Final HS1 Asset Management Annual Statement 2022/23

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Date	8th June 2023

Executive Summary

This year, Year 3 of Control Period 3 (CP3), has been a period of significant change across the HS1 system including the introduction of a new Target Operating Model (TOM) for Network Rail High Speed (NR(HS)), transfer of stations regulation from the Department for Transport (DfT) to the Office of Rail and Road (ORR) and ongoing industrial action.

The new TOM was due to be implemented in CP4; however, HS1 requested an acceleration to deliver benefits sooner as we were keen to support the TOCs in a time of unprecedented cost pressures from macro-economic factors. The TOM includes an organisational re-structure that rationalised seven director roles to four (which have now been appointed). The TOM is an important enabler for the delivery of long-term operations, maintenance, and renewals efficiencies and has supported the achievement of almost £1.5m outperformance by NR(HS) in 2022/23.

The regulation of HS1's stations assets transferred from the DfT to the ORR in July 2022. The change was requested by DfT and HS1 managed the transfer quickly and efficiently, working closely with DfT and ORR to improve regulatory oversight of the station assets and ensure the whole system is overseen by one entity.

Industrial action started in May 2022 and has continued throughout the year. There have been 17 days of industrial action through the year which has significantly impacted on service delivery. HS1's proactive resource planning with NR(HS) and UKPNS resulted in the delivery of 12 hours of route availability on all days of industrial action, except Boxing Day, through training of management grade employees. Industrial action and the re-deployment of staff to maintain services has resulted in indirect impacts such as maintenance delivery backlogs and renewals planning delays which NR(HS) have worked hard to recover through the year.

Throughout these challenges HS1 has delivered good operational performance including 206 delay free days in the year. Stations have also performed well; a particular highlight was St Pancras International Station winning the Best Major Station award in October 2022 at the National Rail Awards.

This has all been achieved during a period of significant geopolitical and macroeconomic pressures which are affecting the entire HS1 system, including:

- Inflation at its highest rate in over 40 years which is being felt in renewals delivery as contractors are showing less interest in renewals tenders, are being more commercially astute and have a lower appetite to risk.
- Energy costs increasing by 300% since summer 2022, despite the hedging strategy employed by HS1energy costs have increased, further increasing TOC cost pressures.
- Time-consuming post-Brexit border arrangements that are limiting the number of Eurostar passengers that can be processed per train.

Lower passenger demand for TOCs as working from home continues to reduce commuting and business travel results in fewer services on HS1, raising costs per service for TOCs and DfT (via the underpin payments) HS1 has used each of these challenges as an opportunity to re-evaluate, identify ways to deliver further efficiency and reduce costs. HS1 has widely engaged with stakeholders to understand concerns and to ensure consistent drive for an outcome that brings benefits to all those that are part of the HS1 system. The closer working relationship between HS1 and the ORR has been welcomed throughout.

The renewals challenges that were reported in the 2021/22 Asset Management Annual Statement (AMAS) have not gone away, and the macroeconomic pressures and industrial action have been felt directly in this area. Despite this, renewals delivery has been improving and £8.6m, 74%, of planned asset renewals for Year 3 have been successfully. To support this, HS1 enhanced its renewals governance to ensure it remained appropriate and added value.

The remaining CP3 renewals portfolio has been reviewed using the outputs of recent asset modelling work undertaken as part of the PR24 preparation and a risk-based approach detailed in the Strategic Asset Management Plan (SAMP). Each renewal has been subject to a deliverability review which will evaluate development status and supply chain readiness. The revised CP3 renewals work bank has been discussed with the ORR and is included in this AMAS. All deferred renewals continue to be effectively managed and HS1 is providing assurance on the decisions made and management of the asset risk.

Throughout this year HS1 has continued to deliver successes including implementation of regenerative braking across the Class 395 fleet, in collaboration with the DfT. This has delivered both environmental and economic benefits to the HS1 system. The benefits have exceeded expectations and early figures show the initiative is currently saving South Eastern Trains £2.6m per year in electricity costs (at October 2022 prices). HS1 has faced some cost challenges in the year versus the CP3 budget, specifically in

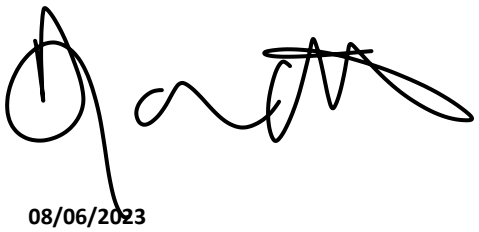
relation to staff and consultants in the year driven by several one-off items and the tail end of its financial stability projects, during the pandemic. HS1 is reviewing the organisation and cost base prior to the submission of PR24 to ensure it is fit for purpose and appropriate for the current environment.

The UK has suffered with a range of exceptional weather events including high temperatures, heavy rain, snow, and very cold temperatures and HS1 assets have performed well during these extreme weather events. HS1, together with NR(HS), shared learning from the extreme weather incidents with the ORR. Further research work has been commissioned with Southampton University to help better understand asset performance in future exceptional weather.

HS1 has progressed many research and development projects this year to investigate and demonstrate how new technology can be applied to the HS1 railway to further improve efficiency. These include ArcGIS to demonstrate the benefits of visualisation; Fibre Optic Acoustic Sensing to support remote condition monitoring and Artificial Intelligence Pantograph Systems to optimise maintenance activities.

Whilst the HS1 system has been subject to a number of significant disruptions throughout this year, HS1 has proactively taken each event as an opportunity to re-evaluate the system position, take steps to mitigate the impact and ultimately realise efficiency to ensure operational standards have been protected. HS1 stands ready to support other initiatives to support TOCs costs, such as the N-1 electrical feeder power reduction scheme and escrow investment strategy amendments. HS1 acknowledges that the opportunities, while important have not been able to offset the macroeconomic impacts that are passed through to TOCs, such as inflation and electricity. With most of the quick wins identified and delivered we must now plan to deliver the more complex and challenging efficiency opportunities such as a one team stations management approach.

HS1 Authorisation and Approval

HS1 Authorisation		Comments
On behalf of HS1 Limited, I authorise this HS1 Draft Asset Management Annual Statement (AMAS) produced in accordance with the Concession Agreement between HS1 Limited and the Secretary of State in schedule 10, section 6.1.1 and in accordance with the HS1 Lease between HS1 Limited and the Secretary of State in schedule 10, section 4.5.1		
Name:	**Dyan Crowther OBE**	
Role:	**Chief Executive Officer, HS1 Limited**	
Signature		
Date	**08/06/2023**	

HS1 Approval		Comments
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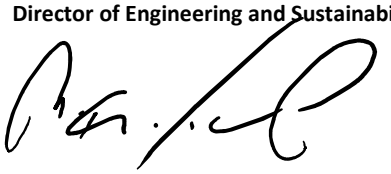
Signature		
Date	**08/06/2023**	

Prepared by		Comments
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Name:	**Joanne Parkes**	
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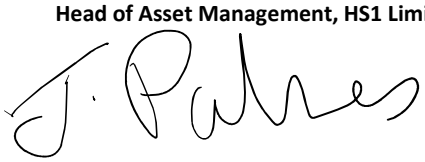
Signature		
Date	**08/06/2023**	

1 Contents

List of Figures

List of Tables

1 Context

1.1 Purpose

The purpose of this AMAS is to provide assurance to the ORR and the Secretary of State that HS1 is fulfilling the Asset Stewardship obligations as defined in:

- the Concession Agreement between HS1 and the Secretary of State in Schedule 10, Section 6 for route
- The HS1 Stations Lease between HS1 and the Secretary of State in Schedule 10, Sections 4.5 and 4.6 for stations.

As an annual document delivered during Control Period 3 (CP3), the AMAS is also an important part of the contemporaneous evidence to demonstrate how HS1 is delivering against commitments from Periodic Review 19 (PR19) and will be key in the Periodic Review 24 (PR24) process. This AMAS also supports the preparation of the ORR's annual report on HS1.

This is the third AMAS of CP3. It covers Periods 1 to 13 of 2022/23, outlining our successes and challenges over the year, and highlighting our plans for the future.

This is the first AMAS to be published since the regulation of HS1 stations assets was transferred to the ORR from the Department for Transport (DfT) in July 2022. This combined AMAS reports on both the route and station assets as part of our harmonised approach to asset management and this document is voluntarily shared with the DfT.

Additionally, while there are no specified reporting obligations for HS1 defined in the Track Access Agreements between HS1 and the operators, this AMAS is shared with the Train Operating Companies (TOCs) and Freight Operating Companies (FOCs). We are committed to providing transparency and engagement with our customers on the efficiency and effectiveness of operations and maintenance expenditure and renewals funded from the escrow accounts. As noted above, the AMAS is a key document for PR24 so we would encourage TOCs and FOCs to provide feedback now rather than waiting until later in CP3.

The circulation list for this AMAS is provided in Appendix 1.

The key regulatory reporting dates for the AMAS, as set out in the Concession Agreement in Schedule 10, Section 6, and HS1 Stations Lease in Schedule 10, Section 4.5 are:

- HS1 submits the Draft AMAS to the ORR by 17 February 2023 (30 business days before year end); and
- HS1 submits the Final AMAS to the ORR by 9 June 2023 (45 business days after year end).

1.2 HS1 System Challenges

2022/23 has been a year of change across the HS1 system. These changes include the introduction of a new TOM for NR(HS), the transfer of station asset regulation from the DfT to the ORR and ongoing slow recovery in passenger numbers post-pandemic. System challenges are reviewed through various stakeholder meetings including periodic HS1 / NR(HS) operator agreement and station concession agreement reviews, risk review meetings and bilateral meetings.

The HS1 system has been impacted by significant macroeconomic and geopolitical challenges including:

- Inflation at its highest rate in over 40 years which is being felt in renewals delivery as contractors are showing less interest in renewals tenders, are being more commercially astute and have a lower appetite to risk.
- Energy costs increasing by 300% since summer 2022, despite the hedging strategy employed by HS1energy costs have increased, further increasing TOC cost pressures.
- Time-consuming post-Brexit border arrangements that are limiting the number of Eurostar passengers on certain services that can be processed per train.
- Lower passenger demand for TOCs as working from home continues to reduce commuting and business travel results in fewer services on HS1, raising costs per service for TOCs and DfT (via the underpin payments); and
- Funding for big technology changes (ERTMS) and climate resilience, as well as the St Pancras station roof are currently unfunded liabilities.

HS1 is a national asset of strategic importance that has delivered significant economic value. The more the asset is utilised, the more benefit accrues to the high-speed system, rail passengers and the broader economy. All parties in the HS1 system – operators (both TOCs and FOCs), the ORR, DfT and HS1 – are working together on strategic solutions to address the significant cost pressures faced by train operators while incentivising utilisation is vital to help deliver the best outcomes for passengers and the economy.

Whilst the HS1 system has been subject to a number of significant disruptions throughout this year, HS1 has proactively taken each event as an opportunity to re-evaluate the system position, take steps to mitigate the impact and ultimately realise efficiency. We have initiated discussions with stakeholders to formulate a system strategy and examine potential solutions – we are not able to deliver this on our own. This year we have instigated system wide engagement and will continue to explore how we all work together differently during PR24 and in CP4.

2 Asset and Operational Performance

This section summarises the safety, operational and asset performance of HS1. Further details can be found in Appendix 2.

To support and drive continuous improvement, we have a balanced scorecard with NR(HS) which covers safety, train performance, station measures, asset management and investment. The scorecard is reviewed each period. It supports our assurance of the ongoing performance of NR(HS) and enables us to work with NR(HS) in a timely manner to make any necessary interventions to ensure good outcomes are achieved.

2.1 Safety

- Overall workforce FWI during 2022/23 was 0.151 > threshold of 0.033.
- HS1 is concerned by the increase in FWI and has formally raised this with NR(HS). In response NR(HS) has produced locally owned safety improvement plans which have been shared with HS1 and presented at the HS1 Safety Sub Committee.
- Safety performance has been continuously above the threshold largely due to the increase in assault of our station staff. Towards the end of 2021/22 NR(HS) introduced Land Sheriffs in stations as a result of an opportunity to reduce British Transport Police (BTP) costs and improve station security. The increased assault of our staff is causing our FWI to trend negatively. We need to understand our change in risk profile as a result of the staffing change and evaluate the benefits being seen.
- An assault in period 12 resulted in a RIDDOR specified injury which, due to the heavier index weighting, caused a significant increase in the FWI.
- ORR is the Safety regulator for NR(HS) and has increased its interactions over the last year including as a result of the Contractor fall at St Pancras in period 5.

Our key safety metrics are:

- For workforce safety: Fatalities and Weighted Injuries (FWI) per million hours worked; and
- For passenger safety: FWI per 10 million passenger footfalls at stations.

Figure 1 shows the total route and station FWI per million hours worked. Overall workforce FWI during 2022/23 was 0.151, compared with the target of 0.033. During 2022/23, there were fourteen lost time injuries, of which eight were RIDDOR lost time events, seven of which were greater than seven days lost time injuries and there was one specified injury, for the NR(HS) workforce and contractors. ORR is the safety regulator for NR(HS). HS1 monitors a range of activity and outcome indicators which include FWI, in order to identify issues and challenge NR(HS) to make improvements. During 2022/23, HS1 raised concerns about trends in safety performance in the regular contract review meetings and ultimately in a formal letter requesting NR(HS) to present its safety improvement plans to the HS1 Board Safety Subcommittee and the HS1/NR(HS) Joint Assurance Board. In response, NR(HS) developed an approach to improving workforce FWI which was presented in September and builds on their approach to local safety ownership.

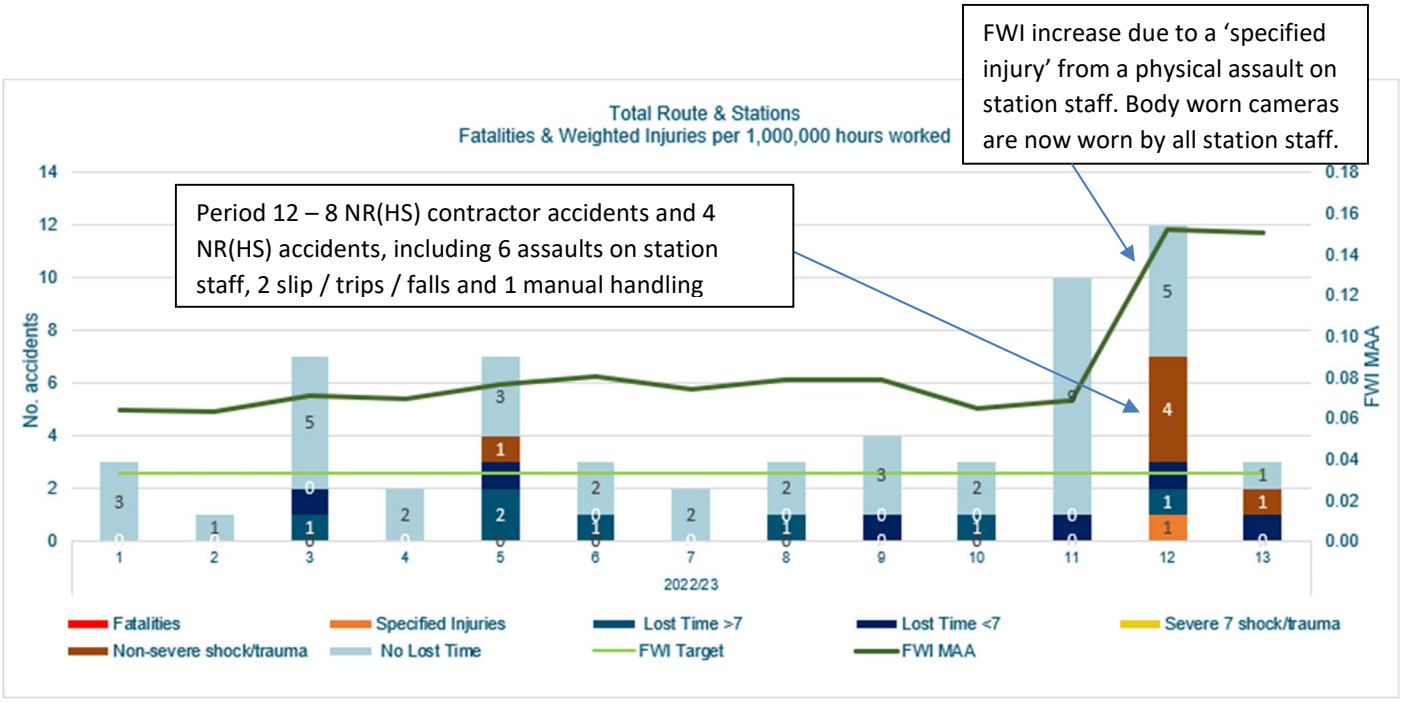


FIGURE 1 - FATALITIES AND WEIGHTED INJURIES PER 1,000,000 HOURS WORKED

The NR(HS) locally owned safety improvement plans (0) have been developed within the delivery functions to address the functional specific risks. This promotes ownership as part of the drive to reduce safety related incidents in their business areas and will have a quantifiable benefit to Workforce FWI reduction. HS1 has discussed the importance of driving safety culture improvements and NR(HS) is reviewing its culture development work.

The most notable of the RIDDOR reportable events was a manual handling incident in period 3, in which an existing back injury was aggravated whilst the operative carried out their normal duties, resulting in 276 days lost time. A Level 1 investigation resulted in the introduction of a new workstream to identify existing injuries to provide early treatment and preventative measures. NR(HS) continue to upskill their maintenance workforce to provide guidance on manual handling techniques while working on site, which will improve interventions in unsafe techniques. Another significant incident was associated with a contractor who fell 1.5m in the shorebase area at St Pancras whilst clearing rubbish which resulted in 45 days lost time and which occurred in period 5. The ORR did make an intervention and its enquiries into this incident concluded at the end of December 2022. An NR(HS) investigation resulted in recommendations to be implemented including: a safety culture improvement campaign, barrier installation at loading docks preventing a similar risk of falling from height and loading dock edges painted yellow to draw attention to the risk.

The Specified Injury accident was because of a physical assault within the St Pancras International Station involving a security operative which took place in period 12. The operative was removing a disruptive passenger from the gate line, when the passenger turned, and head butted the operative which in turn broke the operative's nose. Due to the heavier weighting of a Specified Injury within the FWI calculation compared to other lost time injuries, we have seen a significant increase in the FWI Moving Annual Average (MAA) following this accident (FWI was above the threshold and this event alone resulted in the FWI increasing again as can be seen above). To put this into context, our overall workforce FWI MAA without this one Specified Injury would have been similar to the national workforce FWI MAA of 0.074. Following data analysis carried out in the year we have noted a trend in the number of physical and verbal assaults at St Pancras, and as a result this is being addressed within the Stations team's locally owned safety plans, with initiatives such as the introduction of body worn cameras and conflict avoidance training. The rail industry has also reported an upwards trend of assaults across the network following COVID. It should be noted that towards the end of 2021/22 NR(HS) introduced Land Sheriffs in stations to reduce British Transport Police (BTP) costs and target low level criminality and anti-social behaviour by providing 24/7 security presence. The increased assault of our staff is causing our FWI to trend negatively. We need to understand our change in risk profile as a result of the staffing change and evaluate the benefits being seen.

The remaining 5 RIDDOR accidents relate to:

- a twisted ankle while walking on ballast in period 5.
- a jarred back to an operative from our supplier when a floor tile collapsed into a floor void in period 6.
- a broken toe caused by unsecured equipment falling out of a van in period 8.
- a track contractor received burns to their upper thighs after using strong arm heavy duty hard surface cleaner to remove grease from their body and clothing in period 10.
- a twisted ankle on a stray piece of ballast in period 12.

Further details of accident categories across the year can be found in Figure 31.

Safety investigations have been conducted by NR(HS) or are currently underway for all these events (and all other non-lost-time accidents occurring on NR(HS) managed infrastructure). The investigations identify their own specific actions and recommendations, which can be either management system related, such as changes to safe methods of working, or human factors such as behaviour related actions around improving the way the individual approaches an activity. Additionally, following accidents NR(HS) share their learning internally through methods such as safety bulletins that are briefed to teams.

The passenger FWI is shown in Figure 2[1] for St Pancras International, Stratford International and Ebbsfleet International. The passenger FWI at 2022/23-year end was 0.022 across all areas of the stations and 0.014 for the NR(HS) managed areas, which is better than the threshold of 0.028. The NR(HS) stations team have recently embarked on a project to install artificial intelligence screens which recognise unsafe behaviours as people approach the escalator, such as carrying luggage. The screens warn them to stop. The results of this programme will be monitored over Q1 of the new financial year, and if successful this will be considered for roll out at other escalators to prevent harm to our passengers. Early data has shown a 20% increase in usage of lifts by people with luggage which would indicate the project is promoting safe behaviours and should therefore lead to a reduction in accidents. Locally owned safety plans and safety statistics are monitored every period at the NR(HS) Safety Board and include passenger safety and target key risks such as escalator and slip, trip and fall accidents.

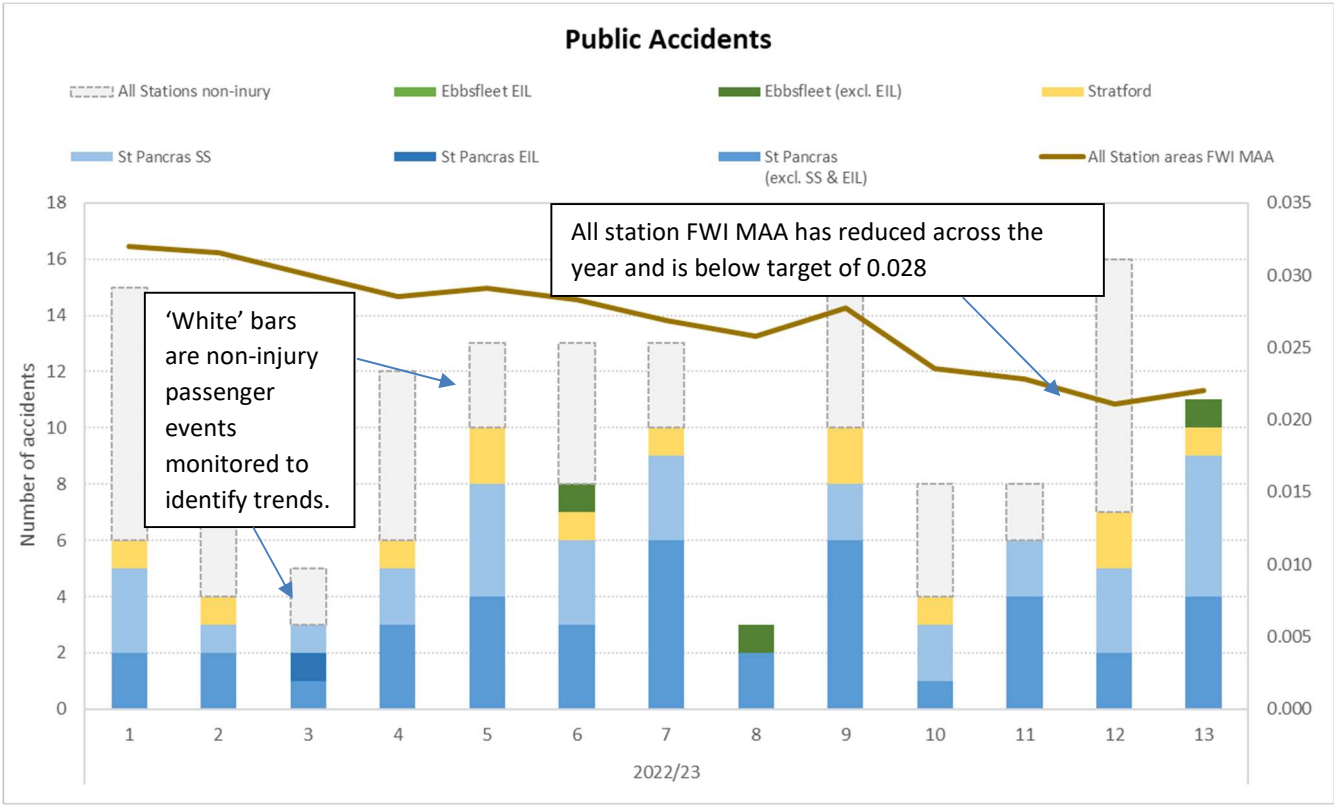


FIGURE 2 - PASSENGER FWI PER 10,000,000 PASSENGER FOOTFALL AT STATIONS

[1] The passenger FWI shown in this figure is that reported by NR(HS) which includes all areas of the infrastructure. HS1 separately reports the passenger FWI for HS1-managed areas of the infrastructure.

At Ashford International station there were no accidents recorded for the Mitie workforce or contractors or members of the public during 2022/23.

The UKPNS team working on HS1 successfully completed another 12 months without a lost time incident or a medical treatment injury. This continues the team's excellent safety record; it is now over 12 years since the last lost time incident. There were no RIDDOR reportable incidents during the period.

2.1.1 Safety Improvement Plans

Locally owned safety improvement plans have been produced for three areas of the business: infrastructure maintenance, route operations and stations operations with an additional two plans in draft for facilities and renewals. The aim of the plans is to identify and predict, through data analysis of previous accidents, the top causes of harm to our workforce and passengers. Workstreams have then been identified in each function to specifically address these areas of concern to drive down our accidents and reverse the trend in the worsening FWI. While progress has been slowed in some areas due to Industrial action, we have seen some good progress with the delivery of workstreams such as:

- the installation of new cable drum racking in the depot to reduce manual handling risks along with a manual handling poster campaign and training programme;
- the installation of improved walking routes and access ramps to reduce slip hazards;
- the introduction of body worn cameras to deter violence towards our staff;
- the installation of bleed kits and defibrillators at our stations;
- the introduction of artificial intelligence in our worst performing escalator to deter passengers from taking unsafe decisions such as carrying luggage on the escalator;
- advanced driver training for our Mobile Operations Managers.

It must be noted that even if our efforts prove successful in reducing the number of workforce accidents, this will not show in our statistics until P12 when our highest weighted accident (the specified injury), drops out of the calculation. This means even with 0 accidents in 2023/24 our FWI will still remain above 0.080 until P12.

Phase 2 plans are also being drafted, these will take a 'proactive approach' to managing safety and will focus on reducing risk involved with existing work practices to prevent future harm. For our infrastructure team this includes workstreams such as improving instructions and training for working in third rail areas and a risk review of undertaking multiple roles within a possession. For our operations team this will see a continued focus on improving the EMMIS work environment to minimise distractions and a continued drive to tackle trespass. A 'Phase 3' route-wide plan will be produced; this is currently being scoped and has formally commenced with a safety strategy day which looked to outline areas of improvement across the business and prioritise these based on risk and dependencies. A follow up session is to be held to map out improvement plans and assign resource. Work is, however, already underway to trial safety behaviour training at various levels of the business, and safety coaching in our frontline teams. These plans will be reported in the periodic NR(HS) Client Report and discussed at Safety Board each period.

It must also be noted that contractors account for 60% of our workforce accidents. Safety Suppliers days will continue as part of a Phase 3 plan, where their safety improvement initiatives will be shared alongside our own learning and initiatives. Periodic contractual reviews will continue, and agendas reviewed to ensure safety conversations are held.

2.2 Trespass and Security

- 27 trespass events in 2022/23 compared to 29 in 2021/22
- HS1 raised concerns about the increase in trespass events on the line of route and to mitigate NR(HS) have introduced a trespass strategy.
- Station trespass events have reduced compared to 2021/22 as a result of station patrols and station infrastructure changes.

During 2022/23, there were 27 trespass events compared to 29 in 2021/22, a decrease of 7.2%. 18 events occurred on the line of route, compared to 6 in 2021/22: an increase of 200%. The remaining 9 events related to stations, which was a reduction of 14 compared to 2021/22, a 60% reduction. This reduction has in part been achieved by the addition of the Land Sheriff station team carrying out station patrols along with the MOMs who attend stations during peak times and altering the station infrastructure such as the redesign of the champagne bar and removal of the Restricted Zone handrail. The work was consulted with EIL and DfT, domestic and international security regulators.

Non-operational trespass increased; there were eighteen events during 2022/23, compared to eleven in 2021/22, an increase of 81. For the majority of 2022/23, trespass incidents did not cause any significant delay; the exceptions were an incident in Period 2 with a trespasser between Nashenden Crossover and Southfleet Junction and in Period 8 with a trespasser between Ashford West Junction and Ashford East Junction.

During the year, NR(HS) has continued to improve its trespass strategy, placing the emphasis on preventative efforts, and coordinating its response with the BTP and other key stakeholders to increase success. To address the increasing trend of rail trespass NR(HS) has developed a strategic mitigation plan which includes identifying hot spots based on trespass data, fence height and damage checks, signage installation and analysing lineside neighbour risks. Risk assessments have been undertaken for all sites with repeat trespass incidents. Once finalised, the plan will be governed through NR(HS)'s operational performance resilience group.

Graffiti continues to be the biggest single crime on the line of route, with most of the attacks seen between Medway Viaduct and St Pancras. During 2022/23 there were 92 incidents, compared to 52 in 2021/22. Due to this increasing trend, and in direct response to the concerns raised by HS1, a managing trespass strategy has been created. This process of managing trespass has been divided into 3 core phases: preparation, delivery, and strategic collaboration. A milestone plan has been created to track these 3 phases for each process identified.

The strategy and mitigation plan includes:

- Identifying hot spots based on trespass data – 5 locations account for 10% of all trespass.
- Fence height and damage checks – with a view to carrying out enhancements to improve security.
- Signage installation – warning signs stating that people will be fined up to £1000. These have been put up at locations (Security fences and Gates) around the St Pancras throat area. This is also required by police to enable prosecution of said trespassers.
- Analysing lineside neighbour risks – such as Biffa bins being used as leverage to climb fencing and walls. Two lineside neighbours were identified and after communicating with them areas next to our fencing were cleared to create a gap.
- The start of the delivery of School Engagements with NR(HS) staff presenting to primary school children on the dangers of railway trespass.

The plan is tracked and governed through NR(HS)'s operational performance resilience group.

NR(HS) is also addressing this increasing trend with immediate, strategic, and site-specific mitigations. The immediate mitigations include the continued use of Wi-Fi cameras at high-risk locations to monitor the infrastructure for trespass in conjunction with trembler alarms for cable/metal theft. Under NR(HS)'s security contract, Land Sheriffs are carrying out a full line of route check of the adequacy of the fence line to get a comprehensive view of potential trespass risk areas, any previous

mitigation that has been applied, and to highlight any locations that could present trespass opportunities. A new contract requirement is to train Land Sheriffs to undertake semi-permanent repairs to damaged fencing.

Site-specific measures introduced this year to mitigate trespass and security incidents have included the deployment of technology at the Medway Viaduct to detect crime in progress and to assist with identifying those responsible, continued use of covert CCTV in the Aveley Viaduct area to give early warning of migrant trespass and a new fence to be erected at Medway Viaduct to deter trespass and false reporting of operational trespass. Recently Google placed an icon on Google Maps within the lease boundary at Medway Viaduct stating it was a good place for train enthusiasts which could be the reason for a rise in non-operational trespass at the location. This has now been removed by Google. Previously the Champagne Bar at St Pancras was an area where people would try to access the Eurostar restricted zone to get back to the European mainland. HS1 has worked with DfT, Eurostar, NR(HS) and Searcy's to redesign the area; stepping aids, handrails, and the gates at the end of each seating area have been removed and there are no tables next to the glass wall. Additionally, a request has been made for a CCTV camera to monitor the gate at shorebase.

2.3 Operational Performance

- Route performance of 7,100 minutes delay > target of 5,500 minutes
- Performance improving over P10 to P13 as asset resilience plans have been successfully implemented.
- Industrial action and a new contract have resulted in station cleaning scores dropping below target in year, but a successful improvement plan has improved performance over P10 to P13
- Lift Escalator and Travelator performance is currently below target, this is an issue being encountered by many infrastructure owners at present as suppliers are struggling to secure parts. HS1 has encouraged NR(HS) to work more closely with suppliers and this has resulted in the recent performance improvement.

2.3.1 Route Performance

Performance for the year to date has not met the target levels agreed for the year. At year end there was a total of 7,100 minutes delay against a target of 5,500 minutes (29% worse than target) and 206 days (approximately 56%) have remained delay free. This underlines the susceptibility of HS1's performance resilience to high impacting incidents, with a single incident capable of exceeding a full period target of delay minutes.

Figure 3 shows the evolution of the seconds delay per train moving average for all incidents on the HS1 infrastructure, excluding non-NR(HS) infrastructure incidents (such as UKPNS responsible incidents), illustrating the performance recorded since the beginning of 2021/22. The relatively high seconds delay per train in P2, P4, P5, P8, P9 and P10 in 2022/23 (represented by the blue bars) were substantially due to the incidents identified in table 1. MAA delay per train was 7.25 seconds in 2022/22 compared with the target of 5.44 seconds.

To improve train performance, HS1 worked with NR(HS) to introduce a new Performance Management Strategy in Period 7 that identified that trespass and points failures were responsible for 54% of all NR(HS) delay minutes. By the end of Period 13 mitigation

plans had resulted in a 7% reduction in trespass year on year and a 20% reduction since Period 7. Delay minutes per incident also declined resulting in improved performance in the last quarter of the year.

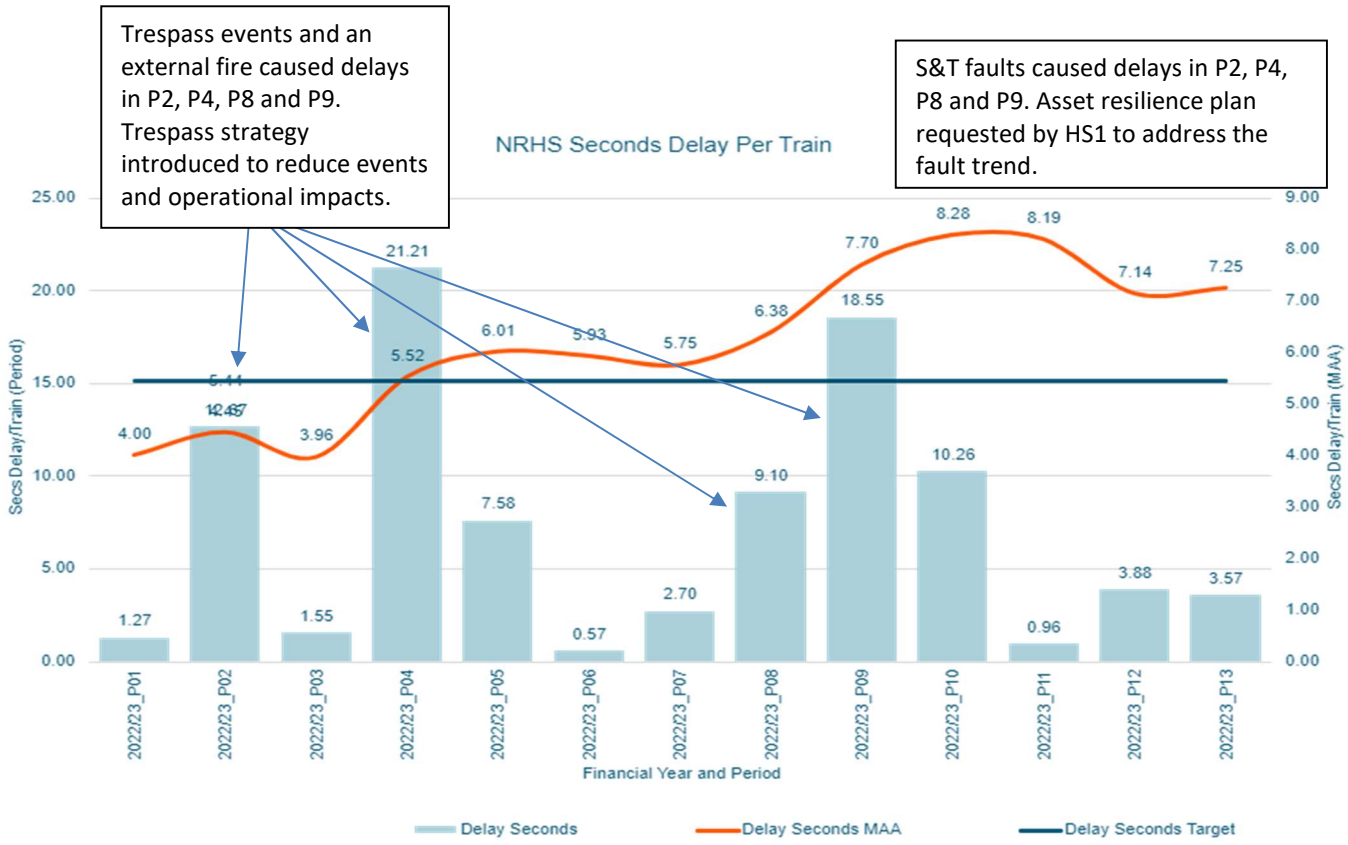


FIGURE 3 - ROUTE DELAY PER TRAIN FOR ALL INCIDENTS (INFRASTRUCTURE AND OPERATIONAL)

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We report all incidents that cause more than 200 minutes delay. In 2022/23, there were ten such incidents, as shown in Table 1, below.

In November, NR(HS) suffered the first major Overhead Line dewirement in their history, caused by a train fault. This unfortunately resulted in stranded passengers on a trapped train and tested the response and recovery capability of all the Operations and Infrastructure teams. NR(HS) were able to safely evacuate the stranded passengers, run single line working past the site for the day to allow our customers to still run a reduced commercial service and safely recover the infrastructure overnight. This was not without challenges and an independent post-incident review commissioned jointly with HS1, concluded positively that the teams undertook the right approach to responding and recovering. The post-incident review has been shared with the ORR.

FIGURE 4 -STRANDED TRAIN BELOW OHLE DEWIREMENT

HS1 continues to work closely with NR(HS) to improve Route performance, challenging asset failures and reviewing improvement plans. This has included developing a performance resilience plan to arrest current performance impacting issues associated with points failures along the line which includes both tactical and strategic actions. NR(HS) has undertaken a full fault review for this discipline to identify root cause trends, component failures and maintenance intervention actions. This data was used to develop containment actions which are being progressed and will continue into the new financial year. The faults, any identified trends and revisions to maintenance and renewals will be captured in the Specific Asset Strategies being developed for PR24.

Period	Date	Delay (Mins)	Incident of Note	Department
Period 2	05/05/2022	235	Track circuit failure at St Pancras International – multiple track circuit failures occurred within quick succession at St Pancras due to an insulated rail joint fault.	Signalling and Telecoms
Period 2	09/05/2022	241	Trespass between Nashenden Crossover and Southfleet Junction	External Operations
Period 4	02/07/2022	313	Fatality between St Pancras International and York Way South Junction related to body on the embankment near the line at exit of London Tunnel 1	External Operations
Period 4	19/07/2022	421	External fire (vehicle) near the HS1 line between Lenham Crossover and Crismill Crossover	External Infrastructure
Period 4	20/07/2022	615	Points Failure (2021) at St Pancras International – the points motor failed. This occurred during the period of extreme heat temperatures which may have been a contributing factor.	Signalling & Telecoms

Period	Date	Delay (Mins)	Incident of Note	Department
Period 8	20/10/2022	265	Points Failure (2251) at Crismill Crossover – the connector feeding the points motor became loose as a result of vibration through the motor under dynamic load.	Signalling & Telecoms
Period 8	01/11/2022	363	Trespass between Ashford West Jn and Ashford East Jn	External Operations
Period 9	25/11/2022	929	Trespass between York Way South Junction and Stratford International West Junction	External Operations
Period 9	26/11/2022	226	Points Failure (2096) at Wennington Crossover	Signalling & Telecoms
Period 10	07/01/2023	210	Points Failure (2021) at St Pancras International – repeat fault of points 2021. Multiple components were replaced to try and identify the root cause including the ECU, motor, relay, and cables. Following extensive investigation, a defective cable was identified as being the root cause.	Signalling & Telecoms

TABLE 1 – SIGNIFICANT INCIDENTS >200 MINS DELAY

2.3.1.1 Industrial action Impact

Industrial action has significantly impacted NR(HS)'s service delivery this year. In total there were 17 days where staff within frontline maintenance and operational grades have taken part in industrial action. This was part of a national dispute currently affecting the whole railway industry and UK economy, recognising there is wider ongoing industrial action within other sectors.

During 2021/22 and Q1 of this year, NR(HS) proactively planned for potential industrial action, training management grade employees for operational competencies, such as Customer Service Assistants and Signallers, and identifying minimum resource level requirements to safely run an operational service. This proactive planning has been a significant success, and they have been able to offer 12 hours of route availability on each day of industrial action, with the exception of Boxing Day.

However, industrial action has impacted both maintenance and renewals delivery. For maintenance, planned attainment was not achieved in periods in which industrial action took place and this resulted in maintenance backlog. To mitigate this, NR(HS) minimised the impact by accelerating critical works where required and through pro-actively replanning activities that were missed. At the exit of P8 (draft AMAS) NR(HS) were forecast to achieve between 70-80% planned attainment due to the extensive strikes over Christmas and the New Year. In the periods spanning this strike action (P10 and P11), they were only able to achieve 72% and 86% planned attainment respectively. Despite this, they were able to improve on this forecast, with a significant amount of recovery through the last 2 periods of the year, and at year end the planned attainment was 87%. Given the significant disruption to the plan this is a positive achievement.

For renewals, the industrial action has had a significant impact on both planning and delivery in year 3. Several volumes had to be replanned within year as a result of industrial action, and 19 volumes planned for year 3 were not delivered due to direct or indirect impacts of strike action. More detail is provided in Section 5 Renewals Planning and Delivery on the volumes impacted, any risks associated with delayed delivery are managed through the deferred renewal process.

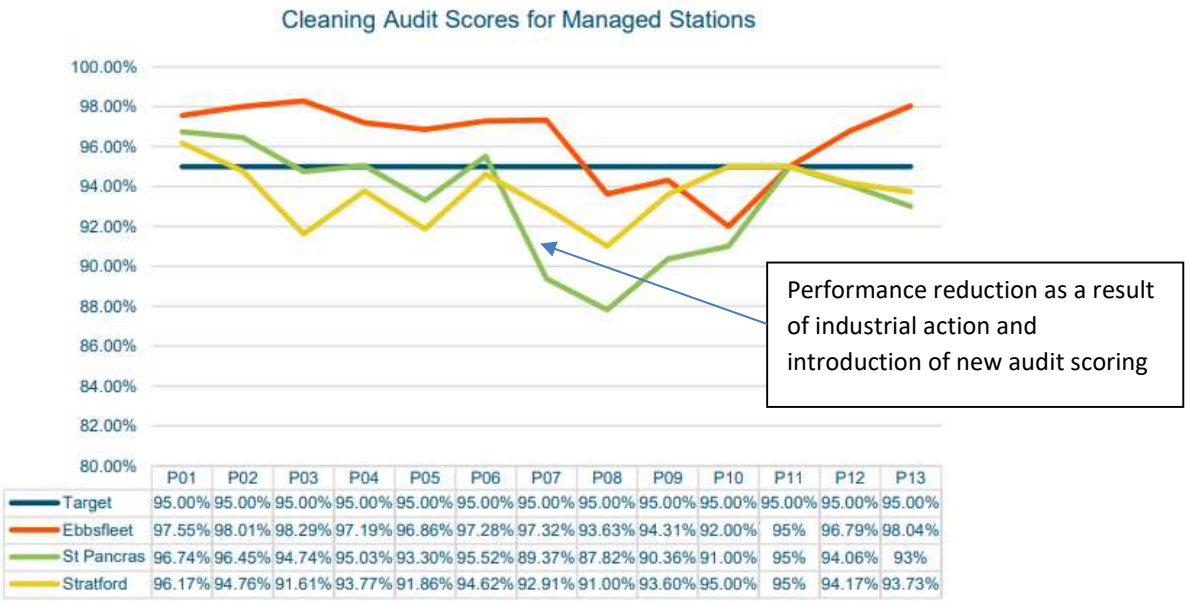
The dispute has also affected TOCs whose staff have been taking part in industrial action, in some instances on different dates to NR(HS) staff. HS1 have challenged NR(HS) to identify opportunities to mitigate the impacts of strikes to accelerate volume delivery where there this may result in periods as an opportunity for additional extended access to the operational railway. This has included the acceleration of Section Insulator renewal works at St Pancras that were originally planned for Christmas 2022, and subsequently would have been cancelled due to the strike action planned in that period.

2.3.1.2 Stations Performance

The key measures of station performance are cleaning audit scores and the availability of lifts, escalators, and travelators.

This year saw a new combined soft services contract go live on 1 April 2022. There were significant challenges in the first months of the new contract, with staff working for Churchill balloted by the RMT for industrial action relating to pay and conditions. This resulted in several days of strike action, which Churchill responded to well, bringing additional resource to the contract to ensure continuity of service. The new contract brought with it a new audit regime for assuring service delivery, and this has resulted in a below target audit output score of 94.4% year to date (to Period 10) as the team has adjusted to the new regime. Churchill has produced an improvement plan which is being used to drive an upturn in quality going forward. By Period 13 Churchill have delivered the plan which has seen a change in their business priority by transferring the stations contract to their transport division, changing the director plus changing contract managers and on-site delivery mangers.

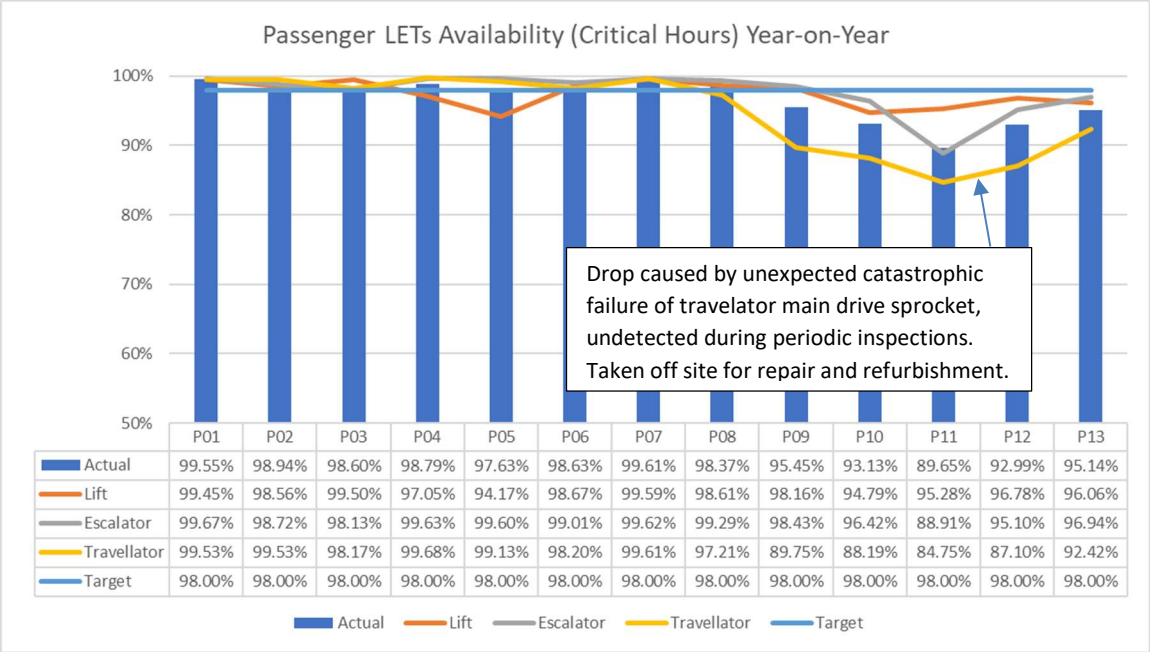
Figure 5 shows station cleaning audit scores for the three stations managed by NR(HS) to Period 10.



	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13
Target	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%
Ebbsfleet	97.55%	98.01%	98.29%	97.19%	96.86%	97.28%	97.32%	93.63%	94.31%	92.00%	95%	96.79%	98.04%
St Pancras	96.74%	96.45%	94.74%	95.03%	93.30%	95.52%	89.37%	87.82%	90.36%	91.00%	95%	94.06%	93%
Stratford	96.17%	94.76%	91.61%	93.77%	91.86%	94.62%	92.91%	91.00%	93.60%	95.00%	95%	94.17%	93.73%

FIGURE 5 – STATION CLEANING AUDIT SCORES

Figure 6 shows the availability of passenger lifts, escalators, and travelators for the three stations managed by NR(HS). The year end availability average is 96.9% against a target of 98%. This is the first year in several years that availability has fallen below target. This is predominantly driven by several significant failures on assets, such as the lift failure at Ebbsfleet International and the travellator failures at St Pancras International. These extended outages have resulted in the abatement cap being reached at Stratford and Ebbsfleet, a significant mechanism that enables us to drive contractor performance through financial penalty. With an ageing asset base, there is a risk of continued failures, and HS1 are challenging NR(HS) to work closely with Schindler to ensure stock of critical spares to enable timely repair. The current refurbishment project continues through 2023 and into 2024, and we will begin work this year to assess which assets will require refurbishment in the next control period. The failures that have impacted the operational performance have been due to unprecedented failures of main components within the escalators and travellators. These failures have been a blend of existing assets components and newly renewed asset components. The stations team have worked hard with Schindler and as a result Schindler are targeting the assets with the most frequent failures to help drive improvements. Q1 2023/24 will also see them make changes for additional dual-skilled engineers, meaning that time to fix is forecast to reduce. Further work is ongoing with Schindler to ensure the recovery plan delivers an improvement in reliability for the assets, and an independent review into asset condition will conclude in Q1 2023/24.



	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13
Actual	99.55%	98.94%	98.60%	98.79%	97.63%	98.63%	99.61%	98.37%	95.45%	93.13%	89.65%	92.99%	95.14%
Lift	99.45%	98.56%	99.50%	97.05%	94.17%	98.67%	99.59%	98.61%	98.16%	94.79%	95.28%	96.78%	96.06%
Escalator	99.67%	98.72%	98.13%	99.63%	99.60%	99.01%	99.62%	99.29%	98.43%	96.42%	88.91%	95.10%	96.94%
Travellator	99.53%	99.53%	98.17%	99.68%	99.13%	98.20%	99.61%	97.21%	89.75%	88.19%	84.75%	87.10%	92.42%
Target	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%

FIGURE 6 – AVAILABILITY OF LIFTS, ESCALATORS, AND TRAVELATORS

As a result of COVID-19, Eurostar has not operated international train services from Ashford International since March 2020. The international station remains open, providing access to domestic train services and car parks within and adjacent to the international station. Mitie continues to provide enhanced cleaning focusing on high touch point areas front and back of house. The concourse lift and escalator remain accessible to domestic customers. The contractual Schedule 8 SLA and KPI's have scored 100% throughout the year.

Eurostar have not confirmed a date to recommence services at Ashford International or Ebbsfleet International. HS1 will continue to maintain the international areas of the stations in a cost-efficient manner, ensuring station asset condition and performance is maintained at sufficient levels to ensure a smooth recommencement of services when needed.

Increased time taken for border processing has led to queues of Eurostar passengers in the main station concourse at St. Pancras International at times when flighted train services are delivered. HS1, NR(HS) and Eurostar have worked together to address this issue and mitigate the negative impact on customer satisfaction, further solutions to reduce customer queue times continue to be evaluated.

2.3.1.3 UKPNS Asset Performance

UKPNS assets continued to perform extremely well with availability of 100% beating the target of 99.9885%. There have been no interruptions of the HS1 power supply since the 2021/22 AMAS.

3 Asset Management

3.1 Asset Management and Asset Information

- Track deterioration model has been developed in year allowing 'data-driven decisions' to be made.
- Specific asset strategies have been drafted for all route and station assets in preparation for PR24. Current asset condition and performance information has been used to develop maintenance and renewal strategies.
- Asset Information audit completed in March 2023 acknowledged that asset information commitments are being delivered upon

This year has been a productive year for HS1 and our strategic partners in asset management. The HS1 portfolio-level Strategic Asset Management Plan (SAMP) has been embedded and NR(HS) has produced its draft SAMP in response. The SAMP has been applied to our route and station asset groups through Specific Asset Strategies (SASs) and Asset Management Plans. PR24 Asset Management workshops have been held with stakeholders to improve their understanding of how the PR24 submission is built up.

More of our innovation and research and development initiatives have been completed, demonstrating the benefits and potential efficiencies to be realised from further digital developments. We have drafted our digital strategy setting out our vision for a digital future; this will support the prioritisation of innovation in CP4.

3.1.1 Asset Management Capability Improvement

HS1 Portfolio-level SAMP: In line with our commitment to improve asset management capability and increase alignment and line of sight across the entire HS1 asset portfolio, this year we have embedded the HS1 portfolio-level SAMP covering the entire asset base into our asset management processes. NR(HS) has responded to the document with its own SAMP for route and station assets. The SAMP provides principles and direction for PR24 and beyond, including the long-term asset management approach, decision-making frameworks, evidence requirements for asset management decisions, and guides the production of investment scenarios to best meet the Asset Management Objectives (AMOs).

A key deliverable of this piece of work is the revised set of AMOs. The AMOs set out the results to be achieved and their weighting helps determine the relative importance in meeting the organisational objectives of HS1 and its customers. Given the events of the last two years, the current economic climate and ongoing uncertainty around revised traffic forecasts, the AMOs consider four recovery profiles. Under a slower recovery, the AMOs give cost a higher weighting at the expense of very high performance (but still meeting our asset stewardship obligations). In line with our organisational strategy and new Asset Management Policy, we include sustainability in our AMOs.

Track deterioration model:

This year significant progress has been made in developing a track deterioration model allowing us to move from design-life led renewals at PR19 to a model that allows us to make 'data driven decisions' on track renewal options. The model uses available data and intelligence to establish the wear caused through historic train paths and maintenance activities. The wear rate is then projected forwards to establish the remaining asset life and forecasts renewal interventions for the four future scenarios set out in our SAMP.

The model uses GIS mapping and visualisation to support the planning of efficient renewals delivery campaigns. The model has been validated by NR(HS) and is now subject to independent assurance through HS1.

The model together with data collected through surveys and the Pandoscope R&D project (See section 4.2.2) has demonstrated that the track asset life can be extended beyond the design-life based forecasts used for renewals planning at PR19. As a result, the CP3 track renewal projects of ballast cleaning and re-railing can be deferred to CP4 without incurring safety or performance risks. Using data to extend asset life will allow us to reduce the long-term renewals requirements and this will be seen in our PR24 submissions.

Specific Asset Strategies (SASs) and Asset Management Plans:

In preparation for the PR24 submission, NR(HS) has used the SAMP and the AMOs to develop SASs for route and station asset groups. The SASs provide an overview of the asset group, its current condition, key asset risks and the approach to maintaining and renewing the asset. The SASs explain the risk-based approach used to forecast future interventions for the asset under each of the four investment scenarios, and how the AMOs will be achieved.

Asset condition and performance information collected since the PR19 submission has been used to develop the strategy documents and to generate renewals plans.

Recent asset condition, performance and deterioration information has also been used to review the remaining CP3 route renewals work bank and as a result a number of renewals have been identified for delivery to be moved to CP4. The projects are spread across Civils, S&T and E&P engineering disciplines. These asset management decisions will reduce the long-term renewals volumes, and this will be reflected in our PR24 submissions.

Digital Strategy: This year HS1 has developed a draft Digital Strategy to provide overarching guidance to CP3, CP4 and CP5 research, development, innovation and embedding.

The draft Digital Strategy builds on the Asset Information Strategy to include our 'digital vision' for technology, visualisation, predictive analytics, and artificial intelligence. The strategy includes specific outcomes that should be achieved to support each of the AMOs. The strategy will be used by our strategic partners as they develop digital improvement plans and roadmaps to provide clear aims and to support alignment.

Deferred Renewals: This year HS1 has undertaken a review of the deferred renewal process followed by NR(HS) to manage the risk posed by the deferral of asset renewals. A number of asset renewal projects have been moved out of the control period for "reconciliation" (to reduce the forecast control period renewals budget back to that agreed through 5YAMS) and a number or renewals have also been moved out of the control period as asset information has revealed that the condition is better than forecast in 2018. Section 5 provides more details of the changes in the renewals work bank.

NR(HS) follow the NRIL standard NR/L2/HAM/02201 "Management of the risk arising from deferred renewals". The process followed by NR(HS) includes:

- Holding a register of all deferred renewals
- A Senior Asset Engineer's risk assessment including appropriate mitigations for each deferred renewal
- Annual review of the deferred renewals registers by the Head of Asset Management.

A joint NR(HS) and HS1 review of the deferred renewal register was completed in June 2022 and potential improvements were recommended by HS1. HS1 will undertake an assurance review of the deferred renewal register annually or following any significant project change. NR(HS) have adopted the improvements and continue to manage the mitigations recorded on the register.

Renewals delivery changes, including deferred renewals are presented by NR(HS) and discussed at the periodic HS1 Renewals Board.

HS1 shares any project that is being delayed or deferred, along with reasons and mitigations, with the ORR through the quarterly renewals review meeting.

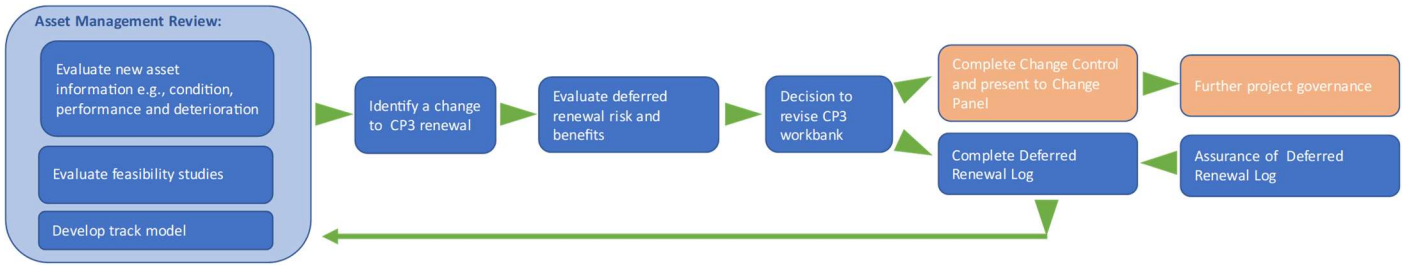


FIGURE 7 - OVERVIEW OF THE DEFERRED RENEWAL PROCESS

Stations Asset Management Improvements: This year NR(HS) has continued work to improve the maturity of its stations asset management system with the aim of achieving ISO 55001 certification within CP3. Activities in 2022/23 have built upon those delivered in the last financial year and in line with the roadmap set. This has included development of the Asset Specific Strategies, which are now aligned to the core service delivery contracts and HS1 framework and integration of the Station assets into a holistic NR(HS) AM system, with key updates to the AM Policy and Strategic Asset Management Plan.

The objectives of this improvement programme are to establish a clear Responsible, Accountable, Consulted, Informed (RACI) matrix, increase decision-making transparency with train operators, increase asset information maturity, optimise the asset management framework in line with the new target operating model (see Section4.1.1 4.4.1), and increase linkages between qualifying expenditure (Qx) and life cycle reports (LCRs) to maximise value from assets.

3.1.2 Delivery of CP3 Business Improvement items, ORR Final Determination and DfT Final Decision Recommendations

At the start of CP3, we extracted all of our CP3 business improvement initiatives and commitments from PR19 and other documentation. This included the 28 route asset management amber recommendations in the ORR Final Determination and the 11 station asset management recommendations in the DfT Final Decision. Following transfer of station regulation to the ORR, progress against the station asset management recommendations is now being monitored by the ORR.

Currently more than 130 items are being tracked, with progress updated periodically and reported quarterly to the CP3 Steering Group, which was set up to oversee delivery and escalate issues.

Table 2– Summary of progress against route and station asset management recommendations

summarises the status of the ORR's 28 amber recommendations on route asset management and the 11 station asset management recommendations. We provide quarterly updates on these to the ORR. A summary of progress against each of the recommendations is set out in Appendix 3.

Action/timescale	Route	Station	Progress
By November 2019 (in response to PR19 draft determination)	5		All completed
Plan to be developed by March 2020	11		10 completed, one ongoing as it has been delayed by COVID-19. Work is ongoing to take these plans forward to address the issue or to make specific improvements.
Due by March 2023	9		Seven completed. We are making good progress on the last two commitments and are providing quarterly updates to the ORR.
Due after March 2023	3	11	We have made good progress on each of the route commitments. We have closed off one additional commitment since the draft 2022 - 23 AMAS. Two commitments are ongoing actions over the duration of CP3. 9 station commitments have been marked as completed and good progress has been made against the remaining 2 station commitments.

TABLE 2– SUMMARY OF PROGRESS AGAINST ROUTE AND STATION ASSET MANAGEMENT RECOMMENDATIONS

-

3.1.3 Asset Information

In 2022/23 HS1 continue to develop the key elements of the Asset Information Management Framework, embedding the Asset Information Strategy and taking forward other key deliverables as discussed below.

The **HS1 Asset Information Strategy**, a core element of HS1's Asset Information Management Framework, has been in place since November 2020. The strategy has been key to communicating our objectives for CP3 to our partners and has provided detail around our common goal – improving our asset information maturity – and the steps to be taken to achieve this.

The Asset Information Strategy articulates a consistent strategic direction for our partners to follow with their own dedicated Asset Information Strategies and Plans during CP3. Progress on this has been good; Mitie and UKPNS have completed their Asset

Information Strategies, and NR(HS) completed a unified strategy for route and stations in March 2023 which is currently being peer reviewed by Network Rail Infrastructure Limited (NRIL).

HS1 has made progress towards compliance with ISO 19650 (see the ProjectWise/BIM section below).

NR(HS) have raised staff awareness, with periodic briefings and communications on asset information activity, such as the completion of audits and best practice when using Asset Information Management Systems, as well as updates on research and development and pilot projects.

The **HS1 Asset Information Management System Roadmap** provides a visualisation of the tasks required for HS1 to fulfil its CP3 asset information objectives. The roadmap is broken down into 10 workstreams that group activities by functions.

Further progress has been made in governance and HS1 Asset Information Standards, Specifications and Requirements. In 2022/23 we have supported NR(HS) to deliver the Asset Data Dictionary for Route Infrastructure, which should be completing in mid-2023. This is a key piece of documentation that will ensure the correct information is collected to enable decision making regarding route assets and will align with the NR(HS) goal of implementing a new Enterprise Asset Management System in 2023.

Audit and Assurance milestone areas are tracking well, with the next route and station asset information quality audits for NR(HS) completed in March 2023.

The **Asset Information Governance Group (AIGG)** is organised into individual working group sessions to discuss progress against the HS1 Asset Information Objectives. This governance structure enables HS1 to monitor the progress of Asset Information objectives with NR(HS), Mitie, NCP and UKPNS, who are at varying levels of maturity when assessed against the IAM Asset Information Maturity scale. NR(HS) is progressing well with Asset Data Dictionary development for the route and implementing the existing Asset Data Dictionary in stations. NR(HS)'s Asset Information Strategy unified across route and stations is scheduled to be completed by March 2023. Mitie continues to perform well in audits and assurance processes and has provided all documentation requested in line with HS1's CP3 commitments. NCP has progressed new Asset Registers based on surveys from its new facilities management partner, which are with HS1 for review in order to identify next steps. UKPNS has demonstrated via its own systems that it holds the information we require.

ProjectWise/BIM (Building Information Management) is our common data environment, holding all information related to the design, construction, and operation of our asset base. In 2022/23 HS1 has embarked on an ambitious reconfiguration programme separating our Project Information Management and the overall HS1 record of design, construction, and operation information. In line with ISO19650 standards on Information Management HS1 now has the facility to run projects through the system and is currently testing renewals projects using this system to ensure its suitability for the long term. The next phase of reconfiguration will see the Operational Record overhauled, and ProjectWise reintegrated into the systems used at HS1, to ensure that all information storage complies with all contracts and agreements held. As part of this, legacy design and construction information will be re-organised and archived, with operational information separated out to make it easier to find, update, share and use. HS1 is championing machine learning processes to restore metadata to all files ensuring that the system performs to a high standard and returns suitable results when users request searches for information. Finally, as part of this reconfiguration, HS1 is developing new Project and Asset Information Requirements that will become part of the overall Employer's Requirements in any tender situation. In 2023 a BIM assessment will commence, helping to determine where HS1 can obtain further value from projects through 3D modelling and data provision. All of these changes will allow the HS1 CAD/BIM standard to be implemented in 2023 with minor changes to the document, which will then be republished.

Oracle EAMS is NR(HS)'s asset management system for the HS1 route. It holds information related to all the assets managed under the Operator Agreement, including all information related to maintenance activities and asset faults.

NR(HS) commissioned a holistic review of its IT strategy in 2021/22, which included EAMS. The review included an assessment of the 'as-is' position and recommendations for a 'to-be' roadmap to support the future NR(HS) operating model. The final report was issued at the end of 2021/22; one of the key recommendations was that a replacement for EAMS should be progressed to deliver NR(HS)'s future asset management requirements.

The project to replace EAMS formally kicked off in P10 with initial stages of the programme focused on scope development, stakeholder engagement and development of system requirements. Stakeholder engagement will be key to the future success of EAMS2 therefore this will be an ongoing item. P13 saw Commercial & Procurement engagement to help identify routes to market. Due to the size and cost of the change, market engagement is not due to start until the summer of 2023 and appointment of a

successful provider until early to mid-2024. This means the current EAMS system will be in use and continue to be supported until 2024 with the current date to have the organisation fully migrated to EAMS2 around Q4 2024/25. This is in line with NR(HS)s commitment to have EAMS2 at steady state for the start of CP4. Ultimately, scoping, selecting, and implementing the backbone to their maintenance management and delivery is a significant change which needs due diligence for a very rare opportunity to transform how they manage our Asset Management data and maintenance scheduling.

Geographical Information Systems and Standards: HS1 are working with NR(HS) to deliver the implementation of a GIS System in ArcGIS. The implementation plan is commencing in May 2023, with a view to the system coming online to compliment the introduction of EAMS2. As part of the implementation, NR(HS) are developing a number of GIS standards and procedures documents to support the use of the system, including data standards and quality standards. The results from the 5G ARDT and ArcGIS trials (sections 4.2.12 & 4.3.1) provided key findings that will influence the development, and ensure clarity of, the long-term GIS requirements, ensuring that all use-cases and processes are captured across the HS1 system. Benefits of a GIS system to the High Speed 1 system include:

- The ability to have a multi-functional tool that could demonstrate a single-source-of-truth shared between High Speed 1 system partners.
- Provision of a home for data and the ability to derive intelligence from data to solve key business challenges such as Automated Inspection, Cross-Domain Integration, Efficient Possessions, amongst others.
- The ability to carry out deeper-level analysis of asset information collected on High Speed 1, to allow the development of key aims of the system, including integrated planning and infrastructure evolution.
- To bring together built assets and route infrastructure assets in a single view and allow all members of High Speed 1 to access information, presented in a way that suits their role and needs for information.
- To form one part of an 'iron triangle' of systems to deliver efficiency across High Speed 1, alongside a modern Enterprise Asset Management System and Common Data Environment.
- Spatial Analysis: methods, algorithms and locational intelligence that can support predictive modelling.
- Remote Sensing and Imagery; allowing High Speed 1 to extract answers from devices and cameras placed across the network.

Asset Information Audit, NR(HS): In March 2023 NR(HS) were audited across route and stations infrastructure on the topic of Asset Information. There was an acknowledgement from the auditors that since the last audit, NR(HS) have been through restructuring which has seen implementation of a new operating model. It is understood that the new operating model has driven improvements to Asset Information capability within the organisation.

The auditors reviewed NR(HS)' new unified Asset Information Strategy which sets out their aims, ambition, and objectives for increasing capability in CP3, CP4 and CP5, getting to the ultimate goal of being seen as a global leader in asset management by the end of CP5.

Areas of improvement from the last audit have been acknowledged as being solved by the auditors this time round, demonstrating that HS1 and NR(HS) are working collaboratively to build capability. Across both audit reports for route and stations infrastructure there were no major or minor nonconformances, 1 area of concern, 4 opportunities for improvement, and 3 strong points.

The audit picked up a good example of our increasing capability in the Track Degradation Model, which the auditors deemed to be an example of best practice. This was alongside the asset management process for route infrastructure being found to be 'good'.

The auditors acknowledged that asset information commitments are being delivered upon, and that the right steps are being taken with new systems such as EAMS2, GIS and ProjectWise improvements, though they may cause some delay to delivery of commitments while the necessary foundational and prerequisite work is undertaken for the long-term.

3.2 HS1 Health, Safety and Assurance

- Regenerative braking introduced on all class 395 trains, reducing power consumption by 5.5GWh per annum and circa £2.6 million annual savings (based on emerging data, using Winter 2022 electricity prices)
- HS1 and NR(HS) working together to deliver an aligned sustainability strategy for PR24.

Through our focus on activity and leading indicators HS1 has challenged NR(HS) to address risk, with particular focus on higher risk operational close calls. The rate is currently '0' and has allowed us to start to talk to NR(HS) about events with high potential to cause significant harm or damage. HS1 have taken a visible leader approach and carry out safety tours across the asset. These tours are undertaken by senior leaders who have all recently received training from the RSSB Human Factors team to improve the quality of these tours. The HS1 senior team has noted that there is a positive safety culture which NR(HS) can build on as they develop their safety culture improvement plans.

HS1 maintains a good relationship with the ORR Principal Inspector for High-Speed Rail. The organisations meet quarterly and discuss how sharing individual assurance activities can benefit both. An example is providing the ORR visibility of the results of the HS1 audit plan.

The HS1 Health, Safety and Assurance Strategy was reviewed in January 2023 to ensure that it remained relevant for HS1. The strategy is linked to the Safety Sub-Committee and its implementation is an HS1 Board objective for each year of the control period. The strategy has three core components: bowtie assessments, assurance and RM3.

- **Bowties:** In 2022/23, HS1 reviewed all the assurance controls in the bowties and assigned effectiveness rankings. These were included in our route and station assurance plans and shared with NR(HS) to ensure a focus on developing responses to the identified critical assurance controls. The majority of the assurance controls identified required greater visibility and are being built into reporting and audit plans so that our assurance programme is targeted.
- **Assurance:** The assurance framework, which makes use of the bowtie inputs and drives the route and stations assurance plans, has been matured further and continues to shape assurance within HS1. To build on the specific assurance plans, HS1 and NR(HS) have developed a joint assurance plan which drives both organisations to share assurance activities across organisational boundaries.
- **RM3:** RM3 remains the core approach to driving maturity improvements within HS1 and the supply chain. HS1 continues to target improvements in the identified key seven spokes of RM3 improvements over CP3. Our year-on-year maturity improvements have increased our capability and our RM3 levels have improved each year. HS1 continues to target improvements in the identified key seven spokes of RM3 improvements over CP3 which are:

    - Leadership (SP1)
    - Board governance (SP3)
    - Objective and target setting (PI2)
    - Control of contractors and suppliers (RCS4)
    - Proactive monitoring arrangements (MRA1)
    - Audit (MRA2)
    - Management review (MRA4)

The process of producing an annual stewardship report for the Joint HS1/NR(HS) Assurance Board has been embedded and the report is produced each December and presented to the HS1 Board Safety Sub Committee. The 2022 report was written by a new independent Chair and discussed how the Assurance Board will evolve in 2023.

The HS1 Business Continuity Plan (BCP) has been reviewed and continues to support the business response. HS1 took part in a business continuity exercise in summer 2022 which involved representatives from various businesses across the Kings Cross Estate, facilitated by the BTP.

HS1 monitors health, safety, and assurance performance against a number of proactive and reactive indicators. Performance against the workforce FWI, passenger FWI and trespass metrics was discussed in Sections 2.1 and 2.2. A summary of performance against other key metrics is set out in Table 3.

Metric	Year End Result 2022/23
Workforce FWI	0.151 against a target of 0.033
Passenger FWI[2]	0.014 against a target of 0.028
Safety tours	16 SMT tours against an annual target of 16. This is on plan for the year.
HSA Strategy plan	All milestones completed as planned.
RIDDOR	8 events (all NR(HS))

TABLE 3–- HEALTH, SAFETY AND ASSURANCE KEY METRICS

Seven of the ORR's CP3 recommendations were specifically related to safety; we have completed the actions against all of these recommendations. Further detail is set out in Appendix 3.

3.2.1 NR(HS) Safety Task Force

The four workstreams that were identified as part of the NR(HS)'s Safety Task Force last year continue to be driven forward with good progress being made across all the areas.

Standards & Controls: The NR(HS) Standards Steering Group (SSG) continues to convene periodically and has responsibility for tracking and assuring the status of the Level 1 and Level 2 standards, ensuring that these documents remain in date. There is a robust process in place to highlight those documents that require action, and the status of standards is reported periodically. Quarterly Standards Briefings inform the NR(HS) business of any changes that have been made. The SSG panel members are now evaluating this process to identify further improvements to streamline and enhance record keeping which will be written into a new document control procedure. This aims to streamline NR(HS) processes whilst enhancing record keeping. This next phase will also review the management of Temporary Non-Compliances from standards with an aim to standardise how these are generated, stored, and communicated.

Safe Working Practices: There has been a full review of the method statements in use by NR(HS) frontline teams, with all documents being revised and updated in line with the associated standards and ensuring that the task methodology is fit for purpose. The NR(HS) 019 standard is due for publication in 2023. Work is underway on the production of an NR(HS) Safe System of Work Pack.

Competency & Training: Following the updating of many business-wide standards within NR(HS), including training standards, pilot courses have been rolled out across a number of staffing grades by NR(HS)'s training provider; and further courses are now being booked.

NR(HS) has begun recruiting a training team to support the business with not only key competencies and role specific training, but also higher education opportunities. A new Higher Education process has been written and was launched in March 2023. The coming year will also see a review of the current training provision and the competency management system to look at new technology options versus how competencies are currently recorded and managed. NR(HS) is also producing a clearly defined and agreed set of roles and role profiles accompanied by a skills matrix.

Assurance: Site inspections and safety conversations have been consolidated with Manager's Engagement Site Visits having superseded these activities. IRIS is used to track and monitor these, with Periodic Dashboards providing a greater level of visibility across the business. The year end number of visits completed is above target at 123%, demonstrating NR(HS) managers'

[2] Note that HS1 tracks and reports the passenger FWI for HS1-managed areas of the infrastructure; this does not include all areas reported within the NR(HS) passenger FWI.

commitment to this activity. To further demonstrate this commitment, NR(HS) aims to improve the quality of conversations through training for management and will review how the data from these conversations is analysed and used to drive improvements across the business.

Engineering Verification was successfully implemented in the business but has been temporarily paused due to the implementation of the Target Operating Model (4.4.1.) A new programme will be developed for 2023/24 and will be overseen by the Engineering and Safety function. Open actions continue to be monitored and tracked to completion by the Compliance and Assurance Advisor.

NR(HS) continues to integrate RM3 into its assurance processes. An RM3 self-assessment was undertaken in 2022 and validated with the Network Rail Southern Region safety team.

Several improvement areas have been identified and will be addressed both in the route-wide safety plan and in the 2023/2024 safety strategy which are both currently in development. Additionally, NR(HS) is to commence an analysis of the last two years' internal and third-party audits findings to identify weaknesses against RM3 criteria. HS1 will continue to conduct RM3 audits on NR(HS), the outputs of which will feed into NR(HS)'s safety plan and strategy; and audit has been carried out this year and results are being compiled.

NR(HS) is now also represented on the RM3 Community of Practice where they can learn from other organisations on how RM3 has been embedded and also share knowledge as they continue to make improvements in this area.

3.2.2 Other NR(HS) Safety Improvement Activities

Fatigue Risk Management Standard Implementation: The new NR(HS) Stations rosters went live in January 2023 for St Pancras, Ebbsfleet and Stratford stations with base rosters compliant with the Fatigue standard. Operations rosters have been updated and gone live and Maintenance baseline rosters also compliant to the HSE FRI calculator. Engagement with the supply chain is also underway to gain assurance that fatigue is being appropriately managed by NR(HS) suppliers.

A new digital rostering system (MyRoster) has been created with input from NR(HS) and the wider Network Rail Infrastructure Ltd. This system will not only ensure rostering is undertaken consistently across the business but will also capture exceedances. User acceptance testing of MyRoster is due to take place in July 2023. Although 75% of the business have now completed the Fatigue Awareness training, NR(HS) are focussing on getting all available people trained so that they understand the associated risks and learn how to better manage fatigue; with the aim of reducing fatigue related incidents.

3.3 Sustainability

3.3.1 HS1 Sustainability Strategy

HS1 launched its original sustainability strategy in Autumn 2020 with a plan to review it after two years to ensure that the targets were still relevant, ambitious yet achievable. The purpose of the original strategy was to gain an understanding of the sustainability context and to confirm and set targets. We have made great progress across the whole of the strategy, completing multiple significant roadmap actions in challenging market conditions.

The review of the strategy was completed in 2022/23. During the review we benchmarked our sustainability performance and ambition against a range of comparators proving that the wider market has not shifted significantly since 2020. The context and need for action remain as urgent as ever and, as attendees of COP 26 and hosts of cross sector workshops, we understand this. The HS1 infrastructure provides a significant opportunity for decarbonisation and our renewed strategy sets out how we plan to support the global shift to a low carbon economy.

Significant work has been undertaken to write the NR(HS) sustainability strategy for CP4. This sees NR(HS) and HS1 align their goals, further demonstrating our shared commitment to reducing our impact on the environment.

FIGURE 8–SUSTAINABILITY PRIORITY AREAS

For each priority area, we have reviewed our 2030 targets and realigned the existing roadmaps showing our plans to deliver on these targets. We published our second ESG report in June 2022 which outlined our performance in 2021/22 and plans for the upcoming years. Our ESG report for 2022/23 is scheduled for publication in June 2023.

Through involvement in the Sustainable Rail Executive and Leadership forums HS1 has taken a key role in shaping the Sustainable Rail Strategy (SRS) We also continuously review our strategy and targets to ensure they are aligned with the wider industry. HS1 is also actively involved in knowledge and expertise sharing both at a local and industry level through a number of working groups.

3.3.1.1 Transparency

HS1 has embedded annual ESG reporting into the business and has started to develop an in house ESG data system. This system will allow for automation and streamlined reporting for the HS1 system.

3.3.1.2 Climate Change and Adaptation

Emissions: Despite rail being 80-90% more carbon friendly than air travel, running our railway has an impact on our climate and contributes to the UK's carbon footprint. When we started our sustainability journey, traction energy use was our biggest carbon impact, contributing around 95% of our total carbon emissions. We are now on a rapid transition to zero-carbon by 2030. We measured our baseline carbon footprint within our 2019 system boundary and identified our carbon 'hotspots'; this enabled us to identify priority areas for action and develop a carbon reduction plan.

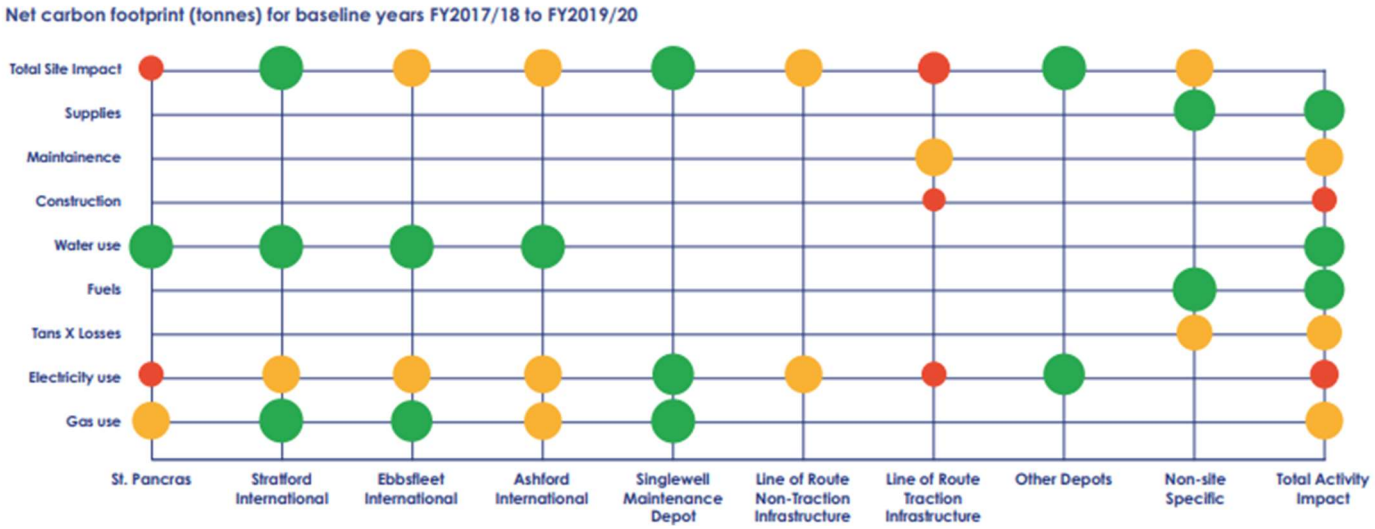


FIGURE 9– OUR BASELINE CARBON FOOTPRINT

We have reviewed the 2019 CFA system boundary and have worked with our energy and carbon auditors to increase our scope to the full Green House Gas (GHG) protocol. In line with the requirements of our Reduce Carbon certification and Science Based Targets we are conducting a full scope carbon footprint analysis beyond energy, and once complete we will develop and implement appropriate reduction plans. To do so, we are carrying out this full assessment back to our baseline year of 2019/20 and expect it to be completed and verified in June 2023.

As part of our work to ensure as much as possible of the energy used on HS1 is renewable, we have activated our Corporate Power Purchase Agreement (CPPA). This deal allows for up to 10MW, around 40% of HS1's electricity use, of green energy to be purchased by HS1 at a fixed price for 10 years, until 2032. We are currently looking to secure our second CPPA which will

account for up to an additional 40% of electricity. These CPPAs are part of our broader green energy work and will cover the majority of our baseload requirements.

Resilience: Sustainability continues to be managed at Board level as a corporate risk with the impacts of climate change also being considered. We have completed both a physical and transitional climate change risk assessment and we are working with the supply chain on how the findings are implemented.

3.3.1.3 Energy Use

We have developed an energy strategy which, in addition to procuring green energy, aims to maximise energy reduction opportunities and evaluate the possibility of onsite renewables. We are also focusing on energy intensity in order to reduce the energy use per passenger/train.

To support the delivery of the energy strategy we have set up the Route Energy and Carbon Team (REACT). REACT will focus on delivering small scale annual projects but also seek to identify additional larger projects and secure funding for schemes such as such as solar farms and the N-1 electrical feeder power reduction scheme. We have aligned survey work with our next Energy Savings and Opportunities Scheme (ESOS 3) mandated submission as both processes will identify and evaluate the viability of energy reduction projects.

3.3.1.4 Resource Use and Waste Impacts

We continue working with our supply chain, our retailers and our TOCs to implement the waste hierarchy and to divert the maximum amount of waste from landfill. Resource use and waste data is now included in HS1's internal corporate dashboard and there is a requirement for all construction project suppliers both for HS1 and our supply chain to report their waste data. A review of the waste portfolio is currently in progress, and we have published waste and materials standards for our project suppliers. Waste recycling remains a challenge, but we will continue to work to increase the recycling rate whilst incorporating circularity and minimisation principles.

In recognition of the quantity of materials used in construction and refurbishment projects we ensure the use of industry best practice. We have published our materials standard which sets out our specifications for construction materials, including the approved/banned lists. We are working with our non-project suppliers who use materials to align their standards to HS1's.

HS1 is fully compliant with water pollution discharge consents and requirements, and report through our internal dashboard. We measure our water usage and its relationship to our carbon footprint.

3.3.1.5 Biodiversity

HS1 manages a diverse estate, from Central London to the Garden of England and we are committed to maintaining a healthy and diverse natural environment. Under the Channel Tunnel Rail Act 1996 HS1 has an obligation to protect and enhance the lineside habitat.

We have surveyed our natural asset and have a baseline of the condition of the habitats along our line of route. To ensure that we have a rounded view we have started to look at opportunities to enhance the natural habitats along Section 2 of the network, although opportunities are limited due to the considerable use of tunnels in this section.

Working collaboratively with NR(HS), we have started to implement the Biodiversity Action Plan (BAP) which acts as the biodiversity strategy covering the next 10 years and which will deliver the target of 20% Biodiversity Net Gain by 2030.

3.3.1.6 Social Impacts

In the 2022/23 financial year we achieved over 809 hours of volunteering by members of the HS1 team, 109 hours more than our ambitious 700 hours target. By actively promoting volunteering opportunities to staff, offering matched funding opportunities, and organising team volunteering days, we have supported various local charities and increased the percentage of staff involved in volunteering to 77%, a 27% increase compared to our target. Our staff value the opportunity to give back to the local community whilst also building relationships with internal and external stakeholders, and our 2023 updated sustainability strategy includes additional targets focused on community engagement and promotion of careers in our industry.

We work to understand our noise impacts and implement mitigation plans where necessary.

3.3.2 Regenerative Braking and On-train Metering

Power consumption	**Finance**
Down by 5.5GWh per annum	Circa £2.6m annual saving (based on Winter 2022 electricity prices)

TABLE 4 - ESTIMATED BENEFITS OF ENABLING REGENERATIVE BRAKING ON THE CLASS 395 TRAIN FLEET

Following the successful conclusion of an 18-month multi-agency project, regenerative braking has been rolled out across the whole Class 395 fleet. HS1 entered a contract with UKPNS to deliver assurance activities and oversee project management activities. Following extensive modelling, operation of test trains and presenting information to the Safety Review Panel, the Class 395 train fleet was permitted to operate in regenerative braking mode entry into service of the full fleet was completed in October 2022. There have been no adverse effects upon the power system and the project has now completed.

The introduction of regenerative braking on HS1's assets has significantly reduced power consumption, reducing the environmental impact and supporting the HS1 sustainability strategy. This initiative has been hugely successful and is currently producing energy savings which surpass those predicted by the pre-implementation modelling. It should be noted that, if sustained, the recent increases in electricity prices will lead to much greater annual savings that will reduce the payback time. Based on emerging data, the benefits of regenerative braking include a 10% energy reduction for the Southeastern fleet, equating to a c. £2.6m annual saving in energy costs.

3.4 Asset Capability and Condition

3.4.1 Route Capability

- Route and station asset condition changing in line with expected degradation rates for the age of the HS1 infrastructure.
- Most route assets have a condition score of 2 or 3 - high reliability or functional condition.
- Works being developed to address leaks in St Pancras transition roof.

Asset capability has remained constant since commissioning with no projected reductions within the HS1 concession period. The maximum line speed remains the highest in the UK at 300km/h and the route availability meets all passenger and freight customer needs at 22.5 tonnes (axle loading). The maximum number of achievable train paths that the signalling system can deliver remains at 20 trains per hour.

Current demand forecasts indicate that existing capacity will be sufficient until 2046 although long term forecasting is particularly challenging in a post-pandemic environment. In practice, the limiting factors for the number of train paths are operation of mixed traffic, turnaround times required at St Pancras International, and the pattern of services being operated.

3.4.2 Stations Capability and Heritage

HS1 and NR(HS) have embarked on a transformational change programme which is essential to deliver continued asset performance and to improve passenger satisfaction levels, delivering a programme of renewals activity not previously undertaken on HS1 stations.

Significant changes to the NR(HS) station management structure continue to be made; the introduction of the NR(HS) Target Operating Model (TOM) will streamline the upper management structure and connect stations and route operations and services to ensure a safer, more secure, effective, and efficient operation.

Throughout CP3 we will continue to develop and implement programmes of work to drive customer satisfaction through the delivery of improvement initiatives whilst identifying and implementing efficiencies to ensure value for money. Examples this year include the new Mechanical Electrical and Public Health (MEP) and Building Fabric contract where the supplier continues to develop a more efficient Planned Preventative Maintenance (PPM) and reactive works order delivery ensuring 100% of their works KPIs.

We recognise the significance of the Grade I listed St Pancras International station as an historic building of exceptional importance and work collaboratively with all stakeholders to ensure this is protected while integrating change and enhancing the customer experience. We have a constructive relationship with Historic England and the London Borough of Camden through our dedicated heritage specialist function. This is delivered through two specialist advisors who focus on all station projects which has ensured that renewals, projects and ongoing maintenance and repair have been carefully and successfully managed to protect the special interest of the asset and achieve the required outcome. In recognition of the specific skills required to maintain this unique building, we have set criteria for the procurement of services within the building, deliver training and have actively supported the ongoing works to manage the asset. Where necessary, consent has been sought for works and all required Heritage Deed approvals (Listed Building consent) have been secured in a timely manner to ensure station works could proceed as planned.

3.4.3 Route Asset Condition

Asset condition information is key to informing decisions for the effective operation, maintenance and renewal of the HS1 infrastructure. With the ageing of the infrastructure, CP3 has seen the first major renewals programme since the construction of HS1, carried out alongside the typical maintenance interventions. The approach to asset management for each asset system and down the hierarchy levels of systems is described in the NR(HS) SAMP and each of the SASs. The approach depends on a number of factors, including asset criticality, failure modes and asset degradation.

HS1 support NR(HS) in the continual improvement of asset condition information to support data driven asset investment decisions. Various R&D projects have trialled how asset condition information can be better recorded, more accurate and updated more frequently. The recent development of the track model has demonstrated the business benefits of better asset information. Table 5Table 5 shows the current asset condition scores within the NR(HS) EAMS by asset type compared to the condition at the end of CP2 (2019/20) as reported in the CP3 5YAMS. Most of the assets have a condition score of 2 or 3, indicating that they are in a high reliability or functional condition, in line with expected degradation rates for the age of the HS1 infrastructure. CP3 marks the beginning of a heavier renewal cycle across the infrastructure; this is illustrated by the results shown for telecoms assets where a significant proportion of the assets are entering the 'near service limit' state, mostly due to obsolescence; this is being addressed by the renewals programme. In addition, the effect of some of the renewal projects is already being seen, particularly for track, where most of the assets in condition 4 at the end of CP2 have already been replaced.

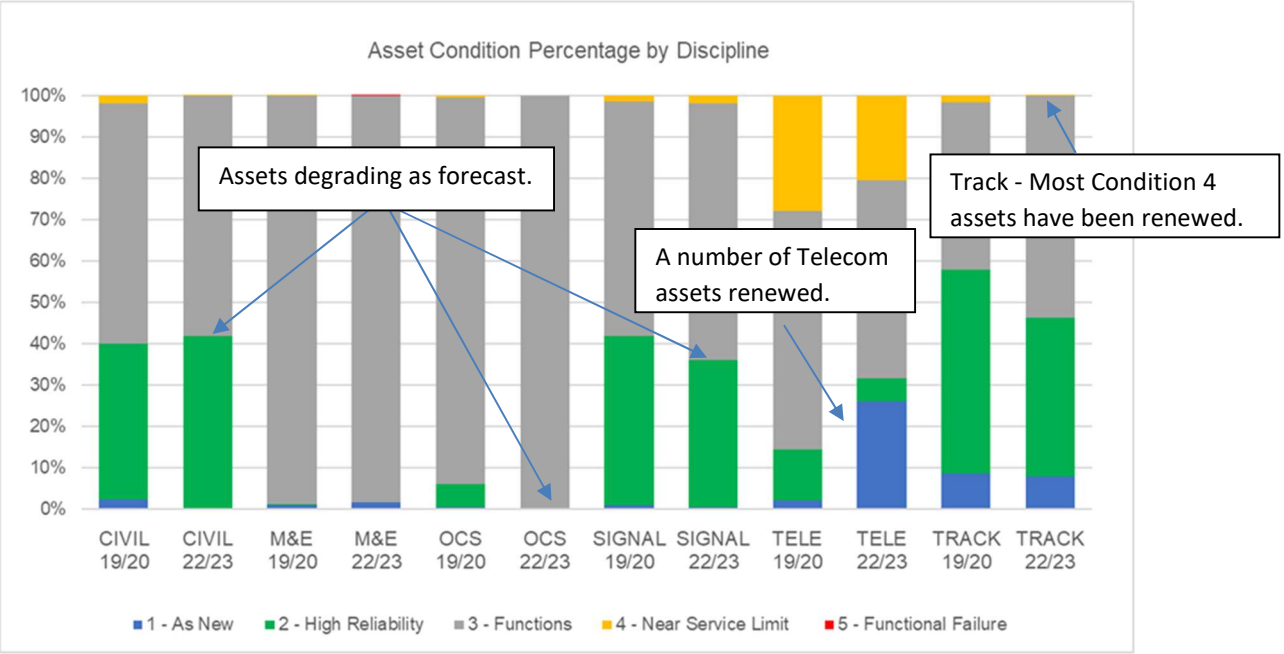


TABLE 5 - BREAKDOWN OF ASSET CONDITION BY DISCIPLINE

3.4.4 Station Asset Condition

Station assets overall are generally performing well and meeting their expected condition although there are lift, escalator and travelator assets that have experienced performance issues due to difficulties obtaining parts and materials from the original manufacturer.

There has been a minor increase in structural issues at St Pancras, notably the transition roof, where we have been managing minor leaks over previous years; these leaks have increased in severity and continue to cause issues on the platforms and concourses below which are collaboratively managed with the TOCs and NR(HS). Ongoing investigations initially identified movement within and between the transition roof and the main deck extension roof structure. NR(HS) and HS1 are working to deliver a connected repair linked to the partial renewal of this asset, renewal works to the north gable end and the transition roof refurbishment works to ensure that we have a cost-effective solution. Access costs for each project are a significant part of the procurement cost, therefore combining the three projects improves delivery efficiency and cost control.

NR(HS) has rolled out a mobile version of the FSI Concept Evolution Facilities Management system (now called MRI Concept) to its Tier 1 contractors with some success but continues to test and refine the system. This now allows the engineering teams to work in real time when delivering Planned Preventative Maintenance (PPMs) and respond more quickly to reactive works with a key advantage being asset condition scoring included within their work bank. This has improved the tracking and impact of PPMs and reactive interventions supplying greater granularity of operating expenditure, ultimately strengthening the link between operating and capital expenditure, allowing it to be utilised with the lifecycle models.

External consultants undertake a survey of all HS1 station assets every 5 years. These surveys are currently being procured and the surveys will be completed in 2023 in preparation for the next iterations of the lifecycle cost reports for PR24.

4 Key Initiatives and Improvements

This section covers the key initiatives and improvements undertaken for both route and stations over the course of 2022/23.

4.1 Innovation, Research and Development

4.1.1 Research and Development Programme

This year our Research and Development (R&D) programme, led by the Research and Development Panel, has seen circa £750,000 committed to projects ranging from short term tactical initiatives to long term university research. Some of these projects are discussed below and a full list is provided in Appendix 4. Approximately £1.99m of the CP3 R&D budget has been committed over CP3 up to February 2023, with initiatives drawing down on their allocated funding over the next 12-18 months, concluding so that project findings can be established and built into the PR24 submission.

Following the development of three challenge statements last year, we have built a robust pipeline of initiatives that have been converted into active R&D projects that follow the challenge statement themes set out in 2021/22: automated inspection, cross-domain integration, and efficient possessions.

The post-project review process for the research and development portfolio will allow us to understand the likelihood and timescales for embedment of the technologies we have investigated. CP3 R&D findings have and continue to help HS1 develop its CP4 R&D strategy, building on what we have achieved in this control period.

In the forthcoming year there are two R&D projects that are important for the High Speed 1 system. The Fibre Optic Acoustic Sensing (FOAS) project will allow us to make use of existing fibre optic cabling in place on the network to turn the cabling into a virtual microphone at the trackside. This is paired with technology that creates algorithms that can understand and relay to users what process is happening based on the sound the cabling picks up. This is a partnership where a number of use cases are being trialled elsewhere on the NRIL network, and High Speed 1 is trialling several of the potential 60 use cases that we could benefit from too. A selection of use cases are:

- *The ability to accurately detect train running (location, speed, acceleration)*
- *Identification of personnel or trespassers walking along the railway*
- *Rail and wheel defect detection*
- *Monitoring of under-track condition, such as UTX and bridges.*
- *Ballast voiding areas on plain line*
- *Feeding back the effectiveness of repair when maintenance has been carried out (e.g., tamping).*

On High Speed 1, we will be testing the installation of FOAS to monitor the fastest part of the infrastructure where trains are travelling at up to 300km/h. We are particularly looking at the performance of 62 swingnose crossings in a high-speed environment. Other technology installed on the railway, such as wheel impact detectors, will help to calibrate the system. The

output of the trial will inform the move to a condition-based approach to asset management and performance availability of the swingnose crossings, in line with the system aims to move towards predictive maintenance capability on the route.

The ongoing academic research project 'Management of Track in Hot Weather' will continue to provide useful findings that will allow us to better manage the railway track in extreme heat conditions, in line with our drive to ensure our assets are resilient to the changing climate.

Out of the 18 initiatives approved in the control period, 7 are fully completed, of which 4 are either being implemented or actively being developed to be implemented on the High Speed 1 system in this control period. 4 initiatives have been completed and are not being taken forward. The successful projects were:

- In-Service Monitoring on Eurostar Trains
- ArcGIS Geospatial Information Model Prototype
- Connected Places Catapult Challenge Statement Identification
- Support for Artificial Intelligence-based Overhead Line Monitoring

The projects not being taken forward are:

- Tunnel Vision
- Bridge Scanning
- OLErt

The reasons for these initiatives being paused are because they require further work to achieve the data quality necessary for full implementation and require further work to realise the desired efficiency to force a change in the maintenance and inspection regimes of assets (applicable to Tunnel Vision and Bridge Scanning). The OLErt initiative has been replaced by the Artificial Intelligence based Overhead Line Monitoring initiative, which has been deemed to have a higher likelihood of success for a lower R&D investment.

The remaining eleven projects are still at work-in-progress stage.

4.2 Route Projects

- Ballast condition data collected through Pandoscope R&D project enabled Ballast Cleaning project to be deferred.
- Successful trial of ArcGIS (Geographic Information System) software delivered; Implementation Plan now being developed.

4.2.1 Tunnel Vision Project

The objective of this project is to demonstrate both a safety and business case for the replacement of traditional physical inspections of tunnel assets with a technological alternative. The benefits of this project include:

- Improved data capture, providing a repeatable inspection, resulting in improved asset data.
- Safety improvement through a reduction of 'boots on ballast' for staff.
- More efficient inspection process through a significant reduction in time to capture the data and through a reduction in subcontractor spend; and
- Reduction in carbon emissions by reducing the number of shifts of the works train.

Following the successful trials in 2021/22, the project has progressed to the development of the safety case for the system, including any additional requirements for testing, and how to commercialise the system. A proposal has been received from the supplier of the system to deliver all bored tunnel inspections in 2023; this is currently being evaluated. NR(HS) staff have used the system to successfully log defects this year using the web-based application for Tunnel Vision. This is an essential input to future machine learning trials on the platform, which are being discussed as a future opportunity.

FIGURE 10 - THE MPV WITH THE TUNNEL VISION EQUIPMENT INSTALLED RECORDING TUNNEL CONDITION

4.2.2 Ballast Refurbishment Project

The track support structure is critical to maintaining passenger ride quality; however, each maintenance intervention to improve track geometry also degrades the ballast. The ballast on Section 1 of HS1 is now reaching a point where maintenance intervention frequency and effectiveness will become inefficient and therefore replacement is needed to maintain the integrity of the asset.

During the development of the ballast cleaning campaign, an innovative technique using Pandoscope technology was integral to the decision to defer work. The technology identifies the level of ballast degradation to ascertain ballast condition and geometry to establish how much of the material could be reused. This will facilitate efficiencies by reducing the consumption of raw materials and increasing the production speed and capacity of the ballast cleaning plant, allowing the work to be delivered with the least disruption possible to the operational railway and minimising the number of shifts required. Working in partnership with Network Rail Supply Chain Operations, any ballast no longer suitable for the high-speed railway will be recycled for use in lower category lines or as construction aggregate.

As we have continued to collaborate with Sol Solutions, SNCF, and Network Rail Eastern Region on best practice with the equipment, we have identified further applications to assess ballast condition around switches and crossings (S&C) and for post-work validation following renewal interventions. Combined with further evidence gathering on our asset, this will allow for better understanding of whole-life behaviour and planning of interventions.

The strategic decision was taken to defer ballast cleaning into CP4 and the data from the Pandoscope was integral to the safety assessment of this decision. The data showed that ballast is at approximately 50% of it used life, which is optimal for strategic cleaning. The material was demonstrated to be clean and free draining, allowing us to continue maintaining high levels of geometry performance.

The information collected so far represents a snapshot in time and is a function of traffic and maintenance activities. We intend to build this data set through the remainder of CP3 and CP4 to better understand the ballast condition and the factors influencing it.

We have continued to collaborate with Sol Solutions, SNCF, and Network Rail Eastern Region on best practice with the equipment, while post-work validation following renewal interventions will be deferred into CP4, we will undertake a detailed investigation into switch and crossing condition in 2023/24. This exercise will allow us to define maintenance and refurbishment activities to maximise the life of rails, bearers, and signalling equipment.

4.2.3 Infrastructure Monitoring using Multi-Purpose Vehicles (MPV) (Cordel)

The objective of this R&D project is to capture imagery and Lidar data from planned MPV recording runs using modern, cost-effective, and miniaturised sensors; to automate large volumes of data processing using machine learning; and to deliver intelligent and actionable inspection results. This will enable NR(HS) to automate inspections and surveys of multi-disciplinary assets automatically across the entire HS1 network in near real-time.

Following successful trials in 2021/22, a 3-month extension was completed in Q1 of this year. From this, NR(HS) has developed a technical work scope for a full year of operational testing, which will be competitively tendered to ensure value for money. This procurement exercise is ongoing. Indicative prices back from the market exceed what was originally assumed in the original business case, therefore further evaluation and engagement with potential suppliers is ongoing.

4.2.4 Digital Bridge Inspections

The results of this project are currently under evaluation to determine whether there is a viable business case to move the project into future phases and business as usual operation. It is thought that this is an effective solution to monitoring bridge assets and enhancing the information collected over current methods and procedures, but further work will be required to automate getting to this stage in a BAU scenario. The current approach to collecting the information produced in this trial is still labour-intensive and requires people to be on and around the asset, where further efficiency could be realised with development of the method of data capture. To remedy this, this initiative could be paired with automated capture technology in the future, such as via drone or other UAV capture. Refinement and a decision on BAU viability for this initiative will be determined through the Innovation workstream of the PR24 process.

FIGURE 11 - 3D BIM MODEL OF HS1 BRIDGE ASSET

4.2.5 Hitachi OLE Monitoring (Overhead Line Equipment in Real Time (OLErt))

NR(HS) has been exploring various options over the last year for in-service dynamic monitoring of the pantograph-OLE interface.

NR(HS) is now working with Hitachi and SE Trains to trial their on-board integrated system on HS1. Hardware is currently being installed on two 6-car units which is planned to be fully fitted by Summer 2023. If successful, the system will facilitate the prediction and identification of OLE defects, such as contact force (hard spots), excessive arcing, and height and stagger out of tolerance to allow intervention before a potentially disruptive incident is caused.

Other benefits include:

- Significantly improved management of the OLE asset, leading to a more reliable train service.
- Provision of data to train operators on the performance of their vehicle pantographs.
- Improved wear and damage to pantograph carbon strips.
- The ability to monitor the in-service dynamic performance of the pantograph-contact wire interface.
- Manual intervention only when needed – reducing the number of possessions required.
- Optimisation of maintenance resource.
- Reduction/elimination of damage and/or disruption on HS1 caused by vehicles entering the railway with material (foliage) entangled within the pantograph; and
- Early identification of potential OLE defects.

4.2.6 Drones

NR(HS) is working with RUAS and Railsacpe, providers of Drone Services to the Rail industry to trial a range of drone-based technologies across the HS1 network to deliver efficiencies to NR(HS), HS1 and other stakeholders. The trial will be a proof-of-concept trial for vegetation control on steep slopes, tree risk canopy surveys, tunnel vent shaft inspections, lineside building / station roofs and underside of bridges / viaducts. Unmanned Aerial Vehicles (UAVs) will be trialled combined with high powered camera sensor(s) to capture an aerial photogrammetry data set.

In parallel, NR(HS) is agreeing an update to the NRIL operating procedure with Route Services Air Ops team to include the HS1 route infrastructure for UAV flights using industry approved products.

The output should achieve an end-to-end capability that will integrate into Esri/ArcGIS online to give access to the most up-to-date information as well as historical data (from the point of first data collection via drone), enabling informed decisions from multiple stakeholders from a single data source and platform.

4.2.7 In-Service Monitoring of Passenger Trains

Building on the success of a prototype ride quality monitor, we have been working with the University of Birmingham, its subsidiary MoniRail and Eurostar to develop a ride quality monitor for use on passenger services. There are two inertial monitoring units mounted to the vehicle body and bogie frame, providing acceleration data as the train traverses the network. The system has been in development since October 2020; however, the last year has seen significant developments.

Phase 2 of the project concluded with a single system installed and operating consistently on a Eurostar service. The reliability and repeatability of the acceleration data has been demonstrated, allowing us to identify areas of deterioration and plan remediation. Converting the accelerations into displacement, the team has also demonstrated good correlation with conventional track recording traces.

The third phase of the project, funded by Innovate UK, will see the technology optimised and developed into a commercial proposition, whilst also deploying a second system on the infrastructure. Further improvements to positional accuracy and the development of a user-friendly interface are also planned over the coming year.

4.2.8 More Value from Data – Machine Learning and Machine Vision (MLMV)

This project aims to use automation and machine learning to either reduce maintenance workload or improve data quality by using existing information in new ways. Following an initial session with Arcadis, the NRIL Technical Authority, in collaboration with Southeastern, identified a total of 14 potential applications. The project will be delivered in three phases over a six-month period.

Phase one will entail further investigation of the available data sources and identification of possible applications. The second phase will develop at least one solution into a proof of concept and prototype user interface. The final phase will deliver a report and recommendations as to how machine learning could be further implemented, and what data sources would be required to do so.

4.2.9 FOAS Technology

The purpose of this R&D project is to demonstrate how Fibre Optic Acoustic Sensing (FOAS) can be used as a distributed trackside acoustic and movement sensor to monitor the condition of high-speed switches and crossings. The project will explore how this information can be used to indicate wear and monitor degradation on the point operating equipment on HS1, prolonging asset life and reducing costs. The technology should also provide feedback on the quality of the intervention once completed.

This project is based on proven trials on NRIL infrastructure, which demonstrated a greater understanding of the rail wheel interface. This should support condition-led maintenance and renewal activities. This technology has approximately 60 use-cases. In conjunction with NRIL and Thales, HS1 will trial one use case, with others being tested on NRIL infrastructure. If successful, the technology would allow HS1 to benefit from all 60 applications.

4.2.10 High Speed Railway Degradation Modelling

The High-Speed Railway Degradation Modelling initiative being developed with the University of Nottingham looks to understand how all of the HS1 infrastructure elements degrade due to either the passage of time or use. This will enable greater accuracy in estimating when replacement is necessary and can be achieved using modelling methods which include Artificial

Intelligence (AI). For systems and structures made of many components and ageing at different rates, there is the further challenge of combining component performance predictions to predict the performance of the system or structure.

The initiative seeks to establish the degradation mechanism for each asset type, and then plan when renewals will be performed. Utilising asset degradation models will enable the asset renewal schedule to be produced in such a way as to minimise costs to HS1. This is being achieved through definition of an optimisation problem which minimises whole system costs and satisfies the constraint of performing renewals with minimal impact on service provision. The modelling will account for the uncertainty in both costs and degradation profiles.

This is a long-term initiative that will continue into CP4.

4.2.11 Extreme Weather Resilience

Record temperatures along the HS1 route during summer 2022 highlighted the risk of reaching the upper limits of the designed operating range for the infrastructure, particularly for the track asset.

As a result, a research project has commenced to understand the behaviour of the track system across a range of temperatures.

Once a baseline is established, we will also simulate degraded states, such as unconsolidated ballast or inadequate rail stress. This will allow a matrix of controls to be developed to assure safe operating conditions as temperatures rise.

The project will develop a mathematical model of track behaviour before validating this in a laboratory environment. The findings of this initial phase are planned for April 2023 to allow validation during the summer through direct observation and measurement on the infrastructure.

While initially developed as a control framework, it is anticipated that the model will also be used to inform future changes to infrastructure installation criteria and management of track following heavy disturbance, such as ballast cleaning.

4.2.12 ArcGIS – Geospatial Information

This year has seen NR(HS) take part in R&D trials on ArcGIS, a Geographic Information System software, in collaboration with HS1 and ESRI UK. The ArcGIS project is a proof-of-concept trial to provide a geospatial representation of assets which can integrate with other systems and software, such as real-time asset monitoring and Basebuild O&M repositories. The project was delivered via an agile delivery approach which breaks the project down into sprints.

Sprint 2 selected data inputs from various functions and departments have been obtained and published into the software, providing a high-level geospatial view of different data sources. A screenshot from the ArcGIS system of assets across an area of the route is shown in Figure 13 .

Sprints 3 and 4 looked at elevated levels of analysis and benefits from layering multiple data sources to provide better information and enable improved decision making. The proof of concept ended early 2023.

FIGURE 12 SCREENSHOT OF ALL ASSETS SHOWN IN ARCGIS

By working together, all sprint workstreams were completed over the course of a 3-month period. Building capabilities around asset mapping, crime tracking, renewals planning, possession management, and most importantly, the combination of a series of datasets on track condition to look at the potential to automate the booking of a possession and creation of an intervention or maintenance task. Additionally, the system demonstrated the ability to capture, process and visualise the data from remote condition monitoring devices, allowing real, or close to real-time asset monitoring in line with our Infrastructure Evolution aspirations, and supporting our transition to risk-based asset management.

Now that the trials have concluded, the intention is to work towards the creation and completion of an ArcGIS Implementation Plan for NR(HS), likely in collaboration with HS1. As part of this, the definition of our desired IT and Systems Architecture will be developed in 2023/24, along with robust data quality, validation, and processing standards, as well job family architecture and

job descriptions for personnel we will need to support these systems and our business as we move toward new system setup. The business-as-usual scenario will see the implementation of ArcGIS aligning seamlessly with EAMS2 and ProjectWise.

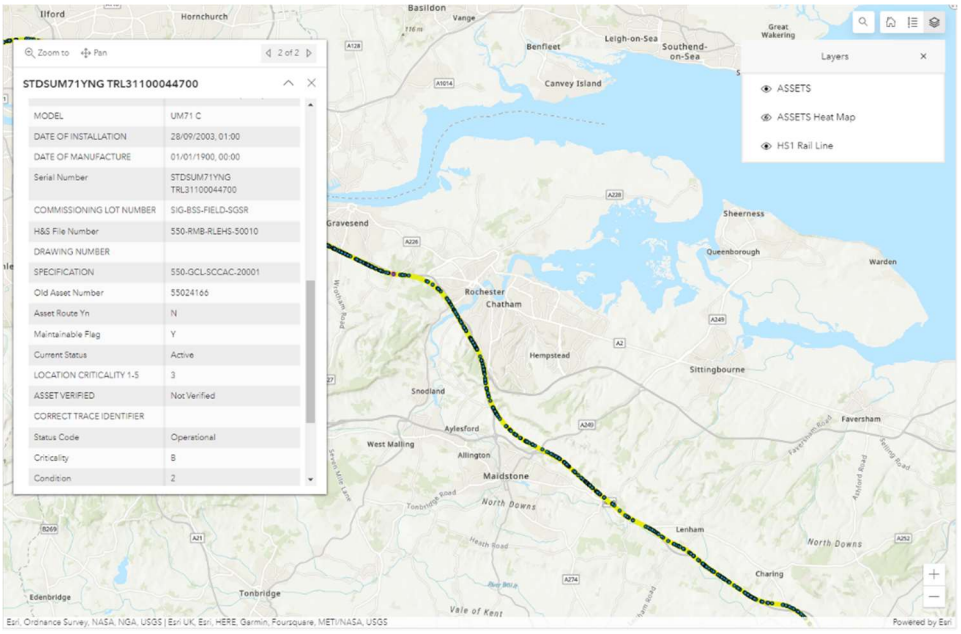


FIGURE 13 - SCREENSHOT OF ALL ASSETS SHOWN IN ARCGIS

4.3 Station Projects

- OpenSpace Operational Digital Twin continues to develop in-line with staggered release of R&D funding. The system is currently assisting financial planners within HS1 to use the data output to inform assumptions about passenger footfall in International Stations. The consolidation of innovative activity in the Stations has resulted in a plan to integrate several data streams into OpenSpace to allow centralisation of information and provide a reliable source of truth for several sets of information about our Stations.

4.3.1 5G Augmented Reality Digital Twin

This project has been key in helping HS1 to develop its Engineering and Asset Management Digital Strategy, which was written in December 2022, and has shaped how HS1 sees the future of remote condition monitoring, cloud-based computing and information visualisation. Further R&D funding has been used to explore more targeted approaches to Digital Twins which have been successful (4.2.12).

4.3.2 Open Space – St Pancras Operational Digital Twin

The third phase of the OpenSpace digital twin of St Pancras International station is in progress, this will support both day-to-day operations and forward operational planning. The OpenSpace platform brings together 3D cameras, CCTV and Wi-Fi system connectivity and the APIs (application programming interfaces) are now being developed. OpenSpace and HS1 are now

investigating the use of LiDAR which is a laser imaging system. This would be installed in departures areas to help manage the customer throughput and flows.

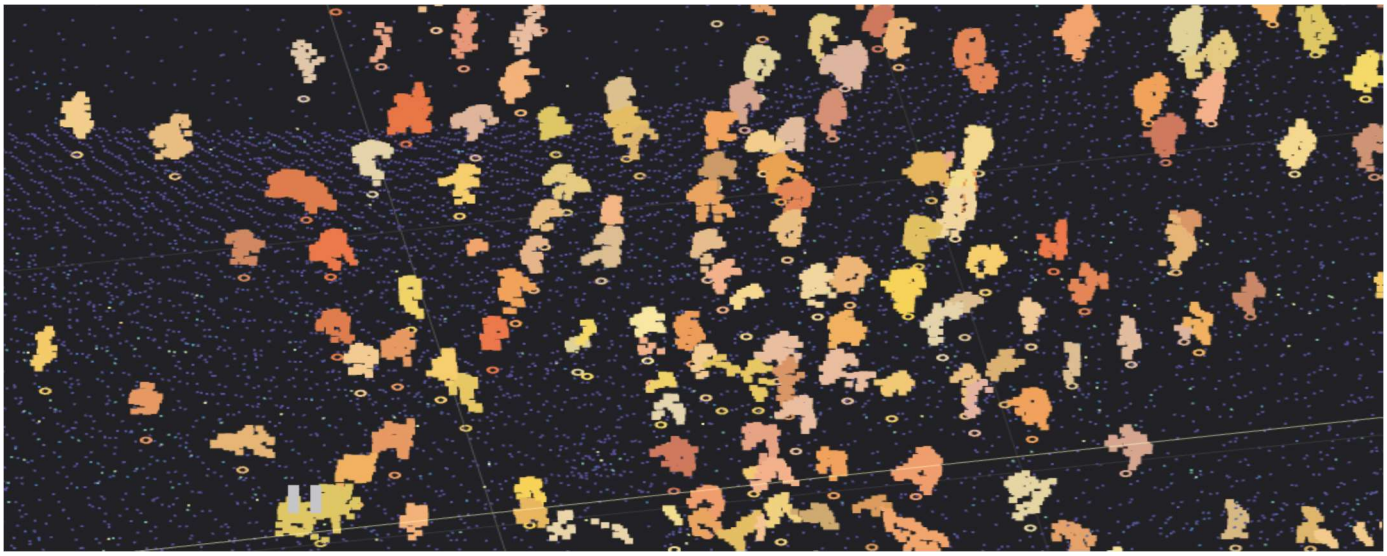


FIGURE 14 - REAL TIME USE OF STATION CONCOURSE

This year HS1 completed station mapping to enable an application that will help customers and staff to navigate St. Pancras International. The mapping application shows a blue dot on the user's phone that will move through the map to show their real time journey. HS1 plan to procure a one-year contract for the mapping application starting in Q2 2023. We will be investigating connecting the application to tickets and the wi-fi system to automatically produce a map for each customer journey.

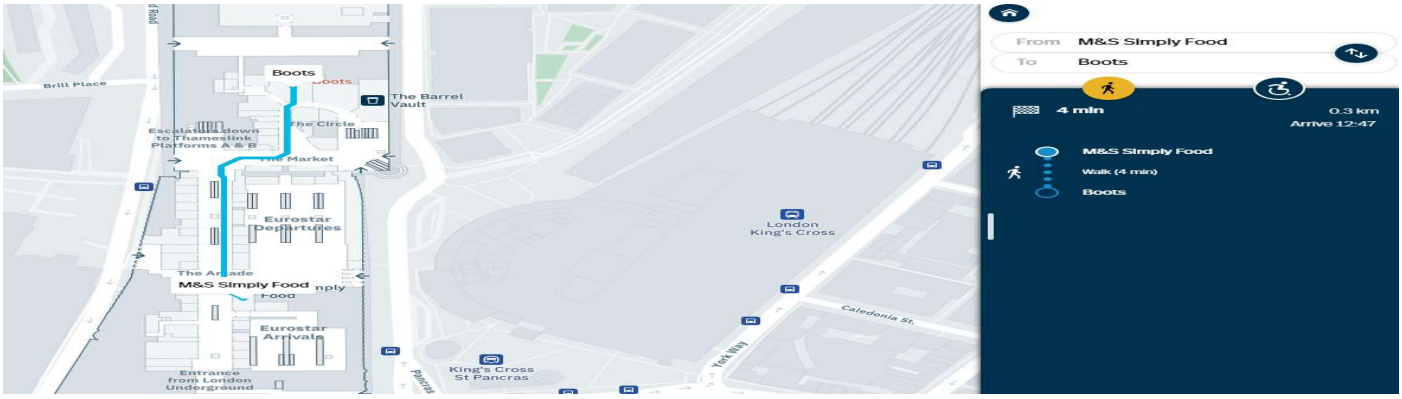


FIGURE 15 - EXAMPLE OF REAL TIME STATION MAPPING

4.4 Organisational Readiness

4.4.1 Modernisation within NR(HS)

- NR(HS) New Target Operating Model introduced ahead of CP4 to deliver additional efficiencies, rationalising director roles from seven to four. The four new directors are now appointed. NR(HS) will report on the cost impact of the restructure in its fishbone analysis that is provided directly to the ORR.

In Q1 of 2022 the NR(HS) Modernisation journey was started. The aim of the programme is to enable NR(HS) to become a more innovative, efficient, and attractive organisation to work for. Modernisation can be broken down into 4 programmes: Management Modernisation (TOM), Infrastructure Evolution, Operations Modernisation and Wider NR(HS) Modernisation.

Management Modernisation 2022 saw the initialisation of the management modernisation programme, which was about NR(HS) taking control of the business, bringing the right parts closer together, caring about what they do and becoming a more efficient organisation. A large part of target operating model implementation was an organisation restructure, reducing the directors from seven to four including a Director of Operations, Director of Infrastructure, Director of Engineering and Safety and a Finance Director. The restructure brought together the right parts of the business to make it easier to run a safe and reliable railway. The four new directors were appointed within NR(HS) in September 2022.

To fully embed the new operating model, work is still ongoing in the following priority areas, resourcing critical vacancies, mapping our core processes, and embedding the Governance, Risk, Assurance, Improvement (GRAI) framework.

Infrastructure Evolution NR(HS)s Infrastructure Evolution programme started in Q4, with a lead appointed who has scoped out key areas for the evolution process to focus on. These are: planned and preventative maintenance; response capability; planning competency; and an organisational review.

Operations Modernisation - Q4 NR(HS) delivered phase 1 of the Operations Strategy that focused on identifying the 'As is' position and began to look at accelerating NR(HS)'s capability within 3 areas: performance modelling to support decision making; resource capability to enable more efficient but effective rostering; and access planning capability to model the optimum paths if access is required for future engineering work.

Wider Modernisation - work has begun with reviewing the accommodation strategy.

4.4.2 HS1/NR(HS) partnership and joint working initiative

Collaborative working has progressed well throughout the year and continues to be developed along the lines of a partnership approach and is now embedded in the joint ways of working between HS1 and NR(HS).

Industrial action and the re-deployment of staff to maintain services has resulted in indirect impacts such as maintenance delivery backlogs and renewals planning delays which NR(HS) have worked hard to recover through the year. With the distractions of industrial action now largely diminished (the impact on maintenance and renewals is noted in this report), industrial action resilience has been built from the 2022/23 experience and NR(HS) is now in a better position to deal with any future industrial action.

The 2023/24 System Strategy/Client Brief has been agreed with NR(HS) and identifies joint working on key strategic workstreams to be delivered by the financial year end. The revised Client Report has seen improvements in reporting and the 2023/24 Scorecard has also been agreed with NR(HS) now reporting periodically against the agreed primary and secondary Scorecard measures.

NR(HS) is supporting the delivery of HS1's key business objectives: delivering the core, influencing campaigns, international operator and investing in retail. The following joint strategic workstreams have been identified for 2023/4 and progress is governed and reviewed through the OA/SCA meeting structure: 1) International Operator, 2) Stations transformation, 3) CP3 Outperformance Share with c. £1.5m to be declared for FYE 2023 and 4) modernisation/productivity. Also of note is that there have been no Re-Openers to the Annual Fixed Price of the Operator Agreement with NR HS. The TOM is an important enabler for the delivery of long-term operations, maintenance, and renewals efficiencies and has supported the achievement of the Outperformance Share for 2022/23 with more to come during CP3.

As part of the ongoing relationship, working in collaboration with HS1, NR(HS) and HS1. have progressed further in developing a joint system strategy which aligns to scorecards and objectives for both organisations

4.5 Performance

4.5.1 Supplementary OCS Insulation

- NR(HS) continue to benefit from best practise knowledge sharing with SNCF and Infrabel through High-Speed Club meetings.

A recurring problem on the HS1 route has been birds flying into the portals of tunnels and making contact between the live overhead catenary system (OCS) and the tunnel lining, resulting in infrastructure damage and disruption to services. In 2020/21, following an incident in London Tunnel 1, NR(HS) carried out extensive research and identified a product to enhance the existing OCS insulation on the catenary conductor and associated supporting steelwork to significantly reduce the risk of similar incidents. The product was successfully installed during 2022/23 at all identified high-risk areas on HS1, at no cost to TOCs.

4.5.2 Best Practice Sharing Initiatives

The High-Speed Club has allowed asset knowledge and experiences to be discussed between SNCF, Infrabel and NR(HS). The High-Speed club meetings have continued this year, with track professionals sharing best practice on inspection and maintenance of swing nose crossings, including the design evolution of the crossing itself. The next meeting will be used to compare approaches to managing ballast compaction following renewal activities and managing vibration around the point motor.

Following the record temperatures experienced during the summer, the group is currently sharing best practice on hot weather resilience and infrastructure risk assessment. This was discussed at the meeting in December 2022. This session was intended to initiate a wider workstream around climate resilience that we plan to take forward in 2023/24.

4.6 Planning

4.6.1 Integrated Planning

Over the last 12 months the Integrated Planning Programme has been looking at the way NR(HS) plans, resources and delivers the maintenance and renewals work bank. Progress has been made in each of the three workstreams.

Planning foundations: NR(HS) produced a safe system of work planning process document, which is based upon the NRIL 019 standard but with amendments to reflect the differences in the rule books and ways of working. This process document was created through working groups comprising of key stakeholders who will be responsible for the final safe work pack. The NR(HS) 019 standard is due for publication in 2023. NR(HS) is sourcing a programme that can create safe work packs electronically and developing training requirements for staff. Phase 1 will be a trial in 2023, with Phase 2 being the full release by the end of 2024.

Analysis and improved technologies: As part of its planning process, NR(HS) has modelled the impact of major renewals works on the train timetable and an access solution for specific access requirements. This model considered the requirements for the renewal works and the requirements of the TOC/FOC. The overall result is a balanced access strategy for completing the works efficiently with minimal impact on passengers. NR(HS) will utilise this process as part of its future works planning process when required.

Cultural change: Changes under the Target Operating Model saw all planners in the business integrated into a single planning team. The new section planner roles will be multi-skilled and will hold the NR(HS) planning competency. This multi-skilled approach ensures all teams within the business have access to a section planner to help facilitate the access planning of works.

4.7 Regulatory

4.7.1 Escrow Holiday

- Good progress made with Periodic Review 24 preparations. Following the launch in July 2022 various stakeholder engagement bilaterals and workshops have been held providing insights into the process and planning.
- Stations regulation was successfully transferred from DfT to ORR in July 2022 which should bring more holistic regulatory oversight of HS1 assets.

As a result of the COVID-19 pandemic, train operators on HS1 experienced a sudden and significant drop in revenue. To offer some mitigation to operator outgoings, HS1 liaised with operators, DfT and the ORR at the time to construct a deferral in the renewals element of OMRC charges and the stations LTC. Operators were offered a deferral of these elements of charges for 16 periods, from Period 1 2020/21 to Period 3 2021/22. Eurostar accepted the offer and is now repaying the deferred amounts with interest over the balance of CP3.

4.7.2 Structure of Charges Review

The HS1 charging structure (and model) is over 10 years old and needed to be reviewed to ensure it continued to fairly attribute charges to operators based on evidence of cost causation, addressed questions of affordability raised by operators facing heightened cost pressures from the COVID-19 pandemic, and supports recovery and growth in HS1 traffic. We had a CP3 commitment to undertake a structure of charges review which we began in May 2021.

HS1 has now completed the Structure of Charges Review, delivering on this commitment. Phase 4 of the Review was published in August 2022; this set out the conclusions, taking stakeholder feedback on the Phase 3 proposals into account, and the next steps for the actions we identified that need to be taken forward through collaborative HS1 system solutions and the PR24 process. During the year HS1 also held two consultations on the rebuild of the HS1 charging model that incorporate the outcomes of the Structure of Charges Review, publishing the response document to the second consultation in February 2023. The changes to the Model that incorporate the Review outcomes will be subject to extensive consultation and ORR determination as part of the PR24 process.

Through this review of charges and, more generally, the impact of COVID-19, HS1 has identified several amendments that are required to the Passenger Access Terms (PAT) and Freight Access Terms (FAT). These were set out in the Phase 3 consultation. We now plan to consult on these PAT/FAT amendments as part of the PR24 process, having focused in 2022 on amending the PAT to incorporate Regenerative Braking and OTM (3.3.231).

4.7.3 Periodic Review 24 (PR24)

Work on the next periodic review, PR24, is well underway. PR24 was formally launched in July 2022 with a stakeholder workshop with accompanying quarterly bilateral sessions. We have since held several rounds of quarterly workshop and bilateral sessions (in October 2022, February 2023, and May/June 2023). Topic-specific workshops on the approach to the renewals annuity, asset management planning and renewals capability have also been held. HS1 is ensuring regular stakeholder engagement in the lead up to the February 2024 submission to keep all stakeholders well informed and to promote discussion and engagement on emerging issues and risks.

We are working closely with our key supplier NR(HS) on the development of our respective 5 Year Asset Management Statements (5YAMS) for CP4 – a key deliverable for PR24. The HS1 5YAMS will outline the operations and maintenance plans for CP4 (2025-2030) and the cost of implementing these plans. A volume-based renewals plan for the next 40 years (2025-2065) will also be included, with an indicative price for the first five years. It will be underpinned by a suite of strategies, from asset management and engineering through to safety and people.

Given the heightened focus on cost efficiencies, HS1 and NR(HS) worked to present stakeholders early on at the October 2022 workshop with an emerging view on the CP4 funding envelope of a 5% reduction in real terms, based on efficiency targets and ambitions of 7.5% for O&M and 10% for renewals, assuming all else held constant. We updated stakeholders in May/June 2023 of our ambition to hold HS1 costs flat in real terms relative to PR19 (see Section 5.6.1) and that we're on track for the targets and ambitions to give a 5% reduction in costs in real terms for CP4. HS1 and NR(HS) are progressing with the bottom-up validation to bring back to stakeholders, and looking to see if further savings can be achieved. NR(HS) has been sharing several asset management and engineering documents with HS1 in emerging form to provide early sight of approach and direction, and to obtain feedback to incorporate into further iterations. This approach forms part of the joint assurance process with HS1.

The HS1/NR(HS) Joint Steering Group continues to meet regularly to ensure PR24 activities progress in a timely manner.

An indicative timeline for PR24 is shown below.

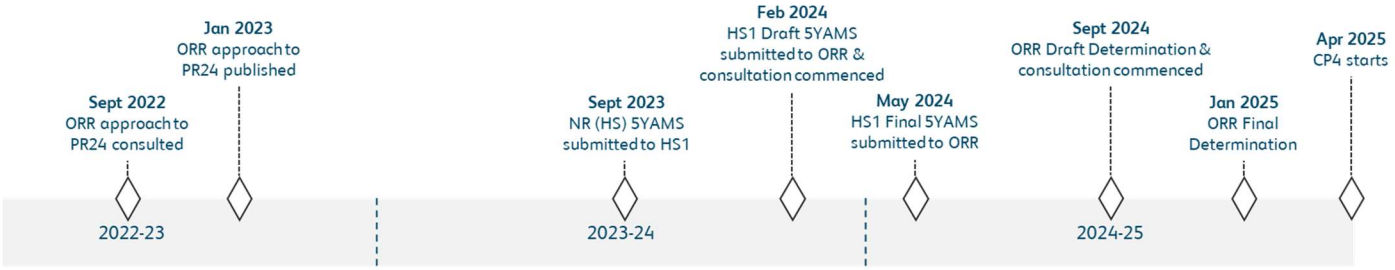


FIGURE 16 - PR24 TIMELINE

4.7.4 Transfer of Stations Regulation

HS1 worked with DfT and the ORR to successfully transfer regulatory oversight of the HS1 station assets to the ORR on 27 July 2022. Consolidating regulatory oversight for route and stations should deliver efficiencies for all parties. The project involved joint work to amend the HS1 Stations Lease to reflect the transfer of oversight and update the provisions related to asset stewardship to reflect best practice (the latter was a DfT commitment made in its PR19 determination on HS1 stations). The ORR also published a second regulatory statement and guidance on how HS1 should meet the regulatory requirements with regard to HS1 stations which aligns with those for route. Since the project began, HS1 has been supporting the ORR to develop its knowledge of the HS1 station assets.

As part of the amendments to the HS1 Lease, we committed to continue reporting on the Stations Long Term Charge. HS1 previously reported on HS1 stations in our AMAS on a voluntary basis to keep stakeholders informed; we have taken the opportunity to highlight stations reporting in the 2022-23 AMAS.

5 Renewals Planning and Delivery

As per the Concession Agreement Schedule 10 Section 6.2 and HS1 Stations Lease Section 4.6, the following section describes the work that has been undertaken in 2022/23 and the work being planned for 2023/24. This section also describes the improvements made to renewals governance and assurance, and progress on long term planning. A breakdown of route and stations renewals performance on a project-by-project basis is provided as an appendix. The reporting format is in line with that agreed with the ORR at the start of CP3.

5.1 Renewals Governance and Assurance

- Periodic renewals meetings reviewed and improved to give greater focus on forward looking plans, issues, and blockers to renewals delivery.
- New renewals performance lead indicators and dashboard introduced in September 2022 to provide better renewals assurance.

The 2021/22 ORR Annual Report on HS1 raised concerns with HS1s ability to deliver renewals. ORR recommended that HS1 undertake a more rigorous assurance regime on NR(HS) and request a recovery plan from NR(HS) on the current shortfall in renewals delivery over years 1 and 2 of the control period.

HS1 responded to the ORR, recognising that performance in years 1 & 2 was not to plan due to several factors. HS1's review of the current governance and assurance confirmed that the correct challenge is being undertaken on the renewals delivery portfolio and is well documented. Year 3 renewals performance at that time (i.e., as of P6) was on plan, and HS1 has been dynamically managing the portfolio, regularly reviewing the work bank against HS1's current Strategic Asset Management Plan (SAMP) and Asset Management Objectives (AMOs), managing any change through the project governance process, supplemented where required with the Deferred Renewals process. HS1 will always seek to deliver the right renewals at the right time providing value for the investment made, so justified changes in the portfolio should be expected.

5.1.1 Governance and Assurance Maturity in CP3 Year 3

To support the management of a dynamic portfolio HS1 have made good progress in their governance and assurance maturity in year 3:

Renewals Board and Reporting

HS1 have undertaken a review of the current periodic HS1-NR(HS) Renewals Board to understand how it could be better structured to suit the maturing of HS1 and NR(HS) project delivery organisations. HS1 have developed a complimentary series of periodic renewal board meetings which focus on Finance & Project Controls, Renewals Change Control, and Renewal Plans, Progress & Milestones. The impact of these changes has been positive, and the level of conversation with NR(HS) has improved with a greater focus on forward looking plans, issues, and blockers to renewals delivery.

In addition to the structure of the renewals board, HS1 have worked with NR(HS) to develop an aligned view of reporting inputs, review processes and outputs to ensure there is a line of sight from NR(HS) data inputs to HS1s assurance processes and into periodic, quarterly, or annual reporting obligations.

Renewals Performance Indicators

Year 3 of CP3 has seen NR(HS) mature in its use of performance indicators through the addition of volumes as a performance currency. For year 3 NR(HS) now report on 'asset volumes delivered vs plan' (baselined at the start of the year) as a performance indicator. This provides greater granularity on actual works completed as a measure of renewals schedule performance, and to align with the wider NRIL scorecard and to provide consistency with reporting of renewal activity to the ORR.

As part of HS1's maturity as a project delivery function, and in response to ORR challenge on proactive renewals assurance, from P6 we have also introduced of a set of leading indicators. These aim to provide confidence in the renewals portfolio by answering the following key assurance questions:

1. How confident are HS1 that the current CP3 plan will be delivered?

2. How confident are HS1 that the in-year plan will be delivered?
3. Are resource and effort being focused on the right areas?

The lead indicator dashboard summarises HS1s view and confidence in renewals delivery, this is based on interrogation of NR(HS) reporting and renewals board inputs (RAG Status Report, Milestone Plans, Periodic Reporting) which are analysed using Power BI. These drive the assurance focus of HS1 and identify where support and intervention may be needed.

The Lead Indicator dashboard has been developed in discussion with the ORR, based on the following principles:

- Utilising existing data sources where possible
- Proportionate to HS1 and the work bank.
- Focuses on HS1's assurance of the portfolio.

This lead indicator dashboard is a maturing process and has been shared at Quarterly Asset Renewal Review meetings with ORR, DfT, and TOCs.

5.2 Route Renewal Delivery 2022/23

This section provides an overview of the CP2 and CP3 Route renewals planning and delivery in 2022/23, as well as outlining the delivery focus for Year 4 2023/24 and Year 5 2024-25.

5.2.1 Summary of Route Renewals Performance Year 3

Planned volume delivery (CP2 & CP3) in Year 3 was 274 volumes vs an actual volume delivery of 200 (73% of plan). Planned spend (CP2 & CP3) in Year 3 was £11.7m vs an actual spend of £8.6m (74% of plan).

This represents a credible performance considering the challenges experienced in year 3 and a significant increase in volume delivered in Year 3 (201) compared with volumes delivered in Years 1 & 2. (67)

A further 19 volumes (7% of plan) would have been delivered but for the impact of industrial action, good work was done to mitigate the impact of industrial action by accelerating volume delivery.

A large proportion of the volume variance experienced in year 3 (20%) has been due to delays in availability of materials. These were lower priority renewals.

Due to disruption experienced in Years 1-3 HS1 instructed NR(HS) to conduct a review of the need and deliverability of the work bank to provide a credible plan for the remaining years. Detail can be found in 5.2.2.

5.2.2 Breakdown of Route Renewals Delivery in Year 3

The planned volume delivery (CP2 & CP3) in Year 3 was 274 volumes vs an actual volume delivery of 200 (73% of plan)

The planned spend (CP2 & CP3) in Year 3 was £11.7m vs an actual spend of £8.6m (74% of plan).

We believe that this represents a credible performance considering the challenges experienced in year 3 and is an improvement in terms of the percentage of planned spend delivered in years 1 (35%) & 2 (68%) and a significant increase in volumes delivered in year 3 (200) compared to years 1 & 2 (67).

NR(HS) have been working proactively to manage and mitigate the impact of the industrial action to identify opportunities to accelerated work. The replacement of the final section insulator at St Pancras was brought forward from Christmas (P9) to P7 to take advantage of access afforded by the ASLEF strikes, in doing so this avoided potential additional costs associated with working over the Christmas period and the risks associated with volunteer resource.

Where strikes have resulted in the cancellation of planned works i.e., crossing assets, preparation and follow up shifts were used to deliver other volumes and accelerate the delivery of HPSS points operating equipment. HS1 have challenged NR(HS) around their agility to respond to strike disruption and what plans they have in place to utilise access and resource in similar ways if impacted by strike action.

We have seen the impacts of more challenging macro-economic factors with reduced appetite from the supply chain on procurements and greater negotiation on terms and conditions particularly around inflationary risk this has resulted in delays to UPS and Local Area Network (LAN) renewals.

A large proportion of the volume variance experienced in year 3 has been due to delays in availability of materials on some lower priority projects, such as ERS/EZP, Local Release Command (LRC) and ITCS test benches.

Progress has also been made on several projects where understanding of scope and asset condition has matured and enabled a change in asset management approach or deliverability strategy which will result in a change to the volumes intended to be delivered in CP3: FOAEC, 10km Rerailing, Ballast Refurbishment. The main source of cost variance in year 3 is due to the decision to defer the ballast renewal works from CP3 to CP4 which is covered in section 5.2.3.1.

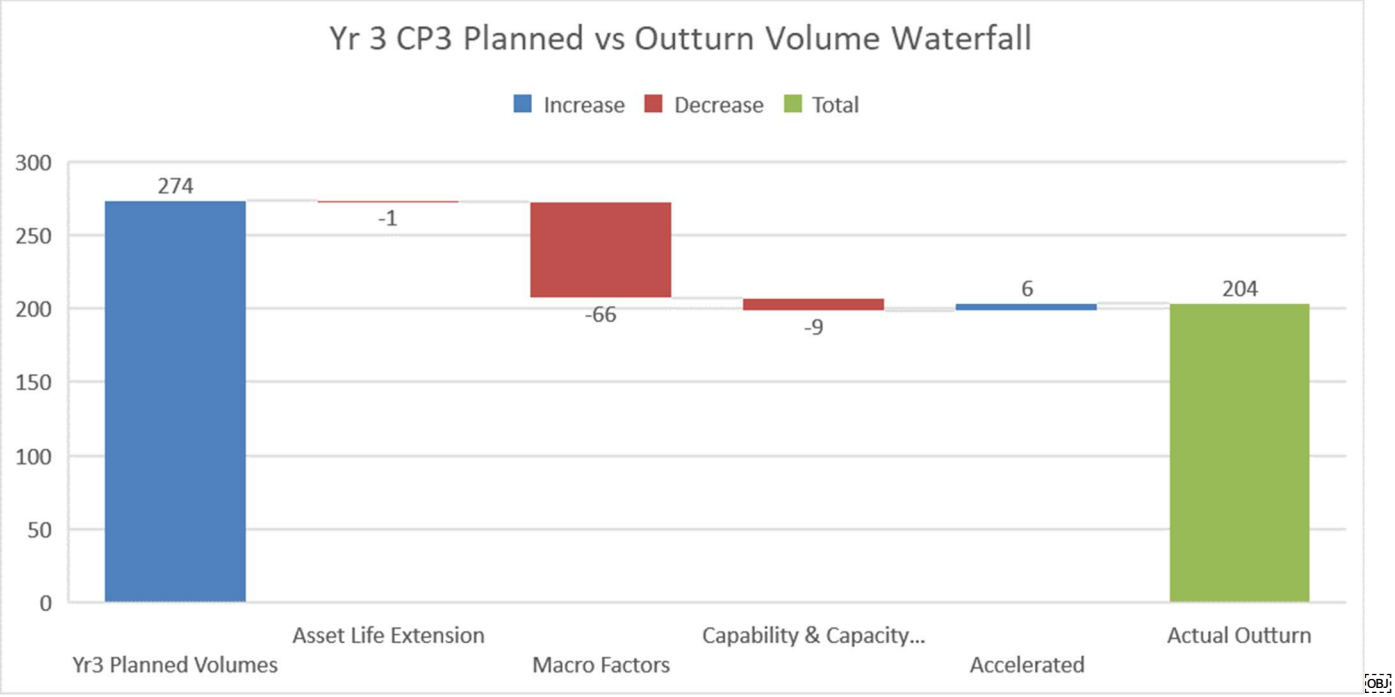


FIGURE 17 - PLANNED VS OUTTURN CP3 YEAR 3 VOLUME WATERFALL

Project Title	Planned	Actual	Variance
UPS (Uninterrupted Power Supply)	3	3	0
VCS	1	1	0
Radio Propagation	0.5	0.5	0
Minor Aircon Units	0	6	6
Renewal of Cross passage door programme	2	2	0
RRAPS	5	0	-5
Crossings Renewals	10	5	-5
Re-rail 10km of track at Section 1	1	0	-1
Bridge Expansion Joints	7	6	-1
Corsica Headhouse Monitoring and Feasibility	1	1	0
GSM-R Handsets	120	120	0
HPSS St Pancras Upgrades	13	19	6
ITCS Test Benches	2	0	-2
Local Area Network LAN	2	0	-2
Local Release Controls	20	5	-15
Vossloh Points Operating Equipment MCEM91	7	4	-3
Marker Boards	1.35	0	-1.35
Renewal of UPS, Rectifiers and Batteries	5	5	0
Switch Blades	3	1	-2
EZP & ERS	40	0	-40
Mod Box's	1	0	-1
Re-Railing at St Panc 3k	1	0	-1
IBJ's Yr1-5	9	6	-3
Expansion Joints (LEJ'S)	4	0	-4
Replacement of Section Insulators at St Pancras International Station	2	2	0
Fire Suppression Cylinders	13	13	0
	273.85	199.5	-73.35

TABLE 6 - YEAR 3 PLANNED VS ACTUAL VOLUMES

HS1 is a modern railway asset and as a result the CP3 work bank is based around proactive strategic renewals before assets have reached end of life rather than reactive when they are a performance/safety risk. As such there is a window of time when these renewals can be delivered without impacting safety or operational performance.

All volumes which were planned to be delivered in year 3 will be replanned for year 4 apart from the Road Rail Access Points due to availability of a suitable products for use on the High-Speed network. This renewal was highlighted in the September response paper to the ORR as a potential project where the full volumes were not likely to be delivered within the control period. All works not delivered within the year are managed through NR(HS)' Asset Management deferred renewals process.

Key route delivery highlights in year 3 included:

- **AR1523 UPS renewals** - The final 2 sites within the project were delivered this year. The equipment was obsolete and no longer supported, and a failure could have resulted in a loss of power to Signalling equipment which was a performance risk. Temporary UPS units were required to maintain support during the renewal works. The works were completed on in September 2022.

FIGURE 18 - STRATFORD UPS INSTALLATION AND TEMPORARY UPS AT SIMD

- **Section Insulators** – The renewal of sectional insulator at St Pancras has been completed. We utilised the opportunity presented by the ASLEF train driver strikes to agree access with Train Operating Companies and completed the works which were scheduled for Christmas 2023. The works addressed a long-term design issue which was causing damage to the pantograph carbons of the Class 395 fleet.

FIGURE 19 - SECTION INSULATOR WORKS BEING COMPLETED AT ST PANCRAS

- **Cross passage door** – The renewal of cross passage door within the Thames Tunnel has been completed. This renewal was required due to the condition of the asset, resulting in it being non-operational. To deliver this renewal required installing an emergency removeable bulkhead to allow delivery during operational hours and removed the risk of safety and operational overruns compared to delivering in engineering hours.

FIGURE 20 - COMPLETED CROSS PASSAGE DOOR RENEWALS IN THAMES TUNNEL

- **Switches and crossings** – 5 crossings (2042 FNC at St Pancras, 2242 SNC Nashenden, 2014 FNC at St Pancras, 2004 FNC at St Pancras and 2117 FNC at Ebbsfleet) and 1 switch (2022 Half Set at St Pancras) was delivered in the year. These are being delivered by utilising multi-disciplinary in-house maintenance teams. We have started utilising Trac Rail Transposer (TRT) to lift the crossings. The benefit of using the TRT's is that they don't require an overhead isolation and optimises the use of access.

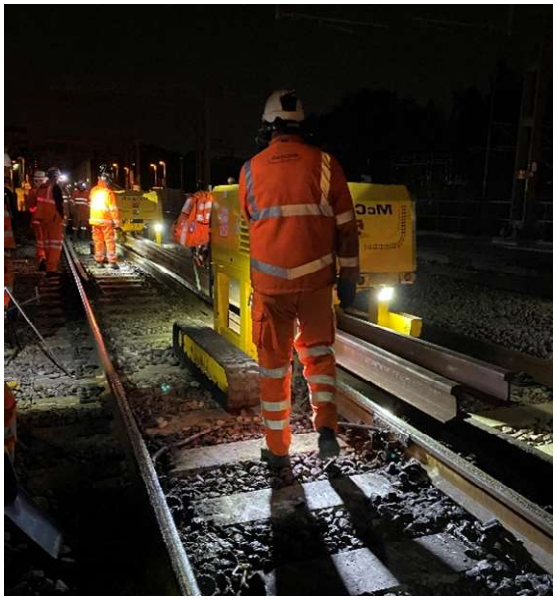


FIGURE 21 - 2042 FIXED NOSE CROSSING, ST PANCRAS

FIGURE 22 - 2242 SWING NOSE CROSSING, NASHENDEN

In addition to the volumes delivered and works completed on site, three projects have reached gate 5 and have confirmed outturn costs. Many of the CP3 renewals are annualised delivery campaigns and therefore will not reach gate 5 until the final year of CP3. Table 7 shows how the outturn cost for those projects reaching gate 5 in year 3 and compares this with the efficient price included within the PR19 determination.

Completed Projects Summary in year.	PR19 Budget (Base cost)	Final Cost	Explanation of difference
GSMR Handsets	£280k	£237k	Reduced volume of handsets required due to understanding of asset condition and understanding of upcoming technology changes.
Fire Suppression Gas Bottles	£230k	£235k	Original scope was 13 sites, variance due to additional fourteenth site identified which was change controlled into the scope from the approved risk pot.
Corsica Street Head House Monitoring	£150k	£115k	Monitoring work identified that no feasibility work was required.

TABLE 7 - GATE 5 PAPERS APPROVED IN YEAR 3 AND OUTTURN COSTS

HS1 has introduced a set of lead indicators for year 3 which it has used to assure renewals delivery performance in year 3. This process highlighted concerns around (i) the slippage of key track renewal procurements (Ballast) and (ii) industrial action for renewals delivery due to availability of safety critical resource and the replanning of aborted works, which would likely result in a significant variance compared to the year 3 plan. Based on the lead indicator dashboard at the end of CP3 year 3 the high-level portfolio status for route only is shown in the below table:

CP3 Route HL Status			
	Portfolio Status	No. of Projects	CP Value £m
CP3	Gate 1-2 (Development)	19	£ 11.8
	Gate 3 (Design/Procurement)	9	£ 33.3
	Gate 4 (Delivery)	22	£ 21.3
	Gate 5 (Complete)	7	£ 1.6

TABLE 8 - CP3 YEAR 3 HIGH-LEVEL PORTFOLIO STATUS FOR ROUTE

As a result of the insights provided by the lead indicators and the impact of industrial action, HS1 requested that NR(HS) undertake a review of CP3 and CP4 work bank ('work bank review' – as set out in section 535.2.3). This takes account of improved knowledge of asset condition and deterioration rates, including early analysis carried out for the PR24 planning process, which would enable works to be phased into future Control Periods. Section 5.2.2 outlines how the work bank review has addressed the issues identified from the Lead Indicators, the impact of this is reflected in the Lead Indicator dashboard for P1 2023/24 following the implementation of the work bank review and these are provided as an appendix.

5.2.3 CP3 Work Bank Review Process

- Due to the age of HS1's infrastructure the renewals work bank is strategic to maintain operational performance.
- There is a window of time for the majority of renewals when they can be delivered without impacting safety and performance, allowing movement of renewals across CPs to optimise asset management and deliverability.
- The main cost variance from work bank review is the deferral of Ballast Renewal to CP4, to enable a more effective delivery strategy. This decision is supported by asset condition data from recent surveys.
- Remaining changes can be grouped into three change drivers: Asset Management led, Deliverability/Emerging PR24 strategy led, Macro Factor led.
- Given the disruption over the first 3 years of the CP it is not possible to recover the volumes required in the final two years. All renewal works that need to be delivered will be over an extended period into CP4.
- Deferred projects have been through the deferred renewals process, there are 3 higher risk projects and NR(HS) have mitigation plans in place to manage this (as described below). All other deferrals present minimal risk and can be managed effectively through existing maintenance plans or with minor mitigations.

This section will outline:

- The reason for the work bank review and the process followed.
- The key outcomes of the process and changes to the work bank
- The assurance undertaken on asset management implications and renewals deliverability, and
- The impact on the CP3 route portfolio base costs and up lifts.

HS1 challenged NR(HS) to undertake a work bank review to provide an asset management justification for the continuation of each project and renewals deliverability to present a plan that they were confident was deliverable for the remaining years of CP3. In the draft AMAS HS1 outlined the process it intended to follow and an intention to include the output within the final AMAS. This was also communicated to ORR, DfT and TOCs at the Quarterly Asset Renewals Review Meeting in February '23. At the end of February HS1 provided an outline of the outputs, interaction points and deadlines leading into conclusion of the work bank review and the AMAS.

NR(HS) conducted an initial asset management led review of the CP3 route work bank and provided regular updates to HS1 Head of Asset Management on the likely asset management led changes. NR(HS) then undertook a renewals deliverability overlay of the asset management revised work bank factoring in resource and previous deliverability rates and external issues supply chain and plant availability.

To ensure that the deadline was met for concluding the work bank review process for the final AMAS, HS1 initiated a series of weekly sessions with NR(HS) to review progress and provide challenge. These were initially joint sessions to ensure alignment over the proposed changes, followed by focused Asset Management sessions to review and assure the deferred renewals log, and Renewals sessions to assure the deliverability of the revised portfolio and the appropriate governance of change.

HS1 challenged NR(HS) to provide further explanation of the reason for cost and volume changes to understand whether these had been driven by asset management data and decisions or by deliverability constraints. From this discussion four categories were identified:

1. Led by a change in asset management approach.
2. Deliverability optioneering & emerging PR24 strategies
3. Impacted by Macro Factors
4. Completed/No changes proposed.

HS1 requested and reviewed further detail in the form of a portfolio reconciliation sheet which provided data showing the movements over time of costs and volume from the periodic review determination to current position at the end of year 3. This has allowed HS1 Asset Management and Renewals teams to better understand the movement and rationales for change on a project basis. Following further review of the revised work bank, HS1 Renewals team grouped the portfolio into the buckets based on the governance to be applied to the projects and their drivers to better understand and assure the proposed changes to the portfolio from an efficient, economic, and timely perspective. These eight buckets are identified and explained with examples in 5.2.3.1

NR(HS) Head of Asset Management presented the Deferred Renewals Log to HS1 Head of Asset Management who has provided assurance that the deferrals and mitigations are appropriate. HS1 have engaged with the ORR on the emerging headlines of the work bank review as set out in the process and timeline. An overview of the process and outputs has been presented to ORR, DfT and TOCs at the May Quarterly Asset Renewals Review meeting. NR(HS) have submitted a formal change control paper which has been approved by HS1 and is supported by the deferred renewals log and CP3 portfolio reconciliation sheet.

5.2.3.1 Output from Work Bank Review Process

The PR19 determination route budget was £52.9m (base cost), through the work bank review process NR(HS) have proposed that CP3 spend (years 1-5) will now be £30.95m (reduction of £22m). The majority of this is driven by the deferral of the Ballast Refurbishment renewal project to CP4, this accounts for £15.3m of the reduction. Given the strategic nature of this renewal, there is minimal risk presented by the deferral. The ballast refurbishment is a strategic renewal, which provides a mid-life refurbishment to extend the life of the asset. Surveys completed under the project development to-date have identified that deferring the renewals would remain within the 'window' for this activity, with the remaining asset life at circa 50% based on the sample size. This intervention has a relatively wide-ranging window for the activity to be completed. Our emerging outputs from the increased track modelling capability developed for the PR24 planning process has identified that there is a similar volume requirement for this activity in CP4.

The driver for the deferral is to enable a more effective delivery strategy following procurement work in CP3. For the ballast refurbishment, there was a lack of market engagement through the formal tendering exercise in this control period, despite revising the access options to try and make the package more attractive. Additionally, due to other external factors within NRIL, there are now other delivery options available in CP4, utilising resources from NR(HS)' parent company. Therefore, it was decided that there is an opportunity to improve and de-risk the delivery strategy by combining the CP3 and CP4 volume requirements into one delivery package in CP4. This may also offer an efficiency in delivery.

Aside from the Ballast the remaining changes can be grouped into three main drivers as highlighted in the previous section:

1. Led by a change in asset management approach.
2. Deliverability optioneering & emerging PR24 strategies
3. Impacted by Macro Factors

The first two categories are positive changes representing good asset management in line with PR24 asset modelling, and appropriate governance to efficiently manage and smooth renewals delivery based on understanding of asset condition and performance. Within the impacted by external macro factors driver there are some schemes which will be deferred that are not optimal asset management options and will require mitigation.

Within each of the three change drivers, governance groupings have been identified to assist in managing the portfolio change and the treatment of individual projects. The table below outlines the different governance grouping and examples of the projects within.

Driver	Governance Grouping	
N/A	**Completed**	*Planned volumes/works delivered.* Cross Passage Doors: volumes delivered and works completed on site.
Led by a change in Asset Management approach	**Deliver reduced volume**	*Reduced number of volumes to be delivered in CP3, project to be closed and any future funding to be sought through the PR24 process.* Long Tunnel Drainage: The revised planned maintenance regime introduced during CP3 has resulted in the drainage system performing more effectively compared to CP2, with no operational performance delay attributed to the drainage in the CP. Scope can therefore be re-phased, with the volume required for delivery in CP3 prioritised to the section of tunnels which are in the worst condition due to their surrounding geology, locations where the drainage system is blocked.
	To be closed	*No volumes to be delivered in CP3 project to be closed and any future funding to be sought through the PR24 process.* Passive Drainage System: The feasibility study completed through the project development has shown that the asset is still in an acceptable condition and therefore the works are not currently required (not the optimum point of intervention). This will be re-assessed in CP4.
Deliverability optioneering & emerging PR24 Strategies	**Strategy Change/'Efficient Closure'**	*Project to continue either to a suitable and efficient hold point then closed or to deliver outputs which support a change in strategy.* Fibre Optic Aerial Earth Connection (FOAEC): Through work that has been done in CP3 it has been identified that the asset condition is good, with a minimal number of faults experienced to-date. There is also redundancy within the system if a fault were to occur. A more efficient approach has been identified to allow this asset to be maintained which has resulted in a change of scope where rather than full renewal in CP3 works will involve moving the position of splice joints to a more accessible location so that replacement works can be done in engineering hours when failure occurs.
	Replace on Failure	*Replace on failure (maintenance) - Items which fail safe - potentially to be removed to maintenance in CP4.* Building Management System (BMS) for air con at headhouse portals: have been stopped and will only be replaced on failure as the asset risk can be managed effectively through maintenance and spares. Failure is not likely to impact safety or performance.
Impacted by external macro factors	**Continue against exiting approval/plan**	*Proceed as planned/current governance – no change planned.* Local Area Network (LAN): this project has passed gate 4, the renewal is required as the system is obsolete and will mitigate the risk of operational impacts, the project will continue as planned and volumes which were planned for delivery in year 3 have been replanned for year 4.
	Prolonged delivery	*Volumes still need to be continuously delivered but over a longer period outside of CP3 window. Funding retained within CP3 budget.* Crossings Renewal: crossing renewals are required to maintain safe operational performance on the network, the plan for year 3 was to deliver 10no. crossing renewals however due to the impact of industrial action only 5 were delivered. The impact of this has been managed through the deferred renewals process however due to access constraints it is no longer possible to deliver the remaining CP3 volumes within years 1-5 therefore some of these crossings will be delivered in years 6&7 as the works are required.

TABLE 9 - CP3 WORK BANK REVIEW SUMMARY

There are three schemes within the prolonged delivery bucket where there is low confidence of delivery in this control period currently: CP3 UPS renewals, Fibre Optic Signalling renewal and a reduced volume of Crossing replacements. These deferrals present a higher performance risk.

NR(HS) will continually work to improve the delivery plan for the higher risk projects to bring the programme back in line with the asset requirement. All projects which have been deferred have been risk assessed and are recorded on the deferred renewals log. Aside from the 3 higher risk projects, all other deferrals present minimal risk and can be managed effectively through existing maintenance plans or with minor mitigations. For Crossing replacements, existing maintenance standards are sufficient to manage the risk from the reduced volume delivery and we will continue to prioritise each crossing in line with condition. The UPS' mitigation plan will be focused on prioritised and phasing of the renewal, with the potential opportunity to harvest spares. The Fibre Optic Signals are in good condition which provides some resilience. We have explored the potential to source critical spares and develop response plans should a failure occur over the last year. Our mitigation for the deferral will revaluate the options for this.

The impacts of the pandemic and industrial action have meant that it is no longer possible to fully deliver some projects within the 5-year boundary of CP3, however these projects will still need to begin delivery in CP3 and extend into the early years of CP4.

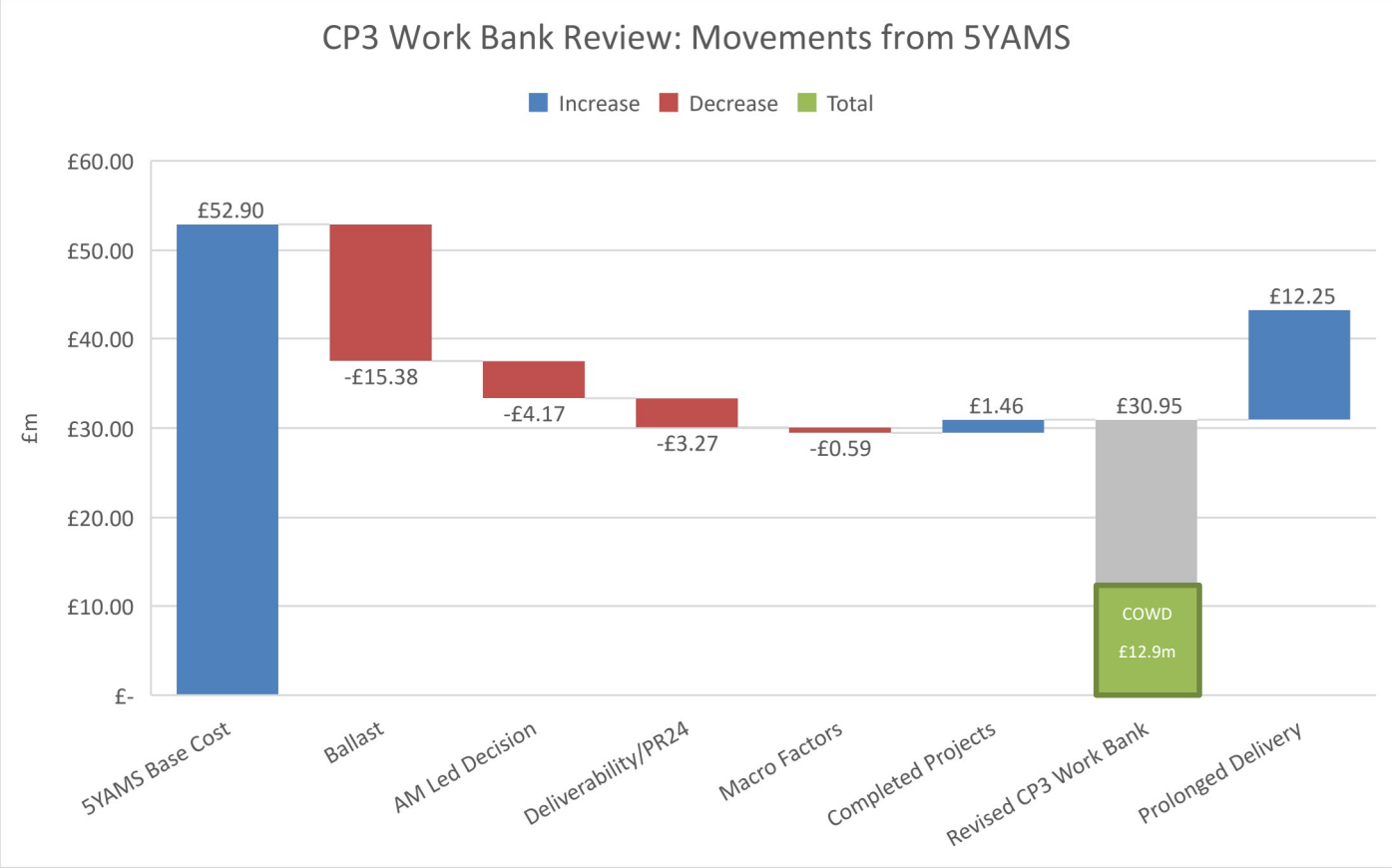


FIGURE 23 - CP3 WORK BANK REVIEW: MOVEMENTS FROM 5YAMS

5.2.3.2 Deliverability Review of CP3 Years 4 and 5 Delivery Plans.

HS1 have conducted a review of the revised portfolio using the RAG status report to understand confidence and deliverability of the remaining work bank in years 4 & 5. This considers key project dependencies: Management Resource, Delivery Resource, and Deliverability Dependencies (i.e., strategy, procurement, access, materials, plant etc.).

Following this review and assurance HS1 believes the revised work bank is deliverable. The chart below shows that of the £30.95m revised CP3 work bank (years 1-5), 70% is either completed or in delivery.

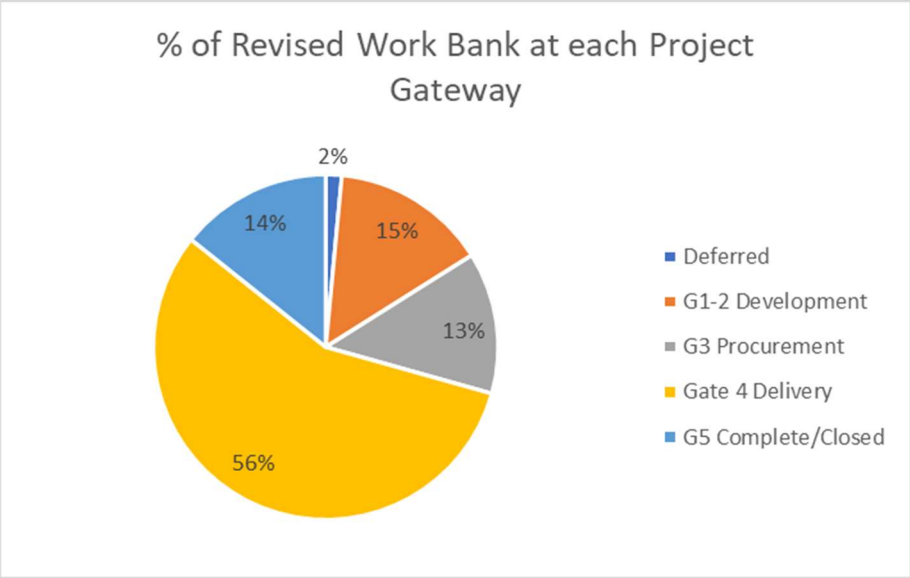


FIGURE 24 - PERCENTAGE OF REVISED WORK AT EACH PROJECT GATEWAY

Year 4's proposed spend is £5.36m which is in line with previous years (spend in year 3 was c£5m with industrial action disruption). The majority of year 4 work is already in delivery and therefore has funding in place (75%). There is a relative jump in planned CP3 spend in year 5 (£12.7) which is a 50% increase compared with CP2 & CP3 combined spend in year 4. This is due to the conclusion of the CP2 works in year 4 which will allow safety critical resource which is currently focused on the close out of the Data Transmission Network (DTN) renewal project to be deployed on CP3 schemes and the expected transition into delivery of two key projects UPS & Fibre Optic Signals which are currently in procurement and due to award mid-way through year 4. The planned spend for year 5 is on par with the spend rate achieved in year 5 of CP2 (c£1m a period).

The main risks to achieving the revised delivery work bank for the reminder of CP3 are:

- Unplanned activity, such as Industrial action and Covid, impacting planned delivery.
- Raw materials supply shortage to meet the delivery programme.
- Access availability (train operating companies (TOC) / freight operating companies (FOC) possession access) to deliver the renewal projects.
- Key delivery resource (in-house) and contractor availability to meet the future planned delivery programme.

5.2.3.3 Impact on the Route Portfolio

The current position at the end of year 3 and NR(HS)' proposed spend (base cost only) for the remainder of the CP3 work bank is shown below:

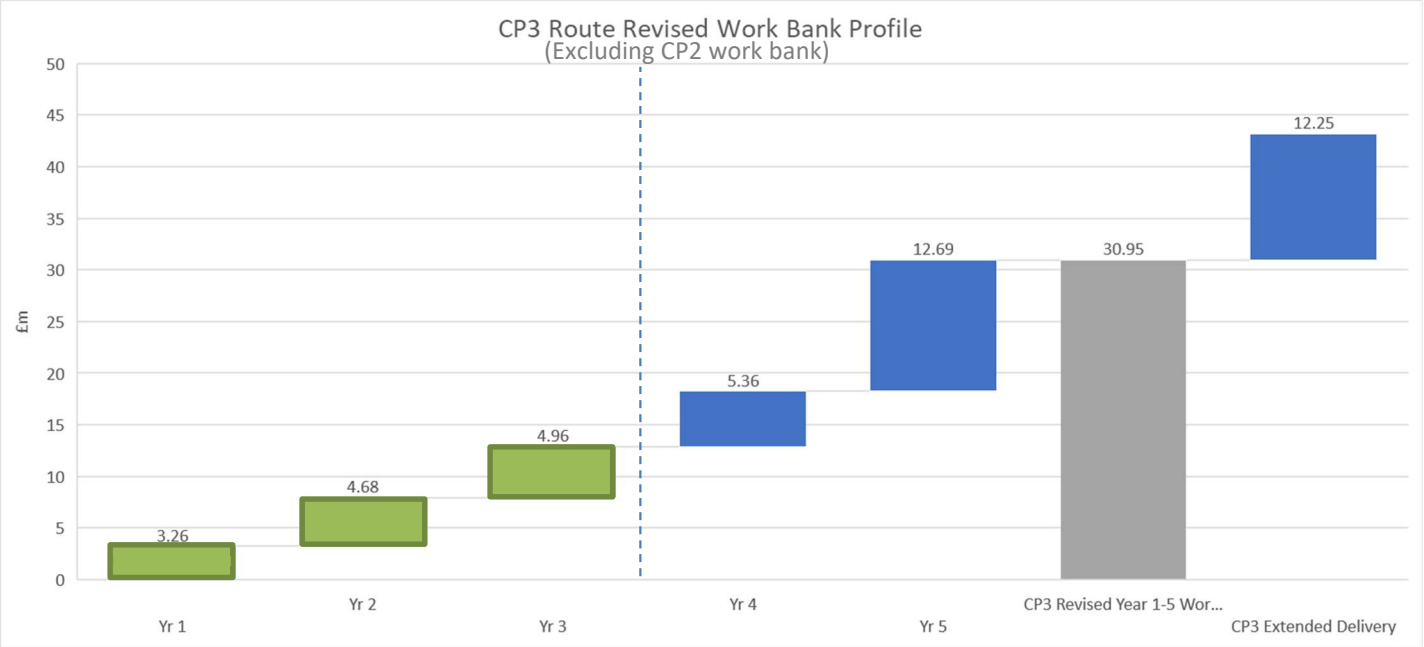


FIGURE 25 - CP3 ROUTE REVISED WORK BANK PROFILE

Following the work bank review the revised base cost target for NR(HS) in years 1-5 of CP3 is £30.95m.

There are several elements in addition to this which are included in the overall portfolio outturn forecast these include some known opportunities (potential acceleration of the CP3 extended delivery works, and CP4 development work) and risks (Replace on Failure schemes being realised). The revised CP3 base cost funding envelope is £48.74m this includes:

- £30.95m of NR(HS)' revised CP3 (years 1-5) outturn cost,
- £12.25m of prolonged delivery spend into CP4.
- £1.6m of opportunity works (New projects, CP4 Development, PMO & CP4+ Capability Development Cost, Process & Technology)
- £0.84m of replace on failure works
- £3.1m additional funding for the CP2 DTN Project

DTN is a CP2 project, whose delivery has been impacted by a number of factors, introduction of additional scope for the Off Trace Route, method of work changes due to safety and asset condition and interruption due to COVID-19. A change request to increase the project authority to complete these critical renewal works has been endorsed by the ORR, the DfT are currently being consulted and have requested clarity on where the additional funds required will be funded from. The additional £3.1m will be funded from the CP3 budget.

When applying the portfolio overlay percentages agreed at the periodic review to this revised funding envelope the new target overlay figures are:

PR Determination Element	Forecast Outturn Figure
Base cost	£48.74m
Mark-up	£4.87m
Risk	£6.76m
PMO	£7.13m*
Efficiency	-£1.17m

TABLE 10 – TARGET OVERLAY FIGURES

There are still projects within development stages and estimating uncertainty particularly associated with the UPS and Fibre Optic Signal renewals. HS1 will reduce the CP3 base cost forecast (financial authority) from £69m to the PR19 determination level of

£52.9m to manage the remaining portfolio. HS1 will provide updates at quarterly intervals where a draw down from this head room is made and the implications on the base cost uplifts.

*The forecast outturn figure for PMO is £7.13m which is 15% of the base cost. This is greater than the 8-12% PMO range identified in the determination and the 10% target. This is due to the PMO costs incurred in years 1 and 2 which were associated with the development of a work bank value of £69m, The disruption caused by macro-economic factors early in the control period, which prompted the work bank review, has prolonged the delivery of CP3 renewals and increased the PMO costs due to replanning and repeat procurement works. Despite the higher costs much of this work is not abortive, as an example a large amount of the Ballast refurbishment work will be used in CP4. The cost target for the remaining two years will be 10% of the base cost (CP2 & CP3).

5.2.4 CP3 Year 4 Route Renewal Delivery

The planned number of volumes to be delivered in Year 4 is 140. To provide greater transparency the key delivery milestones being tracked for year 4 are shown below:

Project Name	Volume Associated	Period Completed	Milestone Description
Switch Blades Yr1-5	1	P2	2018 St Pancras - Delivery into use - Period 02 - 1 x Volume
DTN	1	P6	Delivery into use - Period 06 - 1 x Volume
Crossings Renewals	1	P3	2282 Lenham - Delivery into use - Period 03 - 1 x Volume
Bridge Expansion Joints (8 Structure)	1	P3	Structure 473 Stratford West - Delivery into use - Period 03 - 1 x Volume
LAN	2	P3	Site A& B - Delivery into use - Period 03 - 2 x Volume
Crossings Renewals	1	P4	2044 St Pancras - Delivery into use - Period 04 - 1 x Volume
Switch Blades Yr1-5	1	P4	2040 St Pancras - Delivery into use - Period 04 - 1 x Volume
Crossings Renewals	1	P6	2046 St Pancras - Delivery into use - Period 06 - 1 x Volume
Switch Blades Yr1-5	1	P6	2005 St Pancras - Delivery into use - Period 06 - 1 x Volume
EZP & ERS	20	P6	Delivery into use - Period 06 - 20 x Volume
Crossings Renewals	1	P7	2110 Ebbsfleet - Delivery into use - Period 07 - 1 x Volume
ITCS Test Benches	4	P7	1st – 4th Signal Rooms - Delivery into use - Period 07 - 4 x Volume
LRC	8	P7	Delivery into use - Period 07 - 8 x Volume
Mod Box's	3	P7	Trial Locations - Delivery into use - Period 07 - 3 x Volume
HPSS St Pancras Upgrades	7	P8	Delivery into use - Period 08 - 7 x Volume
Mod Box's	2	P8	Delivery into use - Period 08 - 2 x Volume
Re-Railing at St Panc 3k	0.7	P10	700m St Pancras re-rail - Delivery into use - Period 10 - 0.7 x Volume
Switch Blades Yr1-5	1	P12	2042 St Pancras - Delivery into use - Period 12 - 1 x Volume
Static Switches and Local Rectifiers	26	P13	Delivery into use - Period 13 - 26 x Volume
LRC	12	P13	Delivery into use - Period 13 - 12 x Volume
MCEM91	4	P13	Delivery into use - Period 13 - 4 x Volume
Marker Boards	4.2	P13	Delivery into use - Period 13 - 4.2 x Volume
EZP & ERS	20	P13	Delivery into use - Period 13 - 20 x Volume
IBJ's Yr1-5	9	P13	Delivery into use - Period 13 - 9 x Volume

TABLE 11 – KEY DELIVERY MILESTONES FOR CP4

The high-level portfolio status for the control period is:

CP3 Route HL Status			
	Portfolio Status	No. of Projects	CP Value £m
CP3	Deferred	14	£ 0.5
	Gate 1-2 (Development)	10	£ 4.5
	Gate 3 (Design/Procurement)	6	£ 4.1
	Gate 4 (Delivery)	18	£ 17.4
	Gate 5 (Complete)	7	£ 4.4

TABLE 12 - CP3 ROUTE HL STATUS

5.3 Stations Project Planning & Delivery

- 88% of planned volumes have been delivered in Year 3.
- Success delivering 11 Lift Escalator & Travellator asset renewals: 3no. lifts at St Pancras, 4no. Escalators, 2no. Travellators at St Pancras, 1no. escalator at Stratford and 1no. escalator at Ebbsfleet.
- 3 UPS volumes (12% of plan) not delivered are now on site and will be recovered in Year 4.

In previous AMAS' HS1 has included a summary of Stations renewals progress taken from the Annual Stations Renewals summary papers produced for the DfT. As part of the transfer of Stations regulation from DfT to the ORR, HS1 agreed to formal requirements to report on Station renewals and costs in an AMAS. Information that would have been included in the Annual Station Renewals Summary paper will instead be provided within the AMAS.

This section describes the work that has been undertaken in 2022/23 and the work being planned for 2023/24. This section also describes any changes which have occurred over this period, a summary of efficiencies from projects that have reached Gate 5 and a view of the forecast portfolio outturn.

5.3.1 Summary of station renewals performance Year 3

Planned volume delivery on CP3 station renewal in year 3 was 26 volumes vs an actual of 23 (88%) and planned spend was £2.87m vs an actual spend of £2.11m (74%).

Key highlights include:

Station Communication System Renewal (SCSR). All the systems renewed by the programme are now handed back into operational service. The project is in the close out stage with the acceptance of final O&M's, H&S documentation and all snags closed out during Q3 2022. The eleven sub-systems were delivered in line with the programmes critical success factors. Two of which were maintaining operability of systems through renewal migration and openly managing the differing stakeholder requirements and expectations.

St Pancras UPS replacement. The project has been successfully remobilised following the initial delivery contractor going into administration. This will now deliver in year 4.

Lift Escalator & Travellator renewals. Delivery of 11 assets: 3no. lifts at St Pancras, 4no. Escalators, 2no. Travellators at St Pancras, 1no. escalator at Stratford and 1no. escalator at Ebbsfleet.

Space Heating Renewal. Procurement of Delivery partner to progress the detailed design and delivery procurement of the St Pancras, Stratford, and Ebbsfleet boiler and chiller replacement. This project aims to remove gas fired boilers, a large contributor to the stations CO_2 footprint, with electric heat pump system.

Customer Information System. Delivery of the St Pancras main CIS board renewal has begun, and funding secured to deliver a renewal obsoleted CIS assets across St Pancras, Stratford, and Ebbsfleet in a coordinated manner delivering improved customer information and wayfinding solution that will accommodate future expansion of the system to meet customer and station operation needs.

Following the value gained for the route lead indicator dashboard a similar approach was employed for stations. The stations Lead Indicator dashboard for P1 2023/24 is provided as an appendix. The main issue highlighted via the Lead Indicators has been the Lift Escalator and Travellator renewal across St Pancras, Stratford, and Ebbsfleet Stations. The delivery contractor has performed poorly with slippage in the hand back milestones for the asset's year 3. These assets have now been recovered however HS1 requested a fully integrated plan from NR(HS) on how they will implement the lessons learned to improve performance of the contractor, and how they will provide additional assurance on delivery to restore confidence, focusing on Stakeholder engagement. HS1 have put a Programme Manager in place to support and assure this process. This has resulted in an improvement in delivery performance and assurance. Once this plan has been fully implemented a re-baseline of the programme and phasing may be required with the train operators, through change control.

Other key variances:

- LV Distribution Boards delays due to negotiation of T&Cs with preferred bidder, this is still on-going and being tracked procurement progress tracked periodically at the HS1-NR(HS) renewals board.
- Fire Panel Replacement, NR(HS) conducted additional assurance on the tender submissions to ensure delivery proposals were robust and made suitable assumptions on risk. This is now in delivery.
- St Pancras renewal of platform expansion joints: following initial survey outcome strategy being reviewed as it may be possible to move specification and procuring delivery works rather than further optioneering. Delays due to resource availability.
- Common Data Environment works have been delayed due to issues putting in place a non-disclosure agreement with the supplier to enable them to work on ProjectWise.
- There has been delay on the St Pancras UPS renewal due to the time taken to source and get into contract with supplier following the initial delivery supplier going into administration. The supplier is now onboard and works progressing on site for completion in 23/24.

5.3.1.1 Summary of Changes in Year 3

Two change requests have been submitted by HS1 to DfT in year 3 to increase the level of project authority:

- HS1 submitted a change request to increase the project authority for the CP2 St Pancras UPS renewal following NR(HS) retendering the works after the delivery contractor had gone into administration. The additional costs related to increased material costs and prelim costs due to inflation, design activities not included by the original supplier as well as NR(HS) additional costs for sunk costs on procurement exercise and survey facilitation. This change was approved, and on-site delivery is due to complete within 23/24.
- HS1 submitted a change request to the DfT to accelerate funds from CP4 to deliver the renewal of CIS assets in CP3. These funds supplement the CP2 funds to replace the main CIS board at St Pancras with additional funds to renew platform totems and gate line summary of departures screens at St Pancras, and platform totems at Stratford and Ebbsfleet which are currently unreliable and at end of life. This request was approved and the detailed design of the St Pancras main board and specification for platform totems are being developed for delivery in 2023.

As highlighted in previous quarterly meetings HS1 have reviewed the Ashford renewals portfolio in light of renewal works being on hold due to EIL not currently running services from the station. HS1 have deferred the majority of CP3 renewals works having been through a structured review with HS1 Head of Asset Management and HS1 Head of Stations Engineering & Operations. The Ashford portfolio budget at the periodic review was £2.7m, following the change control the revised work bank for Ashford is

£0.37m. The renewals that have been deferred will not impact the safety and operation of the station and have been made to ensure that renewals work carried out in CP3 are not abortive due to the uncertainty of when services will return to Ashford and how the station operation may change when this happens.

5.3.2 Station Renewal Works planned Year 4

The planned spend in year 4 is £4.85m, of this planned spend £3.47m (70%) already has pre-approval. The key delivery milestones being tracked for year 4 are shown below:

Project Name	Volume Associated	Period Completed	Milestone Description
Lift and Escalators	1	P1	St Pancras T3.4.2 - Delivery into use - Period 01 - 1 x Volume
St Pancras UPS Replacement	3	P4	St Pancras UPS Replacement - Delivery into use - Period 04 - 3 x Volume
Lift and Escalators	1	P4	St Pancras L7.1 - Delivery into use - Period 04 - 1 x Volume
Lift and Escalators	1	P4	Ebbsfleet E1 - Delivery into use - Period 04 - 1 x Volume
Fire Panel Replacement (Stra/ Ebbs)	4	P4	Delivery into use - Period 04 - 4 x Volume
Lift and Escalators	1	P5	St Pancras 2.1.1 - Delivery into use - Period 05 - 1 x Volume
Lift and Escalators	1	P6	Stratford E2 - Delivery into use - Period 06 - 1 x Volume
Lift and Escalators (all stations) Delivery	1	P7	St Pancras L3.1 - Delivery into use - Period 07 - 1 x Volume
Renewal of Platform LV Distribution Boards	10	P12	Delivery into use - Period 12 - 10 x Volume

TABLE 13 - KEY DELIVERY MILESTONES FOR YEAR 4

Summary of year 4 works will include:

- Lift/Escalator/Travelator (LET) Renewals: six assets are planned to be refurbished in 2023/24 (4 at St Pancras, 1 at Stratford, and 1 at Ebbsfleet). This is subject to confirmation via an integrated programme from NR(HS) to justify and re-baseline the renewals access windows. In addition to this will be the design and installation of a temporary lift to mitigate the loss of SETL only lift (from platform to concourse level) life during its refurbishment which will begin in year 4 and continue into year 5.
- St Pancras UPS Renewal: completion of onsite renewals works to renew 3no UPS units, and gate 5 submission in year 4.
- St Pancras Expansion Joints: agreement of renewals specification and approach following surveys, procurement and delivery of renewal works.
- Space Heating Renewal: Development of a detailed design of heat pump system to replace gas fired boilers and roof mounted chillers at St Pancras, Stratford and Ebbsfleet, procurement of delivery contractor with delivery across years 4 and 5.
- Fire Panel renewals (Stratford & Ebbsfleet): delivery works to replace 2 no. fire alarm panels at both Stratford and Ebbsfleet.
- LV Distribution Boards (St Pancras & Ebbsfleet): approval of gate 4 paper and appointment of supplier to deliver the works to replace LV distribution boards located on St Pancras platforms and LV Distribution Board cabinets on Ebbsfleet platforms.
- Close out of gate 5 papers for the following schemes: BMS and UPS at Stratford and Ebbsfleet which have completed delivery works on site.
- Common Data Environment: reconfiguration of the ProjectWise data source, development of process for maintaining operational record, testing, and finalising ProjectWise data source configuration.

The main risk to delivery is currently performance of the LET renewal and NR(HS)' implementation of the improvement plan to provide credible integrated plans to successfully manage the remaining asset delivery. As highlighted in the draft AMAS this is being overseen by dedicated resource from HS1 accelerate the recovery of this key customer/passenger facing project and ensure NR(HS) provide sufficient ownership and assurance of the remaining works.

There are two key projects which will soon be in procurement phases: Space Heating, CIS Renewal (phases 2-5). Where we have seen uncertainty around NR(HS) procurement activity HS1 has taken the development lead on both these renewal projects to mitigate the impacts of resource issues associated with industrial action. HS1 has developed a procurement strategy for the CIS renewals based on the systems and location of the systems in each phase to maximise efficiency. HS1 has appointed dedicated resource to manage the detailed design, procurement strategy for all three stations and procurement of the Space Heating delivery works at St Pancras.

5.3.3 Station Renewals Portfolio Performance

The current high-level aggregated position of the CP3 stations portfolio is shown in the table below.

CP3 Route HL Status			
	Portfolio Status	No. of Projects	CP Value £m
CP3	Not Started	6	£2.21
	Gate 1-2 (Development)	17	£5.04
	Gate 3 (Design/Procurement)	2	£0.69
	Gate 4 (Delivery)	12	£8.94
	Gate 5 (Complete)	2	£0.19

TABLE 14 - CP3 STATION RENEWALS HIGH LEVEL STATUS

Within CP3 the Lift Escalator & Travellator project is in delivery and represents 40% of portfolio, contractor performance has been a concern, but we are still confident of delivery within CP3. Space Heating accounts for £3.8m of gate 1&2 value, HS1 are leading development to ensure meets the project aligns with its sustainability strategy and have appointed a supplier to develop the detailed designs for each station. HS1 is currently seeking justification and evidence from NR(HS) to support PMO costs which have not yet been approved. This amounts to £1.4m and is shown in the table above shown as not started.

5.4 Project Efficiency Reporting

The CP3 project costs agreed in the PR19 final determination were deemed by HS1 and the ORR (and DfT which, at the time approved the project costs for stations) to be the efficient cost of delivery. Delivering the agreed scope of work for the CP3 determination price would indicate that the work had been done efficiently. To track this, we agreed that for each project we would review the final cost of the project once it was completed, against the original CP3 determination cost and record the reasons for any differences. This is captured in the variance summary spreadsheets issued as an appendix with the Final AMAS.

Many of the projects which are currently in the delivery stage are renewal campaigns over multiple years of the control period. All completed projects submit a Gate 5 project close-out paper that details how well the project has gone and explains the differences between the costs at project inception and project close-out. These are shared with the ORR, DfT and TOCs.

5.5 Delivery Capability

Both HS1 and NR(HS) are continuing to build our joint capability within CP3, with focus in the following areas:

Resource – recruitment into key roles and a holistic review of contract resource support for the renewals team. All key roles are expected to be filled before the end of the financial year. As part of the post implementation review of the new NR(HS) operating model, we will also evaluate that the current team has the required skills, experience, and competence.

NR(HS) have continued to utilise Project Delivery Consultancy support this year to provide delivery assurance and resource. As they continue to embed the new Operating Model and recruit internal resource, the requirements for Consultancy support are continually under review.

Process – Continuing to strengthen NR(HS)' PMO processes and capability, to ensure that they meet both their internal and HS1's needs, with NR(HS)'s process outputs providing the required input to HS1. This will also cover project reporting as it is essential that NR(HS) and HS1 collaboratively work to make this more effective and efficient.

Whilst significant disruption persists from industrial action and other macro factors, HS1 will look where necessary at other ways to support capability including utilising its supply chain to access scalable PMO resource to provide capacity to conduct necessary assurance of the work bank and delivery and implementing work flow systems to better manage the submission, review and approval of renewals gate paperwork and change requests.

5.6 Long Term Renewals Planning

5.6.1 Route Renewals CP4+ Capability Work

As part of the PR19 ORR Final Determination it was recognised that to deliver future asset renewal efficiencies within the HS1 concession period covering the 40-year renewals volume, there would be a need to develop NR(HS)' capabilities from current CP3 volumes to those of future control periods. This section provides an update on the progress since the 2021/22 AMAS.

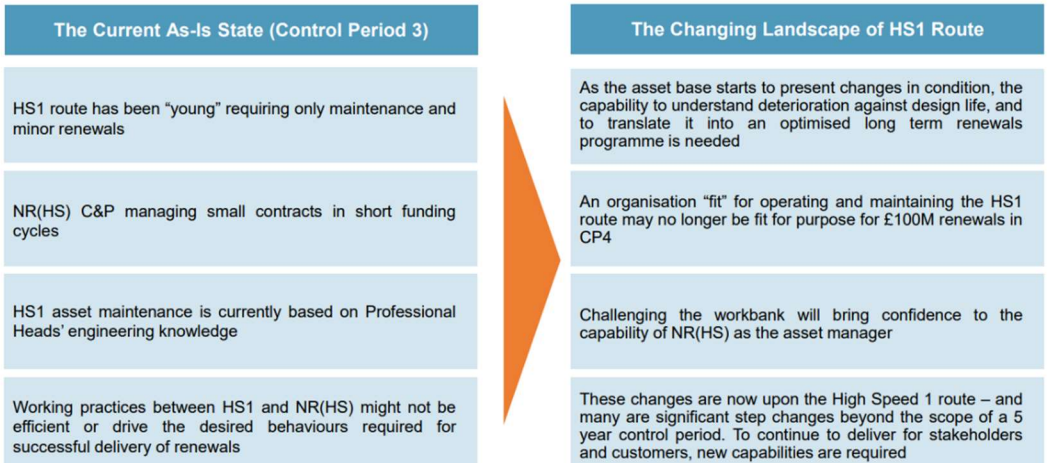


FIGURE 26 - AS IS – TO BE STATES

Delivery Integrator Phase 1 completed in 2021/22 and was presented to the ORR in July 2021, which set out the high-level business case, blueprint and potential efficiency that could be generated by introducing a Delivery Integrator. Phase 2 of this work commenced in April 2022, following competitive procurement of PA Consulting as our development partner. PA Consulting are delivering the work under four specific tranches (in accordance with NR(HS) PR24 submission timescales) to support future procurement of a delivery/capability partner as part of a new NR(HS) / HS1. Collaboration Model in readiness for the start of CP4.

The work is being delivered under the following four tranches:

Tranche 1 – focuses on savings or improvements that can be delivered in CP3; as well as enabling the NR(HS) Commercial & Procurement function to effectively oversee high volumes of complex renewals and O&M, creating the ability to successfully procure and manage a growing volume of heavy asset renewals works, never required before, and manage an engaged supply chain and oversee an organisation level contract.

Tranche 2 – focuses on creating an efficient 40-year renewal plan; developing asset management capability for the future to intelligently drive asset decisions and creating the ability to drive informed decisions on how to best manage and renew the High-Speed assets safely and efficiently for the next 40 years, using data and best practice to deliver optimum safety, commercial service, and performance.

Tranche 3 – focuses on creating the new delivery collaboration model; it is designing one way of working through the creation of a new NR(HS) / HS1. collaboration model which provides organisational delivery effectively and efficiently through streamlined processes and governance, with alignment of ownership and roles and responsibilities for each step of the end-to-end asset management process.

Tranche 4 – will procure the capability as designed and created above through tranches 2 and 3 and embed the new interim state ready for CP4, creating detailed implementation plans to support the future target state.

Outputs following conclusion of tranche 2 volume modelling demonstrate that a delivery integrator is unlikely to be required until later into the HS1 asset lifecycle, therefore NR(HS) are contemplating implementation of both an interim state (capability partner approach) from the commencement of CP4, and target state (delivery integrator approach) likely from CP5+ aligned to the asset and capability requirements in future control periods.

The following progress has been made in each of the tranches:

Tranche 1 – to deliver works more effectively and efficiently, commercial processes have been either been enhanced or designed to specifically suit the HS1 system and aligned to the works commencing under tranche 3 to improve ways of working within CP3 and start to enhance capability to support system requirements of both an interim and target state, including upskilling and mentoring teams in preparation for future contracting methodologies such as use of NEC.

Tranche 2 – a load based, deterioration model has been developed specifically for the HS1 track asset based on the data and intelligence that NR(HS) hold. The model has now been validated and signed off, with HS1 planning to carry out independent assurance of the input and output data and assumptions. The model has the capabilities to provide intervention forecasts for the four future demand scenarios specified within the HS1 SAMP. Through the development of the model input parameters and condition surveys undertaken in CP3, we have been able to demonstrate that the track asset life exceeds the forecasts used during PR19. Execution options and unit costs for each of the options have also been developed to a significantly greater level of granularity for the required volumes of track renewals, to improve the confidence in our forecast. For other assets classes, an obsolescence prioritisation tool has been created to improve the maturity of thinking for asset renewals predominantly driven by obsolescence. Additionally, a draft estimate for the emerging CP4 renewals work bank has now developed and other asset management capability tools such as a cost and volume work bank plan have been created.

Tranche 3 – has developed the high-level principles of the NR(HS) / HS1 collaboration model design which defines the vision, strategic objectives, capabilities, KPI's, roles, responsibilities, governance, risk, incentivisation and process management for an interim and target state enterprise between both NR(HS) and HS1. The NR(HS)/ HS1. collaboration model implementation plan aims to embed any quick wins already identified, such as risk and governance frameworks and processes from year 4 of CP3 to improve efficiency and delivery of the CP3 renewals portfolio and enhance capability in readiness for CP4. This essentially aims to apportion management of cost and risk with those best placed to manage it to enable improved product delivery outcomes and maximise efficiency. Figure 27sets out the roadmap of what tranche 3 has achieved by the end of 2022/23.

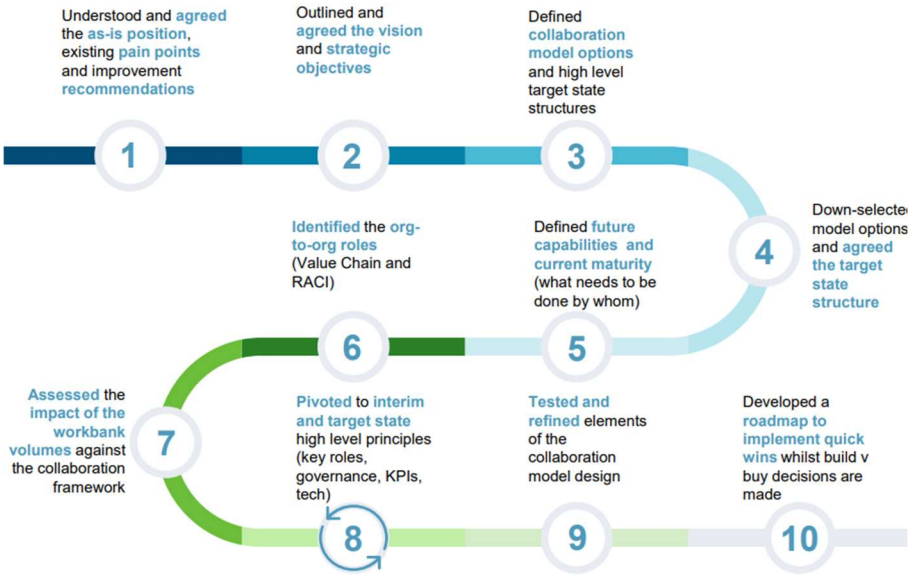


FIGURE 27 - TRANCHE 3 ROADMAP

Tranche 4 - will commence jointly between NR(HS) and HS1. in 2023/24 to ensure capability readiness for renewals delivery in CP4 and beyond. Utilising the outputs of all three preceding tranches, tranche 4 will deliver and embed improvements in capability and efficiencies in the cost and volume of renewals works on HS1 over the next 40 years.

A Capability Development Programme has been created which covers the following twelve areas, aligned to four tranches. The programme looks to drive capability improvements utilising best practice from 'Project 13' principles.

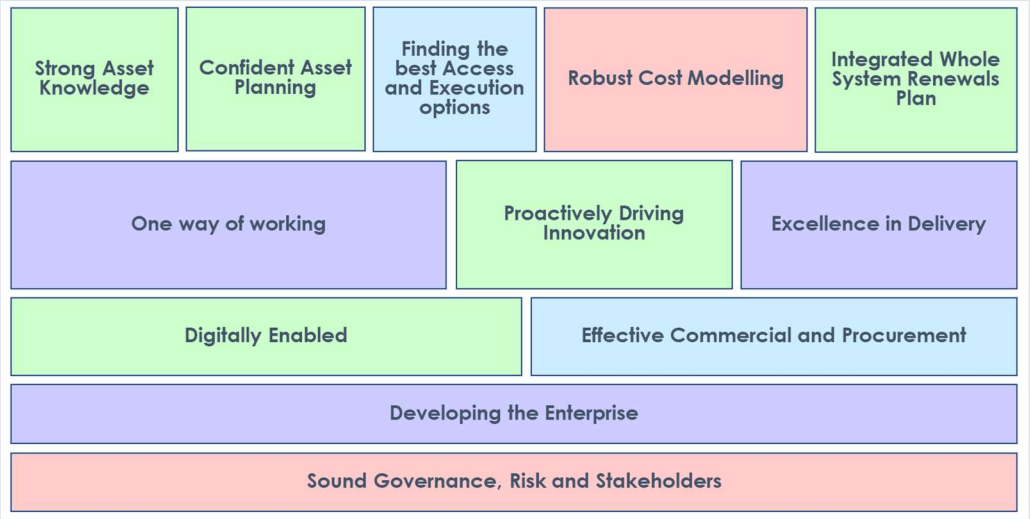


FIGURE 28 CAPABILITY DEVELOPMENT PROGRAMME

To deliver the CP3 work bank more effectively and efficiently, commercial processes have been enhanced and aligned to improve ways of working, including upskilling teams in preparation for future contracting methodologies such as use of NEC.

A load based, deterioration model has been developed specifically for the HS1 asset based on the data and intelligence that NR(HS) hold. Execution options and unit costs for each of the options have also been developed to a significantly greater level of granularity for the required volumes of track renewals, to improve the confidence in our forecast. For other assets classes, an obsolescence prioritisation tool has been created to improve the maturity of thinking for asset renewals predominantly driven by obsolescence.

The high-level principles of the HS1/NR(HS) collaboration model design have been designed. This defines the vision, strategic objectives, capabilities, KPI's, roles, responsibilities, governance, risk, incentivisation and process management for an interim and target state enterprise.

The collaboration model implementation plan aims to embed any immediate changes that can be made in CP3. Those already identified, such as risk and governance frameworks, aim to apportion the management of cost and risk with those best placed to manage it.

Early insights from the tranches, are forecasting that a delivery integrator is unlikely to be required until later into the HS1 asset lifecycle. The programme is therefore assessing the need of an interim state (capability partner), and target state (delivery integrator) likely within CP5, which aligns to the asset and capability requirements in future control periods.

5.7 UKPNS Asset Renewals

UKPNS operates, maintains, and renews the electrical substations and high voltage electricity distribution network on HS1. Significant renewal and replacement projects underway in 2022/23 are:

Supervisory Control and Data Acquisition (SCADA): The SCADA system renewal project will utilise existing fibre routes and add new connectivity to complete a single fibre ring for the railway on which the SCADA traction system will operate. A key issue with the system renewal is future obsolescence and whole life optimisation. The solution chosen was a single design, install and support contract with a build 'refresh and update' of key elements of the assets to enable the system to be optimised at the term of the contract. The innovative project will utilise the latest remote condition monitoring techniques to enable assets such as transformers and circuit breakers to be monitored allowing improvements to the asset knowledge base, using the Hitachi Asset Performance Management (APM) solution for data analytics. The project is currently at the stage of site fitment with most of the sites fitted and commissioned on the Section 1 part of HS1. At Singlewell IMD UKPNS Control room, the main workstation is fully operational and can interface with the commissioned sites.

The focus for 2023 will be to install and commission the remaining sites on Section 2 of the HS1 railway. The project is expected to be complete by the end of December 2023.

Static VAR Compensators (SVCs) and load balancer control systems renewal and upgrade: As part of obsolesce management, UKPNS has initiated a project to replace the current control computers which are approaching the end of their product design life and manufacturer support. The project renews the control computers on the SVCs and the load balancer from the Mach 2.0 system to the latest Mach 3.0 system as well as other components of the SVC such as the ancillaries, cooling control cubicles and protection relays. UKPNS has signed a contract with the supplier, Hitachi to deliver these works. This project will increase operational resilience and is the largest single project since the initial build of the power system. Progress to date has seen the successful installation, commissioning, and entry into service of the equipment on Singlewell SVC 3 +4, Singlewell SVC 1+2 and Choats Road SVC 1 +2. The remaining site at Sellindge Load Balancer will follow in quarter 4 2023 and the project will complete at the end of 2023.

Relay renewals: The relay replacement programme is underway across HS1. Relays have already been successfully replaced at St Pancras AT1, AT2 and Stratford. On Section 1, the programme has been worked up to replace the existing distance protection and automation relays with the new P44T relays that supply the traction feeds at Sellindge and Singlewell. The fitment of 16 new relays has commenced, with the first relays being fitted at Sellindge. The remaining relays at Sellindge and Singlewell, will follow later into 2023.

On Section 2, the fitment programme for new relays at Choats Road is scheduled also for 2023. This is a significant investment, and the traction relays will also interface with the new SCADA system for monitoring purposes.

HS1 Locks: the UKPNS team have completed a project to renew the existing key operated pad locks, with a lock access control solution based on electronic keys combined with electronic cylinders and padlocks. This innovation using electronic locks constitutes a superior replacement for conventional mechanical locks, as well as providing greater security due to configurable access rights that can be allocated specifically to an electronic key. The system is fully operational.

ACB (Air Circuit Breaker) Retrofits: At three sites, UKPN Services renewed the existing ACBs with the latest version. This asset renewal program has been initiated to deal with the manufacturer's obsolescence of the existing ACB units, as the existing units cannot be purchased anymore. By retrofitting certain sites with the latest version of the ACB, this has ensured that UKPN Services has an adequate number of spares should there be an issue with one of the existing units.

Regenerative Braking: HS1 entered into a contract with UKPN Services in 2022 for UKPN Services to deliver the assurance activities and for UKPN Services to oversee the project management of the whole project. Following the successful conclusion of an 18-month multi-agency project, regenerative braking has been rolled out across the whole Class 395 SET fleet. The introduction of regenerative braking on HS1's assets has significantly reduced power consumption, reducing the environmental impact and supporting the HS1 sustainability strategy. This initiative has been hugely successful and is currently producing energy savings which surpass those predicted by the pre-implementation modelling. The benefits of regenerative braking include a 10% annual energy reduction for the SET fleet (5.5GWh per annum), equating to a circa £2.6m saving in energy costs.

Bushing Monitoring System: During the upgrade works on Sellindge SGT, (Super Grid Transformer) the bushings within this transformer have now been fitted with innovative monitoring equipment that provides data on the health and status of each

bushing. The data can be accessed in real-time and by monitoring various parameters will give an early warning in relation to the bushings health and ensure increased asset monitoring. This is a world first and the intention is to fit bushing monitoring equipment on the Super grid Transformer at Barking during the early part of 2023.

6 Upgrades

6.1 European Rail Traffic Management System (ERTMS)

HS1 has consulted with stakeholders on the specified upgrade funding required for early works to develop a single option as a specified upgrade to implement a replacement signalling system. HS1 is now developing a procurement strategy for this phase of work which aims to provide clarity on the most efficient and timely route to renewing the signalling system on the Route whilst taking into account whole system considerations including rolling stock and neighbouring infrastructure. The ORR reconfirmed its position that signalling replacement project should be treated as a Specified Upgrade in its Final Approach for PR24. HS1 will bring forward the Specified Upgrade proposal for the early works for approval by the ORR while we continue to discuss the treatment and funding of the full ERTMS implementation with the HS1 system, including DfT and ORR.

7 Financial Reporting

7.1 Train Numbers

As a result of the COVID-19 pandemic, the number of train services operated in the first three years of CP3 has been significantly below the CP3 forecast in PR19. For the timetable period commencing in December 2020, Eurostar did not bid a First Working Timetable (FWT) and instead entered into a traffic volume commitment of 2,444 train paths for the timetable year. This triggered a volume reopener (see Section 7.2.17.2). The volume commitment ended at the end of Period 9 2021/22 and Eurostar issued FWTs for the timetable year commencing December 2021. We have committed to perform volume reopeners at the Principal Change Date for the balance of CP3. We are now measuring train paths against the assumptions used for the volume reopeners, rather than the CP3 forecast.

A comparison of train paths billed against volume reopener assumptions is shown in Table 15. Eurostar's total volumes in 2022/23 (FWT and spot bids) will be higher than the volume reopener assumptions, while SE Trains' total volumes remain below the domestic underpin but broadly in line with the volume reopener rates.

ANALYSIS OF TRAIN PATHS BILLED vs VOLUME REOPENER							
	As at P13, Financial Year 2022/23						
	YTD	VR YTD	Var	Var %	PR19 YTD	Var	Var %
EIL	7,533	13,735	-6,202	-45%	17,700	-10,167	-57%
SET + Underpin [3]	52,824	52,824	0	0%	55,400	-2,576	-5%
Freight	393	280	113	40%	454	-61	-13%
Total FWT Trains	**60,750**	**66,839**	**-6,089**	**-9%**	**73,554**	**-12,804**	**-17%**
EIL Spot bids [4]	7,037	0	7,037		0	7,037	
SET Spot bids	544	0	544		0	544	
Total Spot bids	**7,581**	**0**	**7,581**		**0**	**7,581**	
Total Trains	**68,331**	**66,839**	**1,492**	**2%**	**73,554**	**-5,223**	**-7%**
[3] Note SET paths booked in FWT = 45,717							
[4] EIL are billed full OMRC on spots until the VR assumption							

TABLE 15 - TRAIN PATHS BILLED (INCLUDES SPOT BIDS AND CANCELLATIONS) COMPARED WITH VOLUME REOPENER ASSUMPTIONS

7.2 Route OMRC Revenue

The Operations, Maintenance and Renewals Charge (OMRC) for the third year of CP3, covering 1 April 2022 to 31 March 2023, for the HS1 route was initially set in 2020 through the Periodic Review process (PR19). This involved a series of consultations with industry stakeholders and ORR. The charges were set at a level which it was intended would enable HS1 to fully recover operating and maintenance costs over the life of the control period. The OMRC rates (excluding OMRCC - i.e., passthrough costs) are rebased in line with the annual increase in RPI. For reference, the February 2022 RPI rate is 320.2 and the base RPI rate (February 2018) is 278.1. Beyond these exceptions, expectation would ordinarily be that OMRC rates remain fixed until 31 March 2025. OMRCC rates are reset every year as required to recover pass through costs and a wash-up is performed on an annual basis (see Section 7.3 for more details).

HS1 currently has Framework Track Access Agreements (FTAAs) in place with Eurostar International Limited and SE Trains Limited. The FTAAs have agreed chargeable journey times for each service group and a rate per minute/per km per train. These parameters, together with train numbers, drive the revenue.

Please note all £ values are in nominal terms and there may be rounding differences.

7.2.1 Impact of Covid-19 and impact on track access charges

The Covid-19 pandemic has led to considerably reduced train operations in CP3 compared with what was forecast in PR19 (as shown above). Whilst HS1 was protected from any income shortfall during the period of advance timetables (approximately six months), that protection fell away as advance timetables with reduced train numbers were booked. The HS1 PAT requires OMRC to be reopened where the forecast volume varies by more than ±4% from the relevant baseline. The reopener sets revised OMRCA2 and OMRCB charges, based on updated expected train minutes, to ensure that HS1 continues to recover enough in charges to cover costs.

HS1 agreed to hold annual reopeners until the end of CP3. HS1 has now executed the third reopener for December 2022. HS1 identified a shortfall of £3m in February 2018 prices (circa £3.5m in February 2022 prices) in OMRCA2 and OMRCB because the percentage split of domestic services in the model did not align with the split of services set by the Domestic Underpinning Agreement. This overstated the expected total domestic minutes used to set the volume reopener charges. OMRCA2 and OMRCB charges have increased by 2-4% in real terms in the third reopener to recover this shortfall over the remainder of CP3. A shortfall in OMRCA2 and OMRCB recovery in timetable years 2020-21 and 2021-22 of £1.3m and £1.7m in February 2018 prices respectively. This equates to circa £1.4m in timetable year 2020-21 in February 2021 prices and £2.0m in timetable year 2021-22 in February 2022 prices. This included a shortfall in recovery of OMRCA2 and OMRCB for renewals funding in timetable years 2020-21 and 2021-22 of £0.3m and £0.4m in February 2018 prices respectively (circa £0.4m and £0.5m in February 2021 and February 2022 prices).

In addition to funding operations and maintenance, an element of the OMRC is designed to build up a fund for future renewals and this money is transferred into escrow. Both TOCs were offered a temporary escrow holiday from Period 1 2020/21 to Period 3 2021/22 inclusive and this offer was accepted by Eurostar.

OMRCC rates are reset every year as required to recover pass through costs and a wash-up is performed on an annual basis.

Despite the revision of OMRC via the volume reopener, income in this year has been much lower due to the reduced FWTs from both Eurostar and SE Trains, as well as the un-recovered OMRCA1 on trains that did not run.

O&M revenue of £79.5m as at Period 13 is £4.0m below the CP3 forecast. This is due to:

- £6.3m lower recovery on EIL train paths,
- £2.4m higher recovery on SET following the Volume Reopeners.
- £0.3m higher recovery on freight; and
- £0.5m from lower pass-through income. Pass-through costs and hence pass through income will increase markedly in later years as increased electricity costs and Business Rates crystalise.

Further breakdown and analysis of revenue appears in Statement 1 and 2 in Appendix 6.

7.3 Route OMRC Expenditure

Overall OMRC expenditure (Statement 1 and 3 in Appendix 6) was £84.6m as at Period 13, £0.6m higher than the CP3 forecast. This is made up of a number of cost lines as described below.

7.3.1 Controlled Track Costs

The majority of spend in this category is for work carried out by NR(HS) under the Operator Agreement. This is a fixed price contract uplifted by RPI + 1.1% each fiscal year. As noted above, OMRC revenue is uplifted by only RPI each year.

Total controlled track costs of £63m in FY23 were £1.0m above CP3. Total HS1 internal costs of £12.3m in FY23 were £2m above CP3 mainly driven by higher staff costs £1m and consultancy costs £1m partially offset by BTP savings £0.2m and other underspends as detailed in Appendix 6 Statement 3. Within this there were a number of efficiencies delivered in the period as detailed in the narrative.

HS1 internal costs have increased due to the additional complexities created by Covid and are not directly linked to inflation. There are however a number of core HS1 costs that are required to run the business where we have seen cost increases in the year which are significantly above inflation. These were audit fees (37% increase) and pension advisors (20% increase) and core IT system costs (114% increase).

HS1 is bearing the impact of this cost rise within the Control Period to meet the concession obligations and manage the business. We are reviewing our organisation and cost base prior to the submission of PR24 to ensure it is fit for purpose for what we need to deliver in the current environment.

7.3.2 Pass Through Costs

Pass through costs are charged to TOCs during the year based on the items agreed as part of PR19. At the end of each year, a wash-up adjustment is carried out to ensure that revenue collected matches the spend for these items.

Overall, the pass-through cost at Period 13 was £0.4m lower than the CP3 forecast. Most of this saving derives from a £1.0m saving on business rates where there was no increase in the year. Although there was also a saving on non-traction power in the first half of the year, from October, electricity prices increased dramatically, and by P13 electricity was £ (0.5) m higher than the CP3 budget. The year-on-year increase in pass through was 10.8% but varied by item between 0% for business rates to 104% for non-traction electricity.

The method for conducting the wash-up of pass-through costs is set out in the PAT and requires the allocation of costs across TOCs based on actual minutes on track. The significant change in train volumes due to COVID-19 has highlighted that the approach set out in the PAT could lead to perverse incentives and outcomes if applied long term. We have discussed this with train operators who have adopted different positions based on their commercial interests. Eurostar raised a challenge to the last invoice although it was paid and to date Eurostar has not pursued a formal dispute on the matter. We will seek to update the drafting of the wash-up provisions in the PAT as part of PR24 to implement a fairer and more accurate approach.

7.3.3 Freight Costs

These are costs which are either specific to the operation of freight services or the costs of maintaining freight-specific infrastructure. Although a lower number of freight services are run, HS1 is still obliged under the Concession Agreement to maintain the assets and therefore incur costs, mainly for work carried out by NR(HS) or NRIL.

7.4 Station charges

A Long-Term Charge (LTC) is set for each station for CP3 to enable HS1 to fully recover the costs of funding renewals at those stations over the control period. This was done through a process similar to the Periodic Review for route with a series of consultations with industry stakeholders and the DfT who had regulatory oversight of HS1 stations at the time. In July 2022, this responsibility was transferred to the ORR (see Section 4.7.4). Within a Control Period, each LTC is subject to an annual RPI-linked adjustment, but the expectation would ordinarily be that charges remain fixed until 31 March 2025 (with limited exceptions).

Operations and maintenance costs for stations assets are called Qualifying Expenditure (Qx). The Qx is set on an annual basis in accordance with the access agreement between HS1 and the train operators – Qx is not regulated.

LTC income collected in the year to Period 13 2022/23 for each station was:

- St Pancras International - £7.8m
- Stratford International - £1.3m
- Ebbsfleet International - £1.7m
- Ashford International - £1.0m

The total Qx costs across the four stations as at Period 13 was £29.9m, £2.7m below budget.

7.5 Renewals

For route renewals, £9.4m was withdrawn from escrow in the year to Period 13. £4.2m was for route renewals charged to route escrow. £220k was for the regenerative braking project works which has now been completed. The drawdown compares to £9.5m the previous year.

Across the four HS1 stations, the number of renewals that have been charged to the respective escrow accounts in the year to Period 13 are:

- St Pancras International - £2.8m
- Stratford International - £0.8m
- Ebbsfleet International - £0.8m
- Ashford International - £0.1m

This is £4.5m in total compared to withdrawals in the previous year of £3.1m for the full year.

Section 5.2 provides commentary on the delivery of route and station renewals in FY2022/23.

7.6 Escrow accounts

As stated above part of the OMRC, and the LTC, paid by TOCs is designed to fund future renewals of the HS1 railway and stations respectively. The funds collected are paid into separate ring-fenced bank accounts (one for route and one for each of the four stations) each quarter.

The route escrow current account balance as at 31 March 2023 is £27.1m. Further funds are invested as at 31 March 2023 for the route are £100.0m with maturity dates at regular intervals up until March 2025. Statement 4 in Appendix 6 provides further detail on the balances.

The total escrow current account balance across the four separate station escrow accounts as at 31 March 2023 was £8.7m. Further funds invested as at 31 March 2023 for the stations are £53.0m; the stations escrow funds have been invested on the same basis as route.

During PR19 we agreed with the ORR and DfT to document in more detail the escrow investment strategy for CP3 with the aim of maximising the interest we could earn on the escrow balances. However, at the start of CP3, market interest rates fell, partially driven by the pandemic, together with a lower and flatter longer term interest rate curve than initially forecast. Due to this, and the Eurostar escrow holiday, that was offered to support their cashflow through the initial months of the pandemic, it was agreed to keep the investments to a shorter tenor of six months to maintain liquidity during an uncertain time (as the associated volatile train paths meant new cash receipts into the escrow were also uncertain). This allowed HS1 to quickly move investments to a longer tenor if and when the interest rate curve improved.

Since December 2021 we have returned to maximising interest earned over the remainder of the control period while ensuring liquidity. This has happened as 1) we have seen market interest rates rise to tackle inflation and 2) train paths stabilise. Therefore, our dedicated and experienced Treasury function have agreed with the ORR, DfT and the TOCs to extend the tenors of the investments from a minimum of six months up to the maximum of 27 months, being the end of CP3. While interest rates are above the forecast rates set out at the start of CP3, this will not close the gap to the CP3 forecast based on current rates. Furthermore, there is still the wider issue of the large gap between interest rates and inflation; HS1 is inputting into DfT's work to amend the Escrow Investment requirements set out in the Concession Agreement to further optimise the interest rates earned in the future.

The two possible enhancements to help narrow the gap between interest earned and inflation are:

1. Appendix 4 of Schedule 10 of the Concession Agreement has limited the ability and willingness of banks to take deposits since the terms are too prescriptive and lack flexibility to meet the latest banking norms. Therefore, we will be unable to maximise returns and increase diversification, which could lead to an even larger interest gap especially as we are nearing investment capacity without making changes.
2. Expanding the scope of Authorised Investments to include money market funds and reverse repurchase agreements so that we are able to diversify and increase returns while maintaining security over the balances.

We have informed the DfT that investment capacity will be reached by June 2023 and therefore there will be a negative impact on TOCs due to the lack of avenues to earn interest income. HS1's stands ready to support DfT in their proposal to make the necessary amendments to the Concession Agreement to address this.

In agreement with DfT, we drew down a total of £0.8m on escrow funds between P13 2020/21 to FY2022/23 for the regenerative braking enabling activities (see Section). We had an agreement in place with SET for the repayment of these funds via the regenerative braking that SET creates, but SET indicated a desire to arrange an earlier repayment and this was fully repaid prior to 31 March 2023.

7.7 Specified Upgrades

The Concession Agreement defines certain expenditure as Specified Upgrades. These projects may be financed either through a grant from the Government, an increase in the Investment Recovery Charge known as an Additional Investment Recovery Charge (AIRC) or a combination thereof.

HS1 is bringing forward a proposal for an AIRC for early works on the ERTMS signalling upgrade, based on the current view that this project must be treated as a Specified Upgrade (while we considered it should be treated as a renewal) (see Section 6.1). We are updating the AIRC proposal following our consultation late last year and further information gathering and will provide details of the AIRC in the Final AMAS and will be reflected in Statement 5 of Appendix 6.

7.8 Management of Efficiencies

7.8.1 HS1 efficiencies

We continue to explore all opportunities to improve cost efficiency for operations, maintenance, and renewal of route infrastructure against the baseline set by the ORR as part of PR19.

The largest element of our cost is the agreements with NR(HS) for route and stations and we continue to work collaboratively with NR(HS) to deliver efficiency savings. We have an agreed methodology for NR(HS) to report this efficiency against the CP3 route determination, as set out in the next Section.

While HS1 has recorded an overspend in FY23 relative to CP3 budget (as set out in Section 7.3.0 above), we have delivered cost savings, which are passed through to train operators and other stakeholders, in the following areas during FY23:

- While business rates is lower than the CP3 forecast for the current year, this was due to Rates not being reassessed by the Valuation office when forecast. An increase had been budgeted. The business rates for future years has now been reassessed, originally increasing by c. 100%. HS1 have responded to urgently manage these costs for TOCs. Working with rating consultants, the Valuation Office Agency and TOCs to drive this charge down from £40m to £27.5m. The cost of this advice (circa £0.1m) has been borne by HS1 with all of the £12.5m cost saving benefit passing to TOCs.
- Regenerative braking has been enabled on the SE Trains Class 395 fleet. This is an important element of the HS1 Sustainability Strategy which will significantly reduce power consumption with an estimated cost saving of around 10% for SE Trains [approx. £2.6m per year using Winter 2022 charge rates)] Billing including data provision via On Train Metering and including Regenerative Braking was put in place with effect from P9 billing.
- HS1 has a well-developed Energy Procurement Strategy which it has utilised to act on behalf of TOCs to take out Corporate Power Purchase Agreements (CPPA) linked to UK renewable assets, helping to fix prices in line with their preferences. The first CPPA was contracted in April 2022 and the first trade secured 20% of renewable energy from October 2022 to September 2032. The second trade has now been completed and adds a further 20% of renewable power to the portfolio for 10 years with effect from 01 April 2023. It is intended that by April 2025 80% of the baseload power will be provided through renewable CPPAs. The first PPA trade which operated from October 2022 provided TOC cost exposure protection of c. £2.5m. We derived these savings from the extent to which the PPA volume of 5MW was below the market average for Winter 22 (October 2022 – March 2023). Prior to October 2022 we had an "over the counter" hedging strategy in place which achieved below market prices throughout the 12 months to end September 2022 and cost avoidance of c.£43.7m during this time for the TOCs. We are circulating an information pack to explain the 2022 purchasing approach to all stakeholders.
- We continue to challenge the cost of our Police Service Agreements with BTP, with the aim of delivering the right level of security and policing at an efficient cost by deploying the right blend of BTP and security resources. This has led to an efficiency saving of c£0.2m.
- Another area where HS1 has sought cost savings in traction electricity for the TOCs is the N-1 Energy Scheme proposal. This scheme would save the TOCs a total of c12.3MWh per day - around £3,600 per day based on Summer 2023 traction electricity prices. HS1 has been ready to implement this scheme since March 2023, but we are waiting for SET to give their agreement in order for us to take this forward.

HS1 conducted an efficiency review in the prior year, bringing in automated invoice and statutory account reporting in Finance as well as streamlining HR processes with the aim of reducing staff costs over time. There are some areas of the business that have required unbudgeted investment in CP3 in order to achieve efficiencies in later years. Further efficiencies will be delivered with the Interim Finance Director role no longer required and the Financial Controller position will not be replaced when the vacancy arises in June 2023. The efficiencies generated by accounting system investment mean that these two roles are now absorbed by the current Finance team which. The Finance team structure is currently under review, with efficiencies expected to be confirmed in FY24.

A list of HS1 cost variance and efficiencies is shown in Statement 3 in Appendix 6.

7.8.2 Costs under the Operator Agreement with NR(HS)

In the first year of CP3, NR(HS) introduced a new methodology, known as the fishbone analysis, to demonstrate how committed efficiencies are categorised and variances explained when comparing to its control period determination, based on the process used by NRIL. The fishbone diagram indicates the movement in costs from the exit point of CP2 through to the post-efficient position.

NR(HS) does not wish to share the fishbone analysis with HS1 for commercial sensitivity reasons. Similarly, to the past two years, NR(HS) has agreed with HS1 and the ORR that it will share its CP3 Year 3 efficiencies report including the fishbone analysis directly with the ORR, separate to the HS1 AMAS, in late May.

NR(HS) provides HS1 with a high-level summary table of its committed efficiencies on a quarterly and year-end basis. While the lack of detailed information prevents us from undertaking our own assurance of NR(HS)'s committed efficiencies, the quarterly updates continue to give us confidence that NR(HS) is on track to achieve its CP3 targets. The ORR takes the role of agreeing, monitoring, and assuring that NR(HS) fulfils its efficiency requirements during CP3. We would welcome a summary of the ORR's views on how NR(HS) is delivering against its efficiency requirements, or any other feedback from the ORR, once it has reviewed NR(HS)'s fishbone analysis. Figure 29 shows the full year summary of NR(HS) efficiencies that HS1 has received from NR(HS).

Reference	Name	BRAG Status (Monetary)	BRAG Status (Plan)	Year End Comment
E-001	Asset Management Effectiveness	Red	Red	S&T renewals have been integrated into the maintenance plans in FY23, however delivery productivity is not as high as envisaged, but delivery is progressing. Automated infrastructure monitoring requires a further operational trial for a period of 1-year which is being progressed. Efficiency opportunity further impacted this year due to Industrial Action. Available resource has prioritised core maintenance, and key planned renewals had to be deferred due to lack of resource.
E-002	PSA - Contribution to NF	Blue	Blue	Negotiated reduction in national functions services under PSA for all of CP3. Continued monitoring of services and spend throughout the financial year, with a view to monitor Network Rail's reorganisation under GBR and any impact on PSA services in future years.
E-003	Subcontractors	Blue	Blue	Packaging and sequencing of planned works has enabled better in-house resource utilisation. Effective business partnering with supply chain resulted in the reduction of contract variations.
E-004	Insurance	Blue	Blue	Negotiated lower premiums based on improved rates impacting this financial year. Efficiency attained due to reduction in train paths and a discount due to historical no claims.
E-006	PSA - SE Route - staff	Blue	Blue	Negotiated reduction in southern region resources under PSA for all of CP3, with a view to monitor Network Rail's reorganisation under GBR and any impact on PSA services in future years.
E-007	Civils & Environmental: contractor cost reduction	Blue	Blue	Risk Based Examinations procedures defined, which resulted in a overall reduction in volume of examinations in the control period. Team reorganisation completed in YR2, resulting in an increase in productivity of team.
E-008	Overtime / Rest Day - Ops	Red	Red	Efficiency not achieved this financial year due to EMMIS resilience cover, industrial action and vacancy gaps. Costs for premium hours greater than target due to cover these impacts which were not anticipated in the 5YAMS.
E-009	Materials (Spares/Stock)	Red	Red	Efficiency not achieved this year primarily as a result of geopolitical/macroeconomic factors which has resulted in increase in material costs
E-010	Area support cost change	Blue	Blue	Review undertaken of support function allocation across NRHS route, to ensure cross charge to stations reflected. Updates to charging arrangements implemented.
E-011	Call-Off Contracts (infra)	Blue	Blue	Call off orders are now no longer used as such as this efficiency has been achieved.
E-012	Overtime / Rest Day (infra)	Red	Red	Efficiency not achieved this financial year due to industrial action, backlog recovery and vacancy gaps. Costs for premium hours greater than target due to cover these impacts which were not anticipated in the 5YAMS.
E-013	Centralised Leased/Owned Plant	Blue	Blue	Centralised management of plant has resulted in better availability and increased reliability. Further enhanced by a change of supplier enabling better unit rates.
E-014	Hotel Accommodation	Blue	Blue	Sustained virtual training implemented during year 1 as a result of COVID-19. Utilising locally sourced training providers minimising travel and accommodation needs.
E-015	Centralised Vehicle Fleet Management	Blue	Blue	Pool vehicle usage monitoring now in place which has restrained unecessary usage. Potential reduction in fleet size post COVID restrictions.
E-016	Establishment efficiency	Blue	Blue	Efficiency achieved this year from reduction in the support functions' headcount through the implementation of the Target Operating Model (TOM) reorganisation, as well as vacancy gaps in the organisation (partially offset on other lines as this has driven increased overtime utilisation). This has been further enhanced by pay restraint across all pay grades, reducing payroll costs.
E-018	RCM (Instead of E-005)	Blue	Blue	Overhaul strategy reviewed. Overhaul tasks are now condition based, extending component life cycles and reducing maintenance costs
	Total Committed Efficiencies			
T-001	PSA - NRIL Guarantee	Blue	Blue	Reduction in NRIL guarantee fee agreed. Continued monitoring of Network Rail's reorganisation under GBR and any impact on PSA services in future years.
	Total Tailwinds			
H-002	Standards update incl cyber security	Blue	Blue	Assessment of cyber threat to ensure alignment to network and information systems directive. Partial usage of headwind required
H-004	S&T - Annual leave T&C changes	Blue	Blue	Terms and Conditions updated for S&T
H-006	SIMD - Recent building issues/aging buildings	Grey	Grey	No drawdown required in year
H-013	PSA - Provision required within PSA for buying training from NRIL	Blue	Blue	Competency requirement assessment has led to partial usage of headwind.
	Total Headwinds			
H-001	PSA - Train Planning/ Capacity planning	Blue	Blue	Increased accountability/outputs required to ensure the specific HS1 train planning requirements are achieved. This has been agreed through the PSA for year 2. Continued monitoring of Network Rail's reorganisation under GBR and any impact on PSA services in future year.
H-005	Increase in UTU Frequency	Grey	Grey	No drawdown required in year
H-007	PSA - SE Route - Performance mgmt./ Delay attribution	Blue	Blue	Agreed improved service as part of PSA negotiation. Continued monitoring of Network Rail's reorganisation under GBR and any impact on PSA services in future years. Costs lower than target, headwind not required.
H-008	PSA - Site Access Control (SACC)	Grey	Grey	No drawdown required in year
H-010	Training alignment to NRIL	Grey	Grey	No drawdown required in year
H-011	Track - Grinding & Tamping Regime	Grey	Grey	No drawdown required in year
H-012	Establishment Headwind	Blue	Blue	New posts implemented in 5YAMS reviewed through the Target Operating Model (TOM) programme. As a result, reduction in cost as not all of the posts have remained in the organisation.
H-009	Civils - Increase in maintenance due to deterioration of assets	Grey	Grey	No drawdown required in year

FIGURE 29 - NR(HS) O&M EFFICIENCIES YEAR 3 Q2 (AS AT PERIOD 6)

Appendix 1. Circulation List

This Draft AMAS has been circulated to the following individuals within the organisations listed below.

Name	Organisation
Nick Tedstone	Office of Rail and Road
Steven Dennis	Office of Rail and Road
Debbie Daniels	Office of Rail and Road
Howard Taylor	Office of Rail and Road
Oliver Mulvey	Department for Transport
Patricia Idaewor	Department for Transport
Marina Stobbs	East Midlands Railway
Steve White	SE Trains Ltd.
Mia Kirkpatrick	SE Trains Ltd.
Jason Lewis	Eurostar International Ltd.
Ian Kapur	GB Rail Freight
Quentin Hedderly	DB Cargo
Peter Graham	Freightliner
Chantelle Casula	Network Rail (High Speed)
Mark Budden	Network Rail (High Speed)
Gavin Baecke	Network Rail (High Speed)
Jennifer Beston	Network Rail (High Speed)

Appendix 2. Safety and Performance

Safety

Lost-Time Injury Frequency Rate (LTIFR)

The LTIFR chart in Figure 30shows the moving annual average LTIFR for the HS1 route and the three stations managed by NR(HS). The LTIFR at Period 8 2022/23 was 0.595 against a target of 0.407; seven workers took off one or more shifts due to a workplace accident in Periods 1 to 8.

In support of the NR(HS) continued commitment to improving these results via the QHSE Strategy, various functional safety improvement plans were launched. The plans review data on workforce and passenger accidents at stations from at least the last five years, analysing the root and underlying causes to establish core trends and developing and implementing improvement actions. The plan has a focus on reducing the number of both verbal and physical assaults on the workforce in partnership with the Land Sheriffs and BTP. All stations are now equipped with body-worn video which staff are strongly encouraged to wear whilst working. Additionally, the quality of NR(HS) investigations into staff assaults has improved in the last 12 months and in the coming year NR(HS) will roll out conflict avoidance training to all frontline employees. It is important to note the difference between FWI (which is our key measure of workforce safety) and LTIFR. LTIFR measures time away from work following an accident and can be adversely affected by minor accidents which result in a number of days away from work. FWI represents the actual harm caused, making it less subjective than LTIFR. In monitoring both, a more balanced picture can be presented between accidents resulting in time away from work and actual harm suffered.

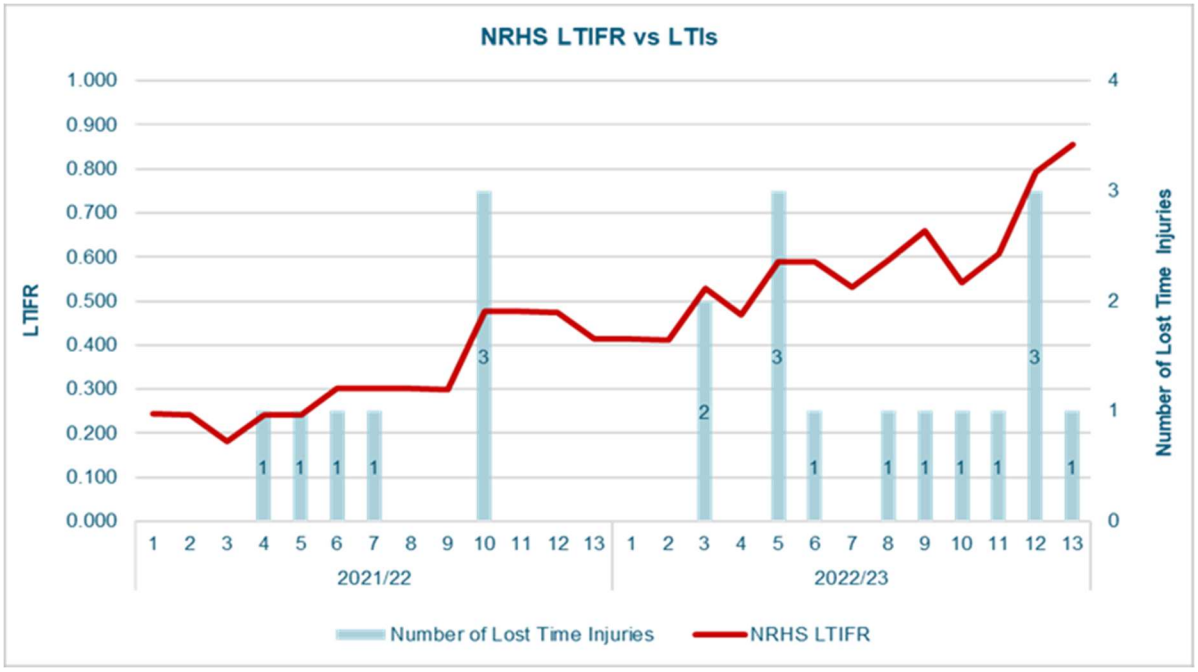


FIGURE 30 – LOST TIME INJURY FREQUENCY RATES

Accidents by Category

Figure 31 shows the number of accidents over the last 13 periods. The top two risks for lost time accidents are 'manual handling' and 'slip/trip/falls'. The root causes for these types of accidents are being addressed through the locally owned safety plans. The plans also focus on other injury types such as 'Assault' related events, as these are significant and account for the largest proportion of accidents in the Stations' environment. HS1 continue to challenge BTP to support NR(HS) through our annual policing plan. BTP are tracking the use of body worn cameras as they have been proven to be effective at reducing assaults. BTP have introduced micro beats [a targeted intelligence led patrol plan] which has driven an increase in BTP visibility.

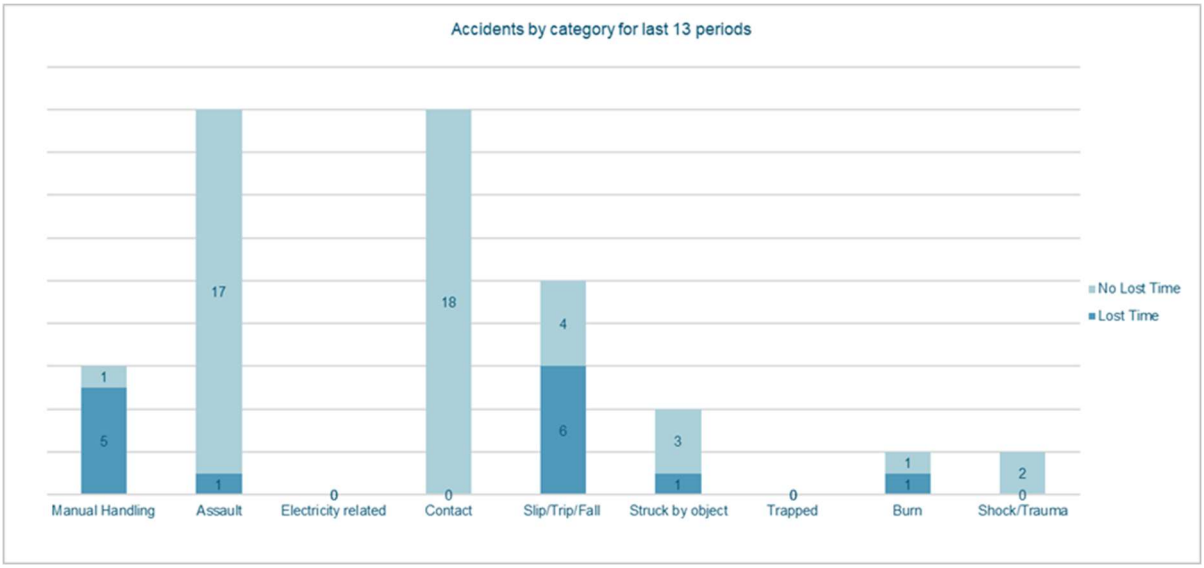


FIGURE 31 – ACCIDENTS BY CATEGORY FOR THE LAST 13 PERIODS

Route Asset Availability

Route Operational Availability

Operational availability is defined as the percentage of time that a specific asset group or system is available for operational use excluding planned maintenance.

$$A_O = [(M_w - M_u)/M_w] \times 100\%$$

$A_O = Operational\ Availability$

$M_w = Minutes\ in\ week$

$$\boldsymbol{M_u = Minutes\ Unavailable\ (Taken\ from\ "total\ time\ to\ repair\ measure")}$$

FIGURE 32 – OPERATIONAL AVAILABILITY EQUATION

The calculation of network availability is based on the following assumptions:

- Monday-Friday: the network is available for 20 hours (no train service between 00.55 and 05.00).
- Saturday: the network is available for 18 hours (no train service between 00.55 and 07.00); and
- Sunday: the network is available for 19 hours (no train service between 00.20 and 05.00).

Between Period 1 and Period 8 there was a total of 265,400 minutes of availability and 4,424 minutes of delay on HS1, 1,964 of which were linked with infrastructure. This represents a network availability of 98.33%.

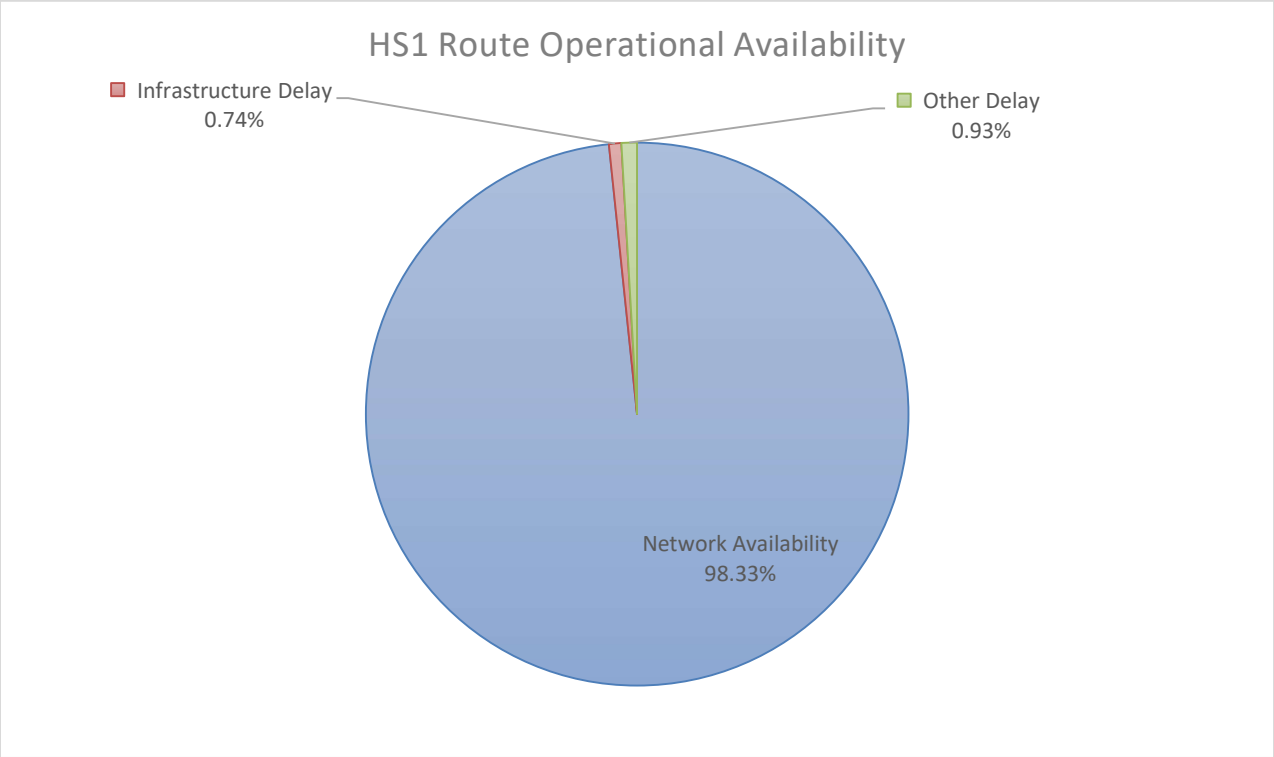


FIGURE 33 - HS1 ROUTE OPERATIONAL AVAILABILITY

Power Availability

Month	Available Mins	UKPNS Fault (Unavailability) Mins	UKPNS Availability
Apr-22	43,200	0	100%
May-22	44,640	0	100%
June-22	43,200	0	100%
July-22	44,640	0	100%
Aug-22	44,640	0	100%
Sept -22	43,200	0	100%
Oct-22	44,640	0	100%
Nov-22	43,200	0	100%
Dec –22	44,640	0	100%
Jan –23	44,640	0	100%
Feb -23	40,320	0	100%
Mar -23	44,640	0	100%

TABLE 16 - UKPNS ASSET AVAILABILITY

Power availability requirements are defined by TSI (technical specification for interoperability) and are reported to HS1 periodically as defined in the UKPNS distribution agreement. As shown in 40, UKPNS assets continued to perform extremely well with availability of 100% up until March 2023, beating the target of 99.9885%.

Maintenance: 87.5% of sites have had the required maintenance completed against the original maintenance plan for the maintenance year. The UKPNS maintenance year runs until the end of March 2023 and the remaining sites will be programmed for completion within this maintenance year. There are two sites in backlog from the previous maintenance year (Singlewell

Yard and Choats Road). This was caused by to the lack of outage windows available, resulting from the Sellindge SGT 5B repairs and the fitment of the new Mach Control system. The outstanding sites will be actioned as soon as reasonably practical, however, UKPNS has undertaken a risk assessment of the missed maintenance to assess the risk level and ensure the risk is suitably managed.

NR(HS) Works Planning Capability

The plan/attainment measure for maintenance is used to determine the effectiveness of the NR(HS) works planning capability and is defined as "the percentage of work completed in the week it was planned". Figure 34 shows the results for 2022/23. At year end the planned maintenance attainment was 87%, below the target of 90%. This is mainly due to the impact of industrial action (2.3.1.1), and also, as a result of staff turnover and sickness.

The majority of the maintenance backlog relates to Overhead Catenary System and Civils assets. All backlog is reviewed and re-prioritised. Where this results in non-compliance to maintenance standards, a formal risk assessment and action plan to recover the position is recorded through NR(HS)'s temporary variation process to manage any safety and performance risk.

Maintenance backlog recovery glidepaths have been developed for each specific discipline and are being monitored through maintenance visualisation.

A safety risk was identified in Q1 of the year by NR(HS)'s maintenance teams, regarding working at height within tunnels. As a result, a decision was made to cancel works for this type of activity while training was organised for NR(HS)'s teams. This demonstrates a strong positive safety culture amongst NR(HS) staff by not attempting works unsafely and raising concerns through the work safe procedure. The required training was successfully delivered, the works re-planned and the position is now recovered.

Compliance risks are being managed and works replanned on a prioritised basis.

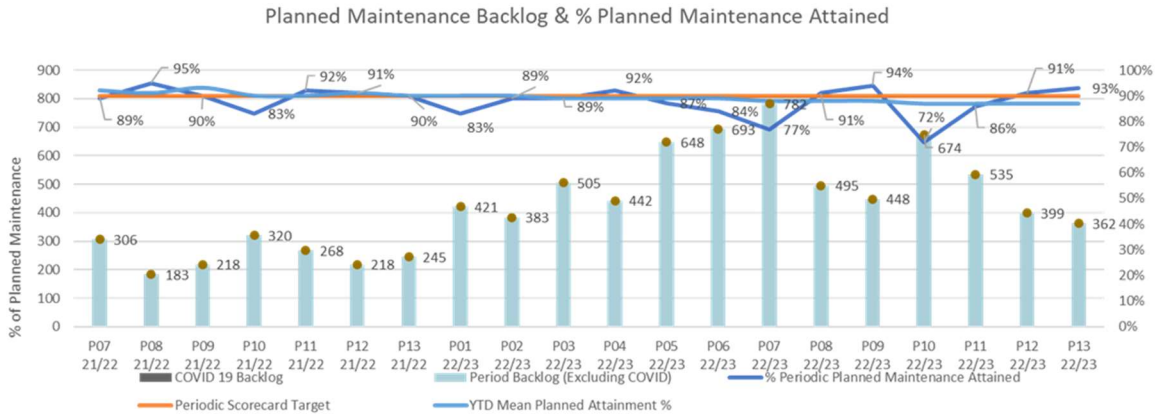


FIGURE 34 – PLANNED MAINTENANCE ATTAINMENT AND BACKLOG

Asset Performance

Seconds Delay per Train

This section shows performance against targets agreed between HS1 and NR(HS) which substantially exceeds the requirements of the Concession Agreement.

Figure 35 shows the moving annual average delay per train for all NR(HS)-related performance-affecting incidents, against the stretch target agreed between HS1 and NR(HS).

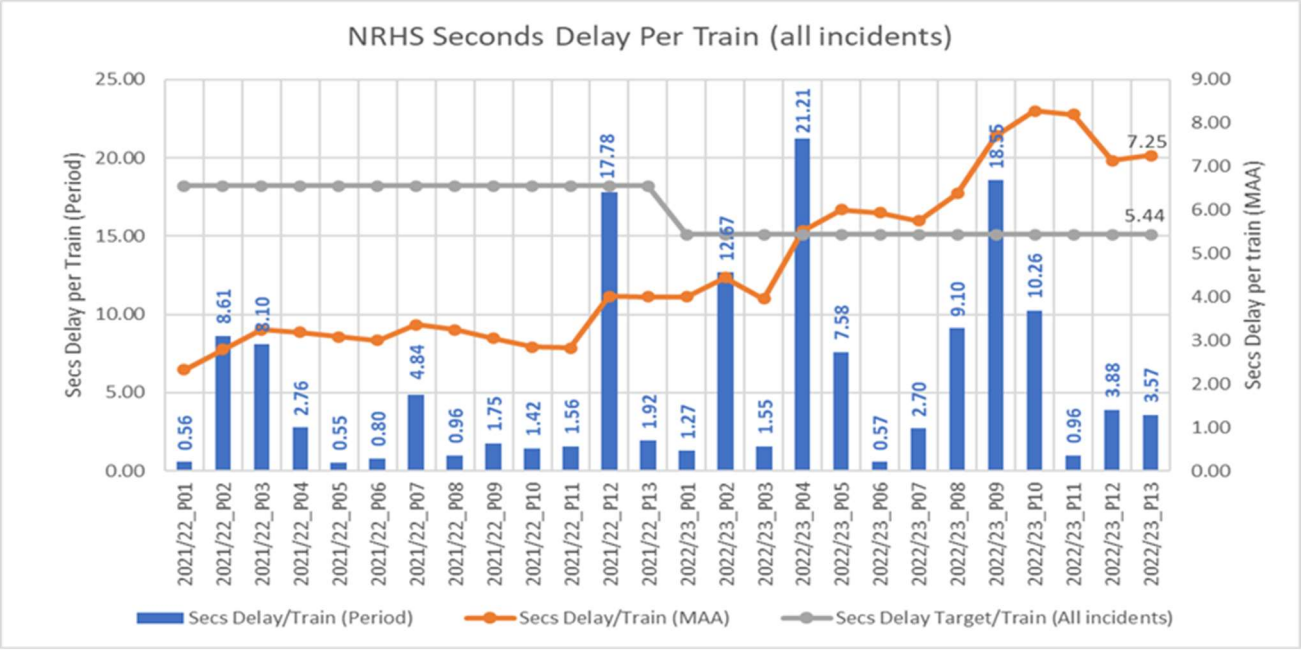


FIGURE 35 - NR(HS)-RELATED ROUTE DELAY PER TRAIN FOR ALL INCIDENTS (INCLUDING NON-INFRASTRUCTURE)

Figure 36 shows the moving annual average delay per train for performance-affecting incidents, limited to delays attributed to route infrastructure, against the stretch target agreed between HS1 and NR(HS).

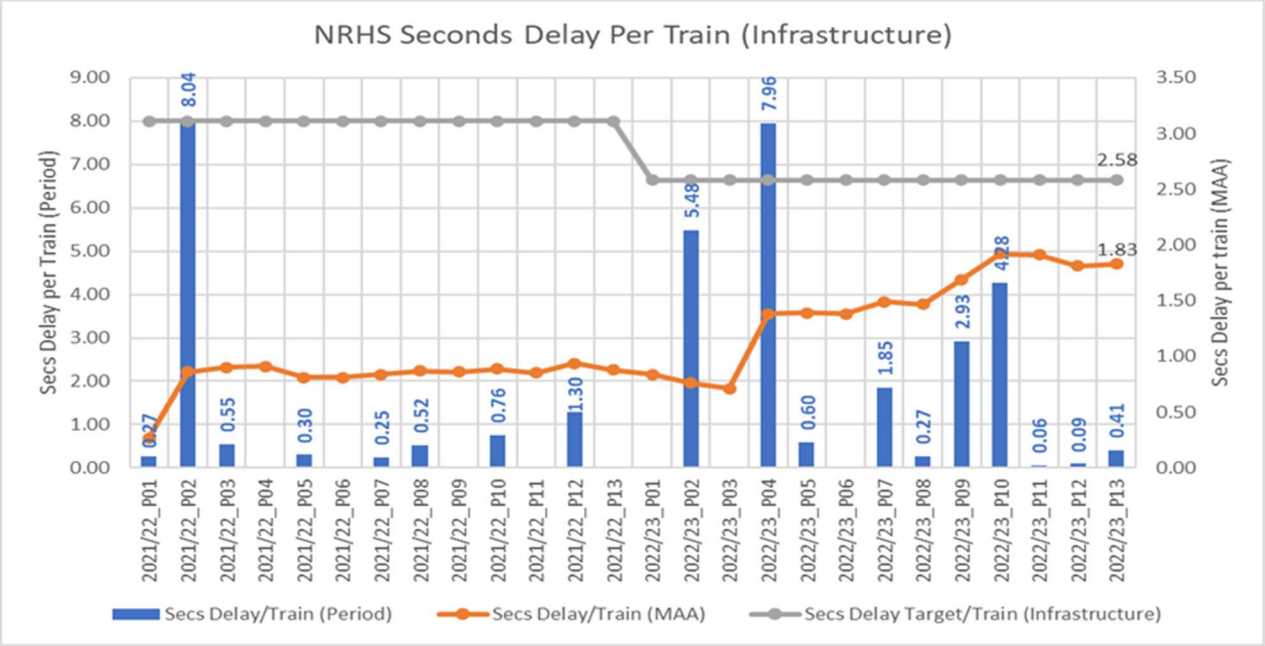


FIGURE 36 – ROUTE DELAY PER TRAIN FOR ALL INFRASTRUCTURE INCIDENTS

The following charts show the moving annual average delay per train for performance-affecting incidents for each asset type, against the stretch targets agreed between HS1 and NR(HS).

Fault Rates by Asset Group

Table 17 group shows faults for each asset group against the targets in the CP3 regulatory submission. With the exception of signalling, HS1 assets are performing well within targets.

Asset Group	Category	CP3 Target	2020-21 Actual	2021-22 Actual	2022-23 Actual
		Ave/Period	Ave/Period	Ave/Period	Ave/Period
Signalling	Fault Level	18	2.08	2.69	5.00
	Service Affecting	1	0.46	0.85	1.13
Telecoms	Fault Level	4	0	0.15	0.13
	Service Affecting	1	0	0.15	0
M&E	Fault Level	9	0.15	0	0.38
	Service Affecting	1	0.08	0	0
OCS	Fault Level	2	0.15	0.08	0.13
	Service Affecting	1	0.15	0	0.13
Track	Fault Level	0.2	0.77	0.38	0
	Service Affecting	0.1	0.15	0.08	0
Civils	Fault Level	2	0.62	0.08	0
	Service Affecting	0	0.08	0	0

TABLE 17 – ROUTE INFRASTRUCTURE FAULTS PER YEAR BY ASSET GROUP

Maintenance Interventions

Faults are categorised into five groups:

- Severity 1: asset fault causes operational delay.
- Severity 2: asset fault with potential to cause operational delay.
- Severity 3 / 4: asset fault identified and rectified prior to potential to cause operational delay; and
- Severity 5: asset fault identified through remote condition monitoring and rectified prior to potential to cause operational delay (linked to a CP2 commitment regarding remote condition monitoring).

As shown in Figure 37, the number of severity 1 and 2 faults has consistently reduced year-on-year through to 2021, meaning that planned maintenance is effective in identifying faults and correcting them before there is an impact to the operational service. This position declined in 2022/23, with more severity 1 and 2 faults experienced when compared to 2021/22.

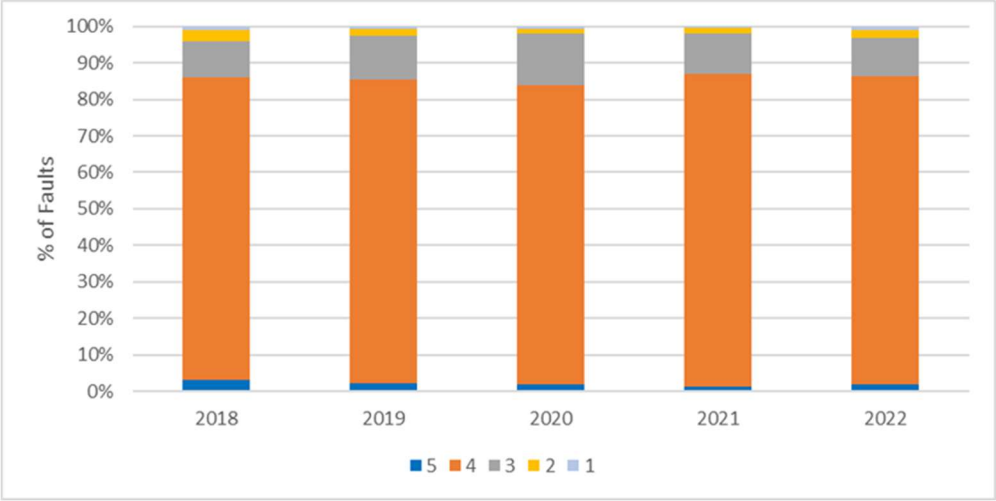


FIGURE 37 - % OF FAULTS BY SEVERITY PER YEAR

A more detailed breakdown of all severity 1 and 2 faults is provided in Figure 38 and Figure 39. There was a total of 68 severity 1 and 2 faults in 2022/23, against a target of 70. Of these, approximately 85% were attributed to Signalling and Control System assets. This is a significant increase in trend for this asset discipline despite the asset condition being relatively good.

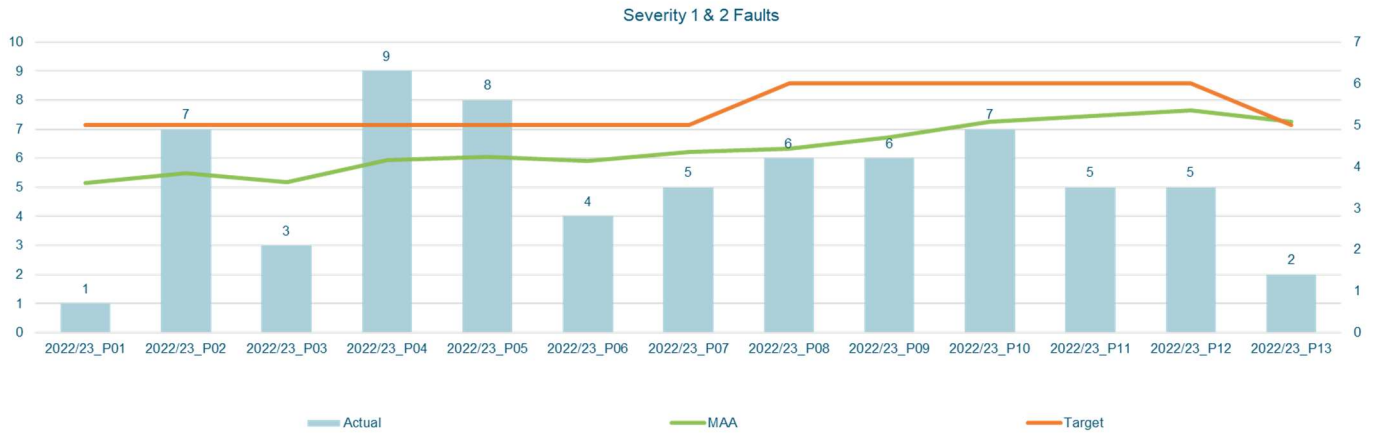


FIGURE 38 - NUMBER OF SEVERITY 1 AND 2 FAULTS PER PERIOD

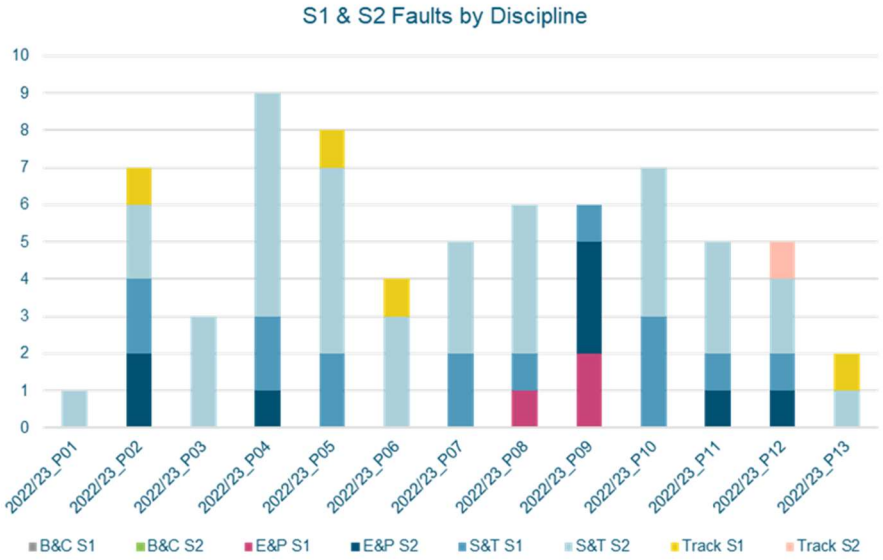


FIGURE 39 - NUMBER OF SEVERITY 1 AND 2 FAULTS PER DISCIPLINE

In terms of total number of faults recorded for all Signalling and Control System asset types this year, there has been a 10% reduction overall compared to 2021/22. However, despite the reduction in total faults, more are service impacting or potentially service impacting.

There are a number of contributing factors for this trend, including:

- Points operating equipment is vulnerable to excessive vibrations and any voiding is causing faults with the point operating equipment.
- As a result, the equipment is maintained at a more regular frequency, therefore identifying more faults, and correcting them.
- HPSS points operating equipment at St Pancras suffered either directly or indirectly during the hot weather in the summer i.e., there was an increase in the number of faults over that period.

- Asset age – HPSS and MCME91 points operating equipment is identified as requiring renewal in CP3, and the renewals programme has commenced.
- We have run more trains in 2022/23 compared to 2021/22, which increases the potential for a fault to impact services and may also result in an increase in failure rate.

In response to this trend, NR(HS) have developed a performance resilience plan, which includes both tactical and strategic actions. A full fault review for this discipline has been undertaken to identify root cause trends, component failures and maintenance intervention actions. This data was used to develop containment actions. These actions are being progressed and will continue into the new financial year.

The fault review identified 3 sub-asset classes which have seen an increase in severity 1 and 2 faults this year. These are MCEM91 and HPSS points operating equipment and HVI track circuits, see Figure 8. The containment actions defined within the performance resilience plan are therefore centred around these asset classes.

There was also an increase in insulated rail joint (IRJ) faults in Q1 at St Pancras. An enhanced inspection and maintenance regime has been implemented and the number of faults has reduced through Q2 to Q4. IRJ faults were identified as one of the root causes of the HVI track circuit failures and therefore, the resilience plan also specifies containment actions specific to the management of IRJ's.

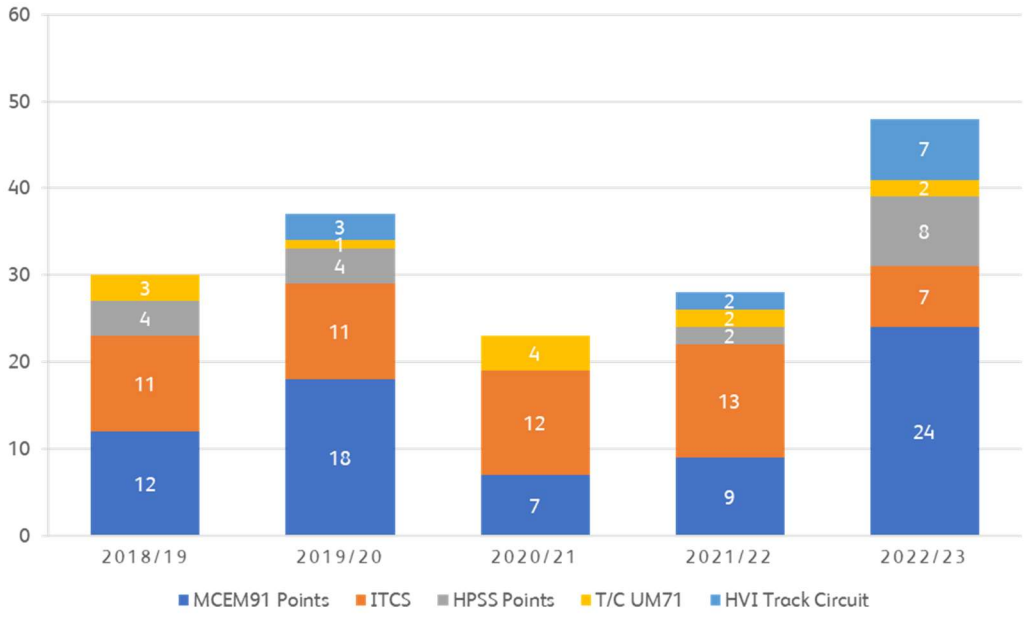


FIGURE 40 - S&T SEVERITY 1 AND 2 FAULTS, TOP 5 ASSET CLASSES

Appendix 3. Asset Management

HS1 Health, Safety and Assurance Management System

The following diagram outlines the structure of the HS1 Health, Safety and Assurance Management System. This approach demonstrates a clear division between HS1 responsibilities and the assurance process for the management of our industry partners.

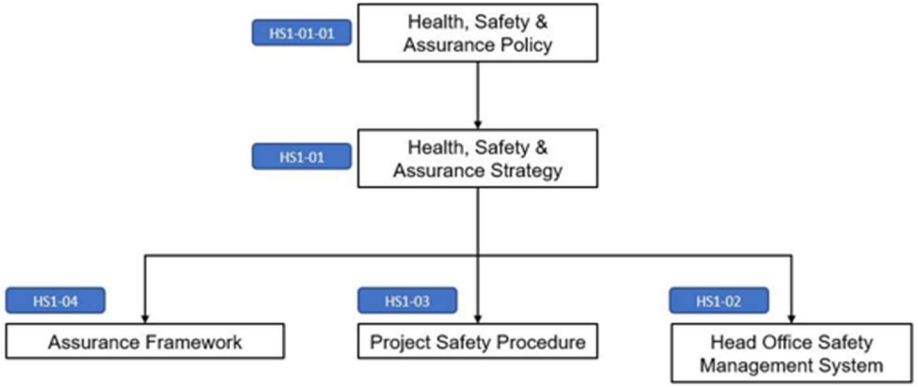
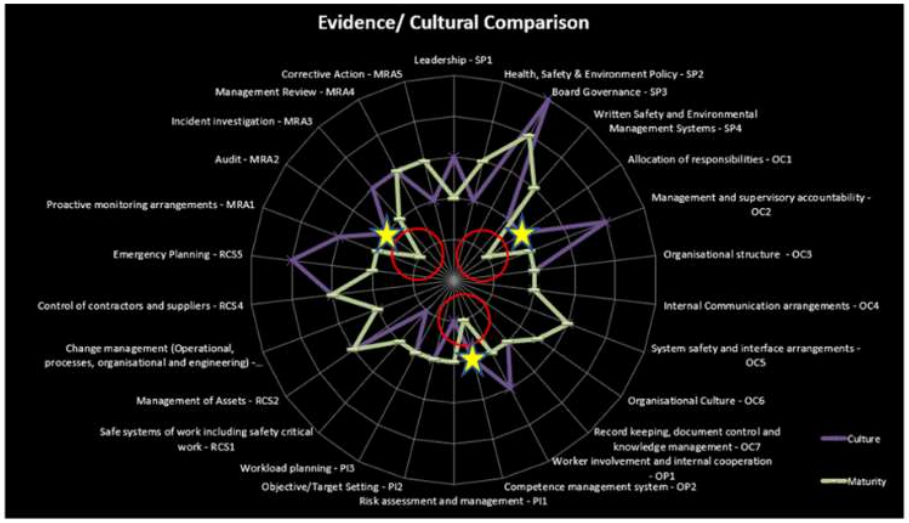
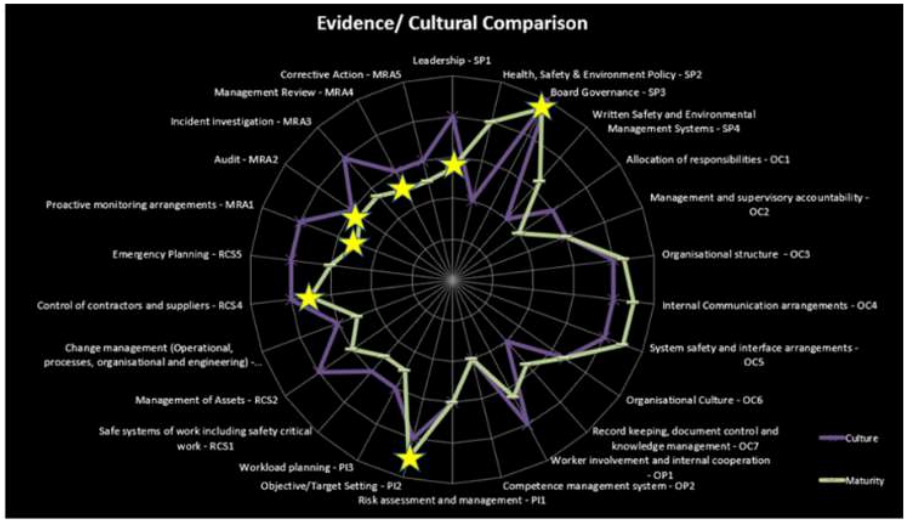


FIGURE 41 - HS1 HEALTH, SAFETY AND ASSURANCE MANAGEMENT SYSTEM



2019 RM3 baseline



2021/22

FIGURE 42 - RM3 EVIDENCE/CULTURAL COMPARISON

CP3 Commitments/Recommendations

Route CP3 commitments/recommendations

Seven of the ORR's Route CP3 recommendations were related to safety. The following table sets out progress against these recommendations.

ORR Ref	Description of ORR recommendation	Action by date	HS1 response within the Final Determination	Progress update	Comment on delivery
1	NR(HS) strategy is aspirational but not measurable.	As plans are finalised for the NR(HS) strategy	HS1 agreed. It will ask NR(HS) to include measurables within the Safety, Environment Assurance Report (SEAR)	NR(HS) now provides the high-level overview of its strategy within the SEAR each period with a RAG status so that progress can be monitored. The strategy links to staff/public safety improvement plans, NR(HS) scorecard and specific improvement projects. We have quarterly strategy review meetings to ensure that it remains measurable and not just aspirational.	Completed
2	Forward looking measures	Combined HS1-tier 1 contractors' RM3 tracked over CP3	HS1 stated it had commenced implementation of RM3 across "key" tier 1 suppliers. Results of suppliers' RM3 self-assessment will be consolidated in HS1 RM3 self-assessment. HS1 was working with NR(HS) and RSSB to develop HS1-specific precursor indicator model – they will model train accident risk through precursors in asset condition and human behaviours.	All tier 1 suppliers completed an RM3 self-assessment. This is being externally validated on an annual basis by HS1 through the CP3 audit programme. COVID-19 recovery has shifted the focus away from the development of a precursor model. This is due to lower train volumes and even lower data points. We will continue to look at the feasibility over the rest of CP3 working in partnership with NR(HS) and the TOCs. With the development of the national Precursor Indicator Model (PIM), where regional and route-specific PIMs are being developed, we will ensure alignment with the relevant models for HS1. HS1 is influencing this work through RSSB working groups.	Completed
3	Gross disproportion test	Ongoing	HS1 will continue to work with NR(HS) to encourage industry best practice, such as gross disproportion test. HS1 should not carry out analysis by itself; the duty holder (NR(HS)) should lead analysis.	HS1 briefed its Safety Sub-Committee on gross disproportion tests and will continue to work with NR(HS) to further embed this within the decision-making processes for the duty holder (NR(HS)). We continue to work with suppliers to consider gross disproportion tests where beneficial.	Completed

ORR Ref	Description of ORR recommendation	Action by date	HS1 response within the Final Determination	Progress update	Comment on delivery
4	More fully embrace RM3	Assessments will be collated and presented to key stakeholders – early in 2020. Progress will be tracked during CP3	HS1 stated that it had fully embraced RM3. Discussed by HS1 Board Safety Sub-Committee in early 2019 and the Board endorsed RM3 approach being applied to all "key" tier 1 suppliers. Mitie and UKPNS had submitted; NR(HS) would by end of October; HS1 by end of 2019. Common improvement projects would be initiated.	All RM3 assessments received and collated. Improvements were discussed; however, COVID-19 overtook this work. The conversation has been picked up with use of RM3 as the criteria for the audit programme. The HS1 Health Safety and Assurance strategy is largely based on RM3. There is a CP3 improvement plan based on RM3 which includes milestones, which will drive maturity improvements within HS1.	Completed
5	Greater distinction needs to be made between activity required for legal compliance and that delivering above legal compliance.		HS1 agreed that it would ask NR(HS) to provide commentary on activities that meet basic compliance and those that go beyond.	NR(HS) now provides a distinction between legal compliance and areas that go beyond compliance. A notable change has been the stations dashboard which shows both legal compliance and non-mandatory compliance. In addition, the SIN002 project picked up the impact of this distinction and has resulted in this being collated in the IT systems in place to manage the station assets.	Completed
6	Actions and milestones for safety by design.		HS1 used the Construction Design & Management (CDM) Regulations 2015. Resources and milestones built into project gateway process. Did not anticipate interventions in CP3 that needed novel design or construction. Key point was that CP3 renewals would not introduce new safety risks.	Safety by design is covered in HS1 Health and Safety employer's requirements and the projects safety procedure and has been provided to the ORR as part of our quarterly reporting. It is also included in the HS1 project gate process.	Completed
7	Avoiding and eliminating risk		HS1 would ensure projects evolve through the gateway process with evidence showing how RAIB reports, and other learning is incorporated into proposal. Learning would also inform future projects, approaches to monitoring and potential revisions to processes. Projects would follow CDM regulations.	Learning from these types of incidents, particularly RAIB, is better suited to NR(HS). HS1 assures itself that NR(HS) and the rest of the supply chain take on board these lessons appropriately. To deliver against this commitment, OPSRAM reviews all RAIB reports for adequacy. Both NR(HS) Head of Safety and HS1 Head of Assurance sit on the OPSRAM meetings and the Joint HS1 Assurance Board, which is independently chaired. The Assurance Board provides a high-level oversight of OPSRAM.	Completed

28 of our Route CP3 commitments reflect the ORR's 28 "amber" recommendations on asset management. The following table sets out progress against each of these commitments.

ORR Ref	Description of ORR recommendation	Action by date	2022/23 progress update	Comment on delivery
1	HS1 to develop an action plan with set milestones for implementation in CP3 of the recommendations contained within the wider AMCL report.	Plan to be developed by end March 2020	We will continue to improve asset management capability in line with other leading asset practitioners and will follow the principles of ISO 55001 asset management best practice. HS1 has produced an Asset Information Vision, Policy, Strategy, and associated Improvement roadmap (action plan) setting out clear objectives for CP3. As described in last year's AMAS, HS1 is now monitoring asset management and wider business improvement initiatives as part of business as usual. The initiatives and recommendations have been extracted from various documents including the AMCL report. HS1 is also working with main suppliers to maintain / develop ISO 55001 asset management systems which include improvement deliverables.	Completed Recommendation for a plan to be developed has been achieved. Plan now being implemented over the duration of CP3.
2	Undertake a follow up review of progress towards a goal of gaining ISO 55001 accreditation.	By end of Year 3 in CP3 (i.e., by March 2023)	We are continuing to strengthen our asset management capability with a focus on asset information. NR(HS) has achieved ISO 55001 accreditation for route. NR(HS) stations has produced a roadmap for accreditation targeting the end of 2023. HS1 intends to work in compliance with ISO 55001. We have a desktop gap assessment planned for June 2023 and intend to secure the certificate by March 2025.	Ongoing
3	Future 5YAMS to document and demonstrate the assurance activities HS1 has undertaken on NR(HS).	In advance of the CP4 5YAMS submission	HS1 provided ORR with the Assurance Framework, Health Safety and Assurance Strategy, and Health Safety and Assurance Audit Standard in October 2021. Assurance Plans are in place for route and stations, which are reviewed quarterly. Assurance is one of the key workstreams identified for PR24. The first draft of the activities and themes that define this workstream was presented at the PR24 Steering Group at the end of January 2022 and will be developed in the coming years. HS1 developed a database of leading indicators which was agreed with NR(HS) and ORR. This will now be used in the ORR, DfT and TOC quarterly renewals update meeting. It will be continuously improved over time as and when required.	Ongoing
4	HS1 to update Asset Management Policy with current status, what will be improved and CP3 targets/milestones.	By end January 2020	HS1 has reviewed the Asset Management Policy to best align it to current areas of focus during CP3 and in preparation for CP4. HS1 reviewed and updated the Asset Management Policy in December 2021. HS1 SAMP published June 2022 includes key deliverable milestones and asset management capability improvement plans. NR(HS) SAMP being updated in preparation for PR24, draft document received December 2022 includes details of planned asset management improvements and timelines for delivery.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2022/23 progress update	Comment on delivery
5	Asset Management Objectives (AMOs) should be subject to review at a suitable frequency.	Plan & programme to be developed and agreed by 31 March 2020	In the February 2020 5YAMS HS1 set out a plan to address the ORR recommendation. The plan is now being put into action with two primary actions: The review of the AMOs as part of the HS1 portfolio-level Strategic Asset Management Plan work; and Current re-baselining of the renewals delivery and future plans to drive work bank prioritisation during both planning and delivery through AMOs and asset risk. The HS1 SAMP including the revised AMOs were issues on 22nd June 2022.	Completed
6	Strategic Asset Management Plan (SAMP) should outline how the stated aims will be achieved and by when.	At next revision or no later than 31 December 2020	HS1 has reviewed the Asset Management Policy to best align it to current areas of focus during CP3. HS1 SAMP for Route and Station assets was issued 22nd June 2022. The HS1 SAMP has been incorporated into the new NR(HS) SAMP, the draft NR(HS) SAMP was issued to HS1 for comment in December 2022.	Completed.
7	Specific Asset Strategies (SASs) should present the expected asset condition at end of control period, hand back and end of the 40-year plan.	At next revision or no later than 31 December 2020	NR(HS) updated the SASs in July 2021 with forecast asset condition scores for all three-time horizons. The SASs have been shared with the ORR.	Completed
8	Regular feedback of Asset Decision Support Tools (ADSTs) outcomes should be shared with stakeholders by HS1.	Plan & programme to be developed and agreed by end March 2020.	The recommendation for a plan to be developed has been achieved (see HS1 AMAS 2020/21). NR(HS) are working with a new supplier to develop TOTEX models for all assets which will be owned by NR(HS). These are still being developed along with the new SASs. We will share the SASs and AMPs with stakeholders as part of our PR24 submission work.	Completed
9	Additional consideration of remote or automated monitoring should be given by HS1.	At next revision or no later 31 December 2020	While HS1 has completed this recommendation, remote and/or automated condition monitoring technologies and initiatives are continuously being reviewed and, when relevant, implemented through our innovation and R&D programme. This is evidenced in a number of the initiatives as set out in our 2021-22 AMASs Examples are: The new tunnel inspection approach; Ballast Refurbishment Project; 5G Augmented Reality Digital Twin project; Infrastructure monitoring using multi-purpose vehicles (MPV) (Cordel); and Digital bridge inspections. In addition, a joint piece of work is ongoing driven by HS1 to align R&D initiatives and the consideration and implementation of new technologies with our asset information strategy.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2022/23 progress update	Comment on delivery
10	Additional consideration of efficiencies, outside normal railway practice should be undertaken by HS1.	By 30 September 2020	As noted in our 5YAMS (page 85), we already undertake benchmarking sessions to review cross-industry comparisons. We will undertake further benchmarking and knowledge gathering in CP3 and, where appropriate and relevant to HS1, we will demonstrate how this has fed into our future plans. As part of HS1's market test investigation, we have undertaken further benchmarking activities. In addition, we will conduct a benchmarking exercise in the development of our CP4 plans. This is additional to a detailed benchmarking dataset we provide to the ORR on an annual basis. We exchanged visits with SNCF and ADIF early in CP3 to capture any lessons learnt. The NR(HS) Target Operating Model was implemented in Autumn 2022.	Completed
11	HS1 to set out the minimum asset data requirements and then report on data quality annually.	At next revision or no later than 31 December 2020	We are working on a number of improvement areas for asset information capability (see AMAS Section 4.1.3 for more detail). We have produced and issued to our strategic partners NR(HS), Mitie and NCP an Asset Data Dictionary for stations and car parks to which they are required to align. For route, asset hierarchy is defined for each discipline in the SASs, which has been provided to the ORR in July 2021 and will be reviewed through the PR24 process. NR(HS) Draft Asset Information Strategy issued April 2023 and HS1 comments returned. Route Asset Data Dictionary now planned to be delivered end of CP3 to align to eAMS2 project. NR(HS) Route and Stations were audited on asset information in March 2023. The audit found non major or minor non-conformances and asset condition was recorded for 99.5% of assets.	Not yet complete. Delivery delayed to end of CP3
12	HS1 to review operations and maintenance risks ownership with funders.	Plan & programme to be developed and agreed by 31 March 2020	This commitment was postponed to focus on COVID-19 response actions. HS1 has taken a stocktake on the treatment of risk with NR(HS) and areas we will explore with funders to better manage risk in CP4. This paper was shared with the ORR and TOCs in March 2023. We are now taking forward the recommendations in the paper and will hold discussions with the Operators in the next few months. The recommendations will feed into the PR24 submission.	Not yet complete. Initial report provided to ORR and TOCs in March 2023. Discussing with TOCs
13	Provide a resource programme with milestones for NR(HS) resilience of key risks workstream.	At next revision or no later than 31 December 2020	The recommendation to provide a resource programme was achieved. Delayed by COVID, HS1 published an updated Business Continuity standard with additional requirements in September 2021, with a new compliance date for both Network Rail and NR(HS) of 31 March 2022. NR(HS) completed its Business Continuity Plan by the compliance date, with the exception of Track due to ongoing priorities in other areas. We continue to make good progress and are steadily working towards the completion of our Business Continuity Plan, ready to hand over to an NR(HS) BCM lead to manage as business as usual by the compliance date.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2022/23 progress update	Comment on delivery
14	Maintenance frequencies to be revisited as more HS1-specific failure data becomes available.	During CP3	HS1 is ensuring NR(HS) has a more risk-centric approach by adapting asset management activities to the level of risk identified through asset condition and degradation modelling. The 2021/22 reviews resulted in revisited, more targeted inspection frequencies for S&C assets (more frequency for critical assets and less frequency for low risk assets); a new HS1 bored tunnel management manual with risk-based frequencies based on historical data; an updated Level 1 standard "the management of civil engineering assets" and other civil assets standards; the asset-specific Geohazard management plans and associated inspection frequencies are being produced to further support the requirements set out in the Level 2 procedure.	Completed
15	HS1 to follow up on water ingress issues identified on site visits.	By December 2019	Specific issue dealt with as noted in the 2019/20 AMAS, namely: Tunnel water ingress (leaks) and the condition of the tunnel drainage were identified as being the root cause of a number of infrastructure faults that had performance impact, including track circuit failures, corroded rail head and silt/sand build up against the rail head. A leak sealing and drainage clearance campaign was undertaken throughout the worst affected sections of the tunnels on the HS1 route, mainly London Tunnel 2.	Completed
16	HS1 to review incentives and monitoring of efficiency to improve maintenance effectiveness.	Plan & programme to be developed and agreed by 31 March 2020	HS1 has worked with NR(HS) to adopt the fishbone methodology for reporting efficiencies and variances to costs. HS1 does not propose to modify the fundamental incentive framework in the Concession Agreement. The Concession was sold with a particular incentive framework, and it is not appropriate to revisit this without an offer of compensation by the Government to HS1's shareholders. HS1 undertook a structure of charges review which included consideration of the cost level/affordability of HS1's services. We concluded this review in 2022/23 and are incorporating the proposed outcomes as part of the PR24 process.	Completed
17	HS1 to review incentives used to optimise asset life before required renewal.	Plan & programme to be developed and agreed by 31 March 2020	This forms part of the key asset management activities in preparation for PR24 and is being actioned jointly by HS1 and NR(HS). Improved modelling capability will be achieved through the adoption of the new WLC tool as well as optimising asset performance. The tool will create the best strategy to manage assets while accounting for business constraints to aid decision making. Improved data capture methodologies such as the tunnel vision and Cordel projects will aid improved degradation modelling by collating more accurate, repeatable condition data.	Completed
18	HS1 to commission an independent review into the effectiveness of its Quality Assurance Board.	By March 2021	An independent review of the Assurance Board was undertaken in the form of a stewardship report by the independent chair; this was submitted to the HS1 Safety Sub-Committee for review. This will become an annual report which will outline the Board's objectives and how it has achieved them and provide assurance to the HS1 Safety Sub-Committee on the effectiveness of the Assurance Board and any recommendations for consideration. We will provide updates on this in each AMAS.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2022/23 progress update	Comment on delivery
19	HS1 to explore with stakeholders if network optimisations could yield lower overall maintenance cost and lower performance penalties.	Plan & programme to be developed and agreed by 31 March 2020	HS1 is including this in the wider workstream for the project integrator for CP4 (and future) readiness as the outputs will potentially help to reduce operations and maintenance costs as well as renewals. The first phase of modelling was completed this year. More information is included in the AMAS. Plans for the second part of modelling will be included in the next AMAS. Ongoing consideration of network optimisation possibilities will occur throughout the control period.	Completed
20	HS1 to provide further evidence to substantiate a number of highlighted renewals in CP3, should it still believe that they are critical.	In response to draft determination – by 30 November 2019	This was concluded in the Final Determination. Each renewal will be subject to stage gate challenge and monitoring.	Completed
21	HS1 to ensure flexibility and resilience to changes to renewals programme (within CP3 and to/from CP4).	Plan & programme to be developed and agreed by 31 March 2020	HS1 provided revised renewals plans for CP3. Managing changes to the renewals programme through the change control process is an ongoing activity during CP3. The change control process is monitored by ORR.	Completed
22	HS1 to review NR(HS) PMO headcount, in light of NRIL benchmarking.	In response to draft determination – by 30 November 2019	We submitted two papers to the ORR with regard to PMO costs, which have been approved by the ORR. There is a significant amount of change currently underway in the NR(HS) project team. The level of PMO support is constantly under review and the level of PMO costs is also approved by the ORR in advance of us incurring the spend. We are currently running close to the target, and we are working to keep PMO costs as low as possible as set out in Section 5.2.1 of the 2021-22 AMAS. See also recommendation 27 regarding the PMO model.	Completed
23	HS1 to establish R&D panel to review benefits & investments.	Plan & programme to be developed and agreed by 31 March 2020	The R&D panel has been set up, Terms of Reference have been developed and we now have an effective framework in place to provide the right level of governance throughout the different cycles of the R&D projects. We are providing updates on the effectiveness of the R&D panel in our AMAS submissions.	Completed
24	HS1 to ensure awareness that Bechtel's CP4-10 direct costs contain a number of omissions and assumptions that will need to be quantified during CP3.	In response to draft determination – by 30 November 2019	Omitted costs will be included in future plans.	Completed
25	HS1 should begin planning for ETCS signalling replacement as a specified upgrade	In response to draft determination – by 30 November 2019	We set out our planning for ETCS (now referred to as the European Rail Traffic Management System – ERTMS – project) in the 2021/22 AMAS. We will provide updates on this project in each AMAS.	Completed
26	HS1 to review blanket 30% risk for CP4-10.	In response to draft determination – by 30 November 2019	HS1 worked with NR(HS) and proposed revised risk contingency of 12.6% per year for long-term renewal forecast based on P50 portfolio basis. The Final Determination concluded on risk contingency of 13% for CP4-10 renewals on the basis of P50 estimates. This was applied in our February 2020 5YAMS.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2022/23 progress update	Comment on delivery
27	HS1 to agree business case with stakeholders for CP4-10 PMO model	Plan & programme to be developed and agreed by 31 March 2020	The issue of the correct project organisation is being addressed through the CP4 project delivery capability improvement programme. The first phase of this work was undertaken in March-July 2020. This developed the scope of work for the improvement programme. We have taken that scope and with NR(HS) have been out to market to find a consultant to undertake the design and implementation of the delivery organisation. A supplier has been selected and the programme business case seeking approval to commence the next phase was sent to ORR in early December. The ORR signed off the business case for the first phase of work and were one of the organisations consulted during the first phase about the organisational capability required. See next item ORR ref 28 for more information.	Completed
28	HS1 to aim to conclude market study as soon as possible, to allow time for investment in CP3 to be ready for start of CP4	Plan & programme to be developed and agreed by 31 March 2020	The 5YAMS stated HS1's plan to come to a decision in the first year of CP3 (i.e., by March 2021) on whether or not to exercise the market testing option for services provided by NR(HS) under the Operator Agreement. HS1 investigated the market test and discussed the outcome with stakeholders. The market test option was not executed and HS1 renegotiated terms with NR(HS). HS1 has received a letter of no objection from the Government.	Completed

Stations CP3 commitments/recommendations

In PR19, DfT made 11 commitments/recommendations for HS1 for CP3. ORR has taken over monitoring of these commitments with the transfer of regulatory oversight from DfT to ORR in July 2022.

DfT Ref	Description of DfT Recommendation	Action by date	Progress Update	Comment on delivery
1	Government's Representative recommends to streamline and update the process to reflect HS1.'s proposed changes to its asset management strategy. In respect of preparation for CP4, the Government's Representatives recommend that an action plan be agreed with HS1 that will cover (as a minimum): • Any amendments required to the HS1 Station Leases and Asset Management Strategy to update them in line with the information requirements of current asset management best practice. • Production of a statement confirming the inputs and sources for the CP4 submission, based on the updated asset management system being used by HS1 that satisfies the requirements of the HS1 Station Leases and recognising it may be presented in a differing form to that set out for the current LCRs.	During CP3	The DfT was responsible for agreeing an action plan with HS1. While no action plan was agreed, HS1 has taken forward these actions in the following way: • This was reviewed and completed as part of the Stations Transfer in consultation and agreement with the DfT and ORR. • This is explained in the SAMP. • This is tracked in the SAMP. The NR(HS) plans to finalise certification for ISO55000 in early 2024. It was agreed between HS1 and DfT that HS1 would not be certified but will align to ISO55000. Completed with DfT in early CP3.	Completed

	• Tracked progress against the adoption of ISO 55000 principles and asset management and monitoring processes to inform the CP4 review; and • iv. Agreed recommendations resulting from the lessons learned exercise to be completed following the publication of the DfT PR19 Final Decision.			
2	The Government's Representatives are encouraged by HS1 proposals to improve asset monitoring and are proposing an annual audit of HS1 Stations asset condition by an independent expert to provide additional ongoing assurance. This anticipates a similar approach taken by the Department for franchised train operators who have FRI leases (full repairing and insuring lease. A lease where the costs of all repairs and insurance are borne by the tenant.)	During CP3	This was a DfT commitment that was not pursued by the DfT. In terms of improving station asset monitoring, HS1 has taken the following actions: • Every 5 years we commission external consultants to conduct an in-depth review of HS1 assets. • In 2016 we commissioned Arcadis to provide an independent report that determined the Target Hand back state of the HS1 assets. • Next independent review is going to procurement in July 2023. We plan to undertake the review in 2023. • ORR agreed this commitment can be completed by reviewing HS1's report on stations asset conditions in the AMAS. We are waiting for ORR's confirmation that this meets this commitment.	Completed
3	There is a need for improved variance analysis, covering deferrals to future control periods, or works brought forward to the current control period, to provide an audit trail across control periods. The Government's Representatives will work with HS1 to agree what additional evidence and reporting is required to support future reviews, and that this is implemented as part of the existing reporting and monitoring arrangements.	During CP3	HS1 now produce an Annual Station Renewals Report which outlines variance of completed projects against the periodic review determination in line with the principles adopted for variance analysis on route as agreed with the ORR in March '22. The Annual Stations Report also includes details on projects deferred or accelerated into the portfolio. Any change which exceeds the agreed project budgets or portfolio budgets is presented to the regulator for approval via the change request process. We provide a summary of this in the AMAS.	Completed
4	Government Representative challenged the notion of whether HS1 have exhibited behaviours with sufficient efficiency and economy, including use of reasonable endeavours to manage NR(HS). In the opinion of the Government's Representatives, HS1 would be able to extract further efficiencies. HS1 recognise in its response to the Targeted Consultation they require additional levers to support delivery of efficient delivery plans through their appointed Station Operator. The Government's Representatives recommend that the Operator Agreement between HS1 and NR(HS) is reviewed.	During CP3	This commitment relates to the Station Concession Agreement with NR(HS), as Operators Agreement is for route. HS1's review did not identify any levers in this agreement to negotiate with NR(HS) on incentives (there are no similar levers equivalent to those in the OA), but we would welcome the opportunity to work with ORR to review the SCA and create additional levers. The ORR has requested to review this contract to better understand this commitment and how to close it out. HS1 has provided the contract to ORR and on 20 January 2023 met with ORR to give an overview of the contractual framework for stations. We expect the ORR to engage HS1 on proposed next steps, if any.	Completed

5	There are quarterly reviews of the variance analysis, and it is recommended that additional model runs are completed as part of the annual review of LTC calculation to give assurance on outturn versus forecast at the end of each complete year, and to informally check the impact of any variances on future forecasts. This will be for monitoring purposes only and not be used to trigger any formal review of the LTC (unless HS1 identify a relevant change of law or circumstance that would allow them to initiate the Interim Review process)	During CP3	This recommendation is related to #3. As noted above, we perform annual reporting on variance. In addition, we present a portfolio level view (for each station) of variance to periodic review budgets on a quarterly basis. This is within the stations section of the Quarterly Asset Renewal Review meetings which are attended by the ORR & DfT. Any change which exceeds the agreed project budgets or portfolio budgets is presented to the regulator for approval via the change request process.	Completed
6	Whilst there is currently a disconnect between the AMS and how it impacts the LCRs, given the stated aspiration to adopt ISO 55000, the Government Representatives recommend that a review of the HS1 Station Leases and AMS is undertaken with HS1 to consider whether they need to be updated.	During CP3	HS1 Stations Leases and AMS were reviewed and amended as part of Stations Transfer project in consultation with DfT and ORR.	Completed
7	Given the LCRs set out the current asset management strategies, there is a need to align the HS1 Station Leases requirements approach to the ISO 55000. The adoption of these systems and processes will improve the inputs to the LCRs, allowing for greater certainty in the plans, and the LCC's that are derived from them. With more robust LCC's the calculation of the LTC will itself be more evidenced based.	During CP3	HS1 Stations Leases and AMS were reviewed and amended as part of Stations Transfer project in consultation with DfT and ORR.	Completed
8	Government's Representatives are clear that HS1 need to make further improvements to risk, and contingency forecasting and further efficiency gains should be expected at future control period reviews.	During CP3	We aligned asset hierarchies on ISO55000 against the LTC models and are progressing work with NR(HS) looking at how to apply standardised risk and contingency forecasting approaches against these hierarchies. We completed all SASs and TOTEX models. The TOTEX models contain risk profiles for each SASs embedded into the model. The process is in line with the route process.	In progress
9	The Government's Representative considered that the CP3 HS1 Stations review revealed a number of issues that were outside the scope of their current decisions as to whether to approve the LCRs for CP3. However, the Government's Representatives considered that some of these issues should be considered in further detail in the future by the Government's Representatives and the Department. These recommended workstreams include: • Exploring the revision of the HS1 Station Leases to update the specified requirements of the LCRs (set out in paragraph 5.2 of the HS1 Station Leases). These revisions would be designed to bring the HS1 Station Leases in line with current asset management best practice, and deciding on the most	During CP3	This was a DfT commitment. HS1 Stations Leases and AMS were reviewed and amended as part of Stations Transfer project in consultation and agreement with DfT and ORR.	Completed

	appropriate mechanism to ensure this drives the correct inputs for CP4; and • ii. Updating the Asset Management Strategy requirements for the HS1 Stations to: a) provide for and assist the implementation of the ISO 55000 suite of methodologies; b) revise and update Life Cycle Cost (LCC) models (see paragraph 3.46 above); c) embed asset monitoring to ensure evidence-based inputs to LCC models; and d) revise and update of LTC model, with the aspiration of completing this work in time for the CP4 Station's review.			
10	The Government's Representatives will work with HS1 to improve LCC modelling; in particular by moving to a model based upon condition-based asset data. Similarly, the Government's Representatives will also work with HS1 to improve LTC modelling to incorporate a more sophisticated approach to modelling risk and contingency indirect costs.	During CP3	We are moving LCC modelling towards a TOTEX based model. This will be looked at as part of the PR24 process and HS1 will update the ORR on the development of the model as it progresses.	In progress.
11	The Government's Representatives recommend that the DfT will continue to work with HS1 to develop longer term options for a station enhancements framework on the HS1 network, which would require amendment to the Concession Agreement.	During CP3	HS1 developed its Station Enhancements Policy in consultation with stakeholders (incl DfT) over 2021-22. HS1 published the policy on the HS1 website in April 2022.	Completed

Appendix 4. Key Initiatives and Improvements

CP3 Route Innovation, Research and Development Projects

CP3 R&D projects

Project	Business Case	Status	Next Step	Expected Cost
Tunnel vision – development of a technology-based solution for tunnel inspection – civils	More efficient inspection methodology. Workforce safety improvement. Data quality improvement.	Completed		£133,867
Tunnel vision – development of a technology-based solution for tunnel inspection stage 2B - civils	See above.	Completed		£ 42,000
Fault prediction using AI/Machine learning – for POE and S&C assets – try to update description, could be machine learning project instead	Improve safety. Increase infrastructure reliability. Support long-term renewal strategies.	Gate 2 approved and In Progress	Provide more video data Arcadis. To validate the use cases to determine if we move to phase 2. Predicted to be in end of May 2023.	£189,415
St. Pancras station operations - a real-time passenger monitoring to optimise operations (Open Space Digital Twin) –	Improved customer and staff experience. Reduced costs. Increased revenues.	In Progress	Capability being built over several years with the station digital twin. Initially focusing on customer flow, before adding further layers such as asset monitoring to the system, CCTV, etc.	£219,957 (funded by HS1) with additional £100,000 from the R&D fund

Project	Business Case	Status	Next Step	Expected Cost
OCS Monitoring using PANDAS Wireless remote condition monitoring system- combines the above fully wireless technology with an integrated camera module to provide high-definition images and video footage –	Optimise maintenance. Provide data to train operators on the performance of their vehicle pantographs. Reduce/eliminate damage and/or disruption on HS1 caused by vehicles entering the railway with material (foliage) entangled within the pantograph.	Gate 2 approved. The trains are planned to be refurbished by Hitachi in 2022. SE Trains will fit the cameras, which is currently planned for December 22. NR(HS) have requested this be accelerated for a sample set if possible.	Progressing a solution with Hitachi. Two vehicles having the cameras installed on them. System trials are planned for second half of 2023.	Approx. £500,000
Under Sleeper-pads – trial extension –	Extend sleepers asset life. Improve reliability and performance. Reduce costs.	Scope confirmed. Gate paper to be submitted for authority. Project moved to BAU (business as usual)	To be added to the track CP4 volumes plan.	£95,506
Remote Condition Monitoring on Point Operating Equipment – benefit assessment –	Improve data quality. Increase asset deterioration rate knowledge. Improve reliability.	Contract with supplier Vossloh. Design stage and Approval ongoing	Design to be completed. Approval to be completed. Power Supply to be provided onsite. Installation should commence April 2023	£189,415
5G Integrated Railway AR Digital Twin	Improve the reliability and fault diagnosis. Provide a means for multi-directional flow of information and improve decision making.	Gate 2 approved	Project closed, did not provide expected outcome. 5G network was not available	£30,000

Project	Business Case	Status	Next Step	Expected Cost
In-service monitoring on Eurostar (phase 1) (Birmingham University/MoniRail) –	Better decision making leading to reduced whole-life costs. Better informed asset management decisions - the right intervention at the right time. Potential reduction in track recording frequency if degradation can be tracked using acceleration data.	Completed		£20,107
In-service monitoring on Eurostar (phase 2) (Birmingham University/MoniRail) –	See above	Completed		£50,000
In-service monitoring on Eurostar (phase 3) (Birmingham University/MoniRail) –	See above	Continuation of Phase 2	Fit to second vehicle in May 2023. Evaluate use cases with supplier for BAU.	Approx. £38,000
Remote monitoring of S&C (Birmingham University/MoniRail) –	Better understanding of the root cause of geometry issues and component failures. Validation of potential monitoring techniques with a view to developing a viable product.	In Progress	Data from 2076 points limited due to good ride quality. Equipment to be moved to a second trial site to prove use case.	Approx. £25,000
Infrastructure monitoring using MPV –	A survey of the infrastructure could be carried out rapidly using the existing multi-purpose vehicles as a platform. This would reduce the number of staff lineside, improving safety and would also significantly reduce access requirements. Automating inspection will allow for better utilisation of staff in	Proof of concept trial has been completed. Further trials planned.	Invitation ITT for one year trial completed and tenders returned, which are currently under evaluation.	£50,000 (Original Trial) £25,000 (2-month extension =£75,000

Project	Business Case	Status	Next Step	Expected Cost
	addressing the risks identified or more detailed targeted examination.			
Digital bridge inspections (Waldeck) - civils	Capture the condition of bridge assets using scanners and photogrammetry to create a 3D cloud point model to better visualise the condition data, leading to improved asset management decision making.	Completed		£45,787
Probabilistic approach to high-speed data sets (University of Edinburgh) –	By modelling the deterioration rate of different track sections against their characteristics and maintenance intervention history, more intelligent algorithms could be built to predict the optimal time frames for maintenance interventions such as manual packing, tamping and ballast cleaning. This would allow resources to be better utilised and would increase the life of assets where maintenance is more frequent than required.	Complete	Research provided proof of concept. Results to be presented at Railway Engineering Conference in June 2023. Discussions in progress with University of Edinburgh to develop this approach through a second PhD and provide recommendations for CP4 maintenance strategy	Engineering support
Fibre Optic Acoustic Sensing (FOAS) –	The objective of the HS1 use case is to investigate the pertinence of using the Fibre Optical Acoustic Sensor technology, to determine a condition factor to trigger interventions on Point Operating Equipment, and Switch and Crossings.	In Progress, going through procurement.	Contract to be signed with Thales for the main part of the project, and Jensen-Jensen for the fibre work to support implementation	£296,212.20

Appendix 5. Renewals Cost Tables

The Excel spreadsheets which accompany this Final AMAS show breakdowns of route and stations renewals cost performance on a project-by-project basis. The route breakdown is in line with that agreed with the ORR for CP3.

- ORR CP3 Station Renewals Portfolio Tracker Yr 3 Q4.
- HS1 AMAS ORR CP3 Y3 Q4 2022-23 Report v1.0

A summary of the revised route renewal project budgets following the output of the work bank review process has also been provided as an accompanying PDF. This provides a record of the revised project budget authorities. The figures shown are the base cost Anticipated Final Costs (AFC) and exclude Risk, RPI Inflation, PMO and NR(HS) Mark Up.

Where projects are still in development stage, the estimate has been developed with best endeavours and may be subject to change and subject to completion of design, site condition surveys or supply chain conditions.

Appendix 6. Route Financial Reporting

Collection and Application of OMRC payments

All values in nominal £ million

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

As at Period 13 2022/23

STATEMENT 1: ANALYSIS OF O&M FINANCIAL PERFORMANCE

	Actuals YTD	CP3	Variance Fav/(Adverse)
Income			
Operations and Maintenance	58.3	61.8	-3.5
Pass through	21.2	21.7	-0.5
Total O&M income	79.5	83.5	-4.0
Cost			
NRHS	47.2	47.2	0.1
Subcontract	3.5	4.3	0.9
Internal	12.3	10.4	-2.0
Sub total: Controlled costs	63.0	61.9	-1.0
Pass through costs	21.3	21.7	0.4
Freight	0.4	0.4	0.0
Total O&M Costs	84.6	84.0	-0.6
Net Performance Regime Cost	-0.0	0.0	0.0
Net Position			
Net income / (spend)	-5.1	-0.5	-4.6

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

As at Period 13 2022/23

STATEMENT 2: ANALYSIS OF O&M INCOME												
	Actuals YTD				CP3				Variance Favourable / (Adverse)			
	EIL	SET	Freight	Total	EIL	SET	Freight	Total	EIL	SET	Freight	Total
Operations and Mtce	15.5	42.3	0.5	58.3	21.8	39.8	0.2	61.8	-6.3	2.4	0.3	-3.5
Pass through	3.7	17.6	0.0	21.2	6.3	15.4	0.0	21.7	-2.7	2.2	0.0	-0.5
Total O&M income	19.2	59.8	0.5	79.5	28.1	55.2	0.2	83.5	-9.0	4.6	0.3	-4.0

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

As at Period 13 2022/22

STATEMENT 3: ANALYSIS OF O&M COSTS

	Actuals YTD	CP3	Variance	Notes
NR(HS)	47.2	47.2	0.0	N/A
BTP	0.9	1.2	0.2	Note 1
NGC Connections fees	0.3	0.6	0.2	Note 2
NRIL costs	1.6	1.8	0.2	Note 3
GSMR	0.3	0.3	0.0	N/A
ORR regulatory and Safety	0.3	0.5	0.2	Note 4
Total Sub-contract	3.5	4.3	0.9	
Staff Costs	6.2	5.2	-1.0	Note 5
Technical Support/Consultancy	2.6	1.6	-1.0	Note 6
Office running costs	1.4	1.3	-0.1	Note 7
Other Costs	1.9	1.8	-0.2	Note 8
R&D	0.1	0.5	0.3	Note 9
Total Internal	12.3	10.4	-2.0	
Total Controlled Track Costs	**63.0**	**61.9**	**-1.0**	
Insurance	3.6	3.5	-0.1	Note 10
Power non EC4T	2.6	2.1	-0.5	Note 11
Rates	8.7	9.7	1.0	Note 12
UKPN Fees and Renewals	6.4	6.5	0.1	Note 13
Total pass-through	21.3	21.7	0.4	
NR(HS)	0.1	0.1	0.0	
NRIL costs	0.2	0.2	0.0	
HS1 costs	0.1	0.1	0.0	
Total Freight	0.4	0.4	0.0	
Total OMRC	**84.6**	**84.0**	**-0.6**	

Note 1: BTP £0.2m underspend

We continue to challenge the cost of our Police Service Agreements with BTP, with the aim of delivering the right level of security and policing at an efficient cost by deploying the right blend of BTP and security resources. This has led to an efficiency saving of c£0.2m

Note 2: NGC connection fees £0.2m underspend

This accounts for UKPNs connection charge. NGC connection fees are £0.2m below CP3 budget due to lower national grid fees as there was lower power usage as demand for trains was impacted by the Covid recovery.

Note 3: NRIL costs £0.2m underspend

5YAMS budgeted a higher number than actual invoices received from Network Rail. There has been a lower level of heavy maintenance on interface assets due to the recovery from Covid and impact on maintenance.

Note 4: ORR regulatory and safety £0.2m underspend

The 5YAMS budget assumed ORR costs would rise given the high risk of litigation from EIL. This has not yet materialised with lower regulatory fees and safety levy billed by ORR. This was partially offset by additional ORR fees for annuity relief exploration and stations transfers. There also remains a risk of EIL litigation.

Note 5: Staff cost £1.0m overspend

The CP3 plan for HS1 was a steady state and the Covid-19 Pandemic significantly increased the complexity of the HS1 business. There was a need to increase headcount to manage the additional work that was caused by the following:

- volume reopeners and ongoing underpin as a result of lower train volumes.
- increased use of spot bidding and resulting invoicing including strike billing and TOCs querying invoices
- active cash and supplier management to maintain liquidity.
- stakeholder relationships requiring more regular dialogue.
- customer challenges around the regulatory framework
- regular forecasting in the volatile market to ensure debt obligations were met.
- Escrow management
- added audit complexities.

In addition to the increased headcount, staff costs have increased due to the following reasons:

- Retention incentives were required for some non SMT staff or high performing staff members to provide certainty through the volatile period including benchmarking salaries
- Due to maternity cover (roles X2) and long-term leave HS1 has required fixed term contractor support to ensures roles were filled. Market rates for salaries have increased in excess of the levels set at CP3. To remain competitive in the current market, where there has been staff turnover, new joiners have started on higher market rates. To support retention in key functions we had to conduct salary reviews to match market rates, this also manifested with turnover in positions
- SMT changes, with an additional SMT, Finance Director, until July 2022 and a regulation and strategy director for 3 months from January

HS1 is actively reviewing the structure to ensure it is appropriate for CP3 and beyond, with examples of leavers not being replaced where the role can be absorbed and provide development for the current team to aid retention. In real terms (Feb 2018 Prices) staff costs are forecast to fall by £0.6m by FY24/25 prior to the completion of the efficiency review, reducing the gap to the original CP3 budget to £0.3m.

Note 6: Technical Support/Consultancy £1.0m overspend

The overspend on technical support and consultancy costs was driven by HS1's need for resilience with the additional business complexities arising from the response to Covid. This response was a mixture of covering for staff who were moved into driving the HS1 response, and consultancy to help improve efficiency in order to reduce costs/prevent future cost increases. Significant drivers:

- £0.3m of Finance consultants due to staff churn while permanent hires were found interims were hired to maintain service and manage the concession. This cost is expected to return to baseline in FY24. In Engineering we have had to take on a consultant CIO to support the review of IT and support the requirements in cyber risk management as critical national infrastructure. There has also been additional support for the COO on Renewal projects and Procurement Portal License.

- £0.3m of Specialist legal support required for items such as Employment advice as well as Procurement support to manage Electricity procurement in the core team etc. This is not an ongoing spend.
- £0.1m of CBRE rates advice. The Rateable Value has doubled so HS1 has spent a significant amount of money in an attempt to reduce the costs borne by the TOCs. This is not an ongoing spend.
- £0.1m of Regulation modeller to assist through Covid uncertainty to deliver the changes to the planned CP3 model refresh. We had planned to do this in house but could not find the right skillset for such a specialist task and recruited an interim resource to complete this which was unplanned. This is not an ongoing spend.
- Unbudgeted recruitment spend from staff churn

In real terms (Feb 2018 Prices) Consultancy Costs are forecast to reduce by £1.0m by FY24/25, reducing the gap to the original CP3 budget to £0.6m. The consultancy spend will reviewed in detail by the end of CP3.

Note 7: Office running costs £0.1m overspend

There has been a significant increase in Software and Support Costs, specifically in relation to Cyber Resilience and compliance with critical national infrastructure requirements. As a key piece of UK infrastructure, and with the risk of cyber-attacks raising, HS1 has invested in our IT systems to ensure they are robust and secure. This investment was not included in the 5YAMS submission. There was an investment in better virtual communication tools over covid and many of these costs continued into FY23.

Note 8: Other costs £0.2m overspend

This overspend is primarily driven by increased spend on environmental initiatives as HS1 has been focusing on sustainability and raising the Company's profile in this space. Investment in the control period includes developing our ESG reporting and other assessments and strategy reviews. This work has been particularly valuable in preparation for TCFD reporting. Refer to section 3.2.3 for further detail on HS1's sustainability strategy.

Note 9: R&D £0.3m underspend

R&D is a timing variance. Refer to section 4.1 for detail on the Research and Development programme.

Note 10: Insurance £0.1m overspend

In FY23 there was an unbudgeted increase in Route and QX insurance. The cost of insurance has also been driven up by cyber security, which is covered by very few insurance policies. For the last renewal HS1 was faced with a hard market with the global benchmark set for Q3 2022 at an average 15% increase in premium across all categories of insurance. HS1 continue to work closely with its broker Marsh to manage and limit the increase in premiums whilst balancing adequate cover. In FY23 the insurance costs have increased by 9% which is below the market increase.

Note 11 : Power non EC4T £0.5m overspend

Higher electricity prices started to pass through to TOCs during the year, leading to an overspend versus CP3 budget of £0.5m in the year. The increase in wholesale energy price was mitigated to some extent by our Corporate Power Purchase Agreements (CPPAs) (see section 7.8.1) and HS1's hedging strategy that locked in cheaper prices until 30 September 2022. However, from 1 October most of our cheaper electricity hedges had expired, leading to a sharp increase in prices. We continue with our electricity buying strategy that combines gradually locking "over the counter" electricity with long term fixed price CPPAs from renewable power assets. This strategy was supported by TOCs but given recent market volatility and high prices, we will be reviewing the hedging strategy to ensure it is fit for purpose, as part of a planned tendering process for our electricity supply contract.

Note 12:Rates £1.0m underspend

The rates revaluation was delayed and the rates multiplier was frozen for two years meaning no increase versus RPI increase assumption in the 5YAMS. However, work is ongoing to minimise the increase from 2023 onwards. See 7.8 above.

Note 13: UKPN Fees and Renewals £0.1m underspend

The underspend has been achieved in the UKPNs connection charge (NGC fees) due to lower power usage and total costs from the National Grid.

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

As at Period 13 2022/23

Statement 4: Analysis of the Escrow Account Route

	Actual	CP3 * to Period 13	Variance
A) Reconciliation of movements in period to 31 March 2023			
Opening balance current account	16.9		
Opening balance investment	84.9		
Deposits Maturing	(91.9)		
Deposit Placed	107.0		
Total Escrow b/fwd	116.9	100.9	16.0
Transfer In	34.3	28.9	5.3
Interest	0.4	1.2	(0.8)
Total transfers in	**34.7**	**30.1**	**4.6**
Drawdowns	(9.4)	(17.4)	8.0
Service Charge	(0.0)		(0.0)
Total drawdowns	(9.4)	(17.4)	8.0
Closing balances	127.1	113.6	28.6
**** Summarised Balances**			
Escrow Current Account as at 31 March 23	27.1		
Escrow Investments as at 31 March 2023	100.0		
Total Escrow Cash	127.1		

* Data relates to 13 periods in Year 3 of CP3 only.The CP3 amount is based on the total renewals, expenditure for CP3 allocated evenly across all periods. An alteration was made to the CP3 phasing of budgeted balances in this report relative to the draft AMAS. (Previous method assumed just a flat phasing of opening balances).
The section on Renewals Delivery provides a more detailed assessment.
Basis of funding:
Monies collected from TOCs is transferred to the escrow account in the period in which it is received
The above is only for Route and does not include Staions, which is in line with the concession agreement

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

As at Period 13 2022/23

Statement 5: Upgrades — Actuals 22/23

i) Analysis of Specified Upgrades and other upgrades HS1 has carried out in respect of the Review Year

In £m nominal

	Period Ending 31 March 2023			Cumulative since 01/04/2020			
	Actual	CP3	Difference	Actual	CP3	Difference	Total CP3
Specified Upgrades	0	0	0	0	0	0	0
Other Upgrades	0	0	0	0	0	0	0
Total Upgrades	0	0	0	0	0	0	0

ii) Analysis of Specified Upgrades and other upgrades HS1 intends, or is required, to carry out in respect of the Year followint the Review Year

in £m nominal

	Period Ending 31 March 2023			Cumulative since 01/04/2020			
	Actual	CP3	Difference	Actual	CP3	Difference	Total CP3
Specified Upgrades	0	0	0	0	0	0	0
Other Upgrades	0	0	0	0	0	0	0
Total Upgrades	0	0	0	0	0	0	0

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

As at Period 13 2022/23

Statement 6: Net Debt

in £m

	Actual	CP3	Difference
A) Reconciliaiton of net debt at 31 March 2023			
Opening Net Debt	0	0	0
Income			
	0	0	0
Expenditure			
Total Expenditure	0	0	0
Financing			
Total financing costs	0	0	0
Closing Net Debt	0	0	0

Commentary:

The charging model assumed no debt. The charges are based on the principle that HS1 recovers its Operating & Maintenance costs in full over the life of the control period. Should significant and material variations occur, and it is agreed with the ORR that the additional costs should be logged up, then it is anticipated that this page would be used to record the logged up charges and any associated finance costs. To date there have been no significant and material events, and none are anticipated.

Appendix 7. Stations Financial Reporting

All values in nominal £ million

HS1 Limited

Asset Management Annual Statement

Collection and Application of LTC payments for each Station

As at Period 13 2022/23

Statement 8: Escrow account summary in Current Account £m

St Pancras	Account
Opening Balance	5.4
Receipts	7.8
Withdrawal	(2.8)
Interest	0.1
Service Charges	(0.0)
Deposits Matured	31.5
Deposit Placed	(36.8)
	0.0
Closing Balance	5.2
Investments	33.5
Closing Balance	**38.7**

Ebbsfleet	Account
Opening Balance	1.5
Receipts	1.7
Withdrawal	(0.8)
Interest	0.0
Service Charges	(0.0)
Deposits Matured	9.5
Deposit Placed	(10.4)
	0.0
Closing Balance	1.5
Investments	7.5
Closing Balance	**9.0**

Stratford	Account
Opening Balance	1.2
Receipts	1.3
Withdrawal	(0.8)
Interest	0.0
Service Charges	(0.0)
Deposits Matured	7.7
Deposit Placed	(8.5)
	0.0
Closing Balance	1.0
Investments	6.5
Closing Balance	**7.5**

Ashford	Account
Opening Balance	1.1
Receipts	1.0
Withdrawal	(0.1)
Interest	0.0
Service Charges	(0.0)
Deposits Matured	7.0
Deposit Placed	(7.9)
Closing Balance	1.0
Investments	5.5
Closing Balance	**6.5**

HS1 Limited

Asset Management Annual Statement

QX income and costs for each Station

As at Period 13 2022/23

STATEMENT 9: ANALYSIS OF STATIONS QX				
	As at P13, Financial Year 2022/23			
	YTD	Budget	Var	Var %
St Pancras	21.0	22.0	1.0	4%
Stratford	3.3	4.0	0.7	18%
Ebbsfleet	3.7	4.3	0.6	14%
Ashford	1.8	2.2	0.4	18%
Total Stations QX	**29.9**	**32.6**	**2.7**	**8%**