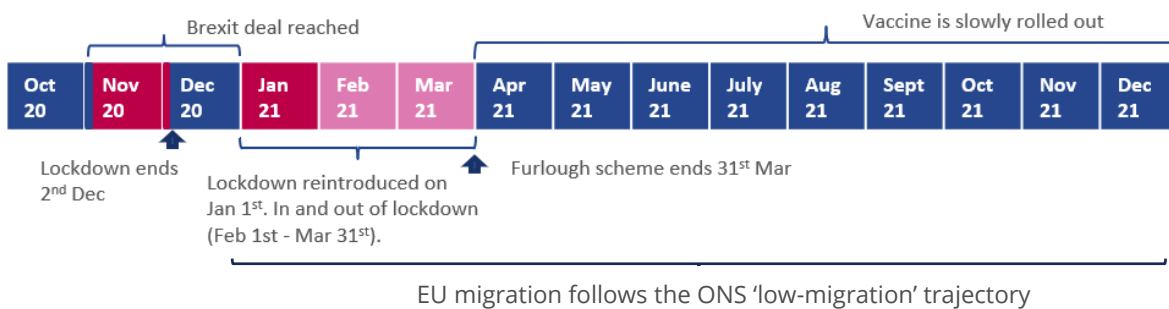


### Low migration scenario assumptions

This is a longer-term scenario, built around Brexit, with only marginal impacts between 2020 and 2025. Beyond 2025, low migration will lead to slower population growth and an ageing population. This will have a dampening impact on long-term GDP via lower economic participation rates, labour supply and weaker consumer spending.

- Long-term GDP growth will be 0.2% weaker than the baseline scenario over 2025 to 2040.
- Weaker GDP growth translates into reduced demand for (private and public) construction output, resulting in noticeably weaker labour demand than the base case over the longer-term horizon.

Below is a timeline that reflects the assumptions around Brexit and Covid-19 that underpin the low migration scenario forecast.



### Scenario impacts

Figure 35 (below) shows the forecast impacts of the above three scenarios in comparison to the baseline scenario.



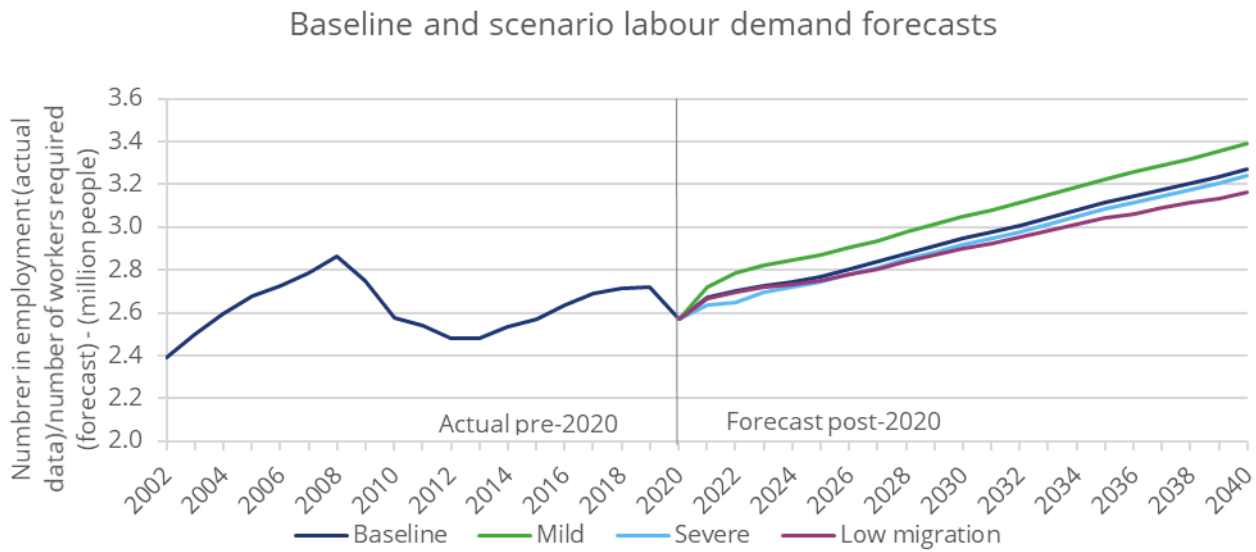


Figure 35: Forecast impacts of the mild, severe, and low migration scenarios in comparison to the baseline scenario.

#### 4.4. Outflows from the UK construction sector labour market

Historically, the outflow rate for construction occupations is 6.3% per year. This is averaged over the period 2006–2016. This covers periods of both growth and decline in UK construction sector output and employment and hence attempts to ‘smooth out’ cyclical fluctuations to identify long-term outflow rates.<sup>30</sup>

We derived forecast outflows by analysing ONS Labour Force Survey data (LFS) for each of the Standard Occupational Classifications (SOC) that we have aggregated into the 28 occupational groups used in the analysis (outlined in Appendix E). These data take account of flows out of the construction sector to:

- other industries;
- unemployment; and
- other (defined as unpaid work for self or relative, looking after family or home, temporarily sick or injured, long-term sick or disabled, retired).

The approach of using historic outflow rates as a proxy to forecast future outflow rates does not explicitly account for factors such as an ageing workforce or any changes in the skills requirements of the UK construction sector due to changes in technologies or ways of working.

Due to limitations and restrictions on the data, it is not possible to produce region-specific outflow rates. It is impossible to isolate the volume flowing to each of the above three areas (other industries, unemployment or other).

<sup>30</sup> Due to a discontinuity in the data in the change from the use of Standard Occupational Classifications 2000 to Standard Occupational Classifications 2010, it has not been possible to determine a long-term flow rate for construction trades supervisors. A weighted average flow rate using data from 2006–2016 has been used for this occupation from the trade occupations who are likely to become construction trades supervisors.

For each occupational group, a UK-wide outflow rate is applied uniformly to the current construction sector workforce in each region. This approach, therefore, cannot explicitly account for the mobility of construction labour and skills between regions within the UK. In addition, the analysis is unable to explicitly account for outflows due to international migration because the Labour Force Survey (LFS) sample is restricted to households within the UK.

The balance of younger people who might enter the construction sector and progress up the career ladder, compared to older people working in construction who are more likely to retire and leave the sector, has an impact on the supply of available construction labour and skills. The age profile for the UK construction sector is compared to the profile for all industries in Figure 36.



Figure 36: Age profile of construction and all industries (source: ONS Labour Force Survey (2019))

There are two key points here:

1. the construction sector has a slightly lower share of workers aged 16–24 (9%) compared to 12% for all industries; and
2. the construction sector has a higher share of older workers aged 55+ (22%) compared to 20% across all industries.

Compared to all industries, the figures above suggest that construction has an ageing workforce, which could have a negative impact on the industry's labour supply and skills over the medium to longer term.

## 4.5. Forecast construction sector labour supply

A key purpose of this report is to assess and understand the occupations and skill sets that may present the UK construction sector with challenges in terms of recruitment and skills retention.

Labour supply consists of people who are employed, as well as those people defined as unemployed or economically inactive, who can be considered to have the potential to meet the labour and skills requirements of the UK construction sector.

Many different factors can contribute to the available supply of appropriately skilled construction workers in a given region at any one time. The analysis in this report provides a quantitative assessment of the minimum available supply. This analysis begins by forecasting outflows from the currently employed UK construction workforce, taking into account retirements, movements into other industries, becoming unemployed or leaving the workforce for reasons such as disability, illness, injury or family reasons. Inflows into labour supply are not considered at this stage.

Figure 37 shows a forecast of labour demand and the available supply for the six regions through which HS2 passes.

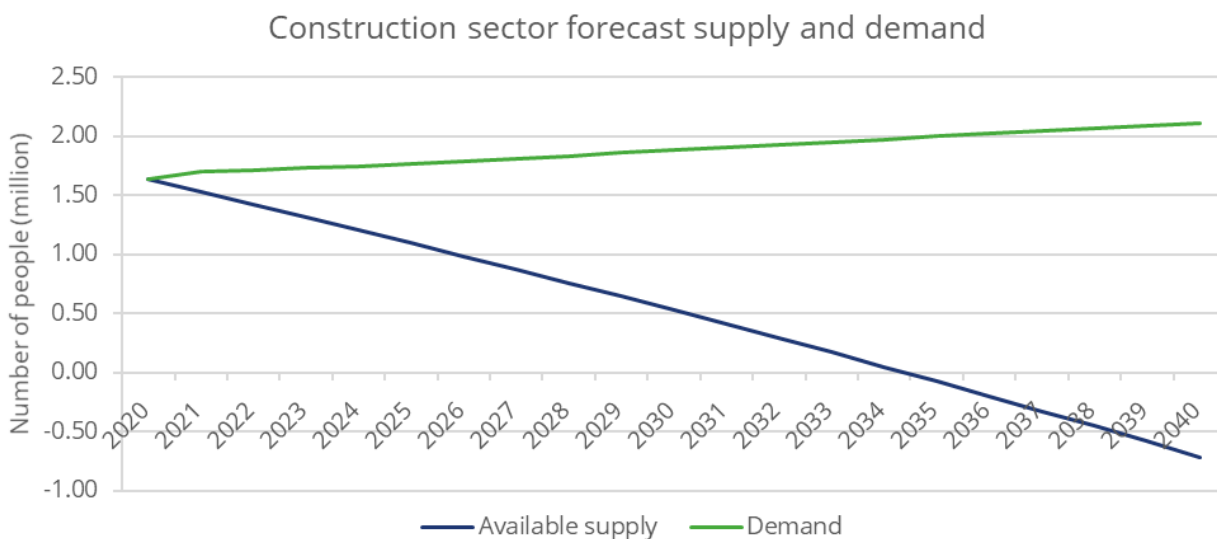


Figure 37: Forecast construction labour demand and available supply in six regions along the HS2 line of route

#### 4.6. Quantitative assessment of the construction sector gross recruitment requirement

Figure 38 (below) shows the baseline construction sector labour gross recruitment requirement (GRR) profile, measured in full-time equivalent opportunities for the six regions along the HS2 line of route.

This profile is the annual difference between the demand for construction sector workers and the remaining available supply, which is adjusted for outflows as the existing workforce declines. This assumes future outflows match the historical outflow rate and does not take account of any possible inflows, which are addressed in the mismatch sections.

This shows, for instance, that in 2030 there is a GRR of 141,000 people which will need to be recruited into the sector to meet the construction labour demand of 1.90 million people. This analysis assumes that any previous year’s recruitment requirement has been met.



Figure 38: Estimates of gross recruitment requirement sector-wide for construction in six regions along the HS2 line of route

## 5. Rail engineering sector analysis

### 5.1. Introduction

The HS2 programme is one of many planned projects for the railway sector – just as it is for the construction sector – to take place over the next two decades. HS2 will take place alongside other UK railway project activity that is estimated at about £5 billion per year in 2020. Section 5 follows a similar structure to section 4's construction sector analysis and is broken down into five further sub-sections.

- 5.2 A snapshot of the UK rail engineering sector, which provides a short overview of recent trends in employment.
- 5.3 Forecasts of economy-wide demand for the rail engineering sector outputs and labour.
- 5.4 Outflows from the UK rail engineering sector, which provides a short overview of recent trends in outflows.
- 5.5 Forecasting available supply in the UK construction sector, which outlines the factors that affect available supply and how it is forecast.
- 5.6 A quantitative assessment of the gross recruitment requirement (GRR) that will have to be met by inflows to satisfy rail engineering sector labour demand.

### 5.2. Snapshot of the rail engineering sector

The rail engineering sector differs from construction in that it does not exist as a specific industrial category within the Standard Industrial Classifications. As such, it is not possible to determine the characteristics of the sector and its workforce in the same way as for construction.

Over the course of the last five years or so, National Skills Academy for Rail (NSAR) has gathered survey information from the rail engineering sector regarding its current workforce. Information has been taken from a mixture of employer-provided survey data and data provided from the Sentinel<sup>31</sup> database of safety critical workers. These data provide the basis to assess the capacity of the rail engineering sector to meet future workforce requirements.

#### 5.2.1 Rail engineering output

National statistics are not available for rail engineering in the same way as they are for construction. As such, rail engineering forecasting models are based on an analysis of the labour content of the industry and the skills mix from surveys.

Future investment levels in rail are gathered from assessments of published plans. NSAR gathers this data and uses it to produce forecasts within its Skills Intelligence Model.

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<sup>31</sup> Sentinel is a safety system in use across the rail industry. It provides rail workers with a passport to work on the rail infrastructure across the United Kingdom and permits workers to access the infrastructure in a controlled manner.

Analysis of rail engineering investment in projects from NSAR’s Skills Intelligence Model has produced the results shown in Table 18.

Year of extract	Planned project expenditure to 2040 per year
2017	£5.8 billion
2018	£8.5 billion
2019	£7.3 billion
2020	£7.4 billion
2021	£5.1 billion

Table 18: Forecast annual expenditure to 2040 over the last five years

There are multiple reasons behind the fluctuating investment levels, not least of which is the inclusion (and then exclusion) of major schemes such as Crossrail 2. In addition, the uncertainty surrounding Network Rail’s long-term project investment levels (excluding all maintenance and renewals) does not lend itself to accurate long-term planning.

However, it is safe to assume that the average level of capital expenditure on projects is planned to be at its lowest level for the last five years. That in itself would alleviate some of the workforce mismatch concerns that may arise from the investment levels, but should not be a signal to relax some of the excellent efforts on sector attraction, apprenticeships, training, education and recruitment.

### 5.2.2 Rail engineering employment

The NSAR surveys and other data provide information on over 242,000 members of the UK rail engineering workforce. NSAR believes that data has been secured from all of the major rail employers and, therefore, we have used a working assumption that the data is approximately 90% to 95% complete.

Accordingly, it is not unreasonable to assume that the sector has a total workforce of close to 250,000 or even higher. The workforce is split between those working for Network Rail (around 45,000), train and freight operators (around 80,000), Transport for London (27,000) and the rail industry supply chain (90,000 to 100,000). The majority of the investment listed is through Network Rail, Transport for London, HS2, East West Rail, Transport for the North or other enhancement schemes where known.

Table 19 (below) shows how the workforce is split into the construction, maintenance and operation of different asset types. The asset type ‘operations’ means those staff involved in activities such as infrastructure operations (e.g. signalling and control) or train operations (e.g. driving or customer service activities on board trains) and is therefore not relevant to this commission.

The number of workers involved in the maintenance, renewal and enhancement of track assets constitutes nearly 30% of the remaining workforce. The traction and rolling stock, electrification and power and SS&T asset types are all highly relevant to HS2. There are no specific ‘high speed rail’ occupations included either within the workforce we have today or in the analysis of future

demand. Any necessary upskilling to and familiarisation of the high-speed environment has not been modelled.

Asset type	Workforce
Operations	73,400
Business management	41,300
Uncategorised	40,400
Track	38,300
Traction and rolling stock	15,800
Signalling and telecommunications	14,100
Systems engineering	7,400
Electrification and plant	4,200
Property, stations and depot	3,900
Civils and structures	3,400
<b>Total</b>	<b>242,200</b>

Table 19: Distribution of workforce by asset types

### 5.2.3 Location of current workforce

Table 20 shows that the workforce working on rail investment projects is split roughly evenly between workers based in London and the South East (51%) and other regions of the UK (49%).

Region	Percentage
South East	31%
London	20%
North West	11%
Yorkshire & the Humber	9%
West Midlands	7%
Scotland	6%
South West	6%
East Midlands	5%
Wales	3%
North East	1%
East Anglia	1%

Table 20: Split of rail workforce in investment projects, by region, 2019

There is no firm evidence of patterns of geographic mobility across the UK in rail engineering disciplines. However, by the very nature of the work and asset cycles the workforce will need, to some degree, to follow the work around the country.

### 5.3. Forecast rail engineering sector demand

We have used a forecast of sector-wide demand for rail engineering labour and skills to determine future recruitment requirements in the sector, alongside estimates of available supply for the relevant occupations. Forecasts of future sector demand have been estimated by converting forecast volumes of rail sector investment into the number of workers required to deliver that investment. This differs from construction as rail engineering is a smaller sector and demand is mostly driven by government investment plans rather than wider macro-economic factors.

The number of people required to deliver a given level of investment is determined by analysing data on the numbers working in the industry and the type of work they are carrying out. A constant number of people at current qualification levels per unit invested is assumed. No allowance is made for productivity growth since there is no historic data on which to base a calculation.

In the short to medium term, where investments plans exist, forecasts for the level of investment in the UK rail engineering sector are taken from published sources, such as Control Period 6 (CP6) Plans and other strategic documents outlining rail expenditure.



Extrapolation is based on reasonable assumptions for funding levels beyond the published periods. For example, we have assumed that investment in maintenance, renewals and operations activities will continue at a relatively constant rate for the foreseeable future, while funding levels for enhancement projects will vary significantly. This is in line with funding parameters set by government for Network Rail's CP6 (2019 to 2024). This provides core funding for renewal, maintenance and operations activities, but funds enhancement projects only where a business case is justifiable and demonstrable.

In addition, the forecast investment levels account for other enhancement schemes that may affect the rail engineering sector's demand for labour and skills during the delivery of HS2. Notably, these are schemes such as Crossrail, Four Line Modernisation by Transport for London (TfL), East West Rail works undertaken on behalf of Transport for West Midlands, Trans Pennine and North West Electrification schemes, other Transport for the North and Northern Powerhouse Rail schemes, New Tube for London and other enhancement or improvement schemes.

The sector investment data becomes less reliable beyond the mid-2020s when there is less certainty around secured funding levels. The levels of investment for enhancement schemes from 2025 onwards are often unknown and, therefore, the projections are based on a continuing level of renewal and maintenance activities. No additional enhancement schemes are included, except where known and predictable.

The forecast of future labour demand for investment projects in rail systems is shown in Figure 39 (below). This is presented for the combined six regions HS2 will pass through.<sup>32</sup> The rail systems demand profile fluctuates over the 2020s with a distinct reduction in the workforce from 2030 onwards. The fluctuations reflect year-on-year changes in the rail systems investment profile. HS2 makes a large contribution to demand in the mid-2020s and mid-2030s, between 20% and 35% per year, tailing off thereafter. In addition, the current modelling predicts that investment for other significant schemes starts to decrease from 2030 onwards, leading to a compounded negative impact on the required workforce.

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<sup>32</sup> London, South East, West Midlands, East Midlands, North West and Yorkshire & the Humber.

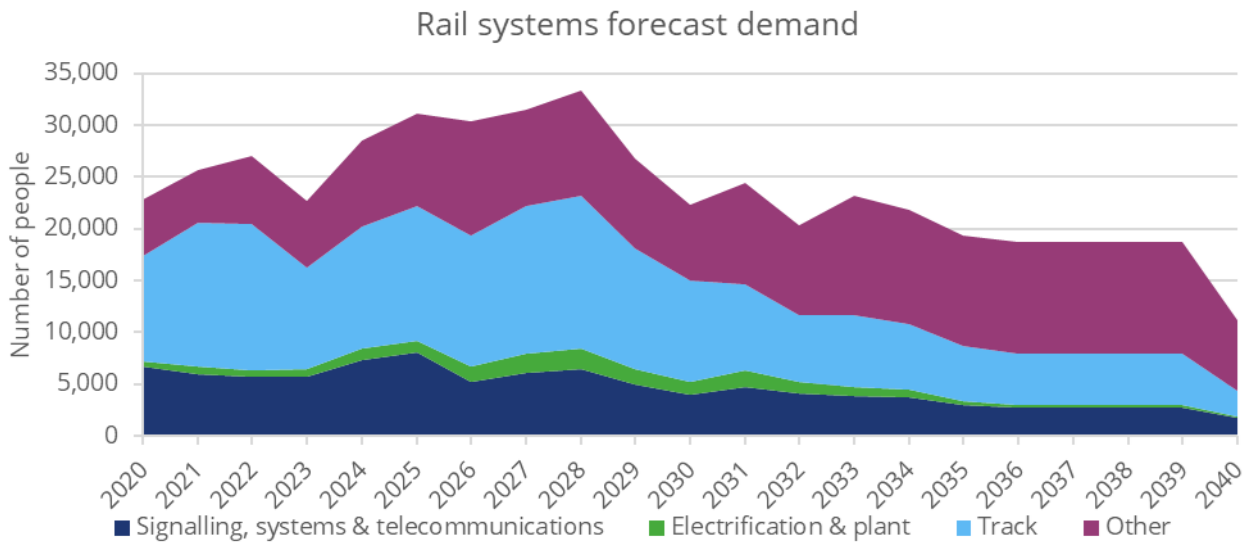


Figure 39: Labour demand forecasts for rail systems in six regions along the HS2 line of route

Figure 40 presents the forecast future labour demand for traction and rolling stock assembly and deployment. As for rail systems, the investment profile produces a fluctuating demand profile. The peaks in the early to mid-2020s and mid 2030s feature a large contribution from HS2. If HS2 was removed, the profile would remain relatively flat from 2025 onwards, decreasing slightly over time to reflect the decreasing nature of demand across the industry.

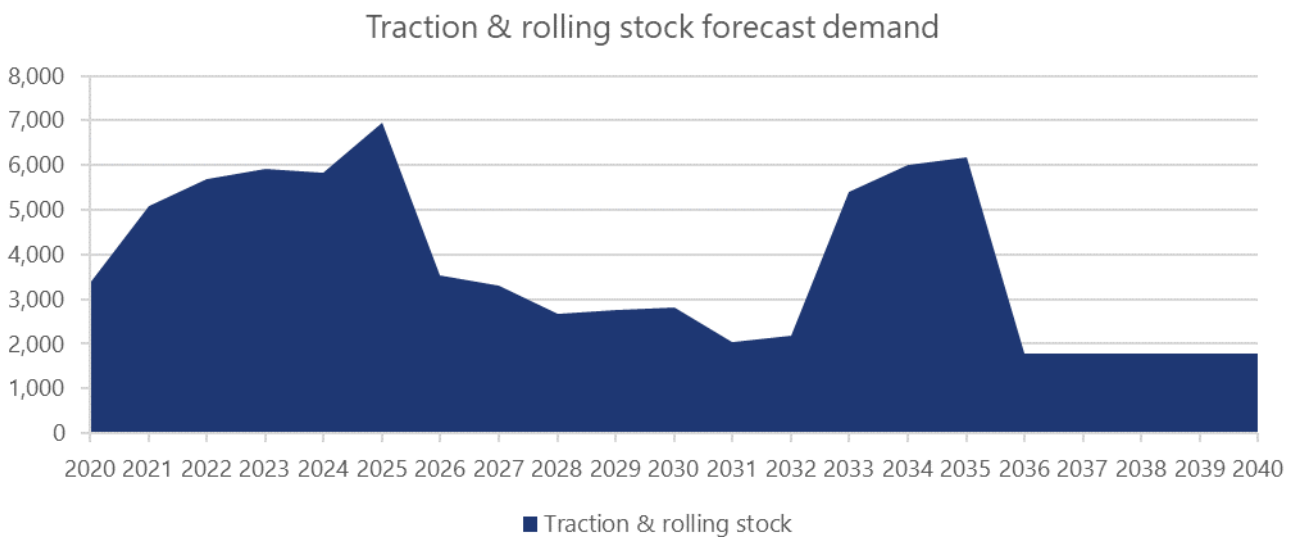


Figure 40: Labour demand forecast for traction and rolling stock manufacture, all regions of UK

## 5.4. Outflows from the rail engineering sector

For each occupational group, the current workforce (as measured by the NSAR survey in 2019) decreases each year according to an assumed outflow rate from the sector. Since the National Statistics data do not separately identify rail engineering as a sector, it is not possible to

precisely follow the approach used for the construction sector. Therefore, in rail we have used the construction historic outflow rates as a proxy for future outflows.

Occupations in the Office for National Statistics Labour Force Survey (LFS) data have been inspected and mapped to the most similar rail engineering job roles. This then allows historic outflow rates (over the period 2006–2016<sup>33</sup>) from the LFS data to be used as a proxy for future outflows in the forecast. Outflow rates for the whole rail engineering sector are 5.7% per year.

This approach implicitly assumes that factors such as the age structure of the workforce, technologies and ways of working in the rail engineering sector remain relatively unchanged in future.

Figure 41 shows that the median age of the rail investment projects workforce is 41 (this includes those classified as “uncategorised”). For maintenance and operations activities, the median age is 45, and for the rail sector as a whole the median age is 44. The median age within the sector has increased since the previous HS2 analysis carried out in 2018, reflecting a lack of investment in younger workforce members overall and a reliance on those who are already qualified or skilled.

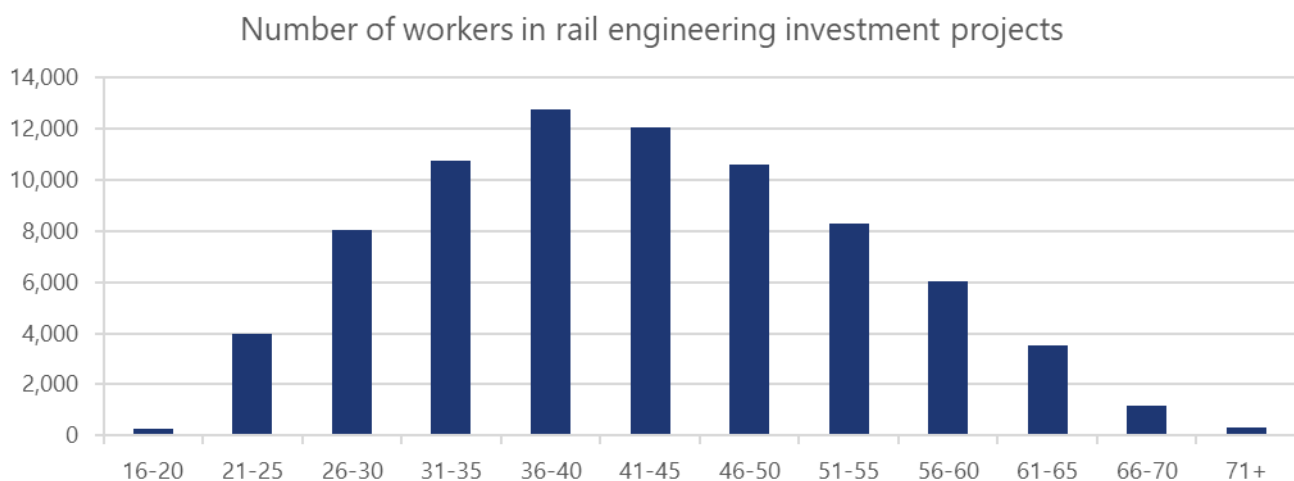


Figure 41: Number of workers in the workforce for rail investment projects by age band, 2019

Between 2021 and 2040, nearly 28,000 workers currently working in rail investment projects will reach the age of 65. It is reasonable to assume that, on average, this will reflect the age at which most of these workers will retire, as this is the current state pension age.

<sup>33</sup> As for the construction analysis, data does not exist for construction trades supervisors from 2006 and so a weighted average of relevant occupations has been used.

## 5.5. Forecast rail engineering sector labour supply

The quantitative assessment of the future supply of rail engineering labour and skills is used in the mismatch analyses, along with labour and skills demand, to determine the recruitment requirement.

A key purpose of this commission is to estimate any potential mismatches between the demand for labour and skills involved in rail engineering investment projects and their available supply.

Forecasting the future available supply of rail engineering labour and skills presents the same challenges as for the construction sector, as described in section 4.4. In addition, there are particular characteristics of railway systems and rolling stock design and manufacture that need to be taken into account.

- Rail systems activities, such as signalling design and equipment manufacture, do not take place at the site of the railway line. With the move towards digital rail systems, the trend towards a higher proportion of the work taking place off-site is likely to accelerate. As a result, the mismatch analysis between skills requirements for these activities and their availability at the level of individual regions is not as meaningful as the aggregated national picture.
- Rolling stock design and manufacture could, in principle, be based anywhere globally.

The method of calculating the available supply for rail engineering is the same as that for construction. Figure 42 shows the demand and available supply for rail systems and Figure 43 shows the same for traction and rolling stock. As for the construction sector, the available supply does take account of forecast outflows, but no assumption is made about inflows as this is addressed in the mismatch analysis section.

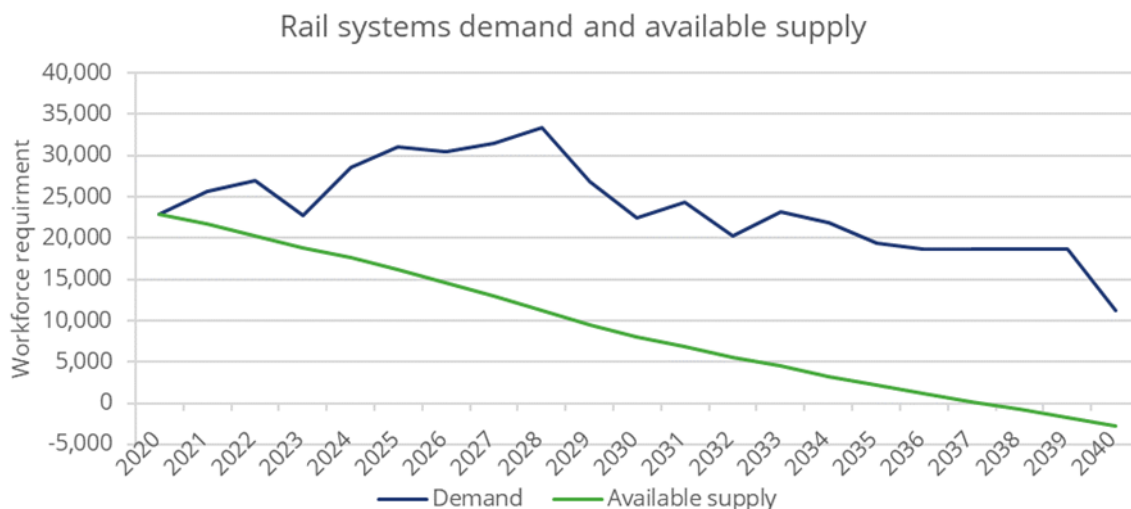


Figure 42: Rail systems sector-wide demand and available supply in six regions along the HS2 line of route



Figure 43: Traction and rolling stock sector-wide demand and available supply in six regions along the HS2 line of route

## 5.6. Quantitative assessment of the rail engineering sector gross recruitment requirement

The gross recruitment requirement (GRR) is derived from the difference between demand and available supply. This analysis assumes that the previous year's recruitment requirement is satisfied.

Figure 44 shows the GRR of labour for rail systems. This is calculated for the six regions combined through which HS2 passes. The apparent decrease in demand over time from 2024 to 2030 and then from 2033 to the end of the 2030s reflects two key features:

1. a prudent approach in the modelling to the unknown level of enhancement schemes investment beyond the mid-2020s (HS2 and other major schemes excepted); and
2. a coincidental completion of Northern Powerhouse Rail schemes at the same time as Phase 2b in the mid-to-late 2030s.

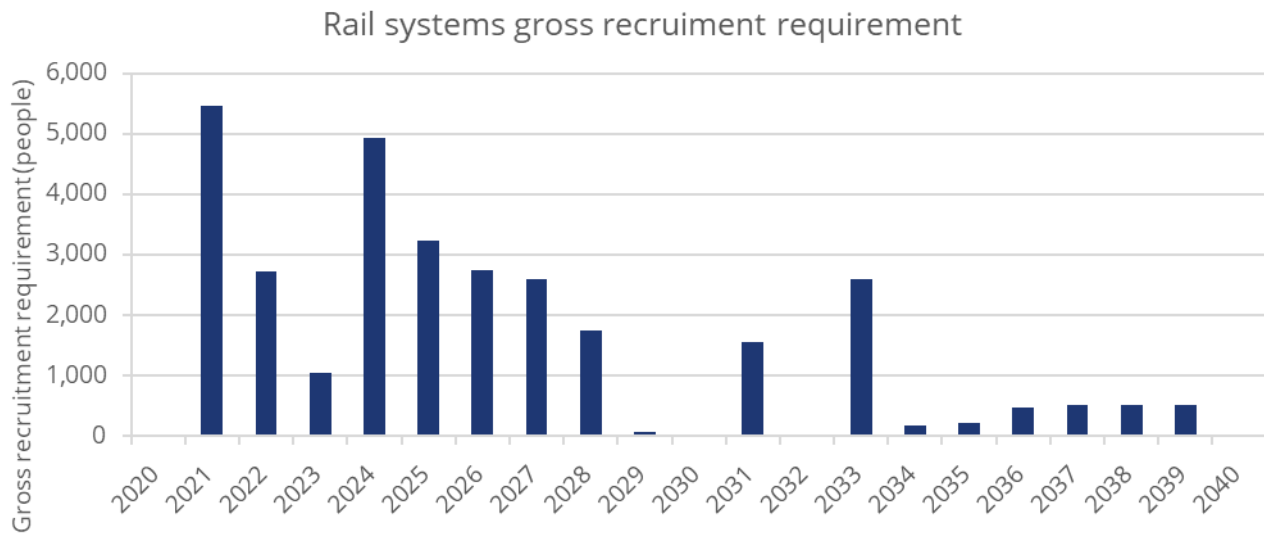


Figure 44: Rail systems sector-wide GRR in six regions along the HS2 line of route

Figure 45 provides a similar assessment of the GRR of labour for traction and rolling stock assembly and deployment. The apparent decrease of demand over time reflects a coincidental completion of a number of fleets such as New Tube for London, East West Rail and Merseyrail’s new fleet, as currently scheduled.



Figure 45: Traction and rolling stock assembly and deployment GRR sector-wide, UK-wide

The following mismatch section will make a judgement on whether this GRR can be sufficiently covered by potential inflows into the workforce on an occupational level.

## 6. Mismatch analysis

This section explores the occupations that may face a potential mismatch between sector-wide demand for labour and skills and their available supply. The mismatch analysis identifies occupations that merit more in-depth analysis to understand any potential challenges to recruitment and retention of workers. It does not provide a definitive analysis.

Figure 46 gives an overview of the sources and sinks of employed workers. The outflows have already been considered for both construction and rail engineering in earlier sections of this report. Prior to considering the mismatches in detail, the following sections take account of the known data on potential inflows.

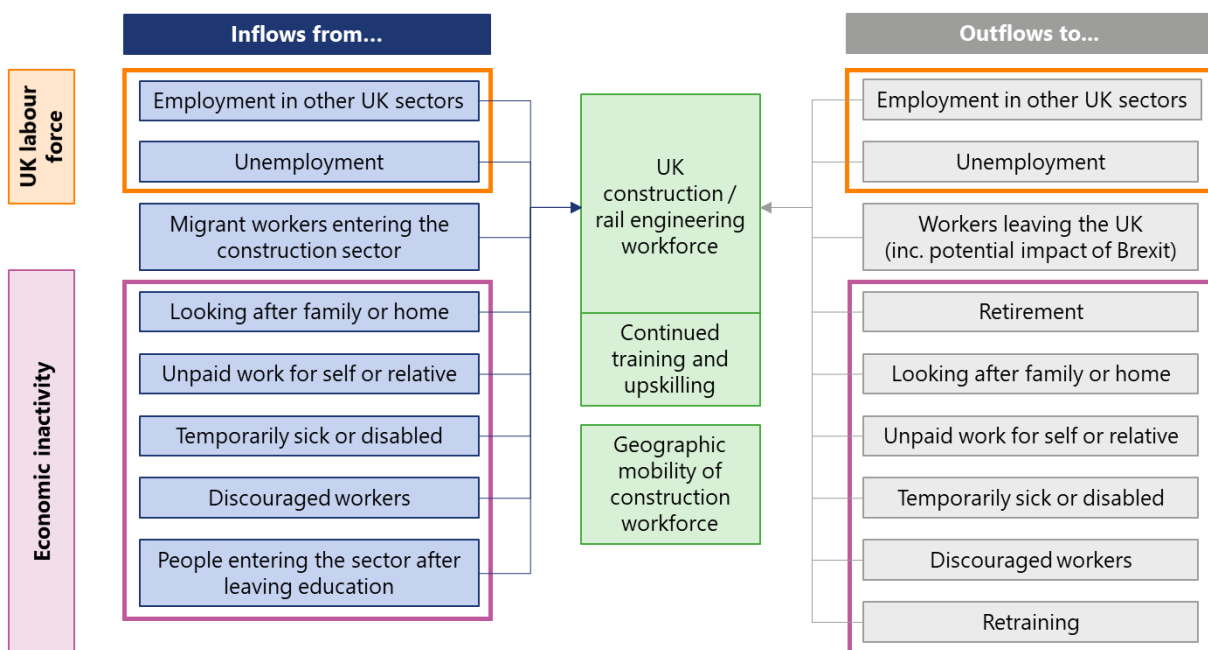


Figure 46: Sources and sinks of employed workers in the UK

The potential mismatches have been estimated using the demand and supply forecasts detailed in sections 2, 4 and 5. This analysis is performed for individual occupations. For each occupation, three main areas are explored to identify whether a mismatch might be of concern for the HS2 programme. An occupation which sees issues in all three areas suggests a mismatch issue of higher concern.

The three areas of exploration are:

1. The presence of an overall sector mismatch for the occupation.

This occurs when labour demand is larger than the available supply (after accounting for outflows). This produces a gross recruitment requirement (GRR) for that occupation. The average annual GRR is then calculated over the period 2021 to the peak demand year for that occupation. This is calculated separately for the Phases One and 2a (London, South East and West Midlands) regions and Phase 2bWL (North West). This is the '**GRR as a share of total demand**' in the mismatch scorecard.

This mismatch may be met by the annual average inflow, which is the historical inflow rate from 2006–2016. This is applied to the forecast for sector-wide demand to produce a forecast of inflows. Inflow rates are calculated using the same methodology as outflows, using data from the ONS Labour Force Survey. The inflows include flows from abroad, other industries, unemployment, and other<sup>34</sup>. The inflow data does not include those entering the sector from training. This is picked up in the deep-dive sections which follow.

2. The relative importance of the occupation to the HS2 programme. This is assessed using the following metrics from the mismatch scorecard.
  - the **'average HS2 demand'**, which is the average annual labour requirement for HS2 from 2021 until the peak of that occupation;
  - the 'average HS2 demand as a share of total construction demand'; and
  - the **'HS2 demand as a share of total HS2 labour demand'**, which gives a comparison of the demand size against total HS2 demand for the phase in question.
3. The size of the wider pool of labour in other sectors that construction sector employers might draw on. This data is not available for rail engineering.

This is portrayed by the **'construction employment as a share of employment in all sectors'** in the below mismatch scorecard. A low construction sector share suggests a large potential pool of labour and skills from other sectors, which construction sector employers could draw on. This is based on an analysis of the standard occupational classification and standard industrial classification Labour Force Survey Data from 2019<sup>35</sup>.

In addition to this, our mismatch analysis considers potential short-term underemployment (i.e. when available workers are not fully utilised) to understand the magnitude of surplus of workers arising from the economic impact of Covid-19, and to what extent they could satisfy recruitment requirements. This considers the reduction in the workforce between 2019 and 2020, which cannot be accounted for by flows out of and into the construction industry.

For relevant occupations, the mismatch analysis also reviews workers' mobility and age demographics to understand how these factors could impact the required labour supply for HS2.

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<sup>34</sup> Other is defined as unpaid work for self or relative, looking after family or home, temporarily sick or injured, long-term sick or disabled, or retired.

<sup>35</sup> It should be noted that occupations will differ in the ease with which they can transition between sectors. Roles whose skills are not sector specific, such as catering and security, will be able to move between sectors more easily than occupations such as civil engineers who develop sector-specific skills.



## 7. Construction mismatch analysis

### 7.1. Labour inflows

In the following sections, we have considered in detail three labour inflows in the construction sector:

- immigration;
- education and training; and
- mobility across UK regions.

#### 7.1.1 Immigration

Labour Force Survey/Office for National Statistics (LFS/ONS) 2019 data shows that between 2016 and 2018, there was a 28% decline in the flow of non-UK construction workers entering the UK. Brexit is likely to be a key driver behind this decline and Figure 47 below breaks down the data into EU groups and continents. Going forward, new UK immigration laws and the points-based system could further reduce the flow of construction workers entering the UK.

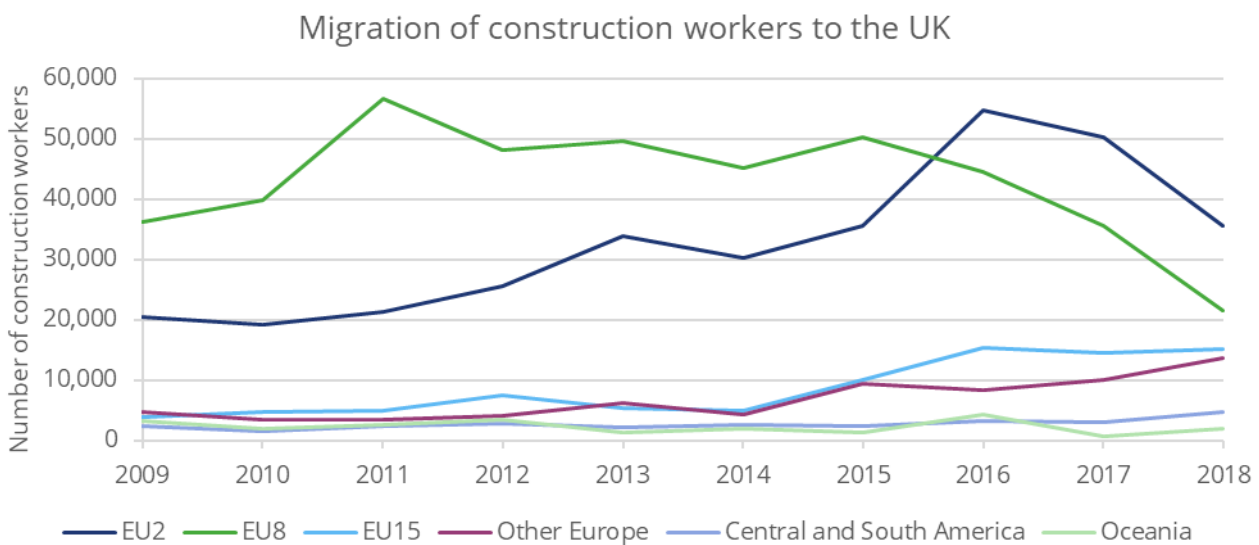


Figure 47: Construction workers of non-UK origin entering the UK by selected origins (source: ONS Labour Force Survey (2019))

Between 2016 and 2018, there has been a 52% decline in entry from EU8<sup>36</sup> and a 35% decline from EU2<sup>37</sup> countries. Conversely, since 2016, we have seen an increase in construction labour from Other Europe (66%) and Central and South America (48%). However, in absolute terms, these increases do not offset the decline in labour from the EU nations.

<sup>36</sup> EU8: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia

<sup>37</sup> EU2: Bulgaria and Romania

The CITB 2020/21 Migration Study also included a review of official migration statistics. This included reviewing data from the 2019 LFS on nationality of the UK construction workforce as shown in Table 21.

Nationality	Percent
UK	89.8
EU14	2.5
EU8	3.1
EU2	2.6
Other Europe	0.6
Rest of the world	1.4
<b>Total</b>	<b>100.0</b>

Table 21: UK's construction workforce by nationality, 2019

The Construction Industry Training Board (CITB) study also found the following.

- In 2019, four-fifths of migrant construction workers in the UK were from the EU (excluding the UK), and they comprise 8% of the total construction workforce.
- Non-UK construction workers are much younger than their UK counterparts. The LFS for 2019 indicates that 34% of the construction workforce that were UK citizens were aged 50–64 compared to 12% among non-UK citizens.
- Employers in London were significantly more likely to make use of migrant workers, as were those who work primarily as subcontractors or for the public sector. The LFS indicates that in 2019, 50% of the construction workforce in London was born outside the UK (though this is lower than the 2018 figure of 54%).
- Overseas-born construction workers with non-UK citizenship are more likely than UK-born workers or migrants with UK citizenship to work in a different region to where they live. This percentage is highest in the regions around London, suggesting they travel into London for work.
- Employers who make use of migrant labour, either directly or indirectly, were more likely to believe that both skilled and unskilled recruitment would become harder in the coming years. In fact, 23% of employers in East and South East England (including London) expect that the points-based immigration system will have an impact on their firm and 75% of employers expect the system to have an impact on the construction industry.

This indicates that the UK has some reliance on non-UK construction workers, so the impacts of Brexit and the new immigration laws are likely to cause issues for the sector's recruitment.

Since half of London's construction workforce was born outside the UK, recruitment could become more challenging in London and the South East regions. Combining this with CITB's recent mobility analysis, which suggests that the construction workforce has become less mobile since 2015, HS2 will need to consider the potential impact on recruitment and skill shortages.

### 7.1.2 Education and training

An important consideration in understanding the inflow of workers to the construction industry is the number of people undertaking relevant training. For most occupations in the construction sector, specific competence training is required. The main exceptions are plant mechanics/fitters and plant operatives, whose skills are transferable from and to other industrial sectors. Recognised qualification achievements are made up of two main strands:

1. further education, typically taking the form of national vocational qualifications (NVQs) and including apprenticeships; and
2. higher education, predominantly made up of degree and postgraduate qualifications, but also including foundation degrees, Higher National Certificates (HNCs) and Higher National Diplomas (HNDs).

Training to level 2 is a competence requirement for any operative intending to work on major construction sites, though for trades occupations, a level 3 qualification is generally required. For managerial and professional occupations, a level 4 or higher is required.

Further education is principally responsible for training at levels 2 and 3, including apprenticeships, though some colleges are now offering qualifications at level 4, mainly in association with higher education establishments. Higher education remains the principal provider of managerial and professional undergraduate and postgraduate degree qualifications, including civil engineering courses.

Figure 48 (below) shows higher education achievements for UK-domiciled students. There is a lag between enrolments and achievements due to the length of courses. A typical undergraduate degree takes three years, so the impact of fee increases for the 2012/13 cohort was not seen until 2015/16, contributing to a reduction of 34% in first degree and other undergraduate construction achievements since 2010/11. The data shows a 19% decline in civil engineering first degree achievements between 2010/11 and 2018/19.

However, construction achievements, including civil engineering, have gradually been increasing since 2017/18. This could reflect the positive impact of university quotas being lifted and the greater access to student financing that was introduced shortly after the fee increases in 2012/13.

Furthermore, the current recession could lead to an increase in university enrolments and the pool of relevant graduates. For instance, a recent UCAS study<sup>38</sup> showed that the 18-year-old entry rate at UK universities rose to a record 37% in 2020, up from 34% in 2019. The report suggests that university enrolments increased in 2020, partly due to students viewing higher education as a more desirable option during the recession and partly due to the government increasing capacity across university courses.

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<sup>38</sup> 'What happened to the Covid cohort?', UCAS, 2020

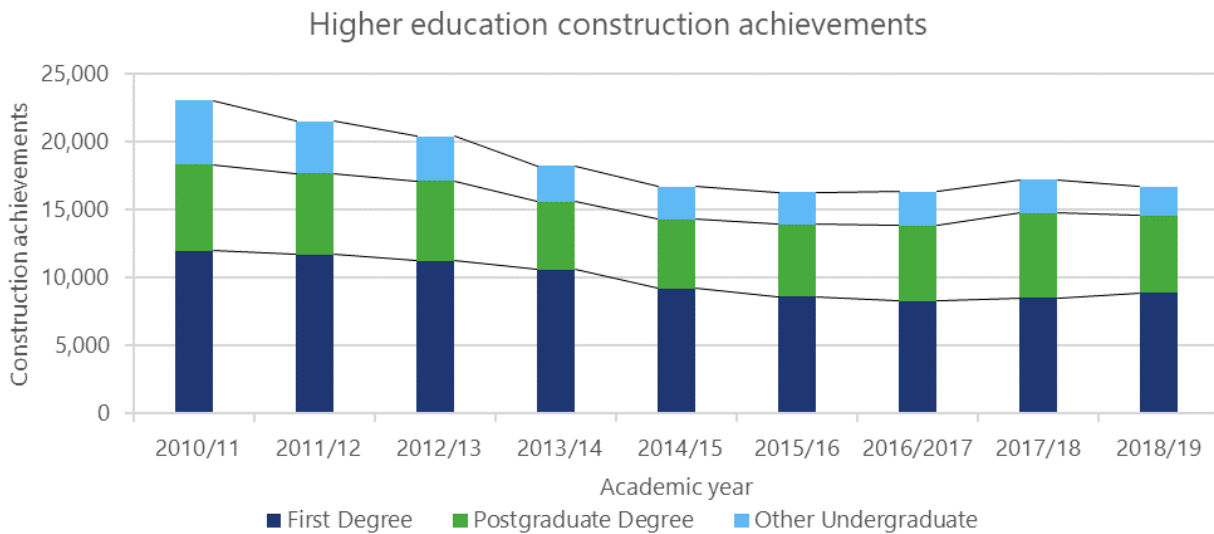


Figure 48: Training overview, higher education – first degree, postgraduate degree and other undergraduate construction achievements 2010/11 to 2018/19 (source: HESA)

Recruitment of higher education graduates could present less of a challenge for HS2, especially as the number of UK-domicile achievements from civil engineering courses has been rising since 2017/18. It is possible that Covid-19 could cause an increase in the number of university achievements as young people view higher education as a safe option during the recession.

Figure 49 provides a breakdown of construction and related subjects at level 2+ qualification certifications issued per year between 2012/13 and 2020/21. The majority of construction qualifications are at level 2 (56%) or level 3 (40%). However, between 2012 and 2016, level 2 achievements fell by 19%, while level 4+ achievements rose by 72%.

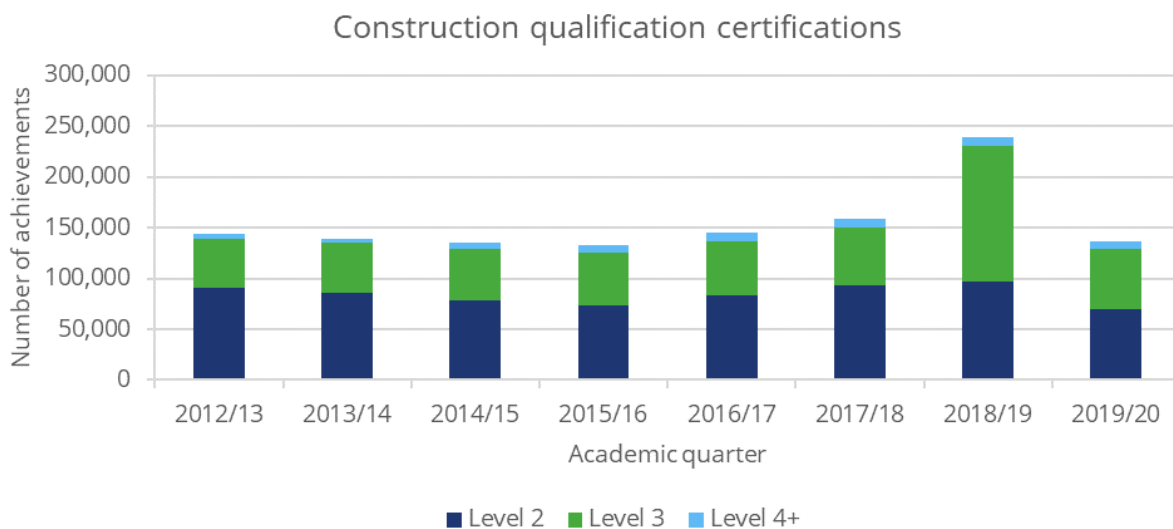


Figure 49: Construction and related subjects, level 2+ qualification certifications issued per year from Q4 2012 to Q3 2020 (source: Ofqual vocational qualification dataset)

Between 2016 and 2019, level 2 achievements rose by 16%. Between Q4 2017 and Q3 2019, the dramatic spike of 134% for level 3 achievements was due to the introduction of new electrical

installation regulations and requirements for competence certification (on-going continuous professional development [CPD]). Practising electricians must comply with the regulations for electrical work, resulting in a sharp increase in relevant level 3 courses associated with this occupation.

Lastly, between 2019 and 2020, there was a decline in certifications across all levels, which could be due to the closure of colleges during the Covid-19 lockdowns. Level 3 achievements more than halved (56% reduction) during these periods, which could be due to the impacts of Covid-19 and the fact that the required courses for level 3 achievements associated with electrical occupations were delivered by CPD in 2018/19.

This analysis suggests that Covid-19 could result in a short-term reduction in the number of construction achievements and, therefore, have a potential impact on the supply of labour with relevant qualifications for HS2.

### 7.1.2.1 Qualifications in the construction workforce

Table 22 shows that the levels of highest qualification varies by occupation. For the occupations involved in design services and management of construction roles, the main qualification is at level 4 and above. For the construction operative occupations, there are far smaller percentages of the workforce qualified at level 4 and above, with most being qualified at levels 2 and 3. When comparing the 2018/19 data with 2015/16 qualification data, the overall profile remains largely unchanged.

	Design and construction management	Construction operatives
First degree	29%	4%
<b>Level 4 and above (including first degree)</b>	<b>61%</b>	<b>11%</b>
Level 3	13%	20%
Trade apprenticeships	4%	13%
Level 2	10%	16%
<b>All with NVQ level 2 and above</b>	<b>87%</b>	<b>60%</b>
Below level 2	7%	14%
Other qualifications	4%	14%
No qualifications	2%	11%

Table 22: Qualifications profile of UK construction workforce, 2018/19 (source: ONS Labour Force Survey (2019))

The distribution of qualifications and the levels of achievement can vary depending on location and occupation. Training at levels 2 and 3 is delivered by a range of organisations from further education colleges through to private training providers, employers and training groups. A significant number of these training organisations are operating and delivering training in close proximity to the HS2 route, with particular concentrations based around the major urban conurbations of London, Birmingham, Manchester, Sheffield and Leeds.

### 7.1.2.2 Apprenticeships (further education)

For construction operatives, apprenticeships is one of the main routes for new entrants into the sector, especially learners aged 16 to 24<sup>39</sup> entering from school or further education. Construction apprenticeships typically take around two years to achieve a level 2 qualification, and another year to progress to level 3.

When considering the data, it should be noted that new policies have been introduced in the field of apprenticeships in England including:

- the establishment of the Institute for Apprenticeships;
- the introduction of the Government Apprentice Levy in 2017;
- the replacement of Frameworks by Standards; and
- changes to government funding policy.

These changes have influenced apprenticeship starts since 2017. However, the headline numbers of around 25,000 in 2017/18 and 2018/19 are consistent with the numbers outlined in our previous report.

### 7.1.2.3 Apprenticeship vacancies

Figure 50 (below) shows apprenticeship vacancy and advert numbers for all sectors. The Covid-19 pandemic has had a considerable impact on recruitment. There was a significant drop in adverts and vacancies between March and May 2020 coinciding with the first national lockdown. A partial recovery was seen from May following an easing of lockdown. However, numbers have not returned to previous levels due to continued uncertainty. The lockdown introduced in January 2021 is likely to cause a further reduction in recruitment numbers during this period.

While Covid-19 could reduce apprenticeship numbers, the pandemic could also create a potential pool of unemployed labour that could work in construction in the coming years.

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<sup>39</sup> The Department for Education data shows that for 2019/20, construction learners aged 16–24 accounted for 83% of all apprenticeship starts. Construction had the largest share of apprenticeship starts for learners aged 16–24 when compared to any other main sector subject area.

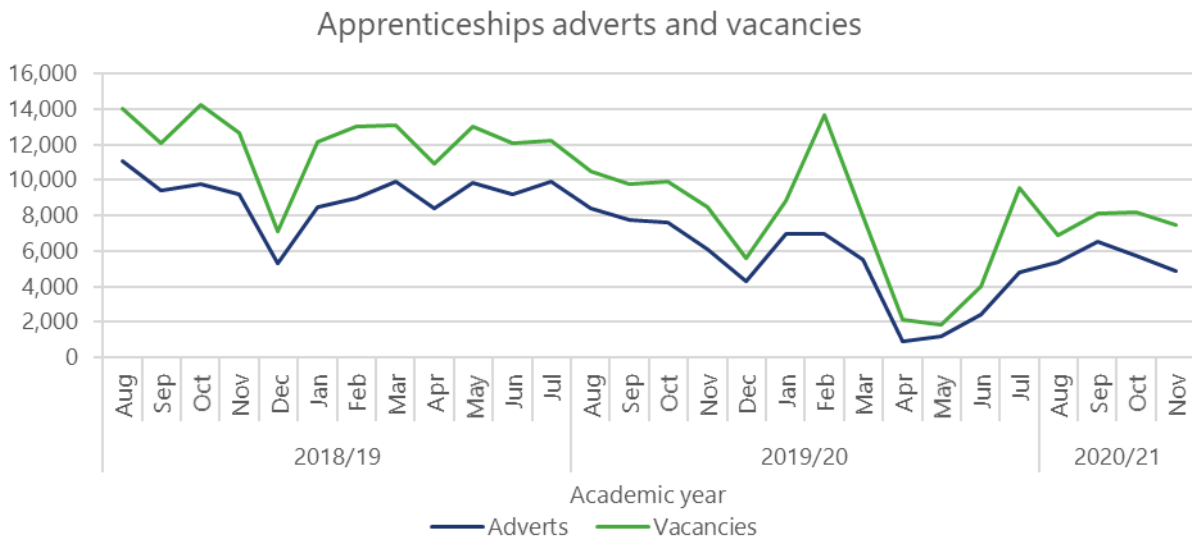


Figure 50: Apprenticeship adverts and vacancies, all sectors

#### 7.1.2.4 Skills gaps

The Department for Education’s Employer Skills Survey 2019<sup>40</sup> shows that construction faced skills gap issues. The study revealed that 38% of construction vacancies were classed as skill-shortage vacancies. Across all sectors, employers citing skill-shortage vacancies stated that it was due to a lack of both technical and practical skills and people and personal skills among applicants.

The study also showed that 47,300 skills gaps were reported for construction’s existing workforce in 2019, suggesting that 4% of the sector was classed as ‘not proficient’ at their job. Skills gaps can arise due to employers not being able to find suitably skilled applicants, or intentionally taking on recruits who are not fully experienced in order to train them. But gaps can also arise for other reasons such as the skills needed within an organisation changing.

A lack of skills can be addressed by training, but the number of employers providing training in England fell from 66% in 2017 to 61% in 2019, (Employer Skills Survey, 2019). Compared to all other sectors, construction had the lowest proportion of staff trained, at 48% of the sector’s workforce (equivalent to around 600,000 people), down from 52% in 2015. These results are partly driven by company size, where construction has a high proportion of companies with two to four employees with around 40% of the sector self-employed.

#### 7.1.3 Mobility within the UK

Figure 51 provides an indication of the extent to which the workforce in the UK construction sector is willing to travel to work. CITB’s ‘Workforce Mobility and Skills in the UK Construction Sector 2018/19’ study shows that the construction sector became less mobile between 2015

<sup>40</sup>[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/955172/Employer\\_skills\\_survey\\_2019\\_research\\_report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/955172/Employer_skills_survey_2019_research_report.pdf)

and 2018. For instance, the 2018 study shows that 67% of survey respondents had travelled on average no more than 20 miles to their current site, compared to 62% in 2015.

Similarly, those who had not travelled further than 20 miles to site increased from 20% in 2015 to 26% in 2018, which, again, suggests that workers have become less mobile. Furthermore, the proportion of workers travelling more than 100 miles for their furthest distance worked dropped from 21% in 2015 to 17% in 2018.

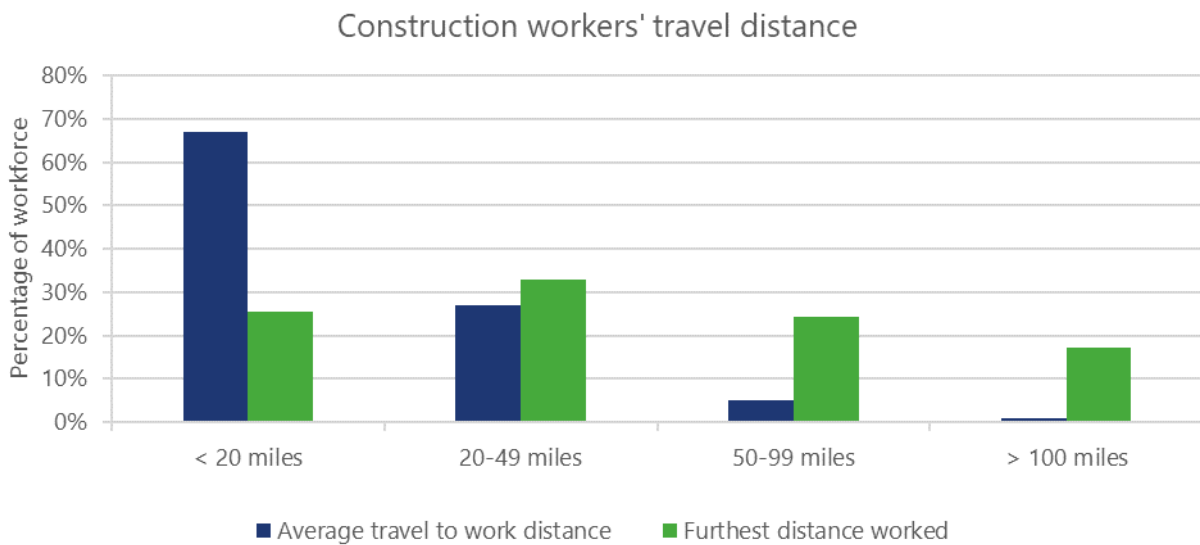


Figure 51: UK construction workers' travel distance (source: CITB, 2018)

Despite relatively short average distances to work, construction workers are willing to travel further distances when required. Figure 51 also shows the distance from workers' current residence (including temporary residences) to their current site of work compared with the furthest distance worked from their permanent/current home. Only 26% of all construction workers have worked no more than 20 miles away from home, but a further 33% have worked between 20 and 49 miles away, while 41% have travelled at least 50 miles.

To examine differences in mobility between regions, Table 23 (below) shows the region/nation workers are currently working in, compared to the region/nation of their last site of work. More details on this table, showing inter-region flows, are given in Appendix E. This indicates that there are some regions from which people are less likely to travel to work in a neighbouring region. The North West (91%) and North East (90%) are particularly notable in this regard.

In the South East, 38% of the workforce have travelled to a neighbouring region for their latest job. Unsurprisingly, a large volume of workers currently working in the South East cited London as their last site of work (14%). The dynamic between the South East and London is also quite pronounced in the opposite direction, with 16% of people currently operating in London citing the South East as their previous site of work.

The East of England also holds a strong relationship with London and the South East, with 31% of workers currently working in the East of England citing London as their last site and 11%



citing the South East as their last site. This suggests some fluidity between these three regions, which is different from most other regions of the UK.

There is a greater proportion of workers currently working in the same region/nation of their last site compared to the level reported in 2015. This further supports the argument that the construction workforce has become less mobile over the last few years.

Region/nation of last site	Percentage of workforce working in the region who also worked in the region on their last site
East Midlands	79
East of England	52
London	73
North East	90
North West	91
Northern Ireland	93
Scotland	98
South East	62
South West	81
Wales	88
West Midlands	71
Yorkshire & the Humber	83

Table 23: Construction workers region/nation of last site before this current site (source: CITB, 2018)

Figure 52 shows the change in apprenticeship starts across the regions on the HS2 route.

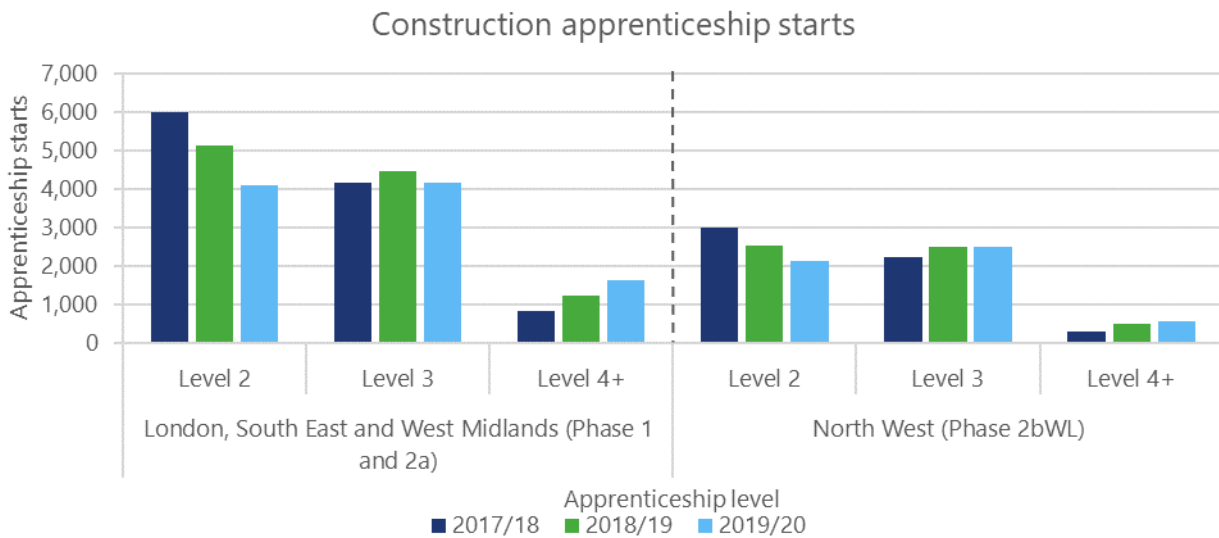


Figure 52: Construction apprenticeship starts, by level and regions along the HS2 line of route per phase (source: Department for Education)

On average, between 2017/18 and 2019/20, 47% of apprenticeship starts were at level 2, and 43% at level 3. However, across this three-year period, 40% of apprenticeship starts in the Phase One and 2a regions were at level 3 compared to 45% in the North West region.

The number of starters on level 2 courses, which includes a range of construction trades and civil engineering operatives, has been declining. For instance, between 2017/18 and 2019/20, level 2 starts fell by 32% across London, South East and West Midlands, and by 29% in the North West. This suggests that the change in apprenticeship policies discussed above could have had a slightly greater impact in the South of England compared to the North.

Starts on level 3 courses have remained relatively stable across all of the regions for the period 2017/18 to 2019/20. Although the number of starts on level 4+ courses has been gradually increasing, it remains low in absolute terms.

Covid-19 could compound the decline in apprenticeship starts, but it is also causing an increase in unemployment. An increase in the number of unemployed creates a potential pool of labour that could work in construction in the coming years. This is either because they are existing workers that have become unemployed, or they are people looking to re-train and work in construction for the first time.

#### 7.1.4 Changing trends

The earlier sections review some of the factors that may cause future UK construction sector inflows and outflows to differ from their historic rates: the demographic profile of the construction workforce, its mobility between UK regions and international migration flows. The analysis here shows that Brexit and Covid-19 are likely to create recruitment challenges for the construction industry.

When comparing our latest analysis with previous analyses – which was covered in the ‘HS2 labour and skills demand and supply forecasting and analysis 2018’ report – it is clear that both Brexit and Covid-19 have impacted the picture for construction.

- The number of construction workers entering the UK from EU8<sup>41</sup> nations grew by 39% between 2009 and 2015. However, between 2016 and 2018, mainly due to Brexit, the number of construction workers entering the UK from EU8 nations fell by 52%.
- Apprenticeship starts across the HS2 regions increased by around a third between 2012/13 and 2015/16, whereas apprenticeship starts across the regions on the HS2 route declined by 3% between 2017/18 and 2019/20. This is partly due to the policies in the field of apprenticeships changing since 2017 (discussed in section 7.1.2.2), but also because it is anticipated that fewer apprenticeships will be available as a result of Covid-19.
- Higher education construction achievements declined between 2011/12 and 2014/15, but this trend has reversed. Possibly as a result of university quotas being lifted and greater access to student financing, first degree construction achievements increased by 3% between 2015/16 and 2018/19. The pandemic could result in more university enrolments and therefore achievements, as higher education is often viewed as a viable option for 18-year-olds during recessions.

Over the medium to longer term, HS2’s recruitment challenges could stem from the other factors discussed above, including an ageing construction workforce or even competing with other construction projects for the industry’s labour.

Furthermore, new UK immigration laws could constrain net migration with a knock-on effect on skills issues and potential labour supply across the sector. To combat the effects of both the immediate and future recruitment challenges, HS2 will have to consider how it can attract and retain the necessary workforce.

For instance, new UK immigration laws could constrain net migration with a knock-on effect on skills issues and potential labour supply across the sector.

The challenges presented by Brexit and Covid-19 to recruitment and skills for the general construction industry, and HS2 in particular, are discussed in further detail in the mismatch sections.

## **7.2. Construction mismatch analysis – Phases One and 2a**

For this analysis, we have considered the availability of labour in the three main regions through which Phases One and 2a pass. This comprises London, South East and West Midlands. The mismatch analysis for construction in Phases One and 2a is summarised in a scorecard in Appendix F.

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<sup>41</sup> EU8: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia

The assessment of each occupation using the above criteria has produced a shortlist of construction occupations, listed in Table 24, which warrant further investigation to understand whether HS2 may anticipate recruitment challenges. These priority occupations (shown in red in both Appendix F and Table 24) are:

- labourers (nec<sup>42</sup>);
- scaffolders;
- construction trades supervisors;
- steel erectors/structural fabrications;
- plant operatives;
- civil engineering operatives (nec); and
- civil engineers.

In addition, the following occupations are identified as being of lower priority, but could benefit from more detailed analysis (shown in amber in both Appendix F and Table 24):

- non-construction professional, technical, IT and other office-based staff;
- logistics;
- plant mechanics/fitters; and
- non-construction operatives.

Each of the occupations listed above are considered in more detail in the following section.

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<sup>42</sup> Not elsewhere classified

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Occupational group	Average total construction demand (2021-peak)	Average gross recruitment (2021-peak)	GRR as a share of total construction demand (2021-peak)	Average HS2 demand (2021-peak)	Average HS2 demand as a share of total construction demand	HS2 demand as a share of total HS2 labour demand (2021-peak)	Potential forecast inflows as a share of average construction demand (2021-peak)	Construction employment as a share of employment in all sectors (2019)
Labourers (nec)	49,000	10,500	21%	1,900	4%	9%	14%	81%
Scaffolders	6,200	700	11%	200	3%	1%	5%	92%
Construction trades supervisors	20,700	2,300	11%	900	4%	4%	5%	48%
Steel erectors/structural fabrication	7,900	800	10%	400	5%	2%	5%	18%
Plant operatives	13,400	1,800	14%	1,200	9%	5%	6%	28%
Civil engineering operatives (nec)	6,100	900	15%	2,400	39%	11%	10%	43%
Civil engineers	20,000	1,600	8%	900	5%	4%	3%	71%
Non-construction professional, technical, IT and other office-based staff	176,100	18,600	11%	3,100	2%	14%	8%	5%
Logistics	11,200	2,100	19%	300	3%	2%	10%	4%
Plant mechanics/fitters	14,900	1,400	9%	1,000	7%	4%	10%	9%
Non-construction ops (nec)	13,000	1,400	10%	800	6%	4%	8%	3%

Table 24: Construction mismatch scorecard: shortlisted occupations – Phases One and 2a

### 7.2.1 Covid-19 and low migration scenario impacts

Table 25 (below) shows the demand impact that each of the alternative construction sector scenarios (the mild and severe Covid-19 scenarios and low-migration scenario) would have for the priority occupations outlined above. This is done by calculating the average total construction demand and average gross requirement recruitment (GRR) under the three alternative scenarios.

The general trend for the occupations mentioned in Table 25 is as follows.

- The mild scenario results in stronger construction output compared to the baseline, which boosts demand for construction workers as employment increases to meet this output. This demand increase would increase the GRR.
- The severe scenario results in a weaker construction output compared to the baseline. This results in a reduction in the demand for construction workers, which in turn reduces the recruitment pressure on labour.
- The low migration scenario has a similar trend and rationale to the severe scenario, but a smaller magnitude. This generally presents itself as a small decrease in construction sector labour demand.

For example, for the construction trades supervisor occupation, the mild scenario increases the recruitment requirement by 22% compared to the baseline. And weaker demand in the severe and low migration scenarios reduces the GRR by 17% and 4%, respectively, compared to the baseline.

Occupational group	Baseline average annual construction demand (2021–peak)	Baseline average GRR (2021–peak)	Change in recruitment requirement vs baseline		
			Mild Covid-19 scenario	Severe Covid-19 scenario	Low migration scenario
Construction trades supervisors	20,700	2,300	500 (22%)	-400 (-17%)	-100 (-4%)
Scaffolders	6,200	700	100 (14%)	-100 (-14%)	-100 (-14%)
Plant operatives	13,400	1,800	200 (11%)	-200 (-11%)	-100 (-6%)
Steel erectors/ structural fabrication	7,900	800	100 (13%)	-200 (-25%)	0 (0%)
Labourers (nec)	49,000	10,500	1,200 (11%)	-700 (-7%)	-100 (-1%)
Civil engineering operatives (nec)	6,100	900	100 (11%)	-100 (-11%)	0 (0%)
Civil engineers	20,000	1,600	-100 (-6%)	-700 (-44%)	-400 (-25%)

Table 25: Comparison of occupational demand and recruitment requirement between baseline and alternative scenarios

## 7.2.2 Priority occupations for further analysis

### 7.2.2.1 Labourers not elsewhere classified

The labourers not elsewhere classified (nec) occupation includes all workers classified as being in elementary construction occupations. Table 26 summarises the mismatch analysis criteria for labourers in Phase One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase One and 2a regions</b>	
Average total construction sector demand (2021–2022)	49,000
Average GRR (2021–2022)	10,500
GRR as a share of total construction sector demand (2021–2022)	21%
Average HS2 demand (2021–2022)	1,900
HS2 demand as a share of total construction sector demand	4%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2022)	6,900
Potential forecast inflows as a share of average construction sector demand	14%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of labourers working in construction, as a share of this occupation in all industries (2019)	81%
<b>Actual training data – Phase One and 2a regions</b>	
Training achievements, including further education and apprenticeships (2019/20)	N/A <sup>43</sup>
Apprenticeship starts (2019/20)	N/A <sup>44</sup>

Table 26: Mismatch analysis criteria for labourers – Phases One and 2a

Based on HS2 demand timings, 2022 is the peak demand year for labourers. Labourers have been identified as a priority occupation for the mismatch analysis, because between 2021 and 2022 in Phases One and 2a regions:

- the GRR (21%) significantly exceeds the average GRR (9%) across all 28 occupational groups. This suggests that 21% of sector-wide demand for labourers will need to be recruited to satisfy the recruitment requirement;
- average HS2 demand for this occupation is 4% of all labourers, which marginally exceeds HS2's total average demand for workers across the 28 occupational groups (3%); and
- average HS2 demand for this occupation is 8% of the total HS2 workforce, which exceeds the overall average of this metric (4%).

<sup>43</sup> There are no further education achievements or apprenticeship starts directly linked to this occupation.

<sup>44</sup> There is no general labouring apprenticeship, however potential cross-over with construction operatives, which we include in the civil engineering operative figures.



The above points suggest that labourers could create recruitment challenges, particularly given the strong recruitment requirement and percentage of total HS2 workforce.

As shown in Appendix G, following 2022 there is a linear decline in demand up to 2029. By 2025, there is a HS2 demand for around 1,200 labourers, which is approximately 3% of this occupation's total construction workforce in the regions.

In the wider construction sector, there is an average GRR of 10,500 construction trades supervisors per year. This means that the construction sector will need to recruit approximately 21% of sector-wide demand each year, which is the highest recruitment requirement across all 28 occupation groups as mentioned above. Table 27 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 14% of total construction sector demand, suggesting a recruitment shortage.	Up to 66%
Training	There are no further education achievements or apprenticeship starts directly linked to this occupation. The pool of workers available to recruit is not therefore restricted to those people possessing particular qualifications.	n/a
Other industries	There is a small proportion of labourers working in other industries; 2019 UK-wide LFS data shows that 81% <sup>45</sup> of all labourers work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a surplus of 1,200 labourers who are potentially underemployed.	Up to 11%

Table 27: Potential methods of satisfying the recruitment requirement for labourers – Phases One and 2a

No single method is likely to satisfy the recruitment requirement as a whole and therefore a combination of these methods will be required for HS2. There are some additional considerations in relation to this occupation.

- LFS 2019 data shows that 16% of labourers are aged 55+, compared with a sector average of 21% for all skilled trades occupations. However, this figure has gradually risen over recent years, up from 8% in 2012 and 10% in 2016. This indicates that retirement rates for this occupation may continue to increase in the future, potentially increasing the outflow rate.

<sup>45</sup> The 81% figure represents labourers working in construction as a percentage of this occupation working in all industries.

- Labourers has been flagged as an occupation that could face recruitment challenges across all three supply regions in Phases One and 2a; with the West Midlands having the highest GRR (23%), compared to London (21%) and the South East (20%).

Labourers could present the most severe recruitment challenges for Phases One and 2a. Along with this occupation having the highest GRR rate compared to all other occupations in Phases One and 2a, none of the above methods will individually satisfy this recruitment requirement.

Also, 81% of all labourers work in construction and, therefore, there is little scope to recruit from other industries. However, while no specific training courses are directly linked to this occupation, there could be unidentified workers with relevant skills and qualifications that could satisfy some of this recruitment requirement.

### 7.2.2.2 Scaffolders

Table 28 summarises the mismatch analysis criteria for scaffolders in Phases One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase One and 2a regions</b>	
Average total construction sector demand (2021–2022)	6,200
Average GRR (2021–2022)	700
GRR as a share of total construction sector demand (2021–2022)	11%
Average HS2 demand (2021–2022)	200
HS2 demand as a share of total construction sector demand	3%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2022)	300
Potential forecast inflows as a share of average construction sector demand	5%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of scaffolders working in construction, as a share of this occupation in all industries (2019)	92%
<b>Actual training data – Phase One and 2a regions</b>	
Training achievements, including further education and apprenticeships (2019/20)	530
Apprenticeship starts (2019/20)	40

Table 28: Mismatch analysis criteria for scaffolders – Phases One and 2a

Based on HS2 demand timings, the peak demand year for scaffolders is 2022. Scaffolders have been identified as a priority occupation for the mismatch analysis, because between 2021 and 2022 in the Phase One and 2a regions:

- its GRR (11%) exceeds the average GRR (9%) across the 28 occupational groups; and
- average HS2 demand for this occupation marginally exceeds HS2's total average demand for workers across the 28 occupational groups.

The above points suggest that scaffolders could create recruitment challenges, mostly due to a strong recruitment requirement across the sector.

As shown in Appendix G, following the demand peak in 2022 there is a gradual decline in demand up to 2031. In 2025, HS2 will demand around 100 scaffolders, which is approximately 2% of this occupation's total construction workforce in the regions.

In the wider construction sector, there is an average GRR of 700 scaffolders per year. This means that the construction sector will need to recruit approximately 11% of sector-wide demand each year. Table 29 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 5% of total construction sector demand, suggesting a recruitment shortage.	Up to 43%
Training	Training for scaffolders mainly occurs at both further education and apprenticeship levels. In the Phases One and 2a regions in 2019/20, training achievements numbered 530 for this occupation, inclusive of apprenticeships.	Up to 76%: if all trained workers choose to work in the construction sector
Other industries	Small potential to further recruit from other industries, as 2019 UK-wide LFS data shows that 92% <sup>46</sup> of all scaffolders work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a surplus of 200 scaffolders that are potentially underemployed.	Up to 29%

Table 29: Potential methods of satisfying the recruitment requirement for scaffolders – Phases One and 2a

No single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods will be required for HS2. While all three Phase One and 2a

<sup>46</sup> The 92% figure represents scaffolders working in construction as a percentage of this occupation working in all industries

regions have similar GRRs for scaffolders, the South East is the region likely to face the most significant recruitment challenges due to the wider occupational requirements in that region.

The analysis above suggests that the scaffolders occupation could create more significant recruitment challenges in Phases One and 2a compared to several other occupations discussed in this section. No individual recruitment method can completely satisfy this occupation's recruitment requirement and there is almost no scope to recruit scaffolders from other industries, as 92% of this occupation work in construction. With training achievements satisfying up to 76% of the recruitment requirement for scaffolders, a continued supply of new workers through training might mitigate some of this occupation's recruitment challenges.

### **7.2.2.3 Construction trades supervisors**

The construction trades supervisors occupation includes both construction and building supervisors, and skilled metal, electrical and electronic trades supervisors. Table 30 summarises the mismatch analysis criteria for this occupation in Phases One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase One and 2a regions</b>	
Average total construction sector demand (2021–2022)	20,700
Average GRR (2021–2022)	2,300
GRR as a share of total construction sector demand (2021–2022)	11%
Average HS2 demand (2021–2022)	900
HS2 demand as a share of total construction sector demand	4%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2022)	1,100
Potential forecast inflows as a share of average construction sector demand	5%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of construction trades supervisors working in construction, as a share of this occupation in all industries (2019)	48%
<b>Actual training data – Phase One and 2a regions</b>	
Training achievements, including further education and apprenticeships (2019/20)	2,070
Apprenticeship starts (2019/20)	10 <sup>47</sup>

Table 30: Mismatch analysis criteria for construction trade supervisors – Phases One and 2a

Based on HS2 demand timings, the peak demand year for construction trades supervisors is 2022. Construction trades supervisors have been identified as a priority occupation for the mismatch analysis, because between 2021 and 2022 in Phase One and 2a regions:

- its GRR (11%) exceeds the average GRR (9%) across the 28 occupational groups; and
- average HS2 demand for this occupation is 4% of all construction trades supervisors, which marginally exceeds HS2’s total average demand for workers across the 28 occupational groups (3%).

<sup>47</sup> Apprenticeship courses have been transitioning from framework to standards since 2017. Framework courses for this particular occupation cannot be identified.

The above points suggest that construction trades supervisors could create recruitment challenges largely due to this occupation's strong recruitment requirement across the sector.

As shown in Appendix G, following the demand peak in 2022 there is a linear drop off in demand up to 2030. By 2025 there is a HS2 demand for around 600 construction trades supervisors in the Phase One and 2a regions. This is approximately 2% of this occupation's total construction workforce.

In the wider construction sector, there is an average GRR of 2,300 construction trades supervisors per year. This means that the construction sector will need to recruit approximately 11% of sector-wide demand each year. Table 31 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 5% of total construction sector demand, suggesting a recruitment shortage.	Up to 48%
Training	Training for construction trades supervisors mainly occurs at both further education and apprenticeship levels. In the Phase One and 2a regions, training achievements in 2019/20 numbered 2,070 for this occupation, inclusive of apprenticeships.	Up to 90%: if all trained workers choose to work in the construction sector
Other industries	Significant potential to further recruitment from other industries, as 2019 UK-wide LFS data shows that only 48% <sup>48</sup> of all construction trade supervisors work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a surplus of 700 construction trade supervisors that are potentially underemployed.	Up to 30%

Table 31: Potential methods of satisfying the recruitment requirement for construction trade supervisors – Phases One and 2a

No single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods will be required for HS2. There are some additional considerations in relation to this occupation.

- LFS 2019 data shows that, in 2019, around 25% of UK construction and building trade supervisors were migrants. New UK immigration laws could have an impact on the supply of construction trades supervisors.
- The GRR for this occupation is more significant in the South East (14%) and the West Midlands (13%), which suggests that these regions could face more significant recruitment challenges than London (9%).

<sup>48</sup> The 48% figure represents construction and building supervisors and skilled metal, electrical and electronic trades supervisors working in construction as a percentage of these occupations working in all industries.

With this occupation's strong training achievements potentially satisfying up to 90% of the recruitment requirement, and good scope to recruit for this occupation from other industries, we are of the view that construction trades supervisors will present less of a recruitment challenge compared to the some of the other occupations discussed.

Given there is no guarantee that all relevant trained workers will choose to work in construction, a continued supply of new workers, combined with consideration of how to attract the 52% of construction trades supervisors in other sectors into construction, could overcome these recruitment challenges.

#### **7.2.2.4 Steel erectors/structural fabrication**

The steel erectors/structural fabrication occupation includes roles such as steel erectors, welding trades, metal plate workers, smiths and forge workers, and metal machining setters. Table 32 summarises the mismatch analysis criteria for this occupation in Phases One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase One and 2a regions</b>	
Average total construction sector demand (2021–2023)	7,900
Average GRR (2021–2023)	800
GRR as a share of total construction sector demand (2021–2023)	10%
Average HS2 demand (2021–2023)	400
HS2 demand as a share of total construction sector demand	5%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2023)	400
Potential forecast inflows as a share of average construction sector demand	5%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of steel erectors/structural fabrication working in construction, as a share of this occupation in all industries (2019)	18%
<b>Actual training data – Phase One and 2a regions</b>	
Training achievements, including further education and apprenticeships (2019/20)	350
Apprenticeship starts (2019/20)	N/A <sup>49</sup>

Table 32: Mismatch analysis criteria for steel erectors/structural fabrication – Phases One and 2a

Based on HS2 demand timings, 2023 is the peak demand year for this occupation. The steel erectors/structural fabrication occupation has been identified as a priority occupation for the mismatch analysis, because between 2021 and 2023 in Phase One and 2a regions:

- its GRR (10%) marginally exceeds the average GRR (9%) across the 28 occupational groups; and
- average HS2 demand for this occupation is 5% of all steel erectors/structural fabricators, which exceeds HS2’s total average demand for workers across the 28 occupational groups (3%).

The above points suggest that this occupation could create recruitment challenges, more so due to a somewhat higher than average HS2 share of total demand for all steel erectors/structural fabrication workers in Phase One and 2a regions.

<sup>49</sup> Apprenticeship figures for ‘steel fixers’, which is not the same as ‘steel erectors/structural fabrication’ have been identified. However, these figures are not significant enough to be included within this analysis.



As shown in Appendix G, following the demand peak in 2023 there is a gradual decline in demand up to 2025, and a sharp drop-off thereafter. In 2025, there remains a demand for around 400 steel erectors/structural fabrication workers, which is around 5% of this occupation's total construction workforce in the regions. Between 2031 and 2034, there is a mild increase in demand before a linear decline until 2040.

In the wider construction sector, there is an average GRR of 800 steel erectors/structural fabrication workers per year. This means that the construction sector will need to recruit approximately 10% of sector-wide demand each year. Table 33 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 5% of total construction sector demand, suggesting a recruitment shortage.	Up to 50%
Training	Training for steel erectors/structural fabrication mainly occurs at both further education and apprenticeship levels. In the Phase One and 2a regions, training achievements numbered 350 for this occupation, inclusive of apprenticeships, 2019/20.	Up to 44%: if all trained workers choose to work in the construction sector
Other industries	Significant potential to further recruit from other industries, as 2019 UK-wide LFS data shows that only 18% <sup>50</sup> of all steel erectors/structural fabrication work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a negligible surplus of steel erectors/structural fabrication that are potentially underemployed. This lack of underemployment implies that steel erectors/structural fabrication in Phases One and 2a have not been as badly affected by the impact of Covid-19 compared to the rest of England, where there is an estimated surplus of 600 for this occupation that are underemployed. Relevant infrastructure works in the regions of Phases One and 2a could have minimised the economic impact of Covid-19 for this occupation.	n/a

Table 33: Potential methods of satisfying the recruitment requirement for steel erectors/structural fabrication – Phases One and 2a

No single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods will be required for HS2. It is also worth noting that the steel erectors/structural fabrication occupation could face worse recruitment challenges in the South East region in Phases One and 2a. This is the only region where this occupation's GRR exceeds the overall average of this metric, at 12%, compared to the West Midlands (9%) and London (7%).

<sup>50</sup> The 18% figure represents steel erectors/structural fabrication working in construction as a percentage of this occupation working in all industries.

There is good scope to recruit for this occupation from other industries, as only 18% of the steel erectors/structural fabrication occupation works in construction. Both training achievements and forecast inflows could satisfy this recruitment requirement by almost 50%.

This analysis points toward steel erectors/structural fabrication workers creating some recruitment challenges, but perhaps not to the extent of the some of the above occupations. This occupation's recruitment challenges could be best addressed through a combination of drawing from other industries and training achievements.

### 7.2.2.5 Plant operatives

The plant operative occupation includes roles such as crane drivers, plant and machine operatives, fork-lift truck drivers, and mobile machine drivers and operatives. Table 34 summarises the mismatch analysis criteria for plant operatives in Phases One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase One and 2a regions</b>	
Average total construction sector demand (2021–2022)	13,400
Average GRR (2021–2022)	1,800
GRR as a share of total construction sector demand (2021–2022)	14%
Average HS2 demand (2021–2022)	1,200
HS2 demand as a share of total construction sector demand	9%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2022)	900
Potential forecast inflows as a share of average construction sector demand	6%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of plant operatives working in construction, as a share of this occupation in all industries (2019)	28%
<b>Actual training data – Phase One and 2a regions</b>	
Training achievements, including further education and apprenticeships (2019/20)	6,810
Apprenticeship starts (2019/20)	N/A <sup>51</sup>

Table 34: Mismatch analysis criteria for plant operatives – Phases One and 2a

<sup>51</sup> No significant apprenticeship figures are available for this occupation.

Based on HS2 demand timings, the peak demand year for plant operatives is 2022. Plant operatives have been identified as a priority occupation for the mismatch analysis because between 2021 and 2022 in Phase One and 2a regions:

- its GRR (14%) exceeds the average GRR (9%) across the 28 occupational groups;
- average HS2 demand for this occupation is 9% of all plant operatives, which exceeds HS2's total average demand for workers across the 28 occupational groups (3%); and
- average HS2 demand for this occupation is 5% of the total HS2 workforce, which marginally exceeds the overall average for this metric (4%).

The above points suggest that plant operatives could create recruitment challenges due to both the strong recruitment requirement and HS2 demand as a share of total demand.

As shown in Appendix G, following the demand peak in 2022 there is a steep linear drop off in demand up to 2029. In 2025, there remains a demand for around 100 plant operatives, which is around 1% of this occupation's total construction workforce in the regions.

In the wider construction sector, there is an average GRR of 1,800 plant operatives per year. This means that the construction sector will need to recruit approximately 14% of sector-wide demand each year. Table 35 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 6% of total construction sector demand, suggesting a recruitment shortage.	Up to 50%
Training	Training for plant operatives mainly occurs at both further education and apprenticeship levels. In the Phase One and 2a regions, training achievements numbered 6,810 for this occupation in 2019/20, inclusive of apprenticeships.	Up to 100%: if all trained workers hold specific qualifications/skills for HS2 and choose to work in the construction sector
Other industries	Significant potential to further recruit from other industries, as 2019 UK-wide LFS data shows that only 28% <sup>52</sup> of all plant operatives work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a surplus of less than 100 plant operatives who are potentially underemployed. This small surplus implies that plant operatives in Phases One and 2a have not been as badly affected by the impact of Covid-19 compared to the rest of England, where there is an estimated surplus of 1,100 plant operatives who are underemployed. Relevant infrastructure works in the Phase One and 2a regions could have minimised the economic impact of Covid-19 for this occupation.	Up to 3%

Table 35: Potential methods of satisfying the recruitment requirement for plant operatives – Phases One and 2a

Other than training, no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods could be required for HS2. It should also be considered that 74%<sup>53</sup> of plant operatives travel less than 20 miles from their current address to their work site, compared to the construction average of 67%. This data suggests that plant operatives are generally less mobile compared to most other construction occupations.

Plant operatives has been flagged as an occupation that could face recruitment challenges across all three supply regions in Phases One and 2a, with the West Midlands having the highest GRR, at 15%, compared to the South East (14%) and London (13%). In all three regions, the GRR for this occupation exceeds the respective overall average for this metric.

While the analysis suggests this occupation could present recruitment challenges, relevant training achievements could completely satisfy this recruitment requirement and, therefore, this occupation is less of a concern compared to the above occupations. Also, only 28% of all plant operatives work in construction, which means there is good scope to recruit from non-construction industries.

<sup>52</sup> The 28% figure represents plant operatives working in construction as a percentage of this occupation working in all industries.

<sup>53</sup> Workforce Mobility and Skills in the UK Construction Sector 2018/19, CITB 2019

However, the adequacy of existing training will be dependent upon the type or category of machinery to be operated, and it cannot be expected that every further education achievement in this area will qualify the holder to operate every type of machinery required for HS2.

#### 7.2.2.6 Civil engineering operatives not elsewhere classified

Civil engineering operatives not elsewhere classified (nec) include a number of construction and maintenance operatives who experience high demand for their services during large-scale infrastructure projects. HS2 is no different in this regard, and the analysis suggests that civil engineering operatives is an occupation that warrants further analysis. Table 36 summarises the mismatch analysis criteria for this occupation in Phases One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 1 and 2a regions</b>	
Average total construction sector demand (2021–2022)	6,100
Average GRR (2021–2022)	900
GRR as a share of total construction sector demand (2021–2022)	15%
Average HS2 demand (2021–2022)	2,400
HS2 demand as a share of total construction sector demand	39%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2022)	600
Potential forecast inflows as a share of average construction sector demand	10%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of civil engineering operatives working in construction, as a share of this occupation in all industries (2019)	43%
<b>Actual training data – Phase One and 2a regions</b>	
Training achievements, including further education and apprenticeships (2019/20)	2,470
Apprenticeship starts (2019/20)	100

Table 36: Mismatch analysis criteria for civil engineering operatives – Phases One and 2a

Based on HS2 demand timings, the peak demand year for this occupation is 2022. Civil engineering operatives have been identified as a priority occupation for the mismatch analysis, because between 2021 and 2022 in Phase One and 2a regions:

- its GRR (15%) significantly exceeds the average GRR (9%) across all 28 occupational groups;

- average HS2 demand for this occupation is 39% of all civil engineering operatives, which significantly exceeds HS2's total average demand for workers across the 28 occupational groups (3%); and
- average HS2 demand for this occupation is 10% of the total HS2 workforce, which exceeds the overall average of this metric (4%).

The above points suggest that civil engineering operatives could create recruitment challenges across all three metrics, but especially given the strong HS2 demand for this occupation – for example, HS2 requiring 39% of all civil engineering operatives in the Phase One and 2a regions.

As shown in Appendix G, following 2022, there is a sharp decline in demand up to 2030. In 2025, there remains a demand for around 1,200 civil engineering operatives, which is approximately 20% of this occupation's total construction workforce in the regions.

In the wider construction sector, there is an average GRR of 900 civil engineering operatives per year. This means that the construction sector will need to recruit approximately 15% of sector-wide demand each year. Table 37 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 10% of total construction sector demand, suggesting a recruitment shortage.	Up to 67%
Training	Training for civil engineering operatives mainly occurs at both further education and apprenticeship levels. In the Phase One and 2a regions, training achievements numbered 2,470 for this occupation, inclusive of apprenticeships, in 2019/20.	Up to 100%: If all trained workers hold choose to work in the construction sector
Other industries	There is some potential to recruit from other industries, as 2019 UK-wide LFS data shows that 43% <sup>54</sup> of all labourers work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a surplus of 400 civil engineering operatives who are potentially underemployed.	Up to 44%

Table 37: Potential methods of satisfying the recruitment requirement for civil engineering operatives – Phases One and 2a

Other than training, no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods could be required for HS2. In each of the three Phase One and 2a regions the GRR for this occupation exceeds the respective overall

<sup>54</sup> The 43% figure represents civil engineering operatives working in construction as a percentage of this occupation working in all industries.

average for this metric. This suggests that civil engineering operatives could create a recruitment challenge in all three Phase One and 2a regions.

While the analysis suggests that the civil engineering operatives occupation has a strong recruitment requirement, it could be completely satisfied through relevant training achievements. Also, forecast inflows could satisfy up to 67% of this recruitment requirement and there is scope to recruit for this occupation from other industries, with only 43% of civil engineering operatives currently working in construction. Therefore, a combination of these discussed recruitment methods should result in civil engineering operatives presenting less significant recruitment challenges compared to the above occupations.

However, a more detailed analysis of the specific skills required within the civil engineering operative role in Phases One and 2a would be required to confirm whether the pipeline of training and apprenticeships will satisfy HS2's requirements. This is because training for this role covers qualifications in subjects as varied as general construction operations, highways maintenance, road building, demolition and tunnelling.

#### **7.2.2.7 Civil engineers**

Table 38 summarises the mismatch analysis criteria for civil engineers in Phases One and 2a.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase One and 2a regions</b>	
Average total construction sector demand (2021–2023)	20,000
Average GRR (2021–2023)	1,600
GRR as a share of total construction sector demand (2021–2023)	8%
Average HS2 demand (2021–2023)	930
HS2 demand as a share of total construction sector demand	7%
<b>Inflows – Phase One and 2a regions</b>	
Average potential forecast inflows into the construction sector (2021–2023)	600
Potential forecast inflows as a share of average construction sector demand	3%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of civil engineers working in construction, as a share of this occupation in all industries (2019)	71%
<b>Actual training data – Phase One and 2a regions</b>	
Higher education achievements, UK (2019/20)	4,300
Apprenticeship starts (2019/20)	240

Table 38: Mismatch analysis criteria for civil engineers – Phases One and 2a

Based on HS2 demand timings, 2023 is the peak demand year for this occupation. Civil engineers have been identified as a priority occupation for the mismatch analysis because between 2021 and 2023, in Phase One and 2a regions:

- average HS2 demand for this occupation is 7% of all civil engineers, which exceeds HS2’s total average demand for workers across the 28 occupational groups (3%); and
- average HS2 demand for this occupation is 6% of the total HS2 workforce, which exceeds the overall average for this metric (4%).

The above points suggest that civil engineers could face recruitment challenges, given it’s a highly in-demand occupation by HS2.

As shown in Appendix G, following 2023 there is a gradual decline in demand up to 2025, with a more gradual reduction thereafter. In 2025, there remains a demand for around 700 civil engineers, which is 3.5% of this occupation’s total construction workforce in the regions.

In the wider construction sector, there is an average GRR of 1,600 civil engineering operatives per year. This means that the construction sector will need to recruit approximately 8% of



sector-wide demand each year. Table 39 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment potentially satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 3% of total construction sector demand, suggesting a recruitment shortage.	Up to 38%
Training	Training for civil engineers mainly occurs at higher education level, with some at apprenticeship levels. In the Phase One and 2a regions for 2019/20, higher education achievements numbered 4,300 for this occupation and there were also 240 apprenticeship starts.	Up to 100%: if all trained workers choose to work in the construction sector
Other industries	There is some potential to recruit from other industries, as 2019 UK-wide LFS data shows that 71% <sup>55</sup> of all civil engineers work in construction.	n/a
Short-term underemployment (potentially due to Covid-19)	In the Phase One and 2a regions there is a surplus of 600 civil engineers who are potentially underemployed.	Up to 38%

Table 39: Potential methods of satisfying the recruitment requirement for civil engineers – Phases One and 2a

Other than training, no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods could be required for HS2. There are some additional considerations in relation to this occupation.

- LFS 2019 data shows that 18% of current civil engineers are aged 55+, compared with an average of 23% for all managerial and professional occupations within construction. This figure for civil engineers is up from 12% in 2016, but still below its 2015 level, at 22%. This volatility makes it difficult to assess whether future retirement rates will diverge from historic trends.
- The highest GRR exists in the West Midlands (11%) region compared to London (8%) and the South East (7%), suggesting a more significant recruitment challenge.

UK higher education training achievements for relevant courses could completely satisfy the recruitment requirement for civil engineers in Phases One and 2a. Also, 71% of all civil engineers work in construction and there is some scope to recruit for this occupation from other industries. With strong achievements and a potential continued supply of trained workers, this occupation is expected to present the least recruitment challenges of the seven discussed occupations in Phases One and 2a.

<sup>55</sup> The 71% figure represents civil engineers working in construction as a percentage of this occupation working in all industries.

### 7.2.3 Other occupations

There are four occupations identified as being at lower risk of facing recruitment challenges, but which might nonetheless benefit from more detailed analysis:

- non-construction professional, technical, IT and other office-based staff;
- logistics;
- plant mechanics/fitters; and
- non-construction operatives not elsewhere classified (nec).

The high-level analysis below for the listed occupations suggests that HS2 could address these recruitment challenges by considering how to attract people in these occupations who are working in other sectors into construction.

In the Phase One and 2a regions, the first two listed occupations above will have an average GRR of 18,600 and 2,100, respectively, between 2021 and 2022. These recruitment requirements represent 11% of sector-wide demand for non-construction professional, technical, IT and other office-based staff; and 19% for logistics.

However, these two occupations are all characterised by a significant number of workers currently working outside of construction. Just 5% of all non-construction professional, technical, IT and other office-based staff currently work in construction. For logistics, the figure is slightly lower, at 4%.

The other two occupations in this group warranting further consideration are plant mechanics/fitters and non-construction operatives. The average GRR for both of these two occupations operating in the Phase One and 2a regions is 1,400 between 2021 and 2022. These requirements for recruitment represent 9% and 10%, respectively, of sector-wide demand.

However, as for the previous two occupations, there is a large pool of workers for both these occupations working outside of construction: 91% of plant mechanics/fitters and 97% of non-construction operatives.

## 7.3. Construction mismatch analysis – Phase 2bWL

The mismatch analysis for Phase 2bWL follows the same methodology used for Phases One and 2a. It focuses on the only region for Phase 2bWL, which is the North West. The Phase 2bWL occupations that are identified in the mismatch analysis for further analysis are different from those identified for Phases One and 2a principally due to regional differences in the existing workforce, the forecast change in sector demand and a different mix of HS2 work in this phase. It should be noted that as the Phase 2bWL construction is further in the future than Phases One and 2a, there is a greater possibility for any labour mismatches to be affected by changes to the labour market.

The mismatch analysis for Phase 2bWL construction is summarised in a scorecard in Appendix F.

The following occupations, shown in red in both Appendix F and Table 40, have been identified as warranting further analysis and consideration:

- labourers
- steel erectors/structural fabrication
- wood trades and interior fit-out
- plant operatives
- construction trades supervisors
- civil engineers
- civil engineering operatives

In addition to the seven occupations outlined above, seven additional occupations (shown in amber in both Appendix F and Table 40) could warrant further investigation, but are of lower priority given the prevalence of workers employed outside the construction sector in these occupations. The occupations in this category are:

- senior, executive and business process managers;
- non-construction professional, technical, IT, and other office-based staff;
- other construction process managers;
- plant mechanics/fitters;
- logistics;
- non-construction operatives; and
- other construction professionals and technical staff.

Within the North West, the occupations above should also be considered in the context of lower levels of mobility of workers in this region compared to other regions of the UK. Section 7.1.3 examined this in more detail, and highlighted the extent to which the workforce in the North West has a tendency to both live and work within the same region.

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Occupational group	Average total construction demand (2021-peak)	Average GRR (2021-peak)	GRR as a share of total construction demand (2021-peak)	Average HS2 demand (2021-peak)	Average HS2 demand as a share of total construction demand	HS2 demand in each occupation as a share of total HS2 labour demand (2021-peak)	Potential forecast inflows as a share of average construction demand (2021-peak)	Construction employment as a share of employment in all sectors (2019)
Labourers (nec)	13,900	2,500	18%	300	2%	4%	15%	81%
Steel erectors/structural fabrication	2,400	200	9%	200	6%	2%	5%	18%
Wood trades and interior fit-out	24,300	2,200	9%	300	1%	4%	6%	68%
Plant operatives	5,800	600	11%	300	5%	4%	7%	28%
Construction trades supervisors	3,800	300	8%	200	6%	3%	6%	48%
Civil engineers	6,400	400	6%	400	6%	5%	3%	71%
Civil engineering operatives (nec)	1,500	200	12%	600	37%	7%	11%	43%
Senior, executive and business process managers	17,600	800	5%	500	3%	6%	4%	8%
Non-construction professional, technical, IT and other office-based staff	37,000	3,200	9%	1,200	3%	15%	8%	5%
Other construction process managers	21,700	800	4%	700	3%	9%	3%	31%
Plant mechanics/fitters	4,800	400	8%	300	6%	4%	10%	9%
Logistics	2,500	400	17%	<100	3%	1%	10%	4%
Non-construction ops (nec)	4,300	300	8%	200	5%	3%	9%	3%
Other construction professionals and technical staff	24,300	1,400	6%	800	3%	11%	5%	25%

Table 40: Construction mismatch scorecard: shortlisted occupations – Phase 2bWL

### 7.3.1 Covid-19 and low migration scenario impacts

Table 41 shows the demand impact that each construction sector scenario (the mild, severe Covid-19 and low migration scenarios) would have for the priority occupations outlined above. This is done by calculating the average total construction demand and average GRR under the three alternative scenarios.

The general trend for the occupations mentioned in Table 41 is the same as that described in section 7.2.1. The mild scenario results in an increased recruitment requirement, while the severe and low migration scenarios reduce the recruitment pressure for labour. Thus, from a demand perspective, the mild scenario could be seen to exacerbate mismatch issues while the other scenarios reduce them.

For example, for the wood trade and interior fit-out occupation, the mild scenario increases the recruitment requirement by 32% compared to the baseline. Compared to the baseline, both the severe and low migration scenarios reduce the recruitment requirement for wood trade and interior fit-out by 14% and 9%, respectively.

Occupational group	Baseline average annual construction demand (2021– peak)	Baseline average GRR (2021–peak)	Change in recruitment requirement with baseline		
			Mild Covid-19 scenario	Severe Covid-19 scenario	Low migration scenario
Construction trades supervisors	3,800	300	100 (33%)	-100 (-33%)	0 (0%)
Wood trade and interior fit-out	24,300	2,200	700 (32%)	-300 (-14%)	-200 (-9%)
Plant operatives	5,800	600	100 (17%)	-100 (-17%)	0 (0%)
Steel erectors/ structural fabrication	2,400	200	0 (0%)	-100 (-50%)	-100 (-50%)
Labourers	13,900	2,500	500 (20%)	-100 (-4%)	0 (0%)
Civil engineering operatives	1,500	200	100 (50%)	0 (0%)	0 (0%)
Civil engineers	6,400	400	100 (25%)	-100 (-25%)	0 (0%)

Table 41: Comparison of occupational demand and recruitment requirement between baseline and alternative scenarios, Phase 2bWL

## 7.3.2 Priority occupations for further analysis

### 7.3.2.1 Labourers not elsewhere classified

The labourers not elsewhere classified (nec) occupation includes all workers classified as being in elementary construction occupations. Table 42 summarises the mismatch analysis criteria for this occupation in Phase 2bWL.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2027)	13,900
Average GRR (2021–2027)	2,500
GRR as a share of total construction sector demand (2021–2027)	18%
Average HS2 demand (2021–2027)	300
HS2 demand as a share of total construction sector demand	2%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2027)	2,100
Potential forecast inflows as a share of average construction sector demand	15%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of labourers in construction, as a share of this occupation in all industries (2019)	81%
<b>Actual training data – Phase 2bWL</b>	
Training achievements, including further education and apprenticeships (2019/20)	N/A <sup>56</sup>
Apprenticeship starts (2019/20)	N/A <sup>57</sup>

Table 42: Mismatch analysis criteria for labourers – Phase 2bWL

Based on HS2 demand timings, 2027 is the peak demand year for labourers. This occupation has been identified as a priority occupation for the mismatch analysis because between 2021 and 2027 in Phase 2bWL:

- the GRR (18%) significantly exceeds the average GRR (8%) across the 28 occupational groups; and

<sup>56</sup> There are no further education achievements or apprenticeship starts directly linked to this occupation.

<sup>57</sup> There is no general labouring apprenticeship, however potential cross-over with construction operative, which we include in the civil engineering operative figures.

- average HS2 demand for this occupation is 4% of the total HS2 workforce, which marginally exceeds the overall average for this metric.

The above points suggest that labourers could create recruitment challenges, particularly in relation to the strong GRR.

Demand peaks for labourers in Phase One and 2a in 2022, and in Phase 2bWL 5% of this peak demand remains in 2023. However, demand for this occupation in Phase 2bWL gradually increases between 2023 and 2027. Peak demand for labourers in Phase 2bWL, which occurs in 2027, is equivalent to approximately 38% of the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following the demand peak in 2027, there is a slight decline before a slight increase in 2029, followed by a steady decline up to 2032. In 2030, there remains a demand of 500 labourers, 3% of this occupation's total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 2,500 labourers per year. This means that the construction sector will need to recruit approximately 18% of sector-wide demand each year. Table 43 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 15% of total construction sector demand, suggesting a recruitment shortage.	Up to 84%
Training	There are no further education achievements or apprenticeship starts directly linked to this occupation. The pool of workers available to recruit is not therefore restricted to those people possessing particular qualifications.	n/a
Other industries	There is a small proportion of labourers working in other industries, as 2019 UK-wide LFS data shows that 81% <sup>58</sup> of all labourers work in construction.	n/a

Table 43: Potential methods of satisfying the recruitment requirement for labourers – Phase 2bWL

This table shows that forecast inflows cannot satisfy the recruitment requirement as a whole, and other sources are negligible. Furthermore, LFS 2019 data suggests that the labourers' workforce has been ageing, with 16% of this occupation aged 55+ in 2016 compared to 8% in 2012. This indicates that retirement rates for this occupation may continue to increase in the future, increasing the recruitment requirement.

<sup>58</sup> The 81% figure represents labourers working in construction as a percentage of this occupation working in all industries.

Labourers could present the most severe recruitment challenges for Phase 2bWL. Along with this occupation having the highest GRR rate compared to all other occupations on Phase 2bWL, none of the above methods will individually satisfy this recruitment requirement. However, 81% of all labourers work in construction and, therefore, little scope to recruit from other industries.

There are no specific training courses directly linked to this occupation, but there could be unidentified workers with relevant skills and qualifications, which could satisfy some of this recruitment requirement.

### 7.3.2.2 Steel erectors/structural fabrication

The steel erectors/structural fabrication occupation includes roles such as steel erectors, welding trades, metal plate workers, smiths and forge workers, and metal machining setters. Table 44 summarises the mismatch analysis criteria for this occupation in Phase 2bWL.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2029)	2,400
Average gross recruitment requirement (2021–2029)	200
GRR as a share of total construction sector demand (2021–2029)	9%
Average HS2 demand (2021–2029)	200
HS2 demand as a share of total construction sector demand	6%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2029)	100
Potential forecast inflows as a share of average construction sector demand	5%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of steel erectors/structural fabrication in construction, as a share of this occupation in all industries (2019)	18%
<b>Actual training data – Phase 2bWL</b>	
Training achievements, including further education and apprenticeships (2019/20)	80
Apprenticeship starts (2019/20)	N/A <sup>59</sup>

Table 44: Mismatch analysis criteria for steel erectors/structural fabrication – Phase 2bWL

<sup>59</sup> Apprenticeship figures for ‘steel fixers’, which is not the same as ‘steel erectors/structural fabrication’ have been identified. However, these figures are not significant enough to be included within this analysis.



Based on HS2 demand timings, 2029 is the peak demand year for steel erectors/structural fabrication. This occupation has been identified as a priority occupation for the mismatch analysis because between 2021 and 2029:

- its GRR (9%) marginally exceeds the average GRR (8%) across the 28 occupational groups; and
- average HS2 demand for this occupation is 6% of all steel erectors/structural fabrication workers, which exceeds HS2's total average demand for workers across the 28 occupational groups (3%).

The above points suggest that this occupation could create recruitment challenges, mainly due to HS2 requiring 6% of all steel erectors/structural fabrication workers in Phase 2bWL.

Demand peaks in 2023 for steel erectors/structural fabrication workers in Phase One and 2a. In Phase 2bWL 20% of this peak demand remains in 2024, and gradually increases between 2025 and 2029. Peak demand for steel erectors/structural fabrication workers in Phase 2bWL, which occurs in 2029, is equivalent to approximately 60% of the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following the demand peak in 2029 there is a linear drop off in demand up to 2032. In 2032, there is a demand for fewer than 50 steel erectors/structural fabrication workers, which is less than 2% of this occupation's total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 200 steel erectors/structural fabrication per year. This means that the construction sector will need to recruit approximately 9% of sector-wide demand each year.

Table 45 provides an overview of how the recruitment requirement for this occupation could be satisfied. It shows that no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods will be required for HS2.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 5% of total construction sector demand, suggesting a recruitment shortage.	Up to 50%
Training	Training for steel erectors/structural fabrication mainly occurs at both further education and apprenticeship levels. In 2019/20 in the North West region, training achievements numbered 80 for this occupation, inclusive of apprenticeships.	Up to 40%: if all trained workers choose to work in the construction sector
Other industries	Significant potential to further recruit from other industries, as 2019 UK-wide LFS data shows that 18% <sup>60</sup> of all steel erectors/structural fabrication work in construction.	n/a

Table 45: Potential methods of satisfying the recruitment requirement for steel erectors/structural fabrication – Phase 2bWL

The analysis here points towards this occupation posing recruitment challenges for Phase 2bWL. No individual method could completely satisfy this recruitment requirement, but forecast inflows could achieve up to 50% of this requirement. However, only 18% of steel erectors/structural fabrication operatives work in construction, which suggests there is good scope to recruit for this occupation from non-construction industries.

### 7.3.2.3 Wood trades and interior fit-out

The wood trades and interior fit-out occupation includes:

- carpenters and joiners;
- furniture makers and other craft woodworkers;
- paper and machine operatives; and
- some construction and building trades (nec).

Table 46 summarises the mismatch analysis criteria for this occupation in Phase 2bWL.

<sup>60</sup> The 18% figure represents steel erectors/structural fabrication operatives working in construction as a percentage of this occupation working in all industries.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2029)	24,300
Average GRR (2021–2029)	2,200
GRR as a share of total construction sector demand (2021–2029)	9%
Average HS2 demand (2021–2029)	300
HS2 demand as a share of total construction sector demand	1%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2029)	1,400
Potential forecast inflows as a share of average construction sector demand	6%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of wood trades and interior fit-out working in construction, as a share of this occupation in all industries (2019)	68%
<b>Actual training data – Phase 2bWL</b>	
Training achievements, including further education and apprenticeships (2019/20)	1,150
Apprenticeship starts (2019/20)	850

Table 46: Mismatch analysis criteria for wood trades and interior fit-out – Phase 2bWL

Based on HS2 demand timings, 2029 is the peak demand year for wood trades and interior fit-out. This occupation has been identified as a priority occupation for the mismatch analysis because, between 2021 and 2029 in Phase 2bWL:

- its GRR (9%) marginally exceeds the average GRR (8%) across the 28 occupational groups; and
- average HS2 demand for this occupation is 4% of the total HS2 workforce, which marginally exceeds the overall average for this metric.

The above points suggest that wood trades and interior fit-out could create recruitment challenges, especially given its recruitment requirement.

Demand for wood trades and interior fit-out in Phases One and 2a peaks in 2025, and in Phase 2bWL 30% of this peak demand remains in 2026. However, demand for this occupation in Phase 2bWL gradually increases between 2026 and 2029. Peak demand for wood trades and

interior fit-out in Phase 2bWL, which occurs in 2029, is identical to the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following the demand peak in 2029, there is a steep linear drop-off in demand for this occupation up to 2032. In 2032, there remains a demand for just under 100 wood trades and interior fit-out operatives, less than 1% of this occupation’s total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 2,200 wood trades and interior fit-out operatives per year. This means that the construction sector will need to recruit approximately 9% of sector-wide demand each year.

Table 47 provides an overview of how the recruitment requirement for this occupation could be satisfied. It shows that no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods will be required for HS2.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 6% of total construction sector demand, suggesting a recruitment shortage.	Up to 64%
Training	Training for wood trades and interior fit-out mainly occurs at both further education and apprenticeship levels. In the North West region, training achievements numbered 1,150 for this occupation, inclusive of apprenticeships. Furthermore, there were 850 apprenticeship starters on relevant courses during 2019/20 in the North West.	Up to 91%: if all trained workers choose to work in the construction sector
Other industries	Some potential to further recruit from other industries, as 2019 UK-wide LFS data shows that 68% <sup>61</sup> of all wood trades and interior fit-out operatives work in construction.	n/a

Table 47: Potential methods of satisfying the recruitment requirement for wood trades and interior fit-out – Phase 2bWL

Furthermore, CITB’s ‘Workforce Mobility and Skills in the UK Construction Sector 2018/19’ study shows that 69% of carpenters and joiners, which are within the wood trades and interior fit-out occupation, travel less than 20 miles from their current address to the worksite. This could suggest that the required pool of carpenters and joiners for HS2 might be restricted and less willing to travel long distances to site. However, this trade is but one of many that fall under the wood trades and interior fit-out occupation.

<sup>61</sup> The 68% figure represents wood trades and interior fit-out operatives working in construction as a percentage of this occupation working in all industries.

Training achievements for wood trades and interior fit-out in the North West could satisfy up to 91% of this occupation's recruitment requirement. There is also some scope to recruit from other industries, as 68% of this occupation work in construction.

Given neither recruitment method can individually satisfy this occupation's recruitment requirement, a combination of a continued supply of new workers through training, and consideration of how to attract the 32% of operatives in other sectors into construction could address these recruitment challenges. This analysis suggests that wood trades and interior fit-out will pose a recruitment challenge, but to less of an extent than the two occupations discussed above.

#### 7.3.2.4 Plant operatives

The plant operative occupation includes roles such as crane drivers, plant and machine operatives, fork-lift truck drivers, and mobile machine drivers and operatives. Table 48 summarises the mismatch analysis criteria for this occupation in Phase 2bWL.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2029)	5,800
Average GRR (2021–2029)	600
GRR as a share of total construction sector demand (2021–2029)	11%
Average HS2 demand (2021–2029)	300
HS2 demand as a share of total construction sector demand	5%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2029)	400
Potential forecast inflows as a share of average construction sector demand	7%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of plant operatives working in construction, as a share of this occupation in all industries (2019)	28%
<b>Actual training data – Phase 2bWL</b>	
Training achievements, including further education and apprenticeships (2019/20)	1,150
Apprenticeship starts (2019/20)	N/A <sup>62</sup>

Table 48: Mismatch analysis criteria for plant operatives – Phase 2bWL

<sup>62</sup> No significant apprenticeship figures are available for this occupation.

Based on HS2 demand timings, 2029 is the peak demand year for plant operatives. This occupation has been identified as a priority occupation for the mismatch analysis because, between 2021 and 2029:

- its GRR (11%) exceeds the average GRR (8%) across the 28 occupational groups; and
- average HS2 demand for this occupation is 5% of all plant operatives, which exceeds HS2's total average demand for workers across the 28 occupational groups (3%).

The above points suggest that this occupation could create reasonable recruitment challenges, given its recruitment requirement and HS2 requiring 5% of all plant operatives in Phase 2bWL.

Demand for plant operatives in Phases One and 2a peaks in 2022, and in Phase 2bWL 8% of this peak demand remains in 2023. However, Phase 2bWL demand for plant operatives gradually increases from 2023 to a peak in 2029, which is equivalent to approximately 58% of the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following the demand peak in 2029 there is a steep decline in demand up to 2032. In 2032 there remains a demand for just under 100 plant operatives, slightly less than 2% of this occupation's total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 600 plant operatives per year. This means that the construction sector will need to recruit approximately 11% of sector-wide demand each year.

Table 49 provides an overview of how the recruitment requirement for this occupation could be satisfied. It shows that no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods will be required for HS2.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 7% of total construction sector demand, suggesting a recruitment shortage.	Up to 67%
Training	Training for plant operatives mainly occurs at both further education and apprenticeship levels. In 2019/20 for the North West region, training achievements numbered 1,150 for this occupation, inclusive of apprenticeships.	Up to 100%: if all trained workers hold the relevant skills and/or choose to work in the construction sector
Other industries	Significant potential to further recruit from other industries, as 2019 UK-wide LFS data shows that 28% <sup>63</sup> of all plant operatives work in construction.	n/a

Table 49: Potential methods of satisfying the recruitment requirement for plant operatives – Phase 2bWL

<sup>63</sup> The 28% figure represents plant operatives working in construction as a percentage of this occupation working in all industries.

CITB's<sup>64</sup> study shows that 74% of plant operatives travel less than 20 miles from their current address to work site, compared to the sector average of 67%, which suggests that this occupation is less mobile. This could suggest that the required pool of plant operatives might be restricted and less willing to travel long distances to site.

Relevant training achievements could completely satisfy this recruitment requirement and only 28% of all plant operatives work in construction, which means there is also good scope to recruit for this occupation from non-construction industries. Therefore, this occupation is less of a concern compared to the occupations discussed above.

However, the adequacy of existing training will be dependent upon the type or category of machinery to be operated. It cannot be expected that every further education achievement in this area will qualify the holder to operate every type of machinery required for HS2.

#### **7.3.2.5 Construction trades supervisors**

The construction trades supervisors occupation includes both construction and building supervisors, and skilled metal, electrical and electronic trades supervisors. Table 50 summarises the mismatch analysis criteria for this occupation in Phase 2bWL.

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<sup>64</sup> Workforce Mobility and Skills in the UK Construction Sector, CITB 2019

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2029)	3,800
Average GRR (2021–2029)	300
GRR as a share of total construction sector demand (2021–2029)	8%
Average HS2 demand (2021–2029)	200
HS2 demand as a share of total construction sector demand	6%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2029)	200
Potential forecast inflows as a share of average construction sector demand	6%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of construction trades supervisors working in construction, as a share of this occupation in all industries (2019)	48%
<b>Actual training data – Phase 2bWL</b>	
Training achievements, including further education and apprenticeships (2019/20)	310
Apprenticeship starts (2019/20)	N/A <sup>65</sup>

Table 50: Mismatch analysis criteria for construction trade supervisors – Phase 2bWL

Based on HS2 demand timings, 2029 is the peak demand year for construction trades supervisors. This occupation has been identified as a priority occupation for the mismatch analysis because, between 2021 and 2029 in Phase 2bWL:

- its GRR (8%) marginally exceeds the average GRR across the 28 occupational groups; and
- average HS2 demand for this occupation is 6% of all construction trades supervisors, which is double HS2's total average demand for workers across the 28 occupational groups (3%).

The above points suggest that construction trades supervisors could create recruitment challenges, especially given HS2's strong demand for this occupation in Phase 2bWL.

Demand peaks for construction trades supervisors in Phases One and 2a peaks in 2022, and in Phase 2bWL 11% of this peak demand remains in 2023. Phase 2bWL demand for this

<sup>65</sup> Apprenticeship courses have been transitioning from framework to standards since 2017. Framework courses for this particular occupation cannot be identified.



occupation gradually increases from 2023 to a peak in 2029, which is equivalent to 56% of the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following the demand peak in 2029, there is a steep decline in demand up to 2032. In 2032 there remains a demand for just under 100 construction trades supervisors, approximately 3% of this occupation’s total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 300 construction trades supervisors per year. This means that the construction sector will need to recruit approximately 8% of sector-wide demand each year. Table 51 provides an overview of how the recruitment requirement for this occupation could be satisfied.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 6% of total construction sector demand, suggesting a recruitment shortage.	Up to 67%
Training	Training for construction trades supervisors mainly occurs at both further education and apprenticeship levels. In 2019/2020 in the North West region, training achievements numbered 310 for this occupation, inclusive of apprenticeships.	Up to 100%: if all trained workers choose to work in the construction sector
Other industries	Significant potential to further recruit from other industries, as 2019 UK-wide LFS data shows that only 48% <sup>66</sup> of all construction trades supervisors work in construction.	n/a

Table 51: Potential methods of satisfying the recruitment requirement for construction trades supervisors – Phase 2bWL

Training achievements for construction trades supervisors in the North West region could completely satisfy this occupation’s recruitment requirement. There is also scope to recruit from other industries, as only 48% of this occupation work in construction.

There is no guarantee that all trained construction trades supervisors will choose to work in construction and, therefore, a combination of these approaches should be considered to overcome these recruitment challenges. Given this analysis, we are of the view that construction trades supervisors will present less of a recruitment challenge in Phase 2bWL compared to the other occupations discussed above.

However, it is worth noting that LFS 2019 data shows that around 25% of UK construction and building trade supervisors were migrants in 2019. New UK immigration laws could therefore have a negative impact on the supply of construction trade supervisors.

<sup>66</sup> The 48% figure represents construction and building supervisors and skilled metal, electrical and electronic trades supervisors working in construction as a percentage of these occupations working in all industries.

### 7.3.2.6 Civil engineers

Table 52 summarises the mismatch analysis criteria for civil engineers in Phase 2bWL.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2027)	6,400
Average gross recruitment requirement (2021–2027)	400
GRR as a share of total construction sector demand (2021–2027)	6%
Average HS2 demand (2021–2027)	400
HS2 demand as a share of total construction sector demand	6%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2027)	200
Potential forecast inflows as a share of average construction sector demand	3%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of civil engineers working in construction, as a share of this occupation in all industries (2019)	71%
<b>Actual training data – Phase 2bWL</b>	
Higher education achievements, UK (2019/20)	4,300
Apprenticeship starts (2019/20)	120

Table 52: Mismatch analysis criteria for civil engineers – Phase 2bWL

Based on HS2 demand timings, 2027 is the peak demand year for civil engineers. This occupation has been identified as a priority occupation for the mismatch analysis because, between 2021 and 2027 in Phase 2bWL:

- average HS2 demand for this occupation is 6% of all civil engineers, which exceeds HS2’s total average demand for workers (3%); and
- average HS2 demand for this occupation is 5% of the total HS2 workforce, which exceeds the overall average of this metric (4%).

The above points suggest that civil engineers could face recruitment challenges, given the high demand in Phase 2bWL.

2023 is the year where Demand for civil engineers in Phases One and 2a peaks in 2023, and in Phase 2bWL 32% of this peak demand remains in 2024. However, Phase 2bWL demand for this

occupation gradually reaches another peak in 2027, which is equivalent to approximately 58% of the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following 2027 there is a decline in demand until 2034. In 2031, there remains a demand for around 100 civil engineers, just under 2% of this occupation's total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 400 civil engineers per year. This means that the construction sector will need to recruit approximately 6% of sector-wide demand each year. Table 53 provides an overview of how the recruitment requirement for this occupation could be satisfied. Other than training, no single method is likely to satisfy the recruitment requirement as a whole and, therefore, a combination of these methods could be required for HS2.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 3% of total construction sector demand, suggesting a recruitment shortage.	Up to 50%
Training	Training for civil engineers mainly occurs at higher education level, with some at apprenticeship levels. In 2019/20, UK higher education achievements numbered 4,300 for this occupation and there were also 120 apprenticeship starts in the North West.	Up to 100%: if all trained workers choose to work in the construction sector
Other industries	There is some potential to recruit from other industries, as 2019 UK-wide LFS data shows that 71% <sup>67</sup> of all civil engineers work in construction.	n/a

Table 53: Potential methods of satisfying the recruitment requirement for civil engineers – Phase 2bWLt

LFS 2019 data shows that 18% of current civil engineers are aged 55+, compared with an average of 23% for all managerial and professional occupations within construction. This figure for civil engineers is up from 12% in 2016, but still below 22% in 2015. This volatility makes it difficult to assess whether future retirement rates will diverge from historic trends.

UK higher education training achievements for relevant courses could completely satisfy the recruitment requirement for civil engineers in Phase 2bWL. As 71% of all civil engineers work in construction, there is some scope to recruit for this occupation from other industries. With strong achievements and a potential continued supply of trained workers, this occupation is expected to present less significant recruitment challenges than the occupations discussed above.

<sup>67</sup> The 71% figure represents civil engineers working in construction as a percentage of this occupation working in all industries.

### 7.3.2.7 Civil engineering operatives not elsewhere classified

Civil engineering operatives not elsewhere classified (nec) include a number of construction and maintenance operatives who experience high demand for their services during large-scale infrastructure projects.

HS2 is no different in this regard, and the analysis suggests that civil engineering operatives is an occupation that warrants further analysis. Table 54 summarises the mismatch analysis criteria for civil engineering operatives in Phase 2bWL.

Criteria (latter year indicates peak year)	Value
<b>Demand, supply and mismatch – Phase 2bWL</b>	
Average total construction sector demand (2021–2029)	1,500
Average gross recruitment requirement (2021–2029)	200
GRR as a share of total construction sector demand (2021–2029)	12%
Average HS2 demand (2021–2029)	600
HS2 demand as a share of total construction sector demand	37%
<b>Inflows – Phase 2bWL</b>	
Average potential forecast inflows into the construction sector (2021–2029)	200
Potential forecast inflows as a share of average construction sector demand	11%
<b>Share of the occupation within the construction sector – UK wide</b>	
Proportion of civil engineering operatives working in construction, as a share of this occupation in all industries (2019)	43%
<b>Actual training data – Phase 2bWL</b>	
Training achievements, including further education and apprenticeships (2019/20)	1,740
Apprenticeship starts (2019/20)	60

Table 54: Mismatch analysis criteria for civil engineering operatives – Phase 2bWL

Based on HS2 demand timings, 2029 is the peak demand year for civil engineering operatives. This occupation has been identified as a priority occupation for the mismatch analysis because, between 2021 and 2029 in Phase 2bWL:

- its GRR (12%) significantly exceeds the average GRR (8%) across all 28 occupational groups;

- average HS2 demand for this occupation is 37% of all civil engineering operatives, which significantly exceeds HS2’s total average demand for workers (3%) across the 28 occupational groups; and
- average HS2 demand for this occupation is 7% of the total HS2 workforce, which exceeds the overall average for this metric (4%).

The above points suggest that civil engineering operatives could create recruitment challenges, especially given strong HS2 demand for this occupation, requiring 37% of all civil engineering operatives in the North West.

Demand for civil engineering operatives in Phases One and 2a peaks in 2022, and in Phase 2bWL 4% of this peak demand remains in 2023. However, Phase 2bWL demand for this occupation gradually increases from 2023 and peaks in 2029, which is equivalent to 56% of the peak demand for this occupation in Phases One and 2a.

As shown in Appendix G, following 2029, there is a linear drop-off in demand up to 2031. In 2032, demand remains for around 200 civil engineering operatives, approximately 12% of this occupation’s total construction workforce in the North West.

In the wider construction sector, there is an average GRR of 200 civil engineering operatives per year. This means that the construction sector will need to recruit approximately 12% of sector-wide demand each year.

Table 55 provides an overview of how the recruitment requirement for this occupation could be satisfied. Both forecasted inflows and training achievements can satisfy the recruitment requirement for civil engineering operatives in Phase 2bWL.

Methods of satisfying the recruitment requirement	Commentary	Recruitment satisfied
Forecast inflows; from migration, unemployed, other industries	Forecast inflow rate of 11% of total construction sector demand, suggesting a recruitment shortage.	Up to 100%
Training	Training for civil engineering operatives mainly occurs at both further education and apprenticeship levels. In 2019/20, in the North West, training achievements numbered 1,740 for this occupation, inclusive of apprenticeships.	Up to 100%: if all trained workers hold the right qualification and/or choose to work in the construction sector
Other industries	There is a proportion of civil engineering operatives working in other industries, as 2019 UK-wide LFS data shows that 43% <sup>68</sup> of all civil engineering operatives work in construction.	n/a

Table 55: Potential methods of satisfying the recruitment requirement for civil engineering operatives – Phase 2bWL

<sup>68</sup> The 43% figure represents civil engineering operatives working in construction as a percentage of this occupation working in all industries.

Civil engineering operatives is expected to cause the least recruitment challenges out of the seven Phase 2bWL occupations discussed. It is the only occupation discussed in this mismatch analysis to have two methods that could each completely satisfy its recruitment requirement: forecast inflows and training achievements. Furthermore, there is good scope to recruit for this occupation from other industries, with 43% of civil engineering operatives working in construction.

However, a more detailed analysis of the specific skills required within the civil engineering operative role in Phase 2bWL would be required to confirm whether the pipeline of training and apprenticeships will satisfy HS2's requirements. This is because training for this role covers qualifications in subjects as varied as general construction operations, highways maintenance, road building, demolition and tunnelling.

### **7.3.3 Other occupations**

There are seven occupations identified as being at lower risk of facing recruitment challenges, but which might nonetheless benefit from more detailed analysis:

- senior, executive, and business process managers;
- non-construction professional, technical, IT and other office-based staff;
- other construction process managers;
- plant mechanics/fitters;
- logistics;
- non-construction operatives (nec); and
- other construction professionals and technical staff.

The common trend among all the above occupations is that only a small percentage of people in these occupations work in construction. The high-level analysis below suggests that HS2 could address these recruitment challenges by considering how to attract people working in these occupations in other sectors into construction.

The first two occupations under consideration are non-site based professionals.

- Senior, executive, and business process managers – the GRR for this occupation is 800, which is 5% of sector-wide demand. Only 8% of this occupation currently works in construction.
- Non-construction professional, technical, IT and other office-based staff – the GRR for this occupation is 3,200, which is 9% of the sector-wide demand. Only 5% of this occupation currently works in construction.

The remaining five occupations have been analysed but are not considered to represent specific challenges. More details are provided in Appendix F.

## 8. Rail engineering mismatch analysis

### 8.1. Rail engineering inflows

#### 8.1.1 Education and training

Engineering is well catered for at both higher education and further education levels. In higher education in 2018/19, there was a total of 173,280 students studying an engineering and technology undergraduate or post graduate qualification at 123 different higher education institutes (HEIs). Approximately 40% of the students are first-year students. In further education colleges, 1% of students are studying engineering and science subjects.

Ofsted 2018/19 data shows there were 42,500 apprenticeship starts in the engineering and manufacturing subject areas, in the relevant six regions along the HS2 route. Table 56 shows the regional breakdown for these apprenticeships starts.

Region	2018/19 starts
East Midlands	5,680
London	3,700
North West	8,630
South East	8,940
West Midlands	8,230
Yorkshire & the Humber	7,310

Table 56: Apprenticeship starts in the engineering and manufacturing subject areas by region

Of these, the split of apprenticeship level is broadly as follows:

- intermediate apprenticeship 20% (level 2)
- advanced apprenticeship 75% (level 3)
- higher apprenticeship 5% (level 4)

There are now a multitude of apprenticeship standards available for relevant subject areas in rail engineering, operations and construction, not to mention the wide choice of project management and general business management areas.

The rail sector has also been open to transferable skills from other sectors, particularly in the engineering and project management occupations. With shortages of skills forecast in rail, it is likely that sources of experienced workers will be sought from other sectors and also overseas labour, notwithstanding the Brexit impacts on European labour.

## 8.2. Mismatch analysis – Phases One and 2a

The mismatch analysis follows the same methodology as for construction (see section 7). The same metrics calculated for construction have also been calculated for rail engineering. The only difference is that the percentage of workers working in other sectors beyond rail engineering is not shown, as the relevant data is not available for rail engineering occupations.

We have calculated the results for Phases One and 2a combined, and separately for Phase 2bWL. Traction and rolling stock has been treated as a national, not a regional, activity and considered as a standalone section covering all phases combined.

Mismatches in civils and structures, property, stations and depots, and operations have not been considered. This is because of the relatively low requirements for these asset types for HS2 and also because the majority of the labour requirements are covered within the construction section.

As for construction, each of the occupations within the relevant asset types (but not including civils, property, and operations for O&M set-up activities) has each been assessed using the following criteria:

- the overall sector mismatch determined by the rail engineering gross recruitment requirement (GRR);
- the relevance to the HS2 programme; and
- the likelihood of the historic inflows being capable of meeting the recruitment requirement should they remain at historic rates.

An overall asset type scorecard has been prepared and those occupations which are of significant concern are then extracted and discussed in turn.

There are some general comments which are applicable to all of the asset types and Phases One and 2a, as well as Phase 2bWL. Typically, the technician roles would be recruited from an apprenticeship scheme or a vocational education scheme, whereas the engineers and project managers would come from an academic, university background requiring science, technology, engineering, and mathematics (STEM) qualifications. There may also be inflows of recruits from other sectors, such as highways or other civil engineering sectors, but many will still require training and 'conversion' to rail.

From National Skills Academy for Rail's (NSAR) wider work on the supply side, we believe there is ample coverage in further education colleges and universities to satisfy the HS2 demand within the supply chain. This is as long as investment in skills and apprenticeships is made now in order to ensure an appropriately skilled workforce exists when required.

Analysis of the mismatches shows a demonstrable positive benefit to be secured by retaining key skills and individuals within the project and the supply chain. This is particularly true in the key engineering areas of signalling, electrification and track. Adopting the correct procurement strategy would also help secure continuity of technical resource from Phase One to future phases.



### 8.2.1 Electrification and plant roles

Electrification and plant (E&P) labour demand peaks in 2028 at around 410 people. This rises from about 100 people in 2025 and declines sharply over the three years following the peak. HS2 demand for this occupation accounts for 48% of the total rail engineering sector requirements between 2021 and 2028. Table 57 shows the mismatch analysis for E&P roles.

Demand, supply & mismatch	
Average total rail engineering sector demand (2021–2028)	440
Average GRR (2021–2028)	60
GRR as a share of total rail engineering sector demand (2021–2028)	14%
Average HS2 demand (2021–2028)	210
HS2 demand as a share of total rail engineering sector demand	48%
Inflows	
Average potential forecast inflows into the rail engineering sector (2021–2028)	20
Potential forecast inflows as a share of average rail engineering sector demand	5%

Table 57: Mismatch analysis for electrification and plant roles – Phases One and 2a

Within E&P the following key occupations for Phases One and 2a may warrant further investigation:

- engineers;
- engineering supervisors and managers; and
- project managers and supervisors.

During Phases One and 2a, HS2 demand for these occupations accounts for an average of 33–58% of total rail engineering sector requirements between 2021 and 2028, which is a significant proportion of the overall workforce. The raw numbers are relatively modest and, with some sensible and timely planning, there should be no concern with finding and/or training appropriate resources.

The analysis suggests that, before accounting for inflows to the sector, the overall rail engineering E&P sector operating in the Phases One and 2a regions will need to recruit, on average, around 60 people per year across the E&P priority occupations between 2021 and 2028.

This projected GRR average is 14% of total rail engineering E&P demand between 2021 and 2028. This is based on the expectation that sector-wide investment levels in the Phases One and 2a regions remain relatively constant at £300–500 million per year up to 2031. In addition to HS2, significant investments for Network Rail E&P Renewals are assumed, but it is worth stating that there is significant longer-term uncertainty for these electrification schemes.

If average historic inflows of labour and skills into these E&P occupations were to be sustained in future, these inflows and targeted training and education would be sufficient to only a small amount of the projected GRR.

### 8.2.2 Signalling, systems and telecommunications roles

For rail engineering signalling, systems and telecommunications roles (SS&T), we see an average GRR of 5% (220 people) from 2021 to the peak in 2026, with average HS2 demand at 26% (1,030 people) of the total demand in UK rail in the same period. Table 58 shows the mismatch analysis for SS&T roles.

Demand, supply and mismatch	
Average total rail engineering sector demand (2021–2026)	4,000
Average GRR (2021–2026)	220
GRR as a share of total rail engineering sector demand (2021–2026)	5%
Average HS2 demand (2021–2026)	1,030
HS2 demand as a share of total rail engineering sector demand	26%
Inflows	
Average potential forecast inflows into the rail engineering sector (2021–2026)	230
Potential forecast inflows as a share of average rail engineering sector demand	6%

Table 58: Mismatch analysis for SS&T roles – Phases One and 2a

Within SS&T the following key occupations for Phases One and 2a may warrant further investigation:

- assistant engineers and engineers;
- engineering designers and managers; and
- project managers and supervisors.

During Phases One and 2a, HS2 demand for these occupations accounts for an average of 17–38% of rail engineering sector requirements between 2021 and 2026. The analysis suggests that between 2021 and 2026, before accounting for inflows to the sector, the overall rail engineering SS&T sector operating in the Phase One and 2a regions will need to recruit an average of 220 people per year across the SS&T priority occupations.

This projected GRR is 5% of total rail engineering SS&T demand from 2021 to 2026. This is based on the expectation that sector-wide investment levels in the relevant Phase One and 2a regions for SS&T projects will remain between £500 million and £1,000 million per year to 2031.

In addition to HS2, this investment pipeline includes notable investments for Network Rail SS&T Renewals, potential digital railway schemes, Four Line Modernisation for Transport for London,

other London Underground and Docklands Light Railway renewal schemes, East West Rail and other potential light rail investments in Birmingham, Manchester and Newcastle.

If average historic inflows of labour and skills into these SS&T occupations were sustained in future, they would be sufficient to satisfy some but not all of the projected GRR. Assuming the inflow is achieved, it is clear that additional interventions will be needed within the sector to avoid workforce shortages in this asset type.

### 8.2.3 Track roles

For rail engineering track, we see an average GRR of 8% (640 people) from 2021 to the peak in 2027, with average HS2 demand at 27% (2,270 people) of the total demand in UK rail in the same period. Table 59 shows the mismatch analysis for track roles.

Demand, supply and mismatch	
Average total rail engineering sector demand (2021–2027)	8,550
Average GRR (2021–2027)	640
GRR as a share of total rail engineering sector demand (2021–2027)	8%
Average HS2 demand (2021–2027)	2,270
HS2 demand as a share of total rail engineering sector demand	27%
Inflows	
Average potential forecast inflows into the rail engineering sector (2021–2027)	470
Potential forecast inflows as a share of average rail engineering sector demand	5%

Table 59: Mismatch analysis for track roles – Phases One and 2a

Within track, a number of key occupations for Phases One and 2a may warrant further investigation, specifically, engineering and project management roles. HS2 demand for these occupations during Phases One and 2a accounts for, on average, between 21% and 29% of total rail engineering track requirements between 2021 and 2027.

These occupations are:

- assistant engineers and engineers;
- engineering specialists, supervisors and managers;
- project managers and senior project managers; and
- project planners.

The analysis suggests that between 2021 and 2027, before accounting for inflows to the sector, the overall rail engineering track sector operating in the Phase One and 2a regions will need to recruit, on average, around 640 people per year across the track priority occupations.

This projected GRR is 8% of total rail engineering track demand from 2021 to 2027. This is based on the expectation that sector-wide investment levels in the relevant Phase One and 2a regions for track projects will remain relatively constant at around £1,500–£2,000 million per year for up to 2030/31.

In addition to HS2, this investment pipeline includes notable investments for Network Rail Track Renewals, potential digital railway schemes, Four Line Modernisation for Transport for London, other London Underground and Docklands Light Railway renewal schemes, East West Rail and other potential light rail investments in Birmingham, Manchester and Newcastle.

If average historic inflows of labour and skills into these track occupations were sustained in future, then these inflows would be sufficient to satisfy some but not all of the projected GRR.

### 8.3. Mismatch analysis – Phase 2bWL

This section presents the mismatch analysis for Phase 2bWL. It follows the same methodology as for Phases One and 2a, but within the context of the North West region.

#### 8.3.1 Electrification and plant roles

For rail engineering electrification and plant (E&P), labour demand peaks in 2026 at around 100 people. HS2 demand for these occupations accounts for 127% of the total rail engineering sector requirements in that time in that region. Table 60 shows the mismatch analysis for E&P roles.

Demand, supply & mismatch for E&P	
Average total rail engineering sector demand (2021–2026)	100
Average GRR (2021–2026)	40
GRR as a share of total rail engineering sector demand (2021–2026)	44%
Average HS2 demand (2021–2026)	120
HS2 demand as a share of total rail engineering sector demand	127%
Inflows	
Average potential forecast inflows into the rail engineering sector (2021–2026)	<10
Potential forecast inflows as a share of average rail engineering sector demand	3%

Table 60: Mismatch analysis for electrification and plant roles – Phase 2bWL

Within E&P, a number of key occupations for Phase 2bWL may warrant further review specifically, engineering, project controls and project management roles. During Phase 2bWL, HS2 demand for these occupations accounts for an average of 127% of rail engineering sector requirements between 2021 and 2026. This high proportion of wider industry demand

presents potential recruitment challenges, but it should be noted that the absolute numbers are relatively modest.

The occupations for potential further review are:

- engineers;
- engineering supervisors and managers; and
- project managers and supervisors.

The analysis suggests that between 2021 and 2026, before accounting for inflows to the sector, the overall rail engineering E&P sector operating in the Phase 2bWL region will need to recruit, on average, around 40 people per year across the E&P priority occupations.

This projected GRR is driven by an expectation that sector-wide investment levels in the North West for E&P projects will remain relatively constant at around £40–£70 million per year for the next 20 years. In addition to HS2, this investment pipeline includes notable investments for Network Rail E&P Renewals and Northern Powerhouse Rail schemes, although it is worth stating that there is significant longer-term uncertainty for electrification schemes.

If average historic inflows of labour and skills into these E&P occupations were sustained in future, these inflows would be sufficient to satisfy some but not all of the projected GRR.

### 8.3.2 Signalling, systems and telecommunications roles

For rail engineering signalling, systems and telecommunications (SS&T), we see a GRR from 2021 to the peak in 2026 of 15% (equating to 80 people) with an HS2 demand of 39% (equating to 220 people at peak) of the total demand in UK rail.

Assuming the inflow is achieved, it is clear that additional interventions will be needed within the sector to avoid workforce shortages in this asset type. Table 61 shows the mismatch analysis for SS&T roles.

Demand, supply and mismatch	
Average total rail engineering sector demand (2021–2026)	570
Average GRR (2021–2026)	80
GRR as a share of total rail engineering sector demand (2021–2026)	15%
Average HS2 demand (2021–2026)	220
HS2 demand as a share of total rail engineering sector demand	39%
Inflows	
Average potential forecast inflows into the rail engineering sector (2021–2026)	30
Potential forecast inflows as a share of average rail engineering sector demand	5%

Table 61: Mismatch analysis for SS&T roles – Phase 2bWL

Within SS&T, a number of key occupations for Phase 2bWL may warrant further investigation, specifically, engineering and project management roles. During Phase 2bWL, HS2 demand for these occupations will account for an average of 39% of rail engineering sector requirements between 2021 and 2026.

The analysis suggests that between 2021 and 2026, before accounting for inflows to the sector, the overall rail engineering SS&T sector operating in the Phase 2bWL region will need to recruit, on average, around 80 people per year across the priority occupations.

This projected GRR average is 15% of total rail engineering SS&T demand from 2021 to 2026. This is based on the expectation that sector-wide investment levels in the Phases 2bWL region remains relatively constant at £100–£150 million per year up to 2026.

In addition to HS2, this investment pipeline includes notable investments for Network Rail SS&T Renewals, potential digital railway schemes, East West Rail, Northern Powerhouse Rail schemes and other potential light rail investments in Birmingham, Manchester and Newcastle.

If average historic inflows of labour and skills into these SS&T occupations were sustained in future, then these inflows would be sufficient to satisfy some but not all of the projected GRR.

### 8.3.3 Track roles

For rail engineering track, labour demand peaks in 2026 at around 1,080 people. HS2 demand for this occupation accounts for around 21% of the total demand in UK rail in the same period. Table 62 the mismatch analysis for track roles.

Demand, supply and mismatch	
Average total rail engineering sector demand (2021–2026)	1,700
Average GRR (2021–2026)	200
GRR as a share of total rail engineering sector demand (2021–2026)	12%
Average HS2 demand (2021–2026)	350
HS2 demand as a share of total rail engineering sector demand	21%
Inflows	
Average potential forecast inflows into the rail engineering sector (2021–2022)	80
Potential forecast inflows as a share of average rail engineering sector demand	5%

Table 62: Mismatch analysis for track roles – Phase 2bWL

Within track, a number of key Phase 2bWL occupations may warrant further investigation, specifically, engineering, project control and project management roles. HS2 demand for these occupations during Phase 2bWL accounts for an average of 21% of rail engineering sector requirements between 2021 and 2026. These roles will require specialist rail engineering training but represent a low proportion of total rail engineering demand.

The analysis suggests that between 2021 and 2026, before accounting for inflows to the sector, the overall rail engineering track sector operating in the Phase 2bWL region will need to recruit, on average, around 200 people per year across the priority occupations.

This projected GRR average is 12% of total rail engineering track demand from 2021 to 2026. This is based on an expectation that sector-wide investment levels in the North West for track projects will remain relatively constant at around £200–£400 million per year for the next 20 years.

In addition to HS2, this investment pipeline includes notable investments for Network Rail Track Renewals, potential digital railway schemes, Northern Powerhouse Rail schemes, East West Rail and other potential light rail investments in Birmingham, Manchester and Newcastle.

If average historic inflows of labour and skills into these track occupations were sustained in future, then these inflows would be sufficient to satisfy some but not all of the projected GRR.

#### **8.4. Mismatch analysis – traction and rolling stock**

We have treated traction and rolling stock (T&RS) differently to the other asset types because of the unique nature in which it is deployed. There are few suppliers for T&RS, who generally operate on a global scale, therefore it is unlikely that any design or manufacturing activity by those suppliers will be undertaken in the UK.

At the time of this report, a supplier has not yet been appointed and, therefore, we must make assumptions about how much work is actually undertaken in the UK. For the purposes of this analysis, we have assumed that design and manufacture of the new rolling stock will be done overseas, and that UK activities will consist of some assembly, testing, commissioning, bringing into service and any operating, maintaining and training activities.

Furthermore, we have been unable to assign any of the labour demand to a particular region, so we have assumed a national presentation of the analysis and not a regional one. Table 63 shows the mismatch analysis for T&RS roles.

Demand, supply and mismatch	
Average total rail engineering sector demand (2021–2035)	4,740
Average GRR (2021–2035)	530
GRR as a share of total rail engineering sector demand (2021–2035)	11%
Average HS2 demand (2021–2035)	750
HS2 demand as a share of total rail engineering sector demand	16%
<b>Inflows</b>	
Average potential forecast inflows into the rail engineering sector (2021–2035)	240
Potential forecast inflows as a share of average rail engineering sector demand	5%

Table 63: Mismatch analysis for traction and rolling stock roles

For T&RS on a national scale, the projected GRR average is 11% (equating to 530 people), with HS2 demand at 16% (equating to 750 people at peak) of the total UK rail demand. Assuming the potential inflow is achieved, it is clear that additional interventions will be needed within the sector to avoid workforce shortages in this asset type.

Within T&RS, engineering roles may specifically warrant further investigation. HS2 demand for these occupations accounts for 11–22% of rail engineering sector requirements between 2021 and 2035. These roles will require specialist rail engineering training and, as they represent such a high proportion of total demand, would require sector-level changes, resulting in a potentially challenging recruitment situation.

These occupations are:

- assistant engineers;
- engineers;
- engineering designers; and
- engineering managers

The analysis suggests that between 2021 and 2035, before accounting for inflows to the sector, the overall national T&RS sector will need to recruit, on average, around 530 people per year across these engineering occupations.

This projected GRR is driven by an expectation that sector-wide investment levels in T&RS projects will remain between £500–£2,000 million per year for the next 20 years. In addition to HS2, this investment pipeline includes notable investments for new T&RS fleets.

Typically, the engineering roles would be recruited through an academic, university background requiring science, technology, engineering, and mathematics (STEM) qualifications. There may also be recruitment inflows from other sectors, such as automotive, but many will still require training and ‘conversion’ to rail.



However, the uncertainty around the procurement and supply chain element of the HS2 T&RS means that these demand and mismatch issues would be better addressed once the preferred supplier is appointed and negotiations are concluded.

## **Appendix A. Construction occupations**

This appendix contains details of the 28 occupational aggregates that are used for construction forecasts and the 166 individual occupations which are aggregated to form these 28 occupational aggregates.

Construction occupations <sup>69</sup> The construction stages during which occupational group is employed is denoted by an "X"	Design	Management	Construction	Broad occupational grouping (overleaf)
Senior, executive, and business process managers	X	X		C
Construction project managers		X		B
Other construction process managers		X		B
Non-construction professional, technical, IT and other office-based staff (excl. managers)	X	X		C
Construction trades supervisors		X		B
Wood trades and interior fit-out			X	D
Bricklayers			X	D
Building envelope specialists			X	D
Painters and decorators			X	D
Plasterers			X	D
Roofers			X	D
Floorers			X	D
Glaziers			X	D
Specialist building operatives (nec)			X	H
Scaffolders			X	H
Plant operatives			X	E
Plant mechanics/fitters			X	E
Steel erectors/structural fabrication			X	H
Labourers (nec)			X	G
Electrical trades and installation			X	F
Plumbing and heating, ventilation, and air conditioning trades			X	F
Logistics			X	H
Civil engineering operatives (nec)			X	G
Non-construction operatives			X	H
Civil engineers	X	X		A
Other construction professionals and technical staff	X	X		A
Architects	X	X		A
Surveyors	X	X		A

In section 2 of this report these occupations have been grouped into seven broad occupational groups as shown on the table below. The code letters refer back to the table on the next page.

Broad occupational group	Reference code
Designers/professionals	A
Management of design and construction	B
Senior management and other office-based staff	C
Building trades	D
Plant operators and mechanics	E
Mechanical and electrical trades	F
Civil engineering operatives and labourers	G
Other operatives	H

The 28 occupational aggregates represent 166 occupations within the construction sector. A full set of the 166 occupations is given overleaf.

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<sup>69</sup> These occupational aggregates represent 166 occupations within the construction industry. A full set of the 166 occupations is given later in this appendix.

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).	
<b>Senior, executive, and business process managers</b>	
(1115) Chief executives and senior officials (1131) Financial managers and directors (1132) Marketing and sales directors (1133) Purchasing managers and directors (1135) Human resource managers and directors (1251) Property, housing and estate managers (1136) Information technology and telecommunications directors (2150) Research and development managers	(1162) Managers and directors in storage and warehousing (1259) Managers and proprietors in other services (nec) (1139) Functional managers and directors (nec) (2133) IT specialist managers (2134) IT project and programme managers (3538) Financial accounts managers (3545) Sales accounts and business development managers
<b>Construction project managers</b>	
(2436) Construction project managers and related professionals	
<b>Other construction process managers</b>	
(1121) Production managers and directors in manufacturing (1122) Production managers and directors in construction (1161) Managers and directors in transport and distribution (1255) Waste disposal and environmental services managers	(3567) Health and safety officers (3550) Conservation and environmental associate professionals
<b>Non-construction professional, technical, IT and other office-based staff (excl. managers)</b>	

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).

(3131) IT operations technicians	(3541) Buyers and procurement officers <sup>70</sup>
(3132) IT user support technicians	(3562) Human resources and industrial relations officers
(3534) Finance and investment analysts and advisers	(4121) Credit controllers
(3535) Taxation experts	(4214) Company secretaries
(3537) Financial and accounting technicians	(7129) Sales related occupations (nec)
(3563) Vocational and industrial trainers and instructors	(7211) Call and contact centre occupations
(3539) Business and related associate professionals (nec)	(7219) Customer service occupations (nec)
(3520) Legal associate professionals	(9219) Elementary administration occupations (nec)
(3565) Inspectors of standards and regulations	(2111) Chemical scientists
(2136) Programmers and software development professionals	(2112) Biological scientists and biochemists
(2139) Information technology and telecommunications professionals (nec)	(2113) Physical scientists
(3544) Estate agents and auctioneers	(3111) Laboratory technicians
(2413) Solicitors	(3421) Graphic designers
(2419) Legal professionals (nec)	(2463) Environmental health professionals
(2421) Chartered and certified accountants	(2135) IT business analysts, architects and systems designers
(2424) Business and financial project management professionals	(2141) Conservation professionals
(2423) Management consultants and business analysts	(2142) Environment professionals
(4216) Receptionists	(2425) Actuaries, economists and statisticians
(4217) Typists and related keyboard occupations	(2426) Business and related research professionals
(3542) Business sales executives	(4124) Finance officers
(4122) Book-keepers, payroll managers and wages clerks	(4129) Financial administrative occupations (nec)
(4131) Records clerks and assistants	(4138) Human resources administrative occupations
(4133) Stock control clerks and assistants	(4151) Sales administrators
(7213) Telephonists	(4159) Other administrative occupations (nec)
(7214) Communication operators	(4162) Office supervisors
(4215) Personal assistants and other secretaries	(7130) Sales supervisors
(7111) Sales and retail assistants	(7220) Customer service managers and supervisors
(7113) Telephone salespersons	(4161) Office managers

<sup>70</sup> This occupational group is split across i) non-construction professional, technical, IT and other office-based staff (excl. managers) and ii) logistics.

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).	
Construction trades supervisors	
(5250) Skilled metal, electrical and electronic trades supervisors (5330) Construction and building trades supervisors	
Wood trades and interior fit-out	
(5315) Carpenters and joiners (8121) Paper and wood machine operatives	(5442) Furniture makers and other craft woodworkers (5319) Construction and building trades (nec) <sup>71</sup>
Bricklayers	
(5312) Bricklayers and masons	
Building envelope specialists	
(5319) Construction and building trades (nec) [See footnote 71]	
Painters and decorators	
(5323) Painters and decorators	(5319) Construction and building trades (nec) [See footnote 71]
Plasterers	
(5321) Plasterers	
Roofers	
(5313) Roofers, roof tilers and slaters	
Floorers	
(5322) Floorers and wall tillers	
Glaziers	
(5316) Glaziers, window fabricators and fitters	(5319) Construction and building trades (nec) [See footnote 71]
Specialist building operatives (nec)	
(8149) Construction operatives (nec) (5319) Construction and building trades (nec) [See footnote 71]	(9132) Industrial cleaning process occupations (5449) Other skilled trades (nec)
Scaffolders	
(8141) Scaffolders, staggers and riggers	
Plant operatives	
(8221) Crane drivers (8129) Plant and machine operatives (nec)	(8222) Fork-lift truck drivers (8229) Mobile machine drivers and operatives (nec)
Plant mechanics/fitters	
(5223) Metal working production and maintenance fitters (5224) Precision instrument makers and repairers (5231) Vehicle technicians, mechanics and electricians	(9139) Elementary process plant occupations (nec) (5222) Tool makers, tool fitters and markers-out (5232) Vehicle body builders and repairers

<sup>71</sup> This occupational group is split across i) wood trades and interior fit-out; ii) building envelope specialists; iii) painters and decorators; iv) glaziers; v) specialist building operatives (nec); vi) steel erectors/structural fabrication; and viii) plumbing and heating, ventilation, and air conditioning trades.

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).	
Steel erectors/structural fabrication	
(5311) Steel erectors (5215) Welding trades (5214) Metal plate workers, and riveters	(5319) Construction and building trades (nec) [See footnote 71] (5211) Smiths and forge workers (5221) Metal machining setters and setter-operators
Labourers (nec)	
(9120) Elementary construction occupations	
Electrical trades and installation	
(5241) Electricians and electrical fitters (5249) Electrical and electronic trades (nec)	(5242) Telecommunications engineers
Plumbing and heating, ventilation, and air conditioning trades	
(5314) Plumbers and heating and ventilating engineers (5216) Pipe fitters	(5319) Construction and building trades (nec) [See footnote 71] (5225) Air-conditioning and refrigeration engineers
Logistics	
(8211) Large goods vehicle drivers (8212) Van drivers (9260) Elementary storage occupations	(3541) Buyers and purchasing officers (see footnote 70) (4134) Transport and distribution clerks and assistants
Civil engineering operatives (nec)	
(8142) Road construction operatives (8143) Rail construction and maintenance operatives	(8123) Quarry workers and related operatives
Non-construction operatives	
(8117) Metal making and treating process operatives (8119) Process operatives (nec) (8125) Metal working machine operatives (8126) Water and sewerage plant operatives (8132) Assemblers (vehicles and metal goods) (8133) Routine inspectors and testers (8139) Assemblers and routine operatives (nec)	(9249) Elementary security occupations (nec) (9233) Cleaners and domestics (9232) Street cleaners (5113) Gardeners and landscape gardeners (6232) Caretakers (9241) Security guards and related occupations (3319) Protective service associate professionals (nec)
Civil engineers	
(2121) Civil engineers	
Other construction professionals and technical staff	
(2122) Mechanical engineers (2123) Electrical engineers (2126) Design and development engineers (2127) Production and process engineers (2461) Quality control and planning engineers (2129) Engineering professionals (nec) (3112) Electrical and electronics technicians (3113) Engineering technicians (3114) Building and civil engineering technicians	(3119) Science, engineering and production technicians (nec) (3121) Architectural and town planning technicians (3122) Draughtspersons (3115) Quality assurance technicians (2432) Town planning officers (2124) Electronics engineers (2435) Chartered architectural technologists (3531) Estimators, valuers and assessors (3116) Planning, process and production technicians
Architects	
(2431) Architects	
Surveyors	
(2433) Quantity surveyors (2434) Chartered surveyors	



## Appendix B. CITB Construction Skills Network forecast

The Construction Skills Network (CSN) is a five-year forecasting methodology which currently estimates to 2025 and has been specifically extended to 2040 for the purposes of this commission.

The CSN model derives the size of the workforce required to deliver the forecast volume of activity at a future point in time. It does so using a panel estimation approach to determine the historical relationship between volume of activity and labour demand. As it is based on historical trends (for as far back as the data series go), it inherently takes account of changes in productivity in the historical data.

The outputs of the CSN are validated by CITB's Technical Reference Group through a series of 12 bi-annual, regional observatories. They are also tested against historical data. The forecasts are produced using Experian's heavily customised version of the National Institute of Economic and Social Research's model called NIGEM. This is used to produce the top-line macroeconomic forecasts, both nationally and regionally, which feed into the demand model developed on behalf of the CITB to forecast construction output and employment for the CSN.

These tools collectively help to inform construction forecast outputs by providing a credible macroeconomic backdrop as well as a bottom-up approach to construction sector forecasting.

Like the baseline, the scenarios do not take account of direct or supply-side impacts on construction, such as whether lower population growth rates would reduce the size of the potential UK construction workforce. The results from this analysis should therefore be considered a partial representation of the scenarios' impacts on the UK's construction sector.

The table on the following page outlines the assumptions which have been made on the three scenarios.

HS2 labour and skills demand and supply forecasting and analysis  
July 2021

Scenario	Mild scenario	Severe scenario	Low migration scenario
<b>Summary</b>	This scenario is mainly for illustrative purposes as it was modelled before the January 2021 lockdown was announced and, hence, does not account for it. However, it is useful in quantifying an upside view relative to the baseline case.	The severe scenario takes a more pessimistic view on the trajectory for the spread of the virus than the baseline scenario.	This scenario has been constructed to understand how lower migration in response to Brexit might impact economic growth and, subsequently, demand for the output of the construction sector.
<b>Key assumptions</b>	<ul style="list-style-type: none"> <li>• Faster vaccine rollout than in the baseline scenario.</li> <li>• Restrictions (but no lockdown) in place over 2021Q1.</li> <li>• Furlough scheme ends in March 2021.</li> <li>• Unemployment rate peaks in 2021Q2, but at a lower rate than in the baseline case.</li> <li>• As in the other scenarios, GDP growth slows in 2021H2 as labour market conditions weaken.</li> <li>• Financial institutions are better capitalised than they were going into the 2008/09 recession.</li> <li>• Credit conditions tighten, but a full-blown credit crunch is avoided.</li> </ul>	<ul style="list-style-type: none"> <li>• National lockdown in place for the full duration of 2021Q1.</li> <li>• Lower growth in 2021H1 compared with the baseline scenario due to heightened restrictions and intermittent lockdowns during 2021Q2.</li> <li>• The furlough scheme extended from April 2021 to June 2021 but on less generous terms.</li> <li>• Th extended lockdown makes retaining staff unviable for many businesses and the unemployment rate rises more sharply than in the baseline case and remains elevated for longer.</li> <li>• Confidence remains low: businesses reluctant to invest and the household savings ratio will stay elevated, stifling consumer spending.</li> </ul>	<ul style="list-style-type: none"> <li>• Same timescales as the baseline for the unwinding of Covid-19-related restrictions, the vaccine roll-out, and the furlough scheme.</li> <li>• The trajectory for UK migration follows the low migration projections from the ONS in which migration is approx. 100,000 per year less than in the ONS base case (principal) from 2025.</li> <li>• Annual average population growth assumed to be 0.2%, compared to 0.4% in the base case; 2.3 million fewer people by 2040.</li> <li>• A faster-ageing population to have a weakening impact on long-term GDP through lower participation rates, labour supply and weaker consumer spending.</li> <li>• Slower GDP growth in turn dampens private construction activity due to weaker demand. The public sector will also have a reduced tax base and higher spending associated with an ageing population impeding its ability to spend on large construction projects.</li> </ul>

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Scenario	Mild scenario	Severe scenario	Low migration scenario
<b>GDP changes</b> Baseline: <ul style="list-style-type: none"> <li>• 3% growth in 2021</li> <li>• 6.5% in 2022</li> </ul>	<b>2021–2022 impact</b> <ul style="list-style-type: none"> <li>• 6% growth in GDP in 2021 with similar growth experienced in 2022 as well.</li> </ul>	<b>2021–2022 impact</b> <ul style="list-style-type: none"> <li>• GDP growth of 2.1% in 2021 and just under 5% in 2022.</li> </ul>	<b>2021–2025 impact</b> <ul style="list-style-type: none"> <li>• Smaller differences in GDP growth between this scenario and the baseline case over 2021–2025 (particularly in the first half of this period) as ONS low migration assumptions of approx. 100,000 fewer migrants per year fully set in from 2025. Between 2020 and 2025, migration does begin to fall but to a much smaller extent.</li> <li>• Unlike the Covid-19-related scenarios that focus more on the short term, the low migration scenario will be more evident in the medium and longer term.</li> </ul>
	<b>GDP recovery</b> <ul style="list-style-type: none"> <li>• GDP will reach its 2019 level by mid-2022.</li> </ul>	<b>GDP recovery</b> <ul style="list-style-type: none"> <li>• In this scenario, GDP is 5.5% below the 2019 Q4 level by the end of 2021, and it takes until 2024 for the remaining loss in output to be recovered.</li> <li>• By 2023, GDP growth to converge to the baseline case's trajectory.</li> </ul>	
			<b>Impact to 2040</b> <ul style="list-style-type: none"> <li>• Longer-term GDP growth to average 1.7% a year between 2023 and 2040, similar to baseline rates. The severe scenario is intended to capture near-term weakness due to Covid-19, the impacts of which will primarily be seen over 2021–2023, rather than out to 2040.</li> </ul>

## Appendix C. Forecasting parameters

Forecasts for the key macroeconomic variables are shown in the baseline scenario.

Main model variables	Annual percentage change																							
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
GDP market prices (2018 prices)	1.7	1.3	1.4	-9.9	3.0	6.5	2.1	1.6	1.6	1.6	1.6	1.7	1.7	1.8	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Final consumption expenditure by households and NPISH <sup>72</sup>	1.1	1.4	1.1	-11.8	3.8	7.1	2.5	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Gross fixed capital formation (investment)	2.8	0.4	1.5	-11.6	0.7	8.6	2.9	1.5	1.3	1.3	1.3	1.4	1.5	1.5	1.5	1.6	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6
Total workforce jobs (job count measure)	1.0	0.5	1.5	-1.7	-1.3	2.1	1.7	1.1	0.8	0.6	0.6	0.6	0.6	0.4	0.5	0.4	0.4	0.4	0.4	0.3	0.4	0.6	0.6	0.7
Bank base rate (level)	0.3	0.6	0.8	0.2	0.1	0.1	0.1	0.1	0.2	0.4	0.6	0.8	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0

<sup>72</sup> Non-profit institutions serving households

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Other model variables	Annual percentage change																							
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Final consumption expenditure by Government	0.7	0.6	4.0	-8.4	12.6	5.0	1.8	1.4	1.4	1.4	1.5	1.8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Domestic demand	1.0	1.2	1.6	-11.8	8.7	6.6	2.2	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Exports of goods and services	5.4	3.0	2.7	-13.9	2.3	6.4	2.8	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total final expenditure	1.9	1.6	1.9	-12.6	7.2	6.8	2.3	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Imports of goods and services	2.6	2.7	2.7	-19.1	5.7	6.7	3.0	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Total population	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Working age population	0.6	0.5	0.7	1.2	0.5	0.2	0.2	0.2	0.2	0.5	1.0	0.8	0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.1
Real household disposable income	0.1	2.4	1.9	0.3	1.4	2.5	2.4	2.3	2.3	2.1	1.7	1.7	2.0	2.0	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.1	2.1	2.1
Average weekly earnings (£/week)	2.3	3.0	3.4	0.9	2.4	2.8	3.2	3.4	3.4	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.4	3.4	3.4	3.4
Consumer prices (2015=100)	2.7	2.4	1.8	0.9	1.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Note: where prices are used those prices are chain linked.

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Major sector	Gross value added growth rates																							
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Construction	6.1	0.1	2.0	-13.7	8.3	8.7	3.0	1.9	1.7	1.6	1.5	1.5	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Agriculture, forestry and fishing	6.3	-3.3	6.5	-0.8	4.6	2.5	-0.5	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Mining and Quarrying	0.7	5.3	-0.7	-6.7	-1.4	1.0	-0.8	-0.9	-0.8	-0.7	-0.6	-0.5	-0.4	-0.5	-0.6	-0.6	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
Manufacturing	2.6	1.3	-1.6	-10.7	4.0	4.9	1.1	0.5	0.3	0.3	0.4	0.6	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
Utilities	0.0	-1.3	1.0	-3.3	1.6	3.4	0.1	-0.1	1.0	1.1	1.2	1.3	1.4	1.4	1.4	1.4	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2
Construction	6.1	0.1	2.0	-13.7	8.3	8.7	3.0	1.9	1.7	1.6	1.5	1.5	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Wholesale and retail	2.0	3.1	2.6	-6.4	7.0	6.6	2.2	1.5	1.3	1.3	1.7	1.7	1.8	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5
Transport and storage	1.0	1.5	1.9	-17.7	-0.5	9.6	3.4	2.1	1.8	1.7	1.7	1.8	1.9	1.9	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7
Accommodation, food services and recreation	2.0	0.5	2.2	-34.6	1.4	15.4	3.0	1.9	1.6	1.7	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.5
Information and communication	4.4	4.5	7.5	-7.2	-0.8	7.5	2.9	2.5	2.4	2.5	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.2	2.2
Finance and insurance	0.4	-0.8	-2.4	-3.0	2.1	4.4	1.5	1.9	2.3	2.4	2.2	2.4	2.6	2.7	2.8	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Professional and other private services	1.1	1.7	1.4	-7.6	1.8	5.2	1.7	1.8	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Public services	0.6	0.5	2.1	-10.8	4.3	7.4	2.8	1.6	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4

## **Appendix D. Forecast demand in construction in HS2 regions, broken down by occupation, 2019**

Occupational group <sup>73</sup>	London	South East	West Mids.	East Mids.	North West	York. & Humber	Total demand
Managerial and professional	170,300	132,600	74,800	53,400	92,600	64,400	588,100
Other construction process managers	35,400	28,300	17,500	17,800	23,700	16,200	138,900
Other construction prof/tech staff	32,900	39,200	17,800	9,500	25,000	16,400	140,800
Senior, exec, and business managers	35,700	30,600	21,200	12,100	19,500	12,900	132,000
Surveyors	14,500	9,000	6,900	4,500	5,600	6,900	47,400
Construction Project Managers	16,700	8,900	2,500	2,700	4,500	3,300	38,600
Civil engineers	9,600	6,500	3,000	4,000	6,500	4,400	34,000
Construction Trades Supervisors	10,400	5,300	4,400	1,900	4,100	3,700	29,800
Architects	15,100	4,800	1,500	900	3,700	600	26,600
Skilled trades	178,400	186,700	115,800	99,600	144,500	116,300	841,200
Wood trades and interior fit-out	33,300	32,300	19,600	15,800	21,700	21,900	144,600
Bricklayers	6,500	8,300	5,300	5,300	9,800	5,900	41,100
Building envelope specialists	20,700	15,200	7,300	6,700	6,300	8,500	64,700
Painters and decorators	15,600	16,500	6,000	7,100	11,000	6,700	62,900
Plasterers	3,400	5,300	3,300	5,200	5,700	5,800	28,700
Roofers	2,500	8,600	4,900	1,500	6,000	5,400	28,900
Floorers	3,100	3,600	1,700	1,400	3,900	2,200	15,900
Glaziers	3,900	3,400	3,800	3,700	3,600	3,600	22,000
Specialist building operatives (nec)	13,000	6,400	4,300	6,200	5,900	4,900	40,700
Scaffolders	1,300	2,700	1,900	600	3,300	2,300	12,100
Plant operatives	6,000	4,400	2,200	4,800	5,700	1,400	24,500
Plant mechanics/fitters	3,100	5,500	6,400	3,500	5,200	3,700	27,400
Steel erectors/structural fabrication	2,300	2,200	3,000	1,600	2,300	2,400	13,800
Labourers (nec)	13,600	21,400	12,500	7,100	13,400	7,000	75,000
Electrical trades and installation	24,300	20,900	14,300	13,800	19,700	15,300	108,300
Plumbing and HVAC Trades	20,700	24,600	12,600	12,000	17,100	14,900	101,900
Logistics	3,600	3,600	4,000	1,800	2,500	1,700	17,200
Civil engineering operatives (nec)	1,500	1,800	2,700	1,500	1,400	2,700	11,600
Office-based staff	79,300	65,800	42,300	25,100	40,700	34,600	288,000
Non-construction prof/tech/IT/other	73,100	62,900	39,200	22,000	36,300	30,100	263,600



Non-construction operatives	6,200	2,900	3,100	3,100	4,400	4,500	24,200
All occupations	428,000	385,100	232,900	178,100	277,800	215,300	1,717,000

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<sup>73</sup> Note: all numbers rounded to nearest 100

## Appendix E. Mobility of the construction workforce

Region/nation of last site	Region/nation currently working in											
	EM	EE	GL	NE	NW	NI	SC	SE	SW	WA	WM	YH
	%	%	%	%	%	%	%	%	%	%	%	%
East Midlands (EM)	79	2	*	1	0	0	0	4	*	0	16	4
East of England (EE)	4	52	6	1	0	0	0	11	1	*	1	*
London (GL)	4	31	73	2	*	1	*	14	4	*	1	3
North East (NE)	0	*	0	90	0	1	*	0	0	*	1	2
North West (NW)	1	0	*	2	91	1	0	1	1	*	4	3
Northern Ireland (NI)	0	0	1	0	1	93	1	0	0	0	0	0
Scotland (SC)	0	*	1	2	1	2	98	0	*	*	*	1
South East (SE)	1	11	16	0	0	1	*	62	8	1	2	*
South West (SW)	1	1	*	0	0	0	*	3	81	4	1	1
Wales (WA)	0	*	*	0	2	0	0	1	2	88	1	0
West Midlands (WM)	7	1	1	0	*	1	1	3	*	0	71	2
Yorkshire & the Humber (YH)	3	0	1	2	2	1	0	*	*	0	1	83
Republic of Ireland	0	0	*	0	0	0	0	0	0	0	0	*
Other parts of Europe	0	0	0	0	*	0	0	0	0	0	1	0
Outside of Europe	0	0	0	0	1	1	0	0	0	0	0	0
Other/unsure	1	2	1	*	1	0	0	1	1	6	1	*
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Note: Construction workers region/nation of last site before this current site; \* denotes less than 0.5% (source: CITB, 2018)

# Appendix F. Occupational mismatch tables

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Phases One and 2a								
Occupational group	Average total construction demand (2021–peak)	Average gross recruitment (2021–peak)	Gross recruitment requirement as a share of total construction demand (2021–peak)	Average HS2 demand (2021–peak)	Average HS2 demand as a share of total construction demand	HS2 demand as a share of total HS2 labour demand (2021–peak)	Potential forecast inflows as a share of average construction demand (2021–peak)	Construction employment as a share of employment in all sectors (2019)
Senior, executive, and business process managers	89,400	8,000	9%	1,300	1%	6%	4%	8%
Construction project managers	28,300	2,000	7%	600	2%	3%	3%	77%
Other construction process managers	83,300	6,400	8%	2,000	2%	9%	3%	31%
Non-construction professional, technical, IT, and other office-based staff	176,100	18,600	11%	3,100	2%	14%	8%	5%
Construction trades supervisors	20,700	2,300	11%	900	4%	4%	5%	48%
Wood trades and interior fit-out	84,100	6,900	8%	800	1%	4%	6%	68%
Bricklayers	19,300	1,400	7%	100	1%	1%	3%	98%
Building envelope specialists	43,200	700	2%	300	1%	1%	1%	80%
Painters and decorators	38,700	3,400	9%	<100	0%	0%	6%	67%
Plasterers	11,500	1,000	9%	<100	0%	0%	5%	98%
Roofers	15,400	1,000	6%	<100	0%	0%	6%	98%
Floorers	8,400	700	8%	<100	0%	0%	6%	91%
Glaziers	11,000	600	6%	<100	0%	0%	5%	56%

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Phases One and 2a								
Occupational group	Average total construction demand (2021-peak)	Average gross recruitment (2021-peak)	Gross recruitment requirement as a share of total construction demand (2021-peak)	Average HS2 demand (2021-peak)	Average HS2 demand as a share of total construction demand	HS2 demand as a share of total HS2 labour demand (2021-peak)	Potential forecast inflows as a share of average construction demand (2021-peak)	Construction employment as a share of employment in all sectors (2019)
Specialist building operatives (nec)	22,500	1,000	5%	700	3%	3%	5%	43%
Scaffolders	6,200	700	11%	200	3%	1%	5%	92%
Plant operatives	13,400	1,800	14%	1,200	9%	5%	6%	28%
Plant mechanics/fitters	14,900	1,400	9%	1,000	7%	4%	10%	9%
Steel erectors/structural fabrication	7,900	800	10%	400	5%	2%	5%	18%
Labourers (nec)	49,000	10,500	21%	1,900	4%	9%	14%	81%
Electrical trades and installation	59,000	2,400	4%	1,100	2%	5%	3%	39%
Plumbing and HVAC trades	55,900	2,800	5%	400	1%	2%	4%	81%
Logistics	11,200	2,100	19%	300	3%	2%	10%	4%
Civil engineering operatives (nec)	6,100	900	15%	2,400	39%	11%	10%	43%
Non-construction ops (nec)	13,000	1,400	10%	800	6%	4%	8%	3%
Civil engineers	20,000	1,600	8%	900	5%	4%	3%	71%
Other construction professionals and technical staff	90,200	6,400	7%	1,400	2%	6%	5%	25%
Architects	23,200	1,400	6%	<100	0%	0%	6%	83%

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Phases One and 2a								
Occupational group	Average total construction demand (2021-peak)	Average gross recruitment (2021-peak)	Gross recruitment requirement as a share of total construction demand (2021-peak)	Average HS2 demand (2021-peak)	Average HS2 demand as a share of total construction demand	HS2 demand as a share of total HS2 labour demand (2021-peak)	Potential forecast inflows as a share of average construction demand (2021-peak)	Construction employment as a share of employment in all sectors (2019)
Surveyors	30,900	1,700	6%	500	2%	2%	4%	73%

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Phase 2bWL								
Occupational group	Average total construction demand (2021-peak)	Average gross recruitment requirement (2021-peak)	Gross recruitment as a share of total construction demand (2021-peak)	Average HS2 demand (2021-peak)	Average HS2 demand as a share of total construction demand	HS2 demand in each occupation as a share of total HS2 labour demand (2021-peak)	Potential forecast inflows as a share of average construction demand (2021-peak)	Construction employment as a share of employment in all sectors (2019)
Senior, executive, and business process managers	17,600	800	5%	500	3%	6%	4%	8%
Construction project managers	4,200	200	5%	200	5%	3%	3%	77%
Other construction process managers	21,700	800	4%	700	3%	9%	3%	31%
Non-construction professional, technical, IT, and other office-based staff	37,000	3,200	9%	1,200	3%	15%	8%	5%
Construction trades supervisors	3,800	300	8%	200	6%	3%	6%	48%
Wood trades and interior fit-out	24,300	2,200	9%	300	1%	4%	6%	68%
Bricklayers	9,000	600	7%	<100	1%	1%	3%	98%
Building envelope specialists	6,600	200	3%	100	2%	1%	1%	80%
Painters and decorators	10,700	900	8%	<100	0%	0%	6%	67%
Plasterers	5,400	500	9%	<100	0%	0%	5%	98%
Roofers	5,900	400	7%	<100	0%	0%	6%	98%
Floorers	3,700	300	8%	<100	0%	0%	6%	91%
Glaziers	3,400	200	5%	<100	1%	0%	5%	56%
Specialist building operatives (nec)	5,200	200	4%	200	3%	2%	5%	43%
Scaffolders	3,100	200	6%	<100	2%	1%	5%	92%

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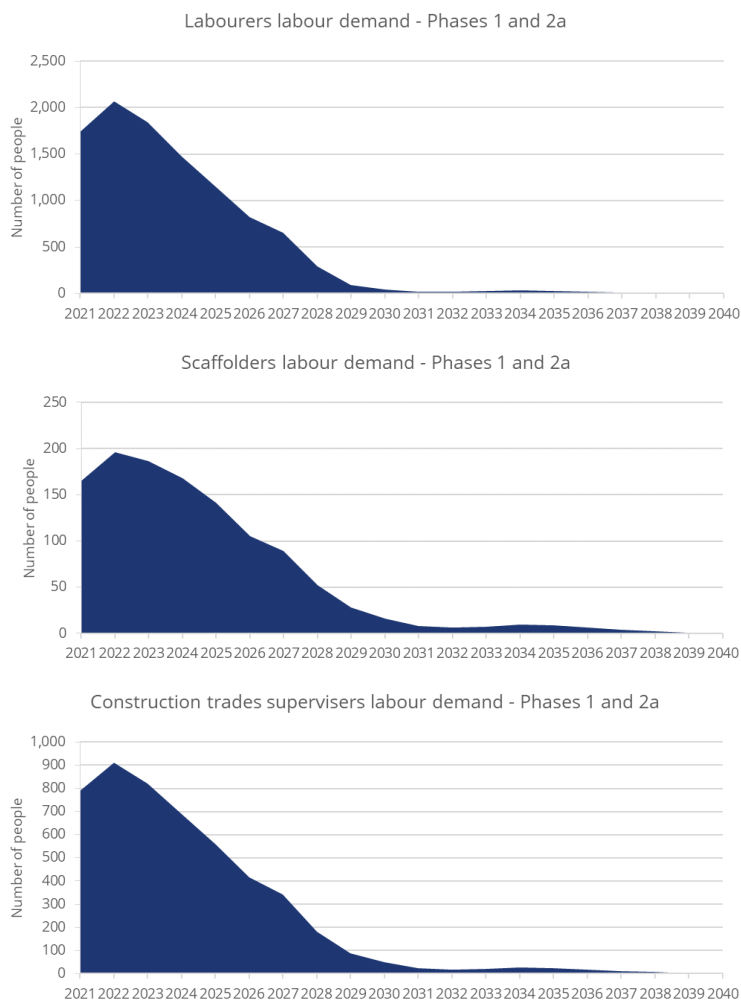
Phase 2bWL								
Occupational group	Average total construction demand (2021-peak)	Average gross recruitment requirement (2021-peak)	Gross recruitment as a share of total construction demand (2021-peak)	Average HS2 demand (2021-peak)	Average HS2 demand as a share of total construction demand	HS2 demand in each occupation as a share of total HS2 labour demand (2021-peak)	Potential forecast inflows as a share of average construction demand (2021-peak)	Construction employment as a share of employment in all sectors (2019)
Plant operatives	5,800	600	11%	300	5%	4%	7%	28%
Plant mechanics/fitters	4,800	400	8%	300	6%	4%	10%	9%
Steel erectors/structural fabrication	2,400	200	9%	200	6%	2%	5%	18%
Labourers (nec)	13,900	2,500	18%	300	2%	4%	15%	81%
Electrical trades and installation	19,800	1,000	5%	400	2%	6%	3%	39%
Plumbing and HVAC trades	16,100	800	5%	200	1%	2%	4%	81%
Logistics	2,500	400	17%	<100	3%	1%	10%	4%
Civil engineering operatives (nec)	1,500	200	12%	600	37%	7%	11%	43%
Non-construction ops (nec)	4,300	300	8%	200	5%	3%	9%	3%
Civil engineers	6,400	400	6%	400	6%	5%	3%	71%
Other construction professionals and technical staff	24,300	1,400	6%	800	3%	11%	5%	25%
Architects	3,800	200	5%	<100	2%	1%	6%	83%
Surveyors	6,000	300	5%	200	4%	3%	4%	73%

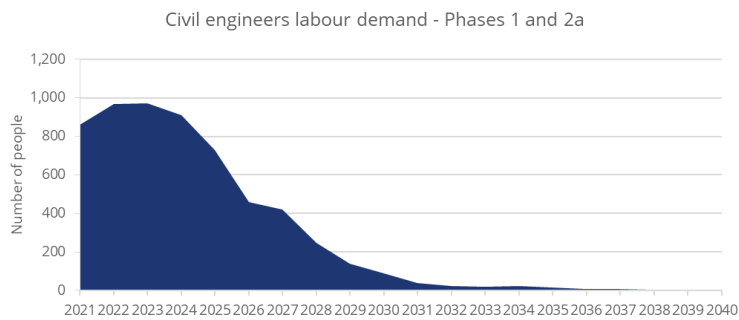
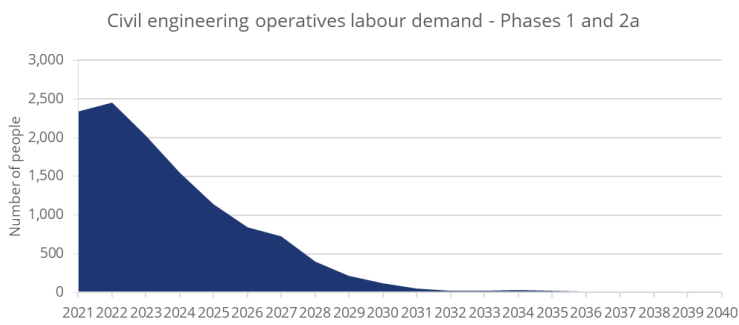
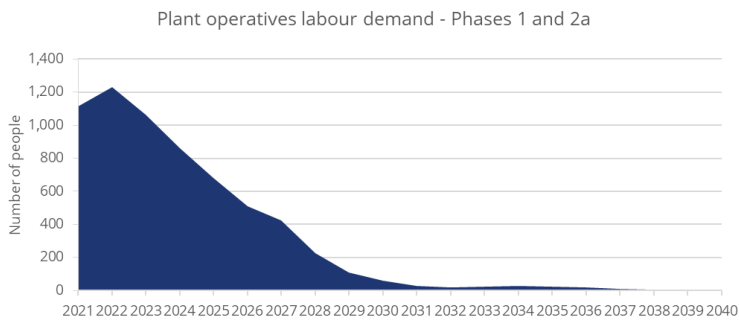
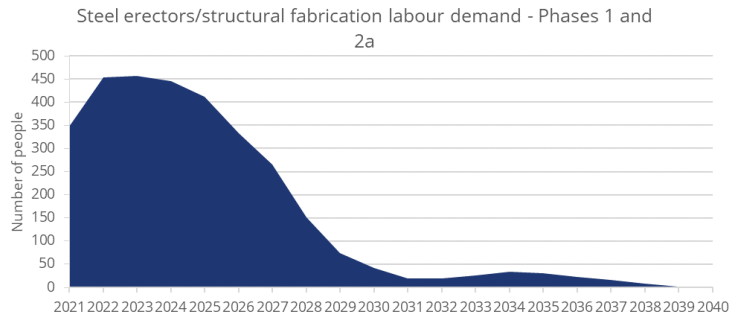


# Appendix G. Occupational demand profiles for priority mismatches

This appendix contains the demand profiles for each of the occupations discussed in the priority mismatch analysis.

## Phases One and 2a





## Phase 2bWL

