

HS1 Asset Management Annual Statement 2021/22



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1 Executive Summary

The rail industry has continued to experience a significant impact from the COVID-19 pandemic over the last year with a large reduction in passenger numbers and staff shortages. The year also finished with the threat of industrial action, our customers, the train operators, are feeling the financial impact of the pandemic and Spending Review like never before and Rail Reform is gathering pace. All this points to the need to think differently and embrace the change that is inevitably coming to deliver an outcome that brings benefits to all those that are part of the HS1 system.

Despite this context, HS1 has had another successful year. The excellent operational performance that HS1 is known for has been maintained; only five incidents accumulated over 200 minutes delay and 71% of days were delay free. Renewals delivery is improving, in particular, the renewal of the data transmission network is going well and there was a successful set of renewals of track and section insulators over Christmas. There has, however, been some delay in route renewals and we are working with NR(HS) to recover this and provide assurance that all works will be delivered in CP3.

The HS1 team continues to drive opportunities to deliver efficiency and reduce costs for train operators. NR(HS) is currently going through an organisational review to design its target operating model; getting the right organisation in place is an important enabler for the delivery of long-term operations, maintenance and renewals efficiencies.

We are progressing our plans to create a more effective and efficient approach to long term renewals delivery, building on the work undertaken in CP2. In the first phase of work this year we created a programme blueprint and business case. The second phase commenced in January 2022, and will look at savings or improvements that can be delivered in CP3, create an efficient 40-year renewal plan, create the new delivery enterprise and bed it in ready for CP4. Our electricity purchasing hedging strategy has insulated train operators from £34 million of price rises from April 2021 to March 2022 compared to a strategy of locking prices just before delivery.

Our CP3 research and development programme has progressed this year with circa £1.4 million now committed to projects ranging from short term tactical initiatives to long term university research and foundational technologies to support our asset information strategy towards a more data-driven approach to decision making.

On sustainability, HS1 has made significant progress in all six of our priority areas and published our first environmental, social, and governance (ESG) report. We are actively involved in industry working groups as we share knowledge and expertise. In November 2021, we hosted a landmark workshop at the World Climate Summit's The Investment COP at COP26 where we discussed how we can achieve a modal shift to high-speed rail.

We have completed Phases 1 to 3 of our structure of charges review and plan to publish our conclusions on Phase 3 shortly. We will be considering next steps in the context of heightened cost pressures due to the continuing pandemic and the Spending Review.

Planning for Periodic Review 24 (PR24) has started with HS1 working closely with NR(HS). Our Joint Steering Group has agreed the outline governance structure and endorsed the asset management workstream activities which are now underway. We are also working with DfT and ORR to look to transfer regulatory oversight of the HS1 station assets to the ORR.

COVID-19 continues to have a significant impact on the rail sector as a whole and the recovery in passenger demand remains uncertain. The number of train services operated in the last two years has been significantly below forecast leading to a significant reduction in HS1 revenue. The pandemic has had

a lasting impact on train operators; we have initiated discussions with lead train operators, ORR and DfT to consider system solutions that can help to address the significant cost pressures faced by train operators and grow demand.

HS1 Authorisation and Approval

HS1 Authorisation	Comments
<p>On behalf of HS1 Limited, I authorise this HS1 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.</p>	
Name:	Dyan Crowther
Role:	Chief Executive Officer, HS1 Limited
Signature	
Date	27/05/2022

HS1 Approval	Comments
<p>On behalf of HS1 Limited, I approve this HS1 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.</p>	
Name:	Richard Thorp
Role:	Director of Engineering and Sustainability, HS1 Limited
Signature	
Date	27/05/2022

Prepared by	Comments
<p>This HS1 Asset Management Annual Statement (AMAS) has been prepared in accordance with the Concession Agreement between HS1 Limited and the Secretary of State in schedule 10, section 6.1.1.</p>	
Name:	Joanne Parkes
Role:	Head of Asset Management, HS1 Limited
Signature	
Date	27/05/2022

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2 Context

2.1 Purpose

The purpose of this Asset Management Annual Statement (AMAS) is to provide assurance to the Office of Rail and Road (ORR) and the Secretary of State that HS1 Ltd is fulfilling the Asset Stewardship obligations as defined in the Concession Agreement between HS1 Ltd and the Secretary of State in Schedule 10, Section 6.1.1 Asset Stewardship and Periodic Review. As an annual document delivered during Control Period 3 (CP3), the AMAS is also an important part of the contemporaneous evidence to demonstrate how we are delivering against our 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 annual report on HS1 Ltd.

This is the second AMAS of CP3. It covers the year 2021/22, outlining our successes and challenges over this period, and highlighting our plans for the future.

Although there are no specified reporting obligations for HS1 stations assets currently defined in either the Concession Agreement or the HS1 Lease between HS1 Ltd and the Secretary of State, information is voluntarily provided for stations assets as part of our harmonised approach to asset management and this document is voluntarily shared with the Department for Transport (DfT). We are looking to make the reporting in the AMAS more formal with the transfer of stations regulation to ORR.

Additionally, while there are no specified reporting obligations for HS1 defined in the Track Access Agreements between HS1 Ltd 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, are:

- HS1 Ltd submits the Draft AMAS to the ORR by 18 February 2022 (30 business days before year end); and
- HS1 Ltd submits the Final AMAS to the ORR by 31 May 2022 (45 business days after year end).

2.2 COVID-19 Recovery and HS1 System Challenges

COVID-19 continues to have significant impacts on our business, customers and suppliers. Emergence of new variants, further lockdowns and restrictions and ongoing uncertainty dampened the recovery in passenger demand and services that started in mid-to-late 2021.

Our processes and practices, and those of our suppliers, to respond to COVID-19 and government requirements have been well embedded, which has allowed us to manage evolving conditions and restrictions more efficiently and effectively. COVID-19 has had no significant impact on performance or on operations and maintenance in 2021/22. The impact of COVID-19 on site works has led to delays in a small number of renewals projects; we are working with NR(HS) to recover this delay.

However, the significant and lasting impact of the pandemic has heightened challenges for train operators and all other parties in the HS1 system. These challenges include:

- Lower passenger demand for TOCs – working from home means less commuting and business travel, and uncertainty around restrictions affected leisure demand for most of the year;
- Fewer services on HS1 raises costs per service for TOCs and DfT (via the underpin payments);
- The impact of the Spending Review and economic conditions on train operators' and DfT's finances;
- Sharp increases in energy costs with significant impacts for users of the HS1 system;
- Challenges for contractual frameworks within the HS1 system, which present an opportunity to consider change to support the current economic climate;
- Funding for big technology changes (ERTMS) and climate resilience, as well as the St Pancras station roof are currently unfunded liabilities; and
- Great British Railways reform will lead to significant change across the wider rail sector with a strong focus on efficiency and cost reduction which will have an indirect impact on the HS1 system.

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 – train operators (both TOCs and FOCs), the ORR, DfT and HS1 – 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. To achieve this, we have initiated discussions with these stakeholders to formulate a system strategy and examine potential solutions – we are not able to deliver this on our own. We will need to look at how we all work together differently in PR24 and CP4 and this will form part of our planning and preparation for PR24 (see Section 5.5.3). We are also considering what we can do to drive further cost savings for TOCs in CP3, such as providing relief on renewals charges.

3 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.

3.1 Safety

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 footfall at stations.

Figure 1 shows the total route and station FWI per million hours worked. Overall workforce FWI for 2021/22 was 0.064, compared with the target of 0.030. There were seven lost time injuries, of which five were RIDDOR lost time events of more than seven days, for the NR(HS) workforce and contractors, compared with zero in the previous year. NR(HS) is regulated by ORR; however, HS1 monitors a range of activity and outcome indicators which include FWI. We identified that some of the activity indicators were adverse to target and challenged NR(HS) to consider further action. In response, NR(HS) has looked to drive safety ownership within the organisation into the business functions. This has been achieved by developing locally owned safety plans supported by the safety function rather than being owned by the safety team. These plans will be reported in the NR(HS) Periodic Safety Report.

The most notable of the RIDDOR reportable events was a member of station staff falling into an under-escalator shaft which has resulted in over 100 days lost time to date. A Level 1 investigation was undertaken which resulted in an action plan being implemented with elements including: an enhanced inspection regime, a review of risk assessments to adequately cover the risk of falling from height, a review of lighting in all plant rooms, a review of warning signage and a review of site safety briefings, including contractor briefings. The ORR also undertook an investigation and wrote to NR(HS) with supporting recommendations; actions are being addressed and dialogue continues with the ORR. Another significant incident was associated with a contractor working on replacing the UPS batteries in lineside buildings which resulted in 12 days lost time due to a burn to the hand; an internal investigation was carried out and suitable recommendations were identified and implemented. NR(HS) has increased its assurance activities around this work activity.

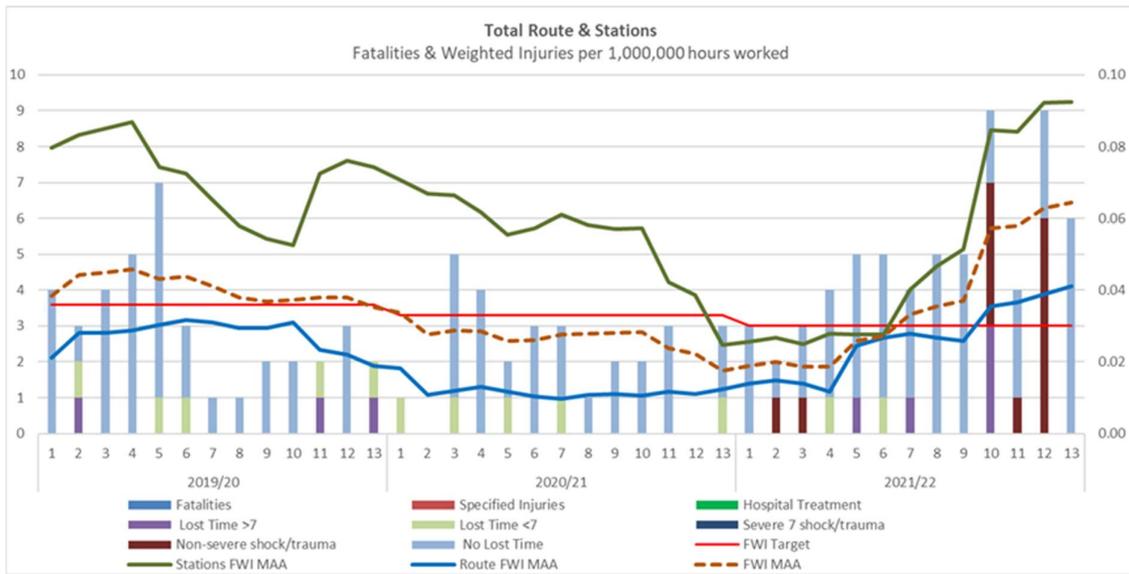


Figure 1 – Route and stations FWI per million hours worked (excludes Ashford International)

The passenger FWI is shown in Figure 2¹ for St Pancras International, Stratford International and Ebbsfleet International. The passenger FWI for 2021/22 was 0.031 across all areas of the stations and 0.021 for the NR(HS) managed areas, which is better than the threshold of 0.040. The large decrease seen in Period 12 is due to a passenger RIDDOR event at the end of the previous year moving out of the moving annual average (MAA). The stations locally owned safety improvement plans include passenger safety and will target key risks such as escalator and slip, trip and fall accidents.

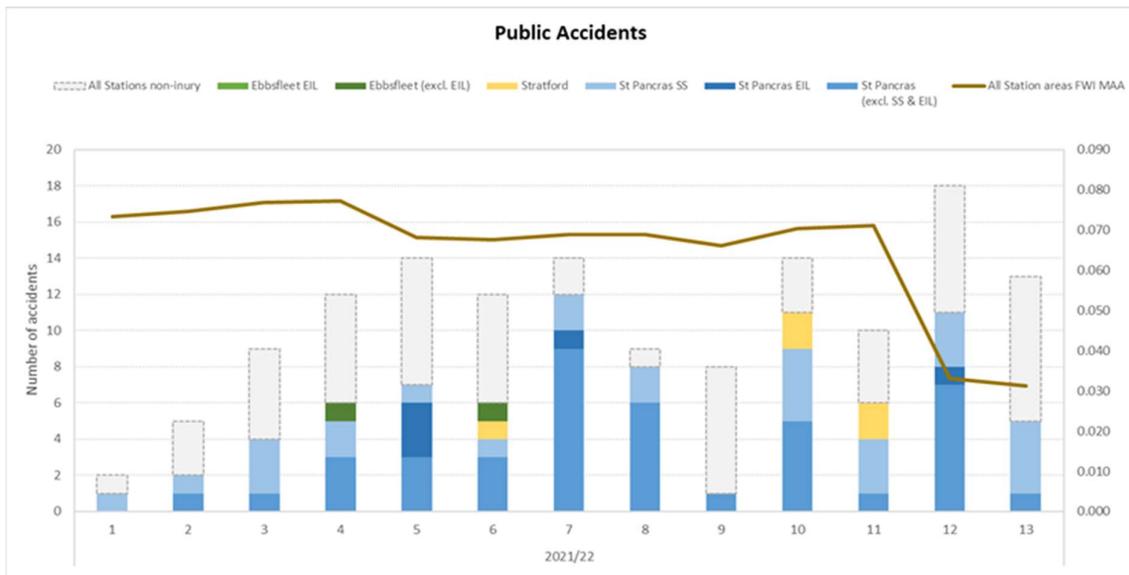


Figure 2 – Passenger FWI per 10,000,000 passenger footfall at stations

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 the year.

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 11 years since the last lost time incident. There was a RIDDOR reportable dangerous occurrence on 3 May 2021 at Ashford Nadir substation. The incident resulted in a flashover within the electrical equipment; there were no injuries and minimal damage to equipment.

3.2 Trespass and Security

Figure 3 shows the number of trespass incidents over the last three years. For the majority of 2021/22 trespass incidents did not cause any significant delay; the exception was an incident in Period 12 with a trespasser on the roof of a Eurostar train at St Pancras International. 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 stakeholders to increase success. Risk assessments have been undertaken for all sites with repeat trespass incidents.

During 2021/22 there were 29 operational trespass incidents (route and stations) compared with 26 for the previous year. Six of the incidents caused train service delays, accruing 597 minutes of delay. Delay per incident (DPI) was 21 minutes, compared with 41 minutes in 2020/21, showing the success of the strategy that has been put in place to deal with service recovery.

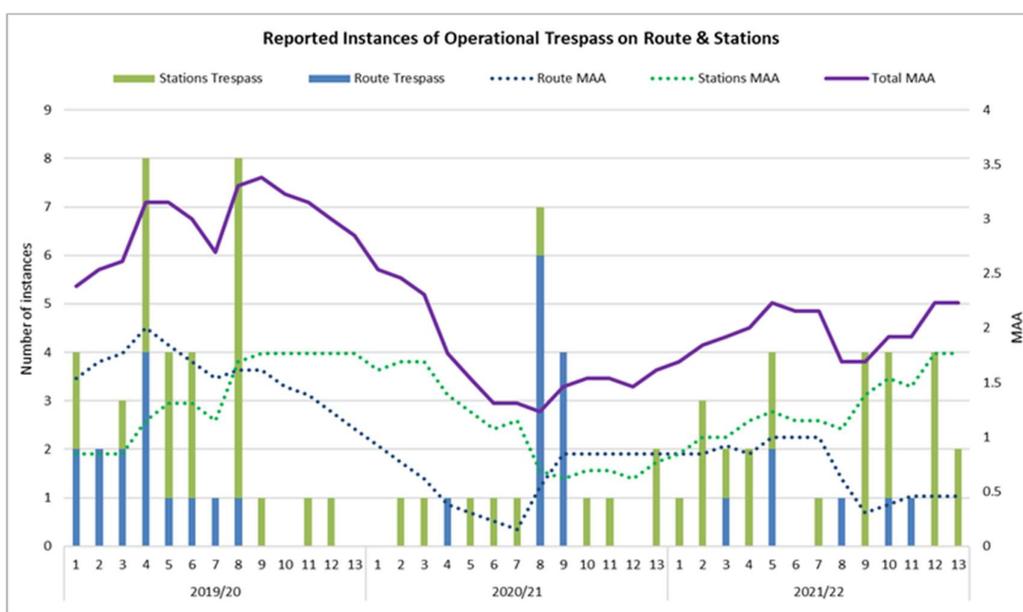


Figure 3 – Reported instances of operational trespass on HS1 route and stations

Trespass events are varied in nature and causes can range from mental illness to fare evasion. The main reason for the trespass incidents (excluding those incidents where the reason is unknown) is repatriation of individuals trying to return to the European mainland via Eurostar. At St Pancras International, the Champagne Bar has been redesigned to remove stepping aids which could allow individuals to gain access to the Restricted Zone and onto a Eurostar train. Further alterations to the Champagne Bar are planned to increase the security of the Restricted Zone.

Following an increase in trespass events during 2020/21, linked to immigrants attempting access to the UK in the Purfleet area, additional cameras were introduced to monitor high risk locations and fencing alterations made at some of these hotspots; these interventions have helped to reduce the number of route trespass incidents. NR(HS) continues to work with the BTP and HS1 Ltd to assess whether further mitigation is required at specific locations.

A new trend of “drop down” trespass events has been seen; this is when a person drops their phone or other personal item on to the track and “drops down” on to the track to recover it rather than asking staff for help. This accounted for seven of the 29 reported trespass events during the year (24%). To address this increasing trend, further training was provided for station staff so that they could safely retrieve dropped items rather than asking passengers to wait until the end of train services to have their items returned.

NR(HS) is continuously reviewing risks and adjusting plans to address any new risks that are identified. This review, in combination with data and information collected, will support any changes/enhancements to the fencing arrangements across the infrastructure if required.

A new bulletin has been introduced, with a weekly crime report highlighting current hotspots not only for trespass but for crime in general; this is distributed to the mobile operations managers, Land Sheriffs, BTP and others. In 2020/21, graffiti was a significant issue on HS1, with noticeable peaks during the COVID-19 lockdowns. While it continues to be an area of focus in 2021/22, there has been a reduction to levels closer to those observed in 2018/19 and 2019/20. The BTP Griffin presentations have now been replaced by monthly See Check and Notify (SCaN) presentations which are carried out virtually via MS Teams relieving the pressure on releasing staff to attend in person. These are available for all HS1 system users.

3.3 Operational Performance

3.3.1 Route Performance

HS1 is a high performing railway and current performance substantially exceeds the targets we have set for NR(HS) under the Operator Agreement. During 2021/22, performance was very strong across HS1 infrastructure with a total of 3,485 minutes delay against a target of 6,500 minutes (46% better than target). The excellent performance in providing resilient infrastructure is also reflected in the 260 delay-free days recorded in the year; 71% of days have been delay-free. There have also been five delay-free weeks in the year, outperforming the yearly target.

Figure 4 shows the moving annual average seconds delay per train for all incidents on HS1. MAA delay per train was 4.16 seconds in Period 13, compared with the target of 6.80 seconds, although it is recognised that Eurostar in particular ran significantly fewer train services during the year. The reduction in traffic on the railway means that incidents naturally attract fewer minutes. We also measure a number of other lead and lag indicators and believe that underlying route asset performance remains high.

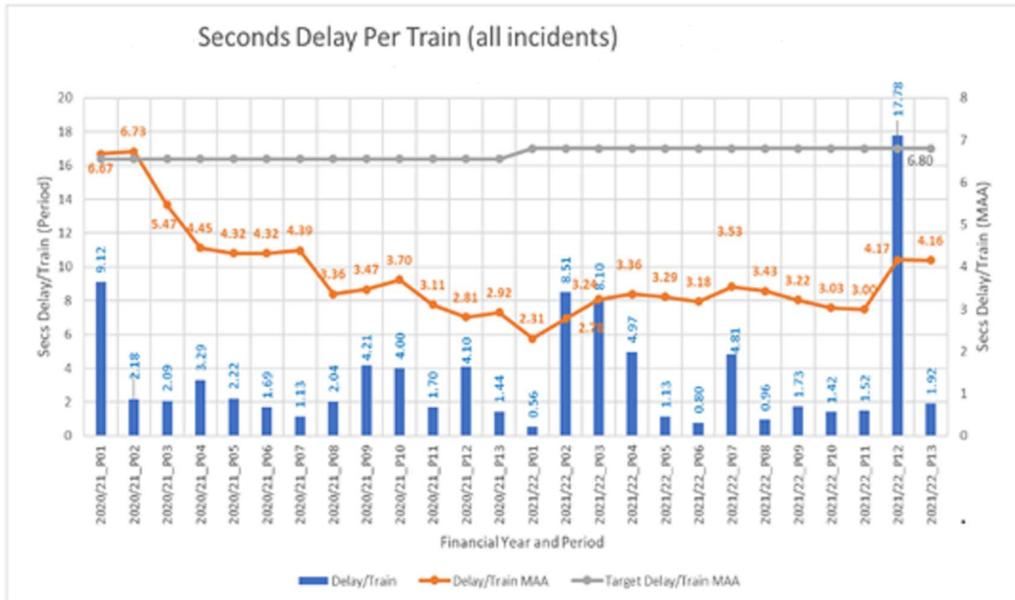


Figure 4 – Route delay per train for all incidents (including non-infrastructure)

We report all incidents that cause more than 200 minutes delay. In 2021/22, there were five such incidents, as shown in Figure 5.

Period	Date	Delay (Mins)	Incident
Period 2	16/05/2021	498	Track circuit failure at St Pancras International caused by water ingress through a seal in a location cabinet. A condition survey was undertaken to check all seals in similar assets to prevent similar incidents. No issues were identified.
Period 3	10/06/2021	373	Points failure caused by a damaged Paulve supplementary detector at Stratford International
Period 7	21/09/2021	292	Track circuit failure at Wennington crossover caused by a tamping machine cutting a cable during a possession
Period 12	16/02/2022	424	Trespass at St Pancras International involving a person on the roof of a stabled Eurostar train
Period 12	04/03/2022	619	OHL failure (caused by a bird's nest) between Wennington crossover and Ebbsfleet International West

Figure 5 – Significant incidents >200 mins delay

3.3.2 Stations Performance

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

In response to COVID-19 NR(HS) completely changed the way that they delivered cleaning operations across the stations, bringing in enhanced cleaning regimes, focusing on high touch points and commonly used areas and introducing autonomous cleaning devices to further enhance delivery. NR(HS) has continued to deliver this highly effective cleaning regime in the HS1 stations and the use of autonomous

cleaning devices is now a requirement for any new cleaning contract. As government guidelines changed through the year, we continued to review efficient and effective ways of working, including our new technology, ensuring we focused on the best changes identified over the previous year to meet our customer and staff expectations.

Figure 6 shows the station cleaning audit scores for the three stations managed by NR(HS). Cleaning audit scores for all three stations have been above target, with an overall average score for the year of 97.24%, demonstrating that the team has continued to perform extremely well in challenging circumstances as passenger numbers varied through the year in response to changing government restrictions.

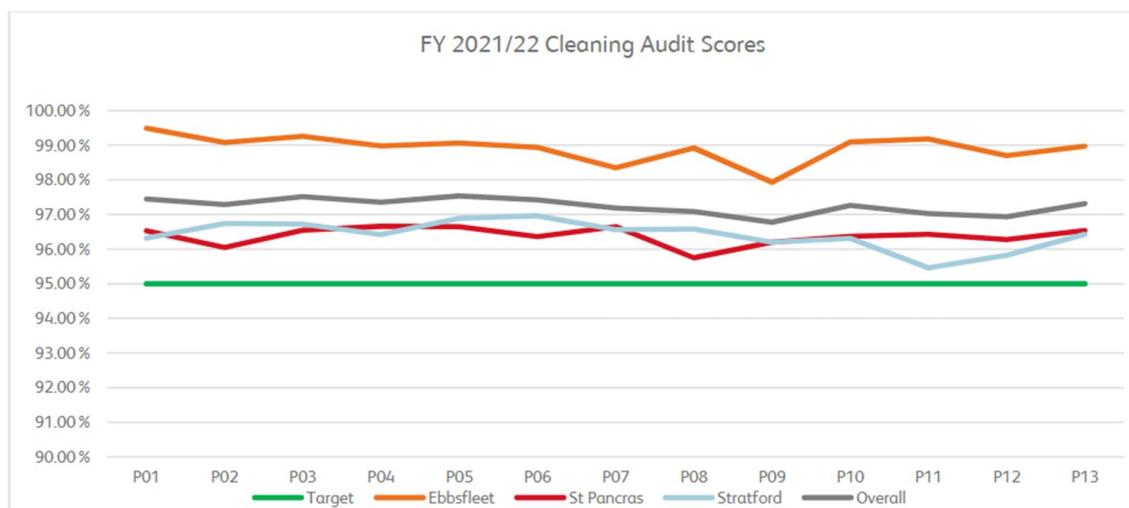


Figure 6 – Station cleaning audit scores

Figure 7 shows the availability of passenger lifts, escalators and travelators for the three stations managed by NR(HS). The availability average for the year was 99.13% against a target of 98%, an impressive achievement given the ageing nature of the asset base. All asset groups performed well, with lifts averaging 98.62%, escalator assets 99.14%, and travelators 99.64%. There was a dip in lift availability in Periods 3 to 5 because of issues with the car park lift at St Pancras and the ability to get parts from the continent. Significant refurbishment activity started on these assets during Period 10, and the programme will run through to 2024. During the refurbishment works we will ensure that the delivery teams, including the affected TOC, have an agreed operational solution that allows them to continue to deliver acceptable availability and passenger service. We developed a scheme for an additional lift at St Pancras as part of the renewals scheme but have so far been unable to gain support for funding this; we continue to discuss with SE Trains.

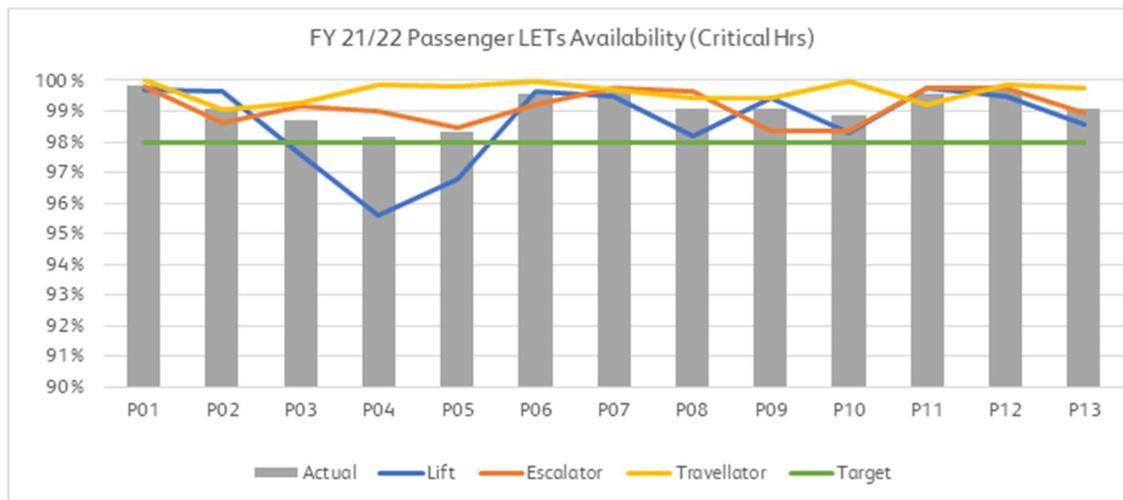


Figure 7 – Availability of lifts, escalators and travelators

At Ashford International, Mitie continues to provide enhanced cleaning focusing on touch points. The concourse lift and escalator remain accessible to customers. The contractual Schedule 8 SLA and KPI's have scored 100% throughout the year.

As a result of COVID-19, Eurostar has not operated train services through Ashford International or Ebbsfleet International since March 2020. The international stations remained open throughout, providing access to domestic train services and car parks within and adjacent to the international stations.

Eurostar is not expected to recommence services at Ashford International or Ebbsfleet International until 2023. We 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 commencement of services when needed.

3.3.3 UKPNS Asset Performance

UKPNS assets continued to perform well with availability of 99.9960% for the year, beating the target of 99.9885%. There was a 21 minute interruption of power on 18 July 2021 at Choats Road; the most likely root cause was a spurious overvoltage event which caused a circuit breaker at Choats Road to trip affecting the 'up' power cable feeding the HS1 railway.

4 Asset Management

4.1 Asset Management and Asset Information

This year has been a productive year for HS1 and its strategic partners in asset management. We have integrated some of our main CP3 commitments into business as usual, such as the Research and Development Panel and the monitoring of our CP3 business improvement initiatives. We have revised our Asset Management Policy, developed an HS1 portfolio-level Strategic Asset Management Plan (SAMP) and commenced our preparations for CP4. We have completed some of our primary innovation and research and development initiatives. We are pleased to see that our strategic suppliers have invested more resources and effort into digitalisation initiatives, a critical enabler to support delivery of efficiencies and improve decision making for medium- and long-term asset management planning, in alignment with HS1's Asset Information Strategy. An example is the asset information improvement roadmap that has been developed by the NR(HS) stations team, discussed below.

4.1.1 Asset Management Capability Improvement

Updated Asset Management Policy: In Q3 2021/22, we reviewed and refreshed our Asset Management Policy as one of the first steps in developing a medium and long term plan aligned with the latest objectives of HS1 and our customers. The updated policy is included in Appendix 3. It reflects the changes in the industry brought about by the COVID-19 pandemic, and the industry response to different market needs. There is a stronger emphasis on finding the right balance between the costs and benefits our assets deliver to passengers, local communities, businesses, and the environment. In addition, sustainability and interoperability are key elements of the policy.

HS1 Portfolio-level SAMP and Revised Asset Management Objectives: In line with our commitment to improve asset management capability and increase alignment and line of sight across the entire HS1 asset portfolio, we have developed an HS1 portfolio-level SAMP which covers the entire asset base: route, stations and car parks. The HS1 SAMP will guide our strategic partners in developing their strategies. 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 performance. In line with our organisational strategy and new Asset Management Policy, we include sustainability in our AMOs.

Stations Asset Management Improvements: Last year NR(HS) started work to improve the maturity of its stations asset management system with the aim of achieving ISO 55001 certification in 2023. Initial activities included an assessment of the existing processes and documentation to identify major gaps against ISO 55001. This has enabled the production of an asset management roadmap, which includes asset information improvements, to develop a station-specific asset management framework aligned with the wider HS1 framework. The roadmap is split into three phases, with completion in September 2023 when certification activities will start. 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 Section 5.2.1), and increase linkages between qualifying expenditure (Qx) and life cycle reports (LCRs) to maximise value from assets.

4.1.2 Delivery of CP3 Business Improvement items and Final Determination Recommendations

In the first year of CP3, we extracted from PR19 and other documentation all of our CP3 business improvement initiatives and commitments, including the 28 asset management amber recommendations in the ORR final determination. 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.

Figure 8 summarises the status of the ORR’s 28 amber recommendations on asset management. We provide quarterly updates on these to the ORR. A summary of progress against each of the 28 recommendations is set out in Appendix 3.

Action/timescale	No.	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 2022	9	Seven completed. We are making good progress on the last two commitments and are providing quarterly updates to the ORR.
Due after March 2022	3	We have made good progress on each of these commitments. Two are ongoing actions over the duration of CP3.

Figure 8 – Summary of progress against ORR’s amber recommendations

4.1.3 Asset Information

In 2021/22 we continued 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 we will take to get there. Progress this year has included the following activities:

- We successfully established the Asset Information Governance Group (AIGG) and absorbed it into business as usual activity (see below);
- 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) plans to complete them by October 2022 for route and March 2023 for stations;
- We have made progress towards compliance with ISO 19650 (see the ProjectWise section below);

- We 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. This includes the collation of 60-80% of the required Asset Information Strategies, as well as improvements to the HS1 Asset Data Dictionary for stations and car parks to include asset criticality, asset condition scoring and asset degradation. We have worked collaboratively over 2021/22 to assist our strategic partners in integrating the requirements of v3.0 of the HS1 Asset Data Dictionary for stations and car parks.
- Information Lifecycle and Building Information Modelling milestone areas continue to progress, alongside software, where all strategic partners are working daily with their respective CAFM systems, and the implementation of mobile applications to aid field data collection are in progress.
- Audit and Assurance milestone areas are tracking well, with the station asset information quality audits for Mitie and NR(HS) being completed in December 2021 (see below).

In 2021/22 we established the **Asset Information Governance Group (AIGG)**. The group meets quarterly, to discuss progress against the HS1 Asset Information Objectives. The AIGG terms of reference were agreed in August 2021. In the first two sessions, we engaged with strategic partners to understand their progress in developing asset information standards, procedures and processes. We have also developed an Asset Information Working Group with the NR(HS) stations team, to allow HS1 and NR(HS) to track and report progress against NR(HS)'s station asset management improvement roadmap into 2023.

Station asset information quality audits for Mitie and NR(HS) were completed in December 2021. The Mitie audit found that station asset information for Ashford International is being well managed and Mitie is on course to achieve ISO 55001 certification in 2022. NR(HS) has developed a roadmap to improve how station asset information is managed; the audit found that there was a structured approach to the development of the asset management system, with the plan in place for being ready for ISO 55001 certification in 2023. Strong points in the NR(HS) plans included ensuring alignment with HS1 requirements and flowing these requirements down to the NR(HS) Tier 1 supplier frameworks.

ProjectWise is our common data environment, holding all information relative to the design, construction and operation of our asset base. Our supplier delivered a ProjectWise reconfiguration report in April 2022. This will allow us to create and tender upgrade work packages throughout the course of 2022/23 to ensure ProjectWise is ISO 19650 compliant. Following this, we will implement an ISO 19650 compliant CAD-BIM standard, which will flow through to ISO 19650 compliant Project and Asset Information Requirements (PIRs and AIRs respectively). Completing this package of works will ensure consistency and accuracy of our information and increase availability and access to asset information.

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. During the NR(HS) Listening Programme the functionality of the system was raised as a concern; in response the Asset Management team initiated a review and upgrade of the tool.

The upgrade aimed to improve the utilisation of the eAMS software by creating a better user experience, streamlining some of the current processes and reducing the administrative demands on frontline teams. In addition, the upgrade would address some of the existing configuration issues which would enable improved data quality and digital data collection. With the implementation of the mobility app, the system would be available to users anywhere and, due to its offline mode, would allow actions that are completed when not connected to the internet (such as in tunnels) to go through once the device reconnects. The project entered the systems integration testing stage during Q4 2021/22. It was found that the DFF (descriptive flex fields) in the app, which allow users to define the information to be captured, are extremely limited and will not provide enough information for work requests; Oracle currently has no definitive plans to upgrade the DFF. NR(HS) was therefore unable to prove the use of the eAMS mobile app as a viable option.

NR(HS) also 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. This assessment supports the conclusions of the eAMS upgrade project. NR(HS) will prioritise planning to deliver on this recommendation in 2022/23 as opposed to trying to further enhance eAMS capability.

4.2 Health, Safety and Assurance Improvements

4.2.1 HS1 Health, Safety and Assurance

The HS1 Health, Safety and Assurance Strategy was reviewed in March 2021 to ensure that it remained relevant for HS1. The strategy is linked to the Safety Sub-Committee and its delivery is an HS1 Board objective for the year. The strategy has three core components: bowtie assessments, assurance and RM3.

- **Bowties:** In 2021/22, the bowties were further developed with critical controls identified and evaluated across all bowties. Reviews of key bowties have been carried out following events to better understand weaknesses and ensure that the assessments remain relevant.
- **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.
- **RM3:** RM3 remains the core approach to driving maturity improvements within HS1 and the supply chain. We have targeted seven spokes of RM3 improvements over CP3. This year we have worked on improvements across many of the bowties and we expect to see increased levels of maturity when we do our assessment early in 2022/23.

Following the first stewardship report on the effectiveness of the joint HS1/NR(HS) Assurance Board in December 2020, the recommendations were reviewed and where appropriate, implemented. Areas identified for focus during 2021 included greater identification of accountabilities and integration across HS1 and NR(HS). The Manchester Arena Attack Inquiry reports were reviewed for lessons that could be learnt not only for security management but also for wider assurance. The Board has focused on guarding against complacency and how we address 'unknown knowns' through remaining curious and demonstrating leadership in our own organisations.

Building on the completed CP3 commitments, the independent chair of the Assurance Board undertook an annual review and produced our second stewardship report in December 2021; this was submitted to the HS1 Safety Sub-Committee for review. This has now become an established process within HS1 and one that we intend to continue.

The HS1 Business Continuity Plan (BCP) has been tested considerably over the last few years through both Brexit and COVID-19 responses and was deemed suitable and sufficient for the business. The BCP is regularly reviewed and a test was carried out for our crisis management team in the spring. In addition to being involved in BTP tests, we will be working with NR(HS) to undertake an immersive test later in the year.

We monitor 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 3.1 and 3.2. A summary of performance against other key metrics is set out in Figure 9.

Metric	Result to P13 2021/22
Workforce FWI	0.064 against a target of 0.0
Irregular working	Rate of 0.059 against an MAA target of 0.6
Passenger FWI ²	0.021
Safety tours	16 SMT tours against a target of 16
HSA Strategy plan	All milestones were met with two requiring follow-up action
RIDDOR	6 events (5 NR(HS) and 1 UKPNS)

Figure 9 – 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.

4.2.2 NR(HS) Safety Task Force

The four workstreams identified as part of the NR(HS) Safety Task Force last year continue to be driven forward with good progress being made across all the areas. The work is largely complete but, due to the complexity of method statement production/updates, some areas are yet to be finalised.

Standards & Controls: The NR(HS) Standards Steering Group 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.

Safe Working Practices: There has been a full review of the method statements in use by frontline teams, with all documents being revised and updated in line with the associated standards and ensuring that the

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.

task methodology is fit for purpose. A draft NR(HS) 019 Standard document has been produced and is with key stakeholders for review. Work is underway on the production of an NR(HS) Safe System of Work Pack.

Competency & Training: There has been a full review of internal and external training received by each of the NR(HS) teams over the last four years. For frontline teams, this will feed into the work that is being carried out by the Professional Heads, to review the competency requirements in NR(HS), ensuring that the level of training is adequate and to the required standard.

Assurance: As part of the work to strengthen NR(HS) worksite assurance, a site inspection timetable has been created with site visits and actions tracked in the CMO system. A Level 1 and Level 2 assurance map has been created. Assurance activity (Level 1 and Level 2) has been mapped, risk assessed and a proposed course of action for improvements proposed. The Engineering Verification (EV) Programme has been agreed across the disciplines, with all disciplines having provided their EV plans to the Assurance Manager and these are being captured in CMO.

NR(HS) remains committed to the use of RM3 as an assessment and improvement tool. During 2021/22, the Safety Task Force project workstreams have used RM3 to identify improvements. RM3 rollout at a delivery level has commenced; the first stage involves awareness and briefing sessions to the operational management team within the stations. The aim is that the application of RM3 in assessing business processes will help support the station safety improvement plan. The level of maturity can then be assessed and improved upon. The safety team is working with the stations leadership team to facilitate the RM3 self-assessments using a workshop approach; this will enable valuable discussion on the RM3 categories and drive the normalisation of responses for a more accurate assessment. Once the briefings and workshops have been completed, the next stage will be practical rollout as a tool to manage change. RM3 self-assessments across other NR(HS) business areas, including operations and maintenance, will follow a similar approach.

An assessment was undertaken in 2019 with a number of NR(HS) Exec members and results captured in the 'RM3 Report NR(HS) 2019', with a number of improvement areas identified. HS1 carried out RM3 audits on NR(HS), which supported the Level 3 assurance activities. The audits were external validation of the RM3 self-assessment undertaken by NR(HS). A similar exercise is planned for 2022 where HS1 will undertake an RM3 (deep dive) independent assessment of NR(HS) ; this is part of a five-year RM3 audit programme.

4.2.3 Other NR(HS) Safety Improvement Activities

Introduction of Sentinel: Sentinel has been used on Network Rail and other rail infrastructures for many years and its introduction on NR(HS) was a theme from the NR(HS) Listening Programme. Sentinel was implemented in May 2021 and fully operational in July 2021. The Sentinel card acts as a passport for colleagues working on railway infrastructure, ensuring that anyone working has the basic competence to do so and is medically fit. Key drivers for the project were GDPR requirements around medical fitness data access, site access control centre delays to access, and the recommendation from the Bridgeway Consulting review of training and competence in NR(HS). Sentinel is considered the 'single version of the truth' with additional benefits around fatigue management and lone worker safety included in the application. Benefits include:

- Real time checking of fitness and authority to work;
- Swipe in and out, recording pre-start safety briefing and for risk assessments where there is less than 12 hours between shifts;

- Site access can be granted with a forgotten card twice a year, after which access is denied; and
- Track visitors permits replace dispensations and cannot be used where competences on the Sentinel card have expired.

Fatigue Risk Management Standard Implementation: NR(HS) is obliged to meet the requirements of the new NR Fatigue Risk Management Standard 003 by October 2022; the new standard will apply to all employees across NR. There are currently 12 workstreams live within the project and there is regular engagement with both functional and trade union representatives. The workstreams cover areas such as roster design and implementation of a rostering system; rollout of new forms and templates; reporting and assurance processes; required training and communications.

The biggest area of concern that has dominated the work this year is the conflict between the fatigue standard and existing contracts of employment in the maintenance teams. NR(HS) is engaging with other regions to explore potential solutions. The stations and operations teams had planned to deliver compliant rosters ahead of the October 2022 compliance date; however, due to complications with the booking of annual leave, these rosters will now be launched in January 2023. This will require NR(HS) to submit a short temporary deviation from the standard.

The second major workstream is the procurement and implementation of a digital rostering system. In order to be compliant with the standard, a digital rostering solution is required to actively manage rosters, fatigue triggers and exceedances in real time and to meet all of the reporting requirements. Implementation of this system is being managed centrally by NR and NR(HS) is actively engaging in this process. Although this system is required to effectively manage fatigue, the project falls outside the fatigue standard scope; it is intended to replace NR's current rostering system with implementation planned for summer 2023. NR(HS) will begin work in 2022 to ascertain what processes need to be put in place to ensure compliance to the standard before implementation of the digital rostering system. Discussions have also commenced about how NR(HS) will manage fatigue of its non-rostered staff, who are outside the scope of the new system.

All other workstreams, including guidance and templates, training and reporting and assurance processes are progressing and will pick up pace in 2022 ahead of the October compliance date.

Migration from OHSAS 18001 to ISO 45001: NR(HS) has successfully completed the migration from OHSAS 18001 to ISO 45001, a new management system standard for occupational health and safety management. The main change is a shift to a holistic approach to safety risk management integrated with core business processes. There is now further emphasis on the NR(HS) leadership team's commitment to taking an even greater active and visible role in safety, and consulting with non-managerial colleagues to ensure their participation. This means that frontline teams must be involved in establishing safety programmes, evaluating their outcomes, and developing improvements. They must also be involved in identifying training needs and evaluating the effectiveness of training. The award of international management system certifications is a significant milestone for NR(HS) towards completing the foundations upon which the organisation can develop into a centre of expertise for high-speed rail.

Improving manual handling tasks: NR(HS)'s manual handling trainers visited NR(HS) in July 2021; key manual handling exercises and training sessions took place at various locations on HS1. These were filmed and made part of the briefing material for NR(HS) employees. The videos form part of a suite of manual handling training videos, developed as preventative training material to reduce accident frequency. NR(HS) experienced a lost time RIDDOR reportable manual handling accident, related to passenger mobility

assistance, following which that video was re-briefed to the station Customer Support Assistants. There have been no further accidents of this type since the re-briefing.

4.3 Sustainability

4.3.1 HS1 Sustainability Strategy

Environmental and social sustainability is critical to the future success of our business. In our 2020/21 AMAS, we reported on the launch of our HS1 Sustainability Strategy. This strategy set out our plans for assessing and improving our performance on sustainability in six priority areas.



Figure 10 – Sustainability priority areas

For each priority area, we have set targets to 2030 and developed roadmaps showing our plans to deliver on these targets. We published a detailed ESG report in 2021 which outlined our performance in 2020/21 and plan to publish annual reports going forward.

We are actively involved in industry and local working groups as we share knowledge and expertise. We have helped shape rail industry sustainability strategies by taking an active part in the Sustainable Rail Executive and Leadership forums which help to ensure that we are aligned. Notably in November 2021, we hosted a landmark workshop at the World Climate Summit's The Investment COP at COP26 where we discussed how we can achieve a modal shift to high-speed rail in partnership with the HS1 system.



Figure 11 – The COP26 Climate Train

4.3.1.1 Transparency

We have started to develop and roll out a reporting dashboard for targets and KPIs across our priorities and we are working with our supply chain to implement this across our business. We have included our sustainability progress in periodic reports, board/quarterly reports and in our first ESG report, [Delivering the Green Gateway](#). This report highlights achievements over 2020/21, the first year of the strategy, and sets out plans for the coming years.

The Task Force on Climate-related Financial Disclosures (TCFD) has developed recommendations designed to help companies improve and increase reporting of climate-related financial information in the areas of governance, strategy, risk management and metrics and targets. We included our first disclosure against the TCFD recommendations in our last ESG report and will be maturing this report to meet all of the recommended disclosures over the coming years.

4.3.1.2 Climate Change and Adaptation

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 have measured our baseline carbon footprint and identified our carbon 'hotspots'; this has enabled us to identify priority areas for action and develop a carbon reduction plan.

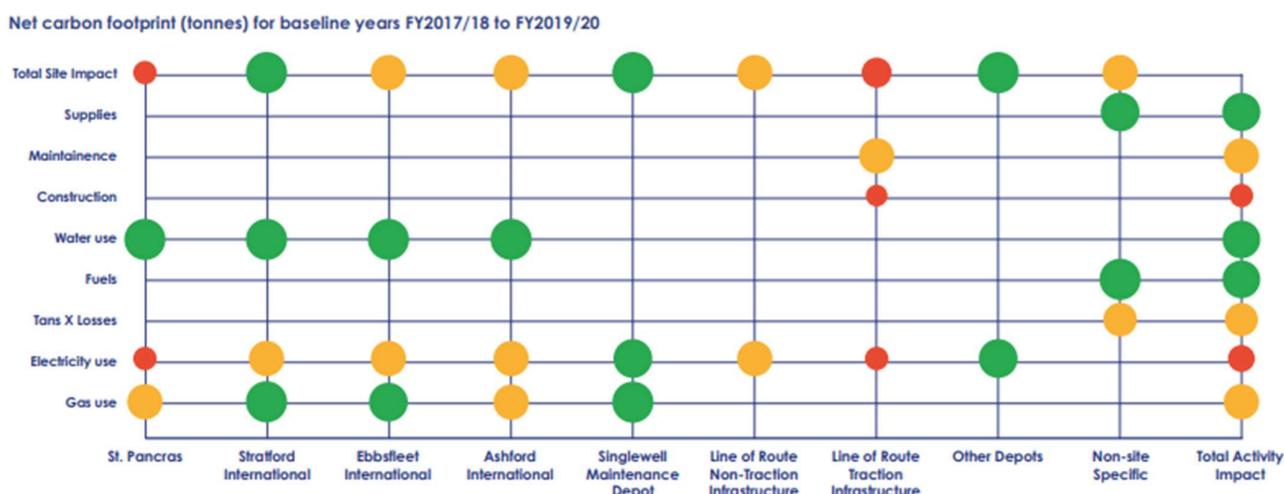


Figure 12 – Our baseline carbon footprint

As part of our work to ensure as much as possible of the energy used on HS1 is renewable, we have recently activated our first trade using a 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. These CPPAs are part of our broader green energy work, which focuses on moving away from securing green electricity through general Renewable Energy Guarantees of Origin (REGOs) – which can be subject to wild price volatility – to securing a majority of our green energy through CPPAs, which provide greater price certainty. By 2024, we hope to have built up our portfolio of CPPAs for renewable electricity to a level that covers the majority of our baseload requirements.

Our risk management framework now includes a sustainability risk at a corporate level, recognising the need to manage climate-related risks. We are completing a Climate Change Risk Assessment (CCRA) which will inform our mitigation plans. We have voluntarily reported under Adaptation Reporting Power round three; we have submitted our CCRA and report to the Government.

4.3.1.3 Energy Use

We have developed an energy strategy which, in addition to procuring green energy, aims to maximise energy reduction opportunities. We are also focusing on passenger utilisation in order to reduce the energy use per passenger.

We have built a consolidated list of all energy initiatives. We have started to implement these initiatives, delivering a range of energy consumption reduction projects including:

- Ongoing optimisation of heating and chilled water generation control;
- Various optimisation tasks on each site's Building Management System including improved pump control, more accurate time schedules and temperature control for air conditioning, ensuring our main heating and cooling plant does not operate in the non-heating and cooling seasons, and better use of demand-based supply of air;
- Air handling unit optimisation; and
- Various areas of energy management improvement through expert consultancy.

The estimated aggregate annual savings from these initiatives are:

- Electricity 806 MWh
- Gas 261 MWh

We are working with SE Trains on the implementation of regenerative braking on the domestic rolling stock to reduce net energy consumption (see Section 4.3.3).

4.3.1.4 Resource Use and Waste Impacts

We are 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. We now include our resource use and waste data in our internal corporate dashboard and require all construction project suppliers both for HS1 and our supply chain to report their waste data. We are reviewing our waste portfolio and developing standards for our project suppliers. In April 2021, we started a trial to monitor and control the waste coming through the Midland Road Service Yard used by station retailers, the hotel and for station operational waste which is allowing us to target our improvement activities.

Our construction and refurbishment projects use large quantities of materials, and we will ensure we follow industry best practice. We have reviewed our specifications for construction materials, including the approved/banned lists. We identified best-in-class, environmental-based material standards and have developed and published our own materials standard for our construction, fit-out and refurbishment projects.

We are 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.

4.3.1.5 Biodiversity

We manage 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 we have an obligation to protect and enhance the lineside habitat.

Our partners NR(HS) and Kent Wildlife Trust (KWT) are surveying our natural assets to develop a baseline. The survey has identified that a Biodiversity Net Gain (BNG) of 20% is achievable by 2030/31 and we have implemented a 10-year biodiversity improvement plan in partnership with KWT and NR(HS).

We have created a Biodiversity Action Plan (BAP) with KPIs for the next 20 years, agreed a BNG metric and a Protected Species Protocol. The BAP identifies key objectives, targets, and KPIs and provides a series of Landscape Focus Areas (LFAs) with an overarching management plan demonstrating from start to finish how KPIs can deliver real gains for wildlife, in a way that makes best use of our existing resources. NR(HS) has translated these documents into its own maintenance standards thereby embedding good biodiversity management into the maintenance of the railway.

4.3.1.6 Social Impacts

We demonstrate our leadership by providing a positive contribution to the communities in and around our stations and lineside, by giving our time and expertise to enable those communities to flourish. We will continue to contribute time, expertise and resources in order to build and sustain thriving communities around our infrastructure that are good places to work, live and do business. We will continue our current work with organisations such as Urban Partners which we help to fund as one of its members and will identify additional partner charities which align to our Sustainability Strategy and support the work they do. For 2021/22, HS1 employees provided 736 hours of volunteering time, meeting the 2022/23 sustainability strategy target a year ahead of plan.

We work to understand our noise impacts and put in place a mitigation plan to reduce the noise levels and impact on our neighbours where necessary.

We will look to identify a suitable social impact methodology against which to report our impacts, beyond just the hours we contribute.

4.3.2 Coalition for Climate Resilient Investment (CCRI)

HS1 has joined the Coalition for Climate Resilient Investment (CCRI), a COP26 initiative supported by over 100 institutions (including institutional investors, banks, insurance companies, rating agencies and governments). CCRI aims to address how the mispricing of physical climate risks manifests in investment decision-making. HS1 is a case study, which is an exciting opportunity for HS1 not only to support a global project but to gain valuable insight and information in return from climate change experts associated with CCRI. We have completed analysis of the track infrastructure to better understand the potential risks associated with projected climate change. To build upon this work, we have commissioned a full climate change risk assessment on the HS1 infrastructure which, when completed in April 2022, will inform future maintenance and renewals plans.

4.3.3 Regenerative Braking and On-train Metering

SE Trains achieved its commitment to install on-train meters (OTM) on all Class 395 units by 31 March 2022 and has another commitment to implement regenerative braking by 30 September 2022. We are working with SE Trains, and other stakeholders where appropriate, on these workstreams.

The introduction of **regenerative braking** on HS1 will significantly reduce power consumption, reducing our environmental impact and supporting the HS1 Sustainability Strategy. Phase 1 of this project is to enable regenerative braking on the SE Trains Class 395 train fleet. A study by Fraser Nash in 2017 estimated the following benefits:

Power consumption	Finance
Down by 12.5GWh	£1.3 million annual saving
16.5% of total used by CI 395s	£6.74 million NPV over 10 years

Figure 13 – Estimated benefits of enabling regenerative braking on the Class 395 train fleet

It should be noted that, if sustained, the recent increases in electricity prices will lead to much greater annual savings that would increase the NPV and reduce the payback time.

To implement regenerative braking on the Class 395 fleet, the following activities are required:

1. Conducting electrical system monitoring, protection, harmonic and electromagnetic compatibility studies, to support acceptance testing and authorisations;
2. Modifying the Class 395 trains, including upgrading software and installing in-train metering; and
3. Testing the upgraded trains and authorising their entry into service.

In October 2020, DfT agreed in principle that activities 1 and 3 can be funded through the route escrow account (with activities under 2 being covered by SE Trains directly).

HS1 has entered into a contract with UKPNS for delivery of the assurance activities and UKPNS is also overseeing the project management for delivery of the whole project. UKPNS has appointed an Engineering Manager to lead the project, developed a detailed programme of actions required from other stakeholders, and engaged with key suppliers and partners. UKPNS has undertaken the detailed modelling required and has shared the results with National Grid. The test plan was developed in conjunction with SE Trains and NR(HS) and the test trains operated successfully in March and early April 2022, with all relevant feeding configurations simulated. No significant issues were encountered. The next stage in the implementation process is to present the data from the test programme to the NR(HS) Safety Review Panel (SRP). After SRP approval, the next key project milestones are regen-enabling all 29 units during September 2022 and project completion in October 2022. Regular update meetings are taking place to track progress of this important project.

The installation of **OTM** will allow HS1 to charge SE Trains for traction electricity based on metered consumption rates. HS1 currently charges operators for traction power based on modelled consumption rates, but it is recognised that using OTM gives a more accurate representation of the power used. The OTM project also acts as an enabler for the regenerative braking project as it allows the electricity saving to be applied to SE Trains and hence drives the business case for the investment. SE Trains completed the installation of meters on its trains in March 2022 and has spent recent weeks updating firmware and improving the GPS on a few of the units. Work is also underway on data collection and transfer to NRIL and to ensure it can be processed by NRIL and NR(HS) before being passed to HS1 for billing processes.

The HS1 **Passenger Access Terms** (PAT) make no provision for OTM or regenerative braking and we are in the process of drafting the required changes. Any change to the PAT has to be agreed by all parties and approved by ORR. As part of this process, we will analyse the data and processes thoroughly to ensure the

robustness of the system and the accuracy of the data from all trains before the move to OTM can be sanctioned. It will also be necessary to establish a system usage percentage to apply to OTM data to allow for the power used by the electrical system between the fiscal billing meter and the meter on the train. This workstream is underway between HS1 and UKPNS.

4.4 Asset Capability and Condition

4.4.1 Route Capability

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 pandemic and 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.

4.4.2 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.

In 2020/21, we collaborated with stakeholders to make significant changes to the NR(HS) station management structure, improving competencies, which enhanced both operations and engineering capability. These changes enabled a step change in the delivery of station operations in 2021/22 with operational, maintenance and renewals activities being delivered at a reduced cost, which is directly attributed to the ability of the management team to identify combined work packages linked with risk. This improved relationships with all stakeholders due to a realistic understanding of business objectives and cost control. The station management team continues to ensure that stakeholder requirements are foremost in any discussion or works plan which continues to ensure that the railway operates 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 MEP and Building Fabric contract came into operation mid 2021: CBRE undertook a period of mobilisation with support from an NR(HS) contractor to ensure a smooth transition and that station MEP statutory and mandatory requirements were delivered. CBRE worked with the NR(HS) management team to ensure no PPM or reactive works order was missed within the early mobilisation stages and within the first few periods of the new contract which continues to deliver 100% of their works KPIs.
- The SIN002 works that were commissioned and completed in early 2021 were all risk reviewed and identified clearly within the CAFM work bank which was completed in late 2021 meaning all assets identified throughout the process now have a specific PPM. This has reduced the risk of future

incidents and ensured that we can clearly identify asset condition as the full PPM includes collecting such data.

- We commissioned an external project delivery technical review and condition assessment for lifts, escalators and travelators. The review identified a reduced intervention requirement and a prioritised renewals programme based on condition; we are using this data to reduce future failure rates as assets in poorer condition will be repaired and replaced earlier. The requirements document was used by NR(HS) to procure the renewals contract.

We recognise the significance of the Grade I listed St Pancras International station as a 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 which we deliver through two specialist advisors who focus on all station projects and specifically retail projects which has ensured that both change in the station 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 was sought for works and all required Heritage Deed approvals (Listed Building consent) were secured in a timely manner to ensure station works could proceed as planned.

4.4.3 *Route Asset Condition*

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

Figure 14 shows the current asset condition scores within the NR(HS) eAMS by asset type, comparing it 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. It can be observed that a significant proportion of the assets are entering the 'near service limit' state, mostly due to obsolescence, and this is being addressed by the renewals programme in CP3. 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.

● CP3 5YAMS **Percent of Assets in each condition status by department**
● 2021/2022 Condition: 1 - As New ; 2 - High reliability ; 3 - functions ; 4 - Near Service Limit ; 5 - Functional Failure



Figure 14 – Breakdown of asset condition by asset type

As part of the implementation of ORR’s 28 asset management amber recommendations, the route SASs now also outline forecast asset condition at the end of the concession and in 40 years. Forecast asset condition is one of our research areas and will improve as more data becomes available for use in improving degradation models. This will help make asset interventions more timely, efficient and effective.

4.4.4 Stations Asset Condition

Station assets are generally performing well and within their expected condition. The targeted survey of lifts, escalators, and travelators ahead of procurement for the CP3 renewals works found that in general their asset condition was better than expected which allowed the team to tailor the scope of work.

We are seeing some structural issues at St Pancras, notably the transition roof, where we have been managing minor leaks over previous years; these have increased in severity and are causing issues on the platforms and concourses below which are being managed with the TOC and NR(HS). Ongoing investigations have initially identified movement within and between the transition roof and the main deck extension roof structure, probably either caused or exacerbated by the movement of affixed roof gantry assets both above and below; DfT is being updated periodically. We 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.

Following HS1 and NR(HS)’s detailed review of NR(HS)’s FSI Concept system in 2019/20; NR(HS) has rolled out a mobile-friendly FSI Concept application which three of its Tier 1 contractors are now testing on

site. The current target date to deploy the application to the entire supply chain is June 2022. This will allow the engineering teams to work in real time when delivering PPMs and respond more quickly to reactive works. As well as an increase in data capture, data quality and reliability will be increased enabling greater asset performance thanks to the digitalisation of processes and tools transitioning from paper-based solutions, with a key advantage being asset condition scoring. This will improve the tracking and impact of PPMs and reactive interventions supplying greater granularity of operating expenditure, ultimately strengthening the link between operating and capital expenditure.

Mitie has now aligned almost in its entirety its Enterprise Asset Management system (Maximo) with the HS1 Asset Data Dictionary; NR(HS) is also progressing with the integration of the Asset Data Dictionary into its Asset Management System (Concept) functionalities and data structure. Once this enabling work is complete, we will proceed with the procurement of the five-yearly asset condition survey of all HS1 stations. The surveys, carried out by independent consultants, will be complete by the end of 2022 in preparation for the next iterations of the Lifecycle Cost Reports for PR24.

Finally, this year we undertook a review of MEP contracts. To reduce the total cost of the MEP works package (contracted and non-contracted), the non-contracted additional works were reviewed, rationalised and included in the new contract. The final output was a saving on the overall combined (contracted and non-contracted) cost.

5 Key Initiatives and Improvements

This section covers the key initiatives and improvements undertaken over the course of 2021/22.

5.1 Innovation, Research and Development

5.1.1 Research and Development Programme

This year our Research and Development programme, led by the Research and Development Panel, has seen circa £1.4 million 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.

We have also developed three challenge statements in the areas of automated inspection, cross-domain integration, and efficient possessions to succinctly articulate our focus areas to prospective suppliers. We will be progressing this through a series of industry workshops and projects over the coming year.

5.1.2 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 anticipated 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.

A series of trials has been carried out this year, using an array of cameras and lighting fixed to the multi-purpose vehicle (MPV). The MPV passes through the tunnel at low speed whilst the cameras record the condition of the tunnel lining. The data (imagery) is then processed and stitched together to form a model of the tunnel, through which the tunnel condition can be examined remotely using a viewer dashboard. The dashboard has been developed specifically for this application and overlays other asset information, such as the surrounding geology to the section of the tunnel, assisting engineers to make informed decisions.

The initial trials were successful in demonstrating the business case. Through this phase, NR(HS) was able to demonstrate that the condition of each long tunnel asset can be captured in a minimum of six shifts (one per tunnel bore); the current physical inspection method requires approximately 40-50 shifts. However, the image quality in the initial trial was not sufficient to enable NR(HS) to demonstrate the safety case.

An additional trial has now been completed using new hardware, which has shown a significant improvement in image capture. This supports the requirements of the safety case, which is anticipated to be approved by June 2022. Following safety case validation and acceptance, the tunnel vision technology will be integrated into the tunnel examinations process for 2022/23. The data visualisation dashboard is also commissioned and ready for use for asset condition review to support remote examination analysis.



Figure 15 – The MPV with the Tunnel Vision equipment installed recording tunnel condition

5.1.3 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 the PandaScope technology was used to identify the level of ballast degradation and to ascertain how much of the material could be reused. This will facilitate efficiencies both in reducing the consumption of raw materials, thereby reducing carbon emissions, and in 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 taken to deliver the work with resulting safety benefits. 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.

5.1.4 5G Augmented Reality Digital Twin

The 5G Augmented Reality Digital Twin (ARDT) was designed to support engineers in making effective decisions in a virtual environment, a key pillar of HS1's planned digital transformation.

HS1 partnered with PAULEY, NR(HS), Athonet UK and the University of Sheffield, Advanced Manufacturing Research Centre (AMRC) to implement this innovative pilot project, the first of its kind on the UK rail network. Innovate UK provided funding for the project.

PAULEY had already developed and built a simulated digital twin for training, and used the core platform to build on and create the fully integrated digital twin on an augmented reality (AR) headset. AMRC installed

remote sensors to capture and store the data required. Athonet UK installed and set up a 5G network to communicate the data from the sensors to the AR headsets. Three assets were monitored – an HPSS point machine in the St Pancras area, and a public lift and escalator on the station.

The project output was a remote condition monitoring system that facilitated fast diagnosis and reduced unnecessary travel. The low-latency, high bandwidth 4G/5G technology allowed operatives to receive high quality, real-time information at the point of need. It further allowed consideration of timely interventions for pre-emptive repairs which are more cost and time efficient than dealing with unpredicted failure.

The project allowed staff to collaborate from multiple locations, using real time data to monitor the live network and deliver preventative maintenance as required. It proved to be a highly effective remote condition monitoring and training platform that allowed users to understand and interpret faults and view maintenance methods as animations, ensuring they are prepared to act quickly and deliver high quality, one-time fixes – with the enhanced benefit that fixes can be applied before a fault has actually occurred, thanks to the visualisation of real time data.



Figure 16 – An example of how live monitoring data for lifts can be explored to diagnose faults remotely

The pilot project was called a flagship project by Innovate UK and demonstrated timely, accurate remote condition monitoring data insight, to support future planning and accelerated decision making.

This research and development project is now complete. The next step will be to take the findings from this pilot project, and other projects across the HS1 business, and use them to form a wider HS1 technology and digital asset management strategy. This work will start in April 2022 with the aim of finishing by December 2022. The strategy is closely linked to the NR(HS) IT strategy and it will be key to driving our digital transformation.

5.1.5 Open Space – St Pancras Operational Digital Twin

We are continuing with the third phase of the OpenSpace digital twin of St Pancras International station to support both day-to-day operations and forward operational planning. The OpenSpace platform will bring together 3D cameras, CCTV and Wi-Fi system connectivity with artificial intelligence processing to provide

station management and operations teams with digital tools to better understand in real time how people move through the station and implement real time passenger management to reduce crowding and improve customer flow, experience and safety. The system will also assist with planning, for example, with the safe re-routing of passengers when repairing or renewing assets and, when connected to the railway timetabling system, will help with predicting short term station customer operational issues due to train delays.

During the COVID-19 pandemic, we have used the ability of the system to monitor in real time social distancing at the monitored station entry and exit points. This allowed staff to use real data to manipulate gatelines and route passengers to deliver the best possible flow for social distancing requirements.

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

The objective of this project is to capture imagery and lidar data from planned MPV recording runs using modern cost effective and miniaturised sensors, automate large volumes of data processing using machine learning and 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.

A five month trial has taken place; initial results are positive, although some improvement in accuracy is required, particularly OCS measurements. A three month extension of the trial to complete an independent assessment of positioning accuracy and to refine the OCS results has been agreed. Once this is concluded, the next stage of the project will be outlined. Once a safety case for the system can be demonstrated, the anticipated benefits include:

- Improved staff safety: Using MPV maintenance vehicles mounted with remote sensing hardware will facilitate the safe reduction of walking and/or manual inspections;
- Reduced cost of asset inspections by using powerful machine learning technology to automate inspections, asset mapping and surveys of the network and assets;
- Enhanced data-driven decision making: Through more thorough and frequent inspections every asset and section of track will have more available data to make stronger, evidence-based decisions; and
- Optimisation of available maintenance resource and increased available train paths: Reducing the need for additional inspection services and track possessions will allow staff to be redeployed and train operators to potentially run more revenue services.

5.1.7 Digital Bridge Inspections

NR(HS) has been working with Waldeck consultancy to develop a digital approach to capturing and reporting the condition of bridge assets to improve the accuracy and quality of inspections. To investigate whether this approach would provide similar benefits on HS1, an initial project was commissioned to digitally record the condition of eight bridge assets of varying size and form on HS1. A terrestrial laser scanner was used to capture multiple aspects of each structure, with each scan taking millions of measurements of the assets' surroundings to build a 3D environment. The output of the inspection is presented in a 360-degree virtual tour consisting of:

- Colourised and geo-located point cloud; and

- Software-agnostic panoptic virtual tour with embedded engineering commentary of the asset's condition.

To align with HS1's aspirations for the aggregation of a digital twin, the point cloud data sets were also utilised to create a 3D BIM model of each asset, with specific asset codification and metadata requirements embedded within the model. The collection of point cloud data sets was undertaken to determine whether this would enable future, non-subjective comparison, analysis and reporting of an asset over time.

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. This will be progressed following conclusion of the tunnel vision project.



Figure 17 – 3D BIM model of HS1 bridge asset

5.1.8 Overhead Line Equipment in Real Time (OLErt)

The OLErt system uses cameras mounted in the train pantograph well to produce real time images of the dynamic performance of the OLE/pantograph. The images are then processed using visual measurement algorithms, which have been developed by Oxford University academics. The algorithms are integrated with analytical platforms which are coupled with precise positional certainty data, to constantly monitor the dynamic performance of the pantograph contact wire interface. This allows 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 they can cause a potentially disruptive incident.

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.

NR(HS) has been working with the supplier and SE Trains to implement a trial of this system on HS1. However, installation of the hardware for the OLert system is dependent on the planned refurbishment of the on-board CCTV system, which has been significantly delayed and may now not occur until the latter part of CP3. NR(HS) has therefore sourced an alternative product (PANDAS V) which provides equivalent functionality, is self-contained and requires very little interface with the train systems other than a 24V DC power supply. NR(HS) is currently working towards trialling the new product during Q2 2022/23.

5.2 Organisational Readiness

5.2.1 Target Operating Model

The target operating model review examines how NR(HS) needs to modify its organisational design to align all parts of the business and get the right organisation in place to enable the delivery of long term efficiencies. There is a time critical need to understand the holistic changes required to successfully evolve NR(HS) and allow it to adapt as required in the future. This will ensure NR(HS) can achieve its obligations and commitments in the second half of CP3 and in future control periods. There are three initial phases of work:

- Phase 1 (high level design) commenced in August 2021 and completed in October 2021. This phase mobilised an internal NR(HS) working group with representatives across the different functional areas. The working group participated in a schedule of workshops to confirm the strategic objectives and design principles for NR(HS)'s future operating model; validate the challenges with the current operating model; establish the case for change and, through optioneering and testing, recommend the proposed future/target operating model high level design.
- Phase 2 (detailed organisation design) commenced in November 2021 and completed in February 2022. This phase was focused on delivering across the priority improvement areas for the operating model as identified in Phase 1 with workstreams covering performance, technology, structure and people. High level business capabilities were mapped to the proposed target operating model functions. The design principles adopted for the development of the target operating model were cascaded into a set of design principles to underpin the development of the detailed organisation design. A process, capability and systems review was carried out to understand the scale of change required. At the end of 2021, NR(HS) conducted further stress testing and refinement of the proposed detailed organisation design, including affordability, by working through scenarios with key internal stakeholders to increase organisational effectiveness during and post implementation. The outputs of Phase 2 were the core processes assessment and the future organisation design and costings.

- Phase 3, the preparation, and necessary steps for organisation implementation, commenced in March 2022 and is proposed to run to 23 May 2022, the proposed 'go live' date for the new NR(HS) organisation structure. Consultation with the Trade Unions has been successfully concluded and the organisation structure is in the process of being safety validated alongside the people processes. Enabling work to support successful implementation of the proposed organisation structure is being carried out in parallel (process mapping, revised governance approach and technology/systems improvement roadmap). The proposed organisation implementation on 23 May 2022 will cover predominantly management and supporting roles. Frontline maintenance, operations and stations roles will be in the scope of a further review in NR(HS) alongside the national programmes (maintenance modernisation and ²1st century operations) later in 2022 and into 2023. Support will continue for eight weeks post 23 May 2022 to embed new ways of working and to ensure tracking and measurement of benefits is established. The post-implementation review of the target operating model implementation will be carried out in November 2022.

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

During 2021, HS1 and NR(HS) agreed several variations to the Operator Agreement to improve ways of working, develop deeper collaborative relationships, and focus on long term efficiencies to derive greater value in the HS1 system. Based on the reporting NR(HS) has provided to HS1, we have confidence they are on track to deliver the committed efficiencies from the PR19 final determination (the fishbone analysis produced by NR(HS) is provided directly to the ORR, see Section 7.7.2).

We have agreed collaboration principles and a governance framework and use our periodic and quarterly sessions to manage this workstream. The joint sessions are having a positive impact on our working relationship.

There are six workstreams within the joint working initiative focusing on: opportunity through closer working synergies, project delivery, train service delivery, asset management (technology utilisation), sustainability and rolling stock, and growth and customer experience in our stations. These workstreams are co-owned by members of the HS1 Ltd and NR(HS) senior teams.

We held three 'closer working' sessions in May 2021, September 2021 and February 2022; the purpose being to align thinking around joint company values, behaviours, and vision and to promote and drive success together. The first session revolved around underpinning the success factors for the workstreams and the value each could derive for the HS1 system. The second session explored HS1 Ltd business needs, 'myth busting' and identifying focus areas such as agreement on HS1 Ltd strategic priorities to unlock full potential. The third session focused on relationships, trust and system opportunities. We also held a joint volunteering session in October to support team relationship building and giving back to our local communities.

Progress on the six joint workstreams is peer reviewed at the OA/SCA quarterly sessions; interim updates will continue to be provided at the periodic OA/SCA Exec meetings where delivery and value outputs are tracked.

An approach to continued joint working has been agreed for 2022/23 to continue building upon our working relationships and to progress initiatives which can continue to drive greater value in the HS1 system.

5.3 Safety and Performance

5.3.1 Supplementary OCS Insulation

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 has been successfully installed at a number of key locations, at no cost to TOCs, and the campaign will continue until it has been installed at all identified high-risk areas on HS1. The target completion date is March 2023.

5.3.2 Best Practice Sharing Initiatives

The High-Speed Club has created a real dynamic between SNCF, Infrabel and NR(HS). Meetings have continued with work progressing across the asset subgroups. However, COVID-19 meant that, until recently, site visits could not be organised. NR(HS) provides HS1 with updates on progress through the regular weekly and periodic reports.

The **signalling and communication systems** subgroup meetings are starting to create the one system approach across various infrastructures using the same technology. Based on sharing experience and best practice, the meetings have been key to developing the renewal strategy for vehicle health monitoring equipment on HS1. The ERTMS rollout experience of other infrastructure managers over existing Class B systems provided valuable information to the CCS Engineering team looking at the future of CCS on HS1. Other subjects related to research and development have been discussed with the group, focusing on the applicability of technologies to develop a condition-based approach to maintenance.

The **overhead catenary system** sessions have been informative and beneficial overall, but the discussions held with Infrabel and SNCF regarding replacement of Schneider FBM switches has been particularly useful. LGV lines 1 and 2 in Belgium have exactly the same sectioning switches as HS1. Due to the increasing failure rate and discontinued support from the supplier, Infrabel is in the process of appointing a contractor to replace all of the switches. The switches on the Belgian high-speed lines have been in service for approximately 20 years. The failure rate of the switches on HS1 is also noticeably increasing and we are experiencing similar support problems from the supplier. Therefore, we anticipate that a replacement programme for the FBM switches on HS1 will be recommended for CP4. Infrabel has committed to share specifications and lessons learnt for any future replacement programme on HS1.

The **track** section split into two distinct workstreams with a meeting approximately every eight weeks for each. The track geometry working group has explored approaches to data capture, maintenance intervention planning and repair methods. This has been of great use in understanding the differing approaches taken by the three infrastructure operators and the reasons behind them. There is a common goal of improving fault prediction and driving efficiency through robust long-term planning. The group will continue to share best practice around track geometry management but also to look at the recording methods and information capture that support the work planning process.

After initially focusing on management of the track components, the switch and crossing working group has expanded to include elements of signalling and switch systems. This combined approach helps to add context to shared areas of concern and to define a holistic approach to rectifying them. The group is

currently focused on the movable area of swing nose crossings and sharing maintenance practices around common failure modes. In order to reduce the likelihood and frequency of these, the group met in Lille in March 2022 to evaluate their respective inspection regimes and will now attempt to define a detailed inspection methodology for the area around the movable point.

The High-Speed Club Steering Committee will meet in the first half of 2022 to agree the future direction and strategy for the Club.

5.3.3 Operational knowledge sharing with SE Trains

In March 2022, the NR(HS) operations team welcomed four Southeastern High Speed trainee drivers to Ashford AFC to see how the signallers and signalling system work. The aim of the day was to promote a better working relationship and to understand the different challenges faced. During the day there was an opportunity to look at EMMIS control, incident management, signalling and communication. This knowledge sharing helped the teams to get a greater understanding of what makes up both signalling and driver roles and provided an opportunity for the teams to educate each other and assist with topics like driver training and risk mitigation, as well as building stronger professional relationships between teams.

5.4 Planning

5.4.1 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: The new NR(HS) Planning Standard has been published following stakeholder review and approval from the Standards Steering Group. The NR(HS) Planning Competency has been reviewed and published. NRIL planner training workshops have been attended over the past few months to review the training content to ensure that NR(HS) is incorporated into the training material. This NRIL training package is to be rolled out to all NRIL planners which now includes those at NR(HS).

Analysis and improved technologies: A new Daily Notice creation tool has been created by an external contractor, which has enabled a member of the planning team to work more efficiently when creating Daily Notices. This enables creation of these documents in less time with fewer errors, which has created approximately two days of efficiencies each week.

Cultural change: this will be included in the target operating model workstream (see Section 5.2.1), which will look at shaping the planning team to meet the needs of the business.

5.5 Regulatory

5.5.1 Escrow Holiday

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 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 has now commenced repaying the deferred amounts with interest over the balance of CP3.

5.5.2 Structure of Charges Review

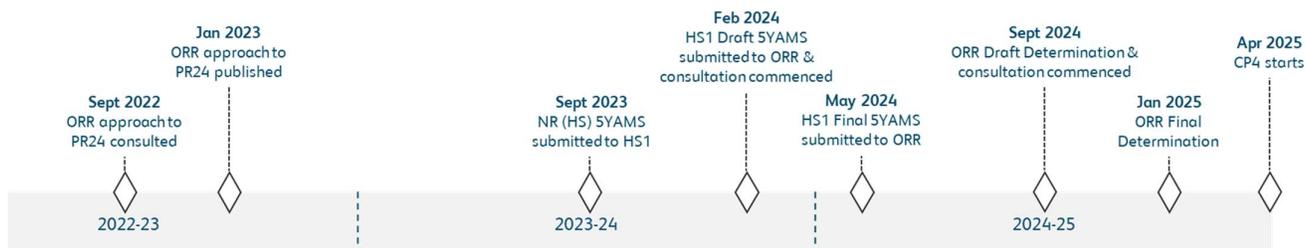
The HS1 charging structure (and model) is over 10 years old and needs to be reviewed to ensure it continues to fairly attribute charges to operators based on evidence of cost causation, addresses questions of affordability raised by operators facing heightened cost pressures from the COVID-19 pandemic,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

We have now completed Phase 1 (initial consultation), Phase 2 (optioneering) and Phase 3 (consultation on proposals) of the review. The Phase 3 consultation with stakeholders (including the ORR) ran between November 2021 and January 2022 and proposed several areas that we will explore with stakeholders that could improve our structure of charges. We will be publishing our conclusions to the Phase 3 consultation shortly. We recognise the heightened cost pressures on TOCs and other parties in the HS1 system in 2022 due to the continuing pandemic and the Spending Review. We will be considering next steps for the HS1 charging structure in this context; it will be a key workstream in HS1's system strategy (see Section 2.2). In April 2022, we published our consultation on the direction of travel for the rebuild of the HS1 charging model that will incorporate the outcomes of the structure of charges review.

Through this review of charges and, more generally, the impact of COVID-19, we have identified several amendments that are required to the Passenger Access Terms (PAT) and Freight Access Terms (FAT). We set these out in the Phase 3 consultation. We plan to consult on PAT/FAT amendments in 2022 and note amendments to the PAT and FAT can only be implemented with the agreement of all parties, and the approval of ORR.

5.5.3 Planning for PR24

We have commenced planning for the next periodic review, PR24. We are working closely with our key supplier NR(HS) on the planning to develop our respective 5 Year Asset Management Statements (5YAMS) for CP4. 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. An indicative timeline for PR24 is shown below.



We held a planning kick-off workshop with NR(HS) in September 2021 to identify key deliverables, dependencies and requirements for PR24. We have established a Joint Steering Group to ensure activities progress in a timely manner. The first meeting in November 2021 agreed the outline governance structure and endorsed the asset management workstream activities which are now underway. In the most recent meeting the joint team endorsed the workstream blueprints agreeing the timeline of activities leading to PR24 submission in May 2024.

5.5.4 *Transfer of Stations Regulation*

We are working with DfT and the ORR to transfer regulatory oversight of the HS1 station assets to the ORR. Consolidating regulatory oversight for route and stations should deliver efficiencies for all parties. This project involves 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). We have also engaged with the ORR as it develops its regulatory statement and guidance on how we should meet our regulatory requirements with regard to HS1 stations. This is a DfT-led project and the ORR has set a deadline of July 2022 for the transfer. While we consider it is a very tight deadline and there are resource constraints, we are making our best endeavours to support the transfer and the project is on track.

6 Project Planning and Delivery

As per the Concession Agreement Schedule 10 Clause 6.2, the following section describes the work that has been undertaken in 2021/22 and the work being planned for 2022/23. This section also describes the improvements made to contracting and procurement, and progress on long term planning.

Appendix 5 provides breakdowns of route and stations renewals performance on a project-by-project basis. The route breakdown is in line with that agreed with the ORR.

6.1 Improvements in Project Planning and Delivery

6.1.1 Delivery assurance and capability

NR(HS) engaged a project delivery consultant (Project Leaders) this year to provide delivery assurance and capability. This has enabled NR(HS) to embed improved delivery processes, particularly for self-delivery projects, demonstrated through the delivery of the stretch volume target for track projects (eight planned vs nine delivered). NR(HS) introduced an Assurance Review Panel for critical works, for example, the delivery of the Christmas blockade works, and has carried out lessons learnt for each renewal to embed improvement for future works.

Under the new NR(HS) target operating model (see Section 5.2.1), NR(HS) intends to align and integrate the Project Management Organisation more closely with asset management, maintenance delivery, procurement and contracting and planning, creating more efficient delivery processes, providing further integration of maintenance and project delivery plans and enabling greater collaborative working. The new operating model will build upon the delivery assurance and capability improvement already delivered in 2021/22.

6.1.2 Contracting and Procurement

In the PR19 final determination the ORR challenged us to be more innovative in the way we procure works. In the first two years of CP3, NR(HS) has used different contracting methods on two projects:

- On Galley Hill earthworks, a project where we were looking to stabilise the deteriorating face of a chalk escarpment, the works were let under an NEC3 Option C target cost model. The works went well and the project was able to return a £31,000 saving to the train operators.
- On the ballast renewal project, the highest cost project in the CP3 portfolio at just over £20 million, the contract will be let using the NEC4 form of contract. The work will be let using Option A (cost reimbursable) for the development works and Option C (target cost) for the main delivery. We asked PA Consulting to undertake an independent review of the NEC4 contract; they were able to advise the NR(HS) contracting team on value-adding modifications to the clauses that NR(HS) had added.

We will continue to explore the use of different types of contracting on the larger contracts we are letting in CP3.

In its CP3 5YAMS, NR(HS) identified a number of works packages within its delivery strategy that would offer value for money by incentivising the supply chain with larger packages of work and streamlining the project authority and governance process. NR(HS) has varied away from these packages over the first two years of CP3, carrying out a high volume of single sourcing for projects, due to the priority of works and the delays experienced. NR(HS) has completed a reconciliation exercise for the remainder of CP3 which has

provided an opportunity to determine which packages remain 'intact' and can still be progressed in future years to drive improved delivery. In addition, NR(HS) is seeking endorsement for the use of existing frameworks within NRIL where these would add value.

As enablers to successful delivery in 2022/23, several of the larger outsourced projects will be completing their procurement and award early in the year and NR(HS) has procured materials in 2021/22 for several self-delivery projects, to enable early mobilisation and delivery.

6.2 Long Term Renewals Planning

6.2.1 Route Renewals CP4+ Capability Work

In CP2, we commenced planning for the step change in renewals that will be required from CP4 onwards, commissioning Bechtel to undertake a deliverability study for 40-year renewals. The study reviewed a number of delivery options and proposed a delivery integrator approach from CP4 onwards. The results of the study were included in the HS1 5YAMS for CP3. We made a CP3 commitment to continue this work by developing an efficient and effective delivery model for all renewal types. The ORR final determination included an element of funding to take this work forward in CP3, and the ORR is overseeing progress.

In March 2021, PA Consulting working with Mott MacDonald undertook the first phase of work to develop renewals capability in HS1 to meet the long term needs of the renewals programme. This phase took the work undertaken in CP2, re-validated the costs and benefits and created a practical implementation plan. A programme blueprint and business case were developed. These were used as the basis for a tender exercise to find a supplier to deliver the capability works.

PA Consulting and Mott MacDonald won the tender for the second phase and work started in January 2022. The work will be delivered in four tranches:

- Tranche 1 will look at any savings or improvements that can be delivered in CP3;
- Tranche 2 will create an efficient 40-year renewal plan;
- Tranche 3 will create the new delivery enterprise; and
- Tranche 4 will bed in the new enterprise ready for CP4.

The works will deliver improvements in capability and also significant savings (expected to be around £300-400 million) in the cost of renewals over the next 40 years.

6.2.2 Long Term Stations Planning

During CP3, we will look to create an improved long-term charge (LTC) model which will support better whole life asset decisions. This will be supported by:

- The asset hierarchy which has been agreed between HS1 and DfT;
- The station asset condition information now available in the CAFM models for all HS1 stations; and
- The quinquennial system-level asset condition assessments.

With this improved model, we are aiming for a better link between the five-year renewals planning cycle for LTC and the annual best estimates process for operations and maintenance costs. The process of scoping, procuring and developing this model will start later this year.

We are working closely with NR(HS) to define the stations asset information requirements, which will be detailed in each of the SASs, and an associated suite of HS1 information standards as NR(HS) looks to take ownership of the production of these documents as they start their journey for ISO 55001 certification.

Since St Pancras International reopened in 2007 HS1 has continued to stimulate the regeneration of the Kings Cross area. Pre-COVID-19 forecasts estimated growth to 80 million visits per year to the station by 2040. We have been proactively working to assess the potential impact of this rapid growth to ensure that St Pancras International remains a global icon. We are currently looking at potential changes in advance of the 2024 Olympics in Paris.

We are continually looking for ways to enhance the customer experience and are trialling a virtual queuing solution for Eurostar customers to test the technology and its effectiveness. If successful, benefits would include queue management with more accurate wait times, avoidance of physical queues at the station tackling operational challenges, an enhanced check-in process and improved overall customer experience.

6.3 CP3 Renewals

6.3.1 Project Efficiency Reporting

The CP3 project costs agreed with the ORR in the PR19 final determination were deemed by HS1 and the ORR 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 annual summary spreadsheet (Appendix 5) and detailed below.

Four projects have been closed out in the first two years of CP3; Figure 18 shows how the outturn cost for these projects compares to the efficient price included in the PR19 determination. The Choats Manor Way and Ebbsfleet expansion joints are smaller projects that were part of a total of £835k for expansion joints and road waterproofing; they did not have specific values allocated so we have shown how costs have moved from the agreed Gate 4 sign off.

Project	PR19/ Gate 4 price	Final cost	Explanation of difference
Culvert relining	£77k (PR19)	£49k	When more detailed survey work of the culvert was undertaken it was realised that a better solution would be to undertake a more localised repair, rather than the originally envisaged more detailed structural intervention, resulting in reduced cost.
Galley Hill earthworks	£682k (PR19)	£760k	The cost increase was due to additional scope. Detailed investigative surveys identified an area of vegetation and a dilapidated flint wall at the top of the chalk spine that was having a direct adverse effect on the performance of the chalk spine. The final designed solution included removing the wall and vegetation and a fencing solution to prevent potential vehicle incursion. The anticipated final cost of the

Project	PR19/ Gate 4 price	Final cost	Explanation of difference
			project at Gate 4 was signed off as £791k. Following ORR advice in the CP3 determination, NR(HS) let the works using a target cost NEC Option C contract which resulted in a saving of £31k. This money remains in the escrow account for use on future projects.
Choats Manor Way expansion joint	£95k (Gate 4)	£93k	n/a
Ebbsfleet Bridge expansion joint	£253k (Gate 4)	£311k	There was a significant amount of change, partly driven by changes at the station created by the new HMRC freight handling facility developed to address issues with Brexit. This changed much of the original thinking on both site access and traffic management around the Ebbsfleet site (adding £18k of cost, paid for by HMRC). In addition, when the top of the road surface was removed, it was clear that there was additional damage that needed to be addressed (£30k). The project then had an extension of time due to falling temperatures putting works on hold and COVID-related delay issues (£10k).

Figure 18 – Outturn cost v efficient price for projects completed in CP3

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.

In summary, changes in project costs have primarily been driven by the scope developing as the project progresses and more information is known or by changes that could not have been foreseen at the start of the project, such as the introduction of the HMRC facility at Ebbsfleet.

6.3.2 Changes to the CP3 Route Renewals Portfolio

Since the publication of our 2020/21 AMAS we have reviewed the projects to be delivered in the remaining years of CP3 and made a number of changes. The main changes are as follows:

- Deferral of the renewal of access roads, gates and stairs as their condition did not require works in CP3;
- Changes to drainage renewals as the detailed surveys undertaken showed that a full renewal was not required at this stage;
- Phasing of the UPS rectifiers and batteries works to start later and run into CP4; as a result of the high costs of renewal, the NR(HS) team is considering more cost effective ways to address the condition of the units;
- Phasing of the MCEM91 HPSS motor and gearbox mechanisms renewals to start later based on condition and the reduced amount of wear in the last two years; and
- An increase in the cost of the crossings to be renewed in CP3 as the cost of materials for the high-speed crossings is higher than originally estimated. The original estimate was based on the costs for low-speed crossings, which are cheaper.

As a result of the changes described above, the CP3 portfolio base cost is little changed at £69 million, compared with £68 million in the 2020/21 AMAS. This excludes the NR(HS) mark up of 10% and the PMO costs of £12.9 million.

The spreadsheet in Appendix 5 has been updated to include all of the changes to the renewals portfolio since the PR19 Final Determination, following a review of the work required in CP3. Column H (rows 1-197) shows the current anticipated spend on CP3 and advanced CP4 projects in the five years of CP3. The reasons for the changes are shown in column I. The new baseline for the reporting of projects in CP3 will be the figures presented in Column H of this spreadsheet. We considered issuing this as a separate change request but are now seeking approval of the change through this AMAS.

We have built into these plans any impacts of reduced usage as a result of COVID-19 in the last two years, though it should be noted that most of the renewals are addressing wear and tear sustained since the railway opened in 2003 (Section 1)/2007 (Section 2).

6.3.3 Route Renewals Delivery Performance

There has been good performance in some areas, in particular, the renewal of the data transmission network (DTN) is going well. There was also a successful set of renewals of track and section insulators over the Christmas period.

We provide the ORR with regular updates on renewals delivery against planned activities in our quarterly reporting meetings. The data is also shared every quarter with the train operators. We also share Gate 4 papers with the train operators as outlined in the CP3 HS1 renewals project governance handbook.

Figure 19 shows the planned v actual cost of work done in 2021/22, split between CP2 and CP3 projects. The spreadsheet in Appendix 5 gives a review of individual project performance. In summary, the main causes of the variance between planned and actual are as follows:

- For CP2 projects, delays have been mainly due to the impact of COVID-19 on site works; this has particularly impacted the DTN renewal.
- For CP3 projects, delays have been due to a shortage of resources either to develop the scope of works or to undertake the procurement of projects.

For 2020/21 the total cost of work done was £8.87 million. There was a £1.98 million shortfall in delivery of CP2 projects and a £5.04 million shortfall in delivery of CP3 projects against the plan set in March 2020.

The total cost of work done in 2021/22 was £9.97 million, split between CP2 and CP3 projects. There was a £2.07 million shortfall in the delivery of the CP2 projects and a £3.51 million shortfall in the delivery of CP3 projects against the plan that was set in March 2021.

NR(HS) provides a monthly update at the HS1 Renewals Board on whether these delays will impact the operation and performance of the railway; at present NR(HS) is stating there will be no adverse effects.

The shortfall in delivery in the first two years of CP3 means that additional works will take place in the remainder of CP3. A similar situation happened in CP2, with works not being delivered in line with the plan. We have raised this with NR(HS); as a result NR(HS) has brought in the project delivery consultants they used to ensure delivery in CP2 to bolster their capability and to provide assurance that the works will all be delivered by the end of CP3.

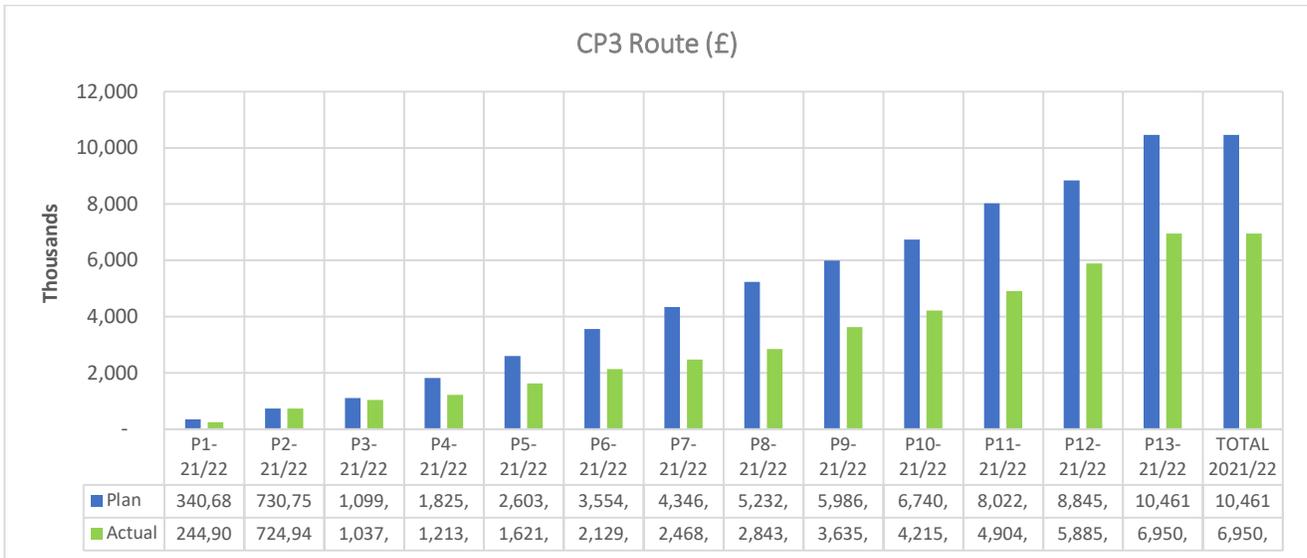
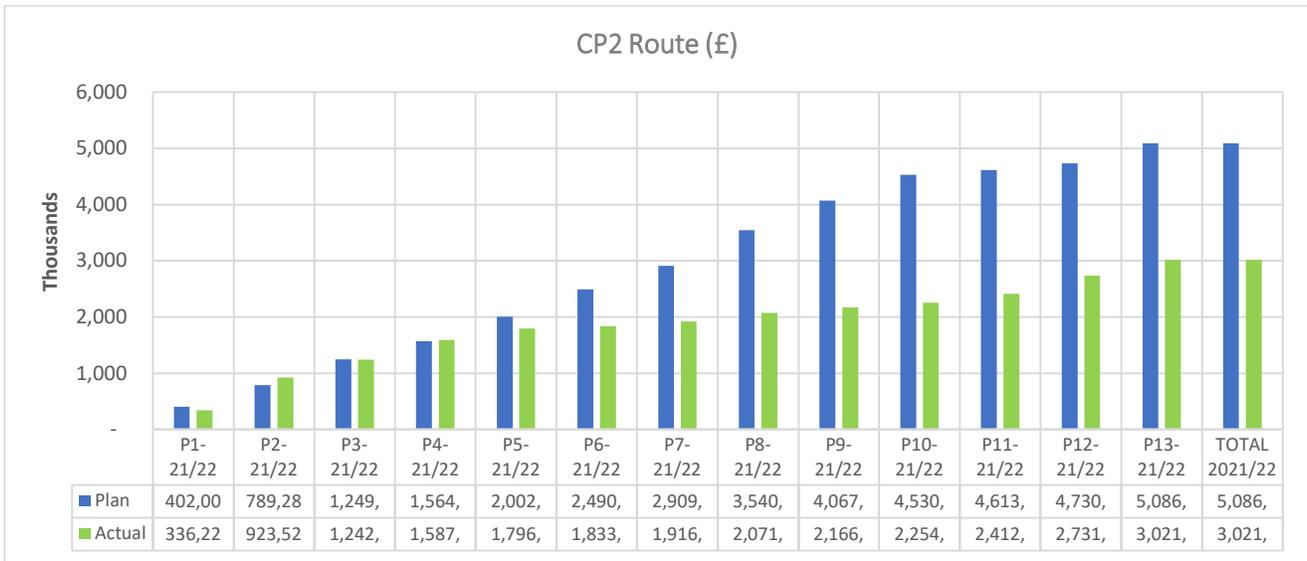


Figure 19 – Cost of Work Done in 2021/22

6.3.4 Summary of Key Route Renewals in 2021/22 and 2022/23

This section describes the key projects being undertaken in 2021/22 and those being planned for 2022/23. More details are provided in the spreadsheet in Appendix 5.

Uninterruptable Power Supplies (UPS) Replacement (S&T CP2): 11 of the 13 sites have been completed and work continues at the next priority site, Ebbsfleet. The remaining site is Stratford.

Data Transmission Network (DTN) (S&T CP2): This project commenced on site early in 2020 and has continued throughout the current year. This is a critical and significant project for the design, commissioning, installation, testing and transition of a replacement HS1 DTN and a replacement Voice Telephony System. 85% of the installation work is now complete and SAT testing is due to start in Q1 2022/23.

Ventilation Control System (S&T CP2): It is anticipated that this will be complete by Period 10 2022/23. This project has worked closely with the DTN project to mitigate delays from the overlap between the projects.

Radio Propagation (S&T CP2): Commissioning of the radio equipment in North Downs Tunnel was completed in Q4 2020/21. Thames Tunnel and London Tunnel are due for completion in P2 2022/23. The project has worked closely with the DTN project to mitigate delays from the overlap between the projects.

Medway River Headwall (Civils CP2): Design work was completed in the summer of this year. The estimate for build construction exceeds the existing PR19 budget (by more than 125%); as a result, the delivery strategy is being reviewed. During this review, the existing maintenance regime will continue. This approach does not introduce any new risk to the operational railway.

RCCS/EMMIS (S&T CP2): The work is now complete, the equipment is in service and the Gate 5 paper has been submitted. Final close out is due in Q1 2022/23.

CME/LME (S&T CP2): This project commenced in 2019/20 and is for the renewal of local / control maintenance equipment associated with the ITCS signalling system. COVID-19 restrictions in France have slowed project progress, however the intention is to complete the physical works in Q1 2022/23.

Road-Rail Access Points (RRAPs) (Track CP3): The design of the RRAP apron has been completed. The procurement process is on hold pending product approval confirmation.

Cross Passage Door Replacement (E&P CP3): The contract has been awarded and the project is mobilising towards starting on site in 2022/23.

Acoustic Barriers (Civils CP3): A decision was made to prepare an outline design for the whole asset in CP3 to enable a fuller and more economic procurement phased through CP3 and CP4. This outline design is complete; the next steps are to establish the framework for detailed design development and delivery.

Bridge Expansion Joints (Civils CP3): Expansion joints cross all overbridge structures on HS1. Advance work was carried out at two of the 10 locations requiring work; the remaining scope has been through the procurement stage which concluded with an award this year. The build contractor has now mobilised with works commencing on site in Q1 2022/23 and being completed in the same year.

Ballast Renewal (Track CP3): 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.

This year we published the specification for the work under an NEC4 form of contract with a target cost model and launched the procurement process in Period 8.

During the tender process, it became clear that the challenges of delivering this activity within the constraints of our infrastructure and the Works Information, combined with the relatively small volume and short duration of the campaign, deterred a number of potential suppliers from expressing interest in the works. Although the tender evaluation process has not been concluded, a decision has been taken to defer commencement of the works by 12 months to start in 2024 allowing adequate time to evaluate and develop technical competence in the supply chain and gain assurance that the works can be carried out safely and compliantly within the identified constraints.

Section Insulator Replacements (E&P CP3): Replacements on St Pancras International platforms 12 and 13 were completed over Christmas 2021. Enabling works for the remaining works on platform 11 and 12 have been completed and NR(HS) is exploring opportunities for delivery in 2022/23 with TOCs.

St Pancras Rerail (Track CP3): 1km of rerail was completed over Christmas 2021.

Crossing Renewals (Track CP3): The target is to replace six crossings a year. This year, one was achieved in Period 8 (2059) one in Period 9 (2136) and one in Period 12 (2048). Three were planned for St Pancras at Christmas but are being replanned.

Switch Blade Replacements (Track CP3): The target of three switches this year has been achieved with an additional replacement of 2018 switch due to a fault. Gate 4 for the remaining work in the last three years of CP3 is currently being compiled, with the access for 2022/23 already in the plan.

UPS Replacement Route (E&P CP3): Following an initial RfQ to address asset failures at Barrington Road, new market intelligence has indicated that the NR(HS) estimate in the CP3 determination will be inadequate for the full renewal of 65 UPS units planned for CP3. A new strategy has been developed to order the renewals into distinct priority tranches, enabling replacements to be phased across two control periods and ensuring that the top priority UPS replacements are delivered in CP3. The new strategy will include a reactive element in the contract that will enable life extension measures or reactive replacement should failures occur over the next five to eight years. Barrington Road extension of life option using battery replacement will be complete in Q1 2022/23. The procurement exercise for the new renewal contract is progressing.

Fibre Optic Aerial Earth Cable (S&T CP3): Originally much broader in scope and involving the replacement of sections of cable as well as the fibre joint boxes, the DTN project provided enough evidence to enable a change in approach this year. Since Period 4 we have been self-delivering enabling work lowering the fibre joint boxes/loops to a maintainable/accessible height. This was done in parallel with a procurement exercise for a specialist third party supplier to replace the 29 joint boxes. The ITT process has concluded however this project may be deferred due to conflicts with the DTN project. The deferral process has commenced and will be finalised in P2 2022/23.

ITCS Test Benches (S&T CP3): Replacement options for the ITCS test benches have been in development this year. The output this year will be the technical work scope, priced schedule and programme for replacement. Discussions regarding the potential for running a product trial (using SNCF specification test benches on HS1) in parallel with SNCF to accelerate the delivery of ITCS test benches have concluded and confirmed that the current products designed specifically for SNCF utilise a French interface and will not be compatible on HS1. Discussions are ongoing with Hitachi to explore further options and internally NR(HS) has been looking at feasible extension of life measures. The first test bench for HS1 is due to arrive in Q4 2022/23.

Vehicle Health Monitoring Equipment (VHME) (S&T CP3): Replacement options for the VHME on HS1 have been in development this year. The output this year will be the obsolescence study, technical work scope, priced schedule and programme for replacement. We have already secured some scarce IR detector componentry which will help extend the life of the current system and anticipate a schedule of similar components to be identified as part of the wider replacement programme. We expect to submit the authority paper this year for the project to mobilise and commence on site in 2022/23.

Point Operating Equipment (POE) (S&T CP3): The objective for this project is to continue with the renewal of the remaining MCEM91 equipment in CP3; around 30 sets of the 107 ends using MCEM POE

were renewed in CP2. Around 60 ends were originally planned for CP3, and we are now looking to reduce this volume, if possible, based on the observable condition of MCEM POE renewed in the next three years. We placed an advanced order with Vossloh to secure the first tranche of components which arrived in P13 2021/22. We have also placed an advance order for the POE for HPSS, and an authority paper for this project will be submitted early in 2022/23.

Fibre Optic Signals St Pancras (S&T CP3): The Gate 4 paper will be presented in Period 4 2022/23.

Signalling Room 15 ITCS Earthing (S&T CP3): The physical work was completed in P13 2021/22 and the Gate 5 submission is being compiled.

C&C Power Supplies (Static Switches and Local Area Rectifiers) (E&P CP3): The second round of procurement was concluded this year and the award is anticipated early in 2022/23 with the design and installation work planned to commence in 2022/23.

Boom Replacement (E&P CP3): This year we have developed the technical specification.

Auxiliary Power Units (E&P CP3): The project will mobilise next year. Depending on the complexity of the SRP process with respect to CSM compliance, we anticipate the design to commence in late 2022/23 and the units to be supplied in 2023/24.

Passive Drainage (Civils CP3): Development work has been completed and recommendations have been prepared. Following a detailed survey of the assets, the extent of work is now not thought to be as acute as previously suggested. Following the production of option paper, the scope of work will be rationalised significantly to a limited programme of well clearance and remote condition monitoring.

Open Route Drainage (Civils CP3): This project is to clear defects on the open route drainage system and restore the system to design performance levels. The technical requirements have been developed this year and procurement is planned for completion by the end of the year. The work is due to commence in 2022/23 and may incorporate some of the other drainage packages for efficiency, this is under review and expected to conclude early in 2022/23.

Long Tunnel Drainage (Civils CP3): Development work to consider whole system options in the London Tunnels and identify preventative/remedial measures to the tunnel linings to address the issues of ingress into the tunnel drainage system has concluded. The development report and options have been completed. Procurement will commence in 2022/23, with the potential for the project to mobilise in 2022/23 or 2023/24 dependent on approvals and access.

10km Rerail (Track CP4A): This project is in the early development stage. Requirements have been developed and the authority paper will be submitted for approval early in 2022/23.

Year 3-5 E&P Projects (E&P CP3): There is a series of E&P projects for which requirements were developed in 2020/21. We are considering the options for delivering these remaining projects, having initially identified possible groupings for frameworks, either existing or new requirements for NR(HS). This option development commenced in Q4 2021/22 and will continue into 2022/23 on a next priority basis. The projects include Ashford Nadir pump control system, Stratford borehole pumps and ventilation shaft attenuators.

6.3.5 Summary of Key Station Asset Renewals in 2021/22 and 2022/23

Reporting obligations for stations renewals are not described in the Concession Agreement; however, under the Stations Lease, HS1 is required to deliver the renewals against an agreed LTC model. This section describes the main stations renewals projects in 2021/22 and planned for 2022/23.

Station Communications System Renewal (SCSR): The main focus of CP2 renewal works in 2021/22 has been the on-site delivery and handover of various communication systems across all four stations. Physical works at Ashford have been completed and handed back into operation. The main station data network (SDN) at St Pancras has been completed and completed systems have been migrated to the new SDN without issue. Final systems at St Pancras, Stratford and Ebbsfleet are due to be completed by June 2022 with production of handover documentation and materials following.

Lift/Escalator/Travelator (LET) Renewals: The main CP3 renewals scheme has progressed well and 2021/22 has seen the mobilisation of the preferred contractor, stakeholder engagement with the TOCs and stations to agree a phasing plan for the works and communications plan, completion of necessary design works, and gaining heritage approval for the scheme. On-site works began in January 2022 with work on three assets at St Pancras International which are due to complete by the end of April 2022. An efficiency opportunity identified by HS1 to accelerate an asset from CP4 into these CP3 works has been approved by the DfT. A further eight assets are planned to be refurbished in 2022/23. Plans and designs will also be developed for a temporary lift to mitigate the loss of service on L4.2 during its refurbishment.

St Pancras UPS Renewal: The contractor for this project went into administration in 2021/22. The project was in the delivery stage but work on site had not yet started. The project team is working with the administrators, and the subcontractors who were working on the project, to develop a plan to remobilise and deliver this renewal project in 2022/23.

Space Heating Renewal: Technical specialists have undertaken a review of the existing space heating systems at St Pancras, Stratford and Ebbsfleet to identify heat recovery potential and ways to reduce the reliance on gas fired boilers and associated carbon emissions. A preferred option and design concept have been produced. Next year will see the development of a detailed procurement strategy and delivery structure for the remainder of the project. This will identify the best way to procure and deliver the detailed design of the system which will begin in 2022/23.

St Pancras Expansion Joints: Survey and investigation works will begin in 2022 to understand the condition and root cause of deterioration in structural expansion joints, identify refurbishment/renewal options and develop a preferred renewals strategy with agreed specification.

6.3.6 UKPNS Asset Renewals

UKPNS operates, maintains and renews the electricity substations and high voltage electricity distribution network on HS1. Significant renewal and replacement projects underway in 2021/22 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. This 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 fitment across the various sites. The main workstation has been installed at Singlewell IMD with several auto transformer (AT) stations commissioned onto the system. The project is expected to be complete by the end of December 2022.

Static VAR Compensators (SVCs) and load balancer control systems renewal and upgrade: As part of obsolescence 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, and has started regular meetings to progress the project. The programme will last for four years and the agreement includes an arrangement to maintain the equipment through to 2035. This project will increase operational resilience and is the largest single project since the initial build of the power system. The detailed designs have been received and fitment on the first sites will commence in Summer 2022.

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 in the year. On Section 2, the fitment programme for new relays at Choats Road is also scheduled for 2022. This is a significant investment and the traction relays will also interface with the new SCADA system for reporting purposes.

Sellindge SGT 5B: Following concerning results from the oil samples from two of the HV bushings associated with SGT 5B, the transformer was taken out of service. Two new bushings were purchased, fitted and tested. National Grid undertook its reconnection works in early February. Innovative bushing monitoring equipment has also been fitted and commissioned. This is a world first and allows the hydrogen within the bushing to be continuously monitored and provides an assessment of the health of the bushing to allow for an early indication of any potential issue. This equipment will be able to be linked up to the new SCADA system that UKPNS is installing. Sellindge SGT 5B was successfully brought back into service in February 2022.

6.4 Upgrades

6.4.1 4G installation

Last year we completed the installation of 4G along the HS1 route, at no cost to the train operators or to the taxpayer. Work is currently underway to augment the mobile coverage in St Pancras International to provide a seamless 4G experience from St Pancras International to the Channel Tunnel.

6.4.2 European Rail Traffic Management System (ERTMS)

In 2017, HS1 commissioned a study to understand the migration path for the HS1 signalling system to a future train control system. The study reviewed the key drivers for change and produced a financial appraisal. On the basis of current demand forecasts, the capacity of the existing system is sufficient until 2046. The main driver to change the existing signalling system is obsolescence. The current estimated end-of-life is 2035-2040.

HS1 has commenced early engagement with SNCF, Eurotunnel, Infrabel, train operators and suppliers to put in place a collaborative approach to renewing the signalling system. Renewal on HS1 is currently scheduled for 2032 to align with the deployment schedule of Infrabel, SNCF and Eurotunnel. This will offer best value for money by reducing system integration costs (between each signalling system along the route).

In 2020/21, work was undertaken to validate the business case for ERTMS on HS1 and develop the requirement to migrate the signalling and train control system to ERTMS. NR(HS) worked with Network Rail Consulting and specialists from Network Rail's Technical Authority on a proposal for the development of a business case and subsequent early stages of the ERTMS migration project, with outline costings.

In its PR19 determination, the ORR determined that the ERTMS signalling upgrade would be a Specified Upgrade (while HS1 considered it should be treated as a renewal). We are bringing forward a Specified Upgrade proposal for early design works on ERTMS in 2022, while continuing discussions with the ORR and DfT about the issues this approach may cause for the TOC affordability.

7 Financial Reporting

The charges for the second year of CP3, covering 1 April 2021 to 31 March 2022, were set in 2019. The charges are rebased in line with the annual increase in RPI with NR(HS) costs having an additional 1.1% each year. For reference, the February 2021 RPI rate is 296.0 and the base RPI rate (February 2018) is 278.1. Please note all £ values are in nominal terms and there may be rounding differences.

Further detail is provided in Appendix 6.

7.1 Train Numbers

As a result of the COVID-19 pandemic, the number of train services operated in the first two years of CP3 has been significantly below the CP3 forecast. 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). 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 Figure 20. Note that for the purposes of this table, Eurostar's volume commitment has been treated as if it were an FWT. Eurostar's total volumes in 2021/22 (volume commitment and spot bids) were higher than the volume reopener assumptions, while SE Trains' total volumes remained below the domestic underpin .

ANALYSIS OF TRAIN PATHS BILLED vs VOLUME REOPENER				
	As at P13, Financial Year 2021/22			
	YTD	Volume reopener YTD	Variance	Variance %
EIL	2,346	3,875	-1,529	-65%
SET	46,572	53,380	-6,808	-15%
Freight	421	453	-32	-8%
Total FWT Trains	49,339	57,708	-8,369	-17%
EIL Spot bids	3,184	0	3,184	
SET Spot bids	1,355	0	1,355	
Total Spot bids	4,539	0	4,539	
Total Trains	53,878	57,708	-3,830	-7%

Figure 20 – Train paths billed (includes spot bids and cancellations) compared with volume reopener assumptions

7.2 OMRC Revenue

The Operations, Maintenance and Renewals Charge (OMRC) for CP3 was set following 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. With limited exceptions, and subject to an annual RPI-linked adjustment, the expectation would ordinarily be that charges remain fixed until 31 March 2025.

As noted above, the COVID-19 pandemic has led to considerably reduced train operations. Whilst HS1 was protected from any income shortfall during the period of advance timetables (approximately six months), that protection falls away as advance timetables with reduced train numbers are booked. The HS1 PAT requires OMRC charges to be reopened where the forecast volume varies by more than $\pm 4\%$ 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.

The first reopener was triggered in December 2020, where charges were set based on a Eurostar volume commitment of 2,444 train paths for December 2020 to December 2021 and a forecast for a sharp rebound in the timetable year commencing in December 2021. HS1 executed the second reopener for December 2021 based on a reasonable evidence-based view on expected train numbers for Eurostar (7,223 trains for December 2021 to December 2022) and, for SE Trains, the number of trains determined by the domestic underpin. The revised OMRCA2 and OMRCB charges have increased compared with 2021, given Eurostar's expected train volumes for timetable year 2021/22 are significantly lower than the DfT forecast used in the 2020 volume reopener.

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.

HS1 Ltd 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.

As noted above, in spite of COVID-19, the first year of CP3 was largely protected because TOCs had booked large FWTs in advance. This year, despite the revision of OMRC via the volume reopener, income has been much lower due to the reduced FWTs from both Eurostar and SE Trains.

O&M revenue of £62.3 million as at Period 13 is £14.6 million below the CP3 forecast due to:

- **£(14.1) million** from lower FWTs, including lost OMRCA1 that is not recovered under the volume reopener or domestic underpin agreement; and
- **£(0.5) million** from reduced pass through income, although this will be offset by reduced pass through costs.

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

7.3 OMRC Expenditure

Overall OMRC expenditure (Statement 3 in Appendix 6) was £77.2 million as at Period 13, £1.1 million lower than the CP3 forecast. This is made up of a number of small 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.

Controlled track costs were £0.2 million below the CP3 forecast as at Period 13. Within this:

- Subcontract costs showed a saving of £0.5 million, split between BTP, NGC and regulatory costs.
- Consultants and technical support costs were £(0.7) million higher, including additional consultancy costs arising from the HS1 response to COVID-19. 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.
- Office and other costs were £0.2 million and £0.3 million lower than budget respectively comprising savings from the reduced costs incurred with staff working from home.
- Research and development was £0.1 million above forecast. The total research and development budget for CP3 will be spent over the duration of the control period.

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 £0.9 million lower than the CP3 forecast. Most of this saving derives from non-traction power with a £0.6 million saving due to reduced consumption and sell backs of excess electricity at prices higher than the purchase price. There is also a £0.3 million saving on business rates where there was no increase in 2021/22.

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 has raised a challenge to the 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 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 few freight services ran during the period, 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 Renewals

£9.4 million of route renewals have been charged to route escrow in the year to Period 13. This is low compared to withdrawals in the previous year and reflects the delay in delivery of some renewal projects (see Section 6.3.3).

7.5 Escrow account

As stated above, part of the OMRC paid by TOCs is designed to fund future renewals of the HS1 railway. The funds collected are paid into a separate ring-fenced bank account each quarter. The route escrow balance as at Period 13 is £16.9 million. Funds invested as at Period 13 for the route are £84.9 million with maturity dates of six and twelve months. The stations escrow funds have been invested on the same basis. Statement 4 and Statement 7 in Appendix 6 provide further detail on the balances.

During PR19 we agreed with the ORR and DfT to improve the escrow investment strategy for CP3 by making it more efficient and allowing us to maximise the returns available to reduce the forecast to actual interest gap by investing more in long-dated investments. However, since 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 in order to maintain liquidity during an uncertain time and to allow us to quickly move investments to a longer tenor if and when the interest rate curve improved. This approach was agreed with the ORR, DfT and the TOCs prior to each round of investments. From late December 2021, our dedicated experienced treasury function has been able to capitalise on more favourable interest rates and has subsequently extended the length of some of the investments from a minimum of six months to 12 months. The interest gap remains a fundamental issue and, as at the end of Period 13, the interest gap since the start of CP3 was £2.1 million for the route escrow and £1.1 million for the stations escrow, driven by the lower rates (even at longer tenors) and lower cash investments due to fewer train paths. Although we expect the interest gap to reduce, as there have been increases in the underlying market rates, there is now a wider issue due to the much larger gap between interest rates and inflation.

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. In order to diversify and increase returns while maintaining security over the balances, we are looking to explore the use of money market funds, government debt instruments, financial and corporate debt instruments such as commercial paper programmes or secured deposits.

We are in discussion with DfT about how to take this forward since the Concession Agreement would need to be updated to allow an expansion of the investment options.

We will draw down on escrow funds for the regenerative braking enabling activities once we finalise the funding agreement with SE Trains and DfT (see Section 4.3.3). The agreement will specify SE Trains' repayment process, and that we provide quarterly updates to SE Trains on the project and escrow repayment balances.

7.6 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 (IRC) or a combination thereof. There are currently no Specified Upgrades to report on.

The ORR determined that the ERTMS signalling upgrade would be a Specified Upgrade (while we considered it should be treated as a renewal). We are bringing forward a Specified Upgrade proposal for early design works on ERTMS in 2022, while continuing discussions with the ORR and DfT about the issues this approach may cause for TOC affordability (see Section 6.4.2).

7.7 Management of Efficiencies

7.7.1 HS1 efficiencies

As part of PR19, the ORR determined an efficient level of cost for the operations, maintenance and renewal of the route infrastructure. We are continuing to explore all opportunities to improve cost efficiency against this baseline.

The largest element of our cost is the agreements with NR(HS) for route and stations. We are working collaboratively with NR(HS) to improve efficiency. As noted in the 2020/21 AMAS, we agreed a methodology for NR(HS) to report its efficiency against the CP3 route determination and this is set out in Section 7.7.2 below.

During 2021/22, we have delivered cost savings, which are passed through to train operators, in the following areas:

- Through more efficient and effective station management, we project a saving of around £2.5 million in 2021/22 (subject to final wash-up). These savings have been achieved with no reduction in standards and maintain performance at the highest levels (see Section 3.3.2). Stations estimates for next year show increases well below inflation in spite of the cost pressures from significant increases in asset inspections (assets at height), increased National Insurance charges and nationally mandated Sunday working payments to staff.
- Cost efficiency and renewable sourcing continue to be key elements of the HS1 Energy Procurement Strategy (EPS). This remains key to supporting the journey to net zero by 2030 as recently re-communicated at COP26. The EPS has been agreed with and supported by stakeholders including train operators and our electricity supplier, npower Business Solutions. The hedging strategy adopted within the Electricity Supply Contract has so far demonstrated staggering success through forward purchasing and effectively reducing HS1's exposure to volatile market conditions. Analysis shows that the strategy will have insulated TOCs from £34 million of price rises from April 2021 to March 2022 compared to a strategy of locking prices just before delivery. Extending the horizon to the end of September 2022 increases the saving to £52 million. We will continue to carry out monthly forecasting of demand and sell-back of electricity purchased ahead but no longer required as a result of COVID-19 efficiently, selling back excess electricity at prices in excess of that paid where possible. However, general energy market conditions mean that our energy prices are expected to be significantly impacted when the current hedging period ends.
- 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 reduced BTP costs by circa 13%. Just over 70% of BTP charges are passed through to train operators as part of stations Qx, so train operators benefit immediately from this saving.

A full list of HS1 costs and efficiencies is shown in Statement 8 in Appendix 6. The overall value of the items listed shows a favourable position across HS1 of £2.4 million, mostly driven by a £3.3 million saving on non-traction electricity and £0.8 million on BTP (note that these figures include stations as well as route OMRC). These savings are partly offset by areas where HS1 has overspent, most notably including spend on interim staff and consultants to manage the business reaction to COVID-19. We expect these COVID-related costs to decline as we return to a business as usual position and have active plans to stand down the additional resource/consultancy requirements over coming months

We are continuing our work on regenerative braking for the 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 £1.3 million per year for SE Trains once it is fully implemented (see Section 4.3.3).

For route renewals, the CP3 project costs agreed with the ORR in the final determination were deemed to be the efficient cost of delivery. As noted in Section 6.3.1, we review the final cost of each project once completed against the original CP3 determination cost and record the reasons for any differences.

7.7.2 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. Similar to last year, NR(HS) has agreed with HS1 and the ORR that it will share its CP3 Year 2 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 21 shows the Q3 2021/22 update which is the latest that HS1 has received from NR(HS). NR(HS) will provide the full year summary in late May.

CP3 5YAMS Efficiencies, Tailwinds, Headwinds, and Enablers – Year 2, Quarter 3 (at Period 8) Update

Plan BRAG Status Key

Blue	Initiative has been delivered (i.e. milestones have been hit and we are waiting for the benefits to be realised).
Green	Initiative is in place with delivery plan and milestones and the business is confident in delivery.
Amber	Partial plan in place with some confidence of delivery.
Red	Commitment to save, no plan in place to deliver.
Grey	Initiative has either been replaced with another or not applicable in the Financial year

Monetary BRAG Status Key

Blue	Achieved in full
Green	Forecast to achieve in full
Amber	Partially achieved or at risk
Red	Missed
Grey	No Spend or Initiative replaced

Reference	Name	BRAG Status (Monetary)	BRAG Status (Plan)	Comment
E-001	Asset Management Effectiveness	Green	Green	Integrated planning initiative in progress and will in part deliver efficiencies through more efficient use of resources and access, generating capacity for projects planning. Further review of standards to be undertaken to consider changes in maintenance activities.
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	Green	Blue	Packaging and sequencing of planned works to enable better in-house resource utilisation. Bi-monthly workshop's in place to review opportunities within contracts.
E-004	Insurance	Blue	Blue	Negotiated lower premiums based on improved rates impacting this financial year. Efficiency attained due to reduction in train paths, however risk that this efficiency will not be sustained in future years due to (1) insurance market risk driving unusually low premiums, and (2) train paths start to increase as TOCs recover from COVID-19.
E-005	Managed Railplant mothballing	Grey	Grey	Fixed term contract in place throughout CP3 so no efficiencies to be realised. However target saving has been re-allocated to E018.
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	Green	Green	Risk Based Examinations (RBE) procedures defined. Implementation of contractor activities in house, resulting in reduction of tactile inspections. RBE has resulted this year in an increased volume of inspection, with internal resource utilised as opposed to external contractors.
E-008	Overtime / Rest Day - Ops	Red	Red	Efficiency unlikely to be achieved this financial year due to EMMIS resilience cover. Forecasted efficiency savings in other initiatives mitigates against monetary target in 21/22. This efficiency will be reviewed for future years.
E-009	Materials (Spares/Stock)	Green	Green	Centralised stock control through use of vending machines with plan to expand to other satellite locations enabling 24/7 access. Implementing reviews of other consumables items and stock control options to aid delivery of efficiency.
E-010	Area support cost change	Blue	Blue	Review undertaken of support function allocation across NR (HS) route, to ensure cross charge to stations reflected. Updates to charging arrangements implemented.
E-011	Call-Off Contracts (infra)	Green	Green	Reprioritised due to COVID-19 works. Additional resource identified to gain traction and commence re-tendering in year 2.
E-012	Overtime / Rest Day (infra)	Green	Green	Continuous review and control of premium hours usage. Exploring opportunities for greater insight to help shape changes of rostering usage.
E-013	Centralised Leased/Owned Plant	Green	Green	Integrated planning initiative to be implemented year 2 with the potential to improve overall CP3 monetary commitment.
E-014	Hotel Accommodation	Green	Green	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	Green	Green	Pool vehicle usage monitoring and fleet size reduction in place post COVID-19 restrictions. Any savings could be offset by a potential new headwind for the replacement of the current fleet with hybrid/EV vehicles.
E-016	Establishment efficiency	Green	Green	Opportunities and plans underway as part of Network Rail's reorganisation under GBR and NR (HS)'s operating model review.
E-018	RCM (Instead of E-005)	Green	Green	RCM initiatives approved with tunnel inspections progressing to plan.
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.
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-002	Standards update incl cyber security	Green	Green	Standards updates undertaken and going through sign off process. Continuous review and assessment of cyber threat to ensure alignment to network and information systems directive.
H-004	S&T - Annual leave T&C changes	Blue	Blue	Terms and Conditions updated.
H-006	SIMD - Recent building issues/aging buildings	Grey	Grey	Asset verification resulted in updated asset list and visual inspection's completed. Headwind not materialised this financial year.
H-007	PSA - SE Route - Performance mgt/ 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.
H-009	Civils - Increase in maintenance due to deterioration of assets	Green	Green	Assessment of vegetation strategy currently in progress to influence additional maintenance requirements. Annual environmental report due December 2021, which may result in some remedial works.
H-003	Asset Management - Software maintenance	Green	Green	eAMS software update business case approved in year 1 and implementation brought forward to deliver in year 2. Implementation of changes to eAMS rescheduled for January 2022.
H-005	Increase in UTU Frequency	Grey	Grey	Enabler not to be utilised due to no further UTU requirements this financial year.
H-008	PSA - Site Access Control (SACC)	Grey	Grey	Enabler not to be utilised due to SACC being replaced by Sentinel.
H-010	Training alignment to NRIL	Green	Green	Establishment of training and competency programmes commenced, to redesign our track safety training initiative.
H-011	Track - Grinding & Tamping Regime	Green	Green	PLPR is not viable at present on NR (HS) infrastructure, however other initiatives including IRISys software are being explored to improve prediction of track degradation.
H-012	Establishment Headwind	Blue	Blue	New posts implemented as planned.
H-013	PSA - Provision required within PSA for buying training from NRIL	Amber	Amber	Spend has been partially utilised. Enabler is dependant on headcount reduction.

Figure 21 – NR(HS) O&M efficiencies Year 2 Q3 (as at Period 8)

Appendix 1. Circulation List

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

Name	Organisation
Steven Dennis	Office of Rail and Road
Debbie Daniels	Office of Rail and Road
Howard Taylor	Office of Rail and Road
Hubert Nomamiukor	Office of Rail and Road
Oliver Mulvey	Department for Transport
Patricia Idaewor	Department for Transport
Verity Tabberer	East Midlands Railway
Steve White	SE Trains Ltd.
Sue Ellis	SE Trains Ltd.
Jason Lewis	Eurostar International Ltd.
Ian Kapur	GB Rail Freight
Quentin Hedderly	DB Cargo
Peter Graham	Freightliner
Barry Earl	DRS
Chantelle Casula	Network Rail (High Speed)

Appendix 2. Safety and Performance

Safety

Lost-Time Injury Frequency Rate (LTIFR)

The LTIFR chart in Figure 22 shows the moving annual average LTIFR for the HS1 route and the three stations managed by NR(HS), and compares it with Network Rail Southern Region and Network Rail's national results. The LTIFR for 2021/22 was 0.414 against a target of 0.407; seven workers took off one or more shifts due to a workplace accident in the last year.

The route LTIFR at Period 13 was 0.217 and there were two lost time events over the year. The stations LTIFR was 0.651 and there were five lost time events. In support of the NR(HS) continued commitment to improving these results via the QHSE Strategy, a station safety improvement plan was launched. The plan will review data on workforce 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. 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.

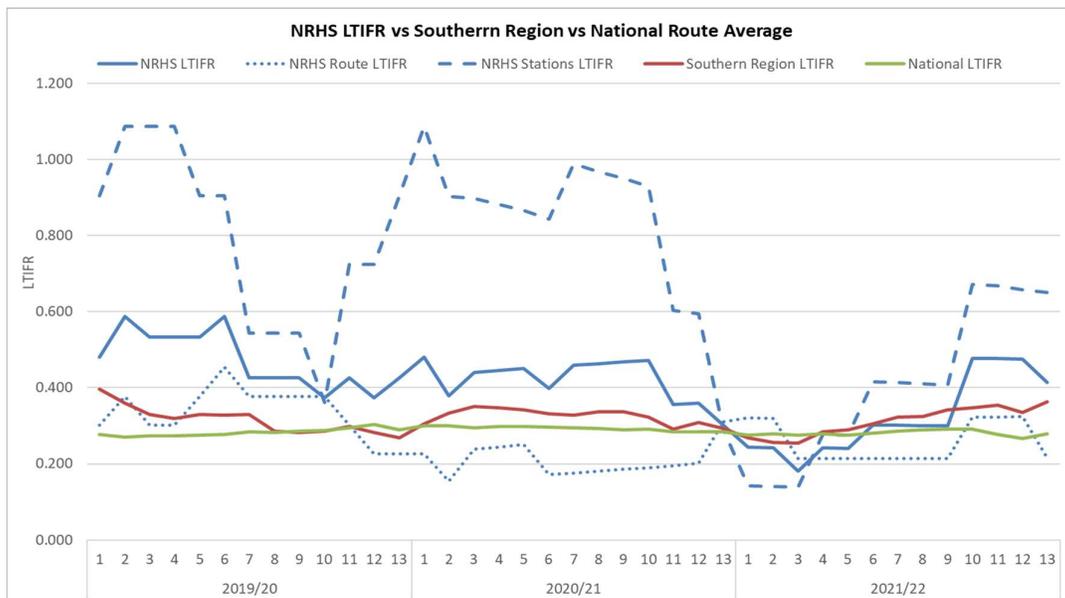


Figure 22 – Lost-time injury frequency rate

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.

Accidents by Category

Figure 23 shows the number of accidents in 2021/22. The top two risks for lost time accidents were manual handling and assault; NR(HS) has developed safety improvement plans for each of these accident

categories. In addition, a more focused station safety improvement plan has been developed with an area focusing on reducing assault and manual handling events involving employees. Figure 23 also indicates that the number of contact related events is significant but these have not resulted in lost time injuries. During the previous reporting year and into 2021/22 a programme of behavioural safety awareness training has been developed and rolled out to staff for the station environment.

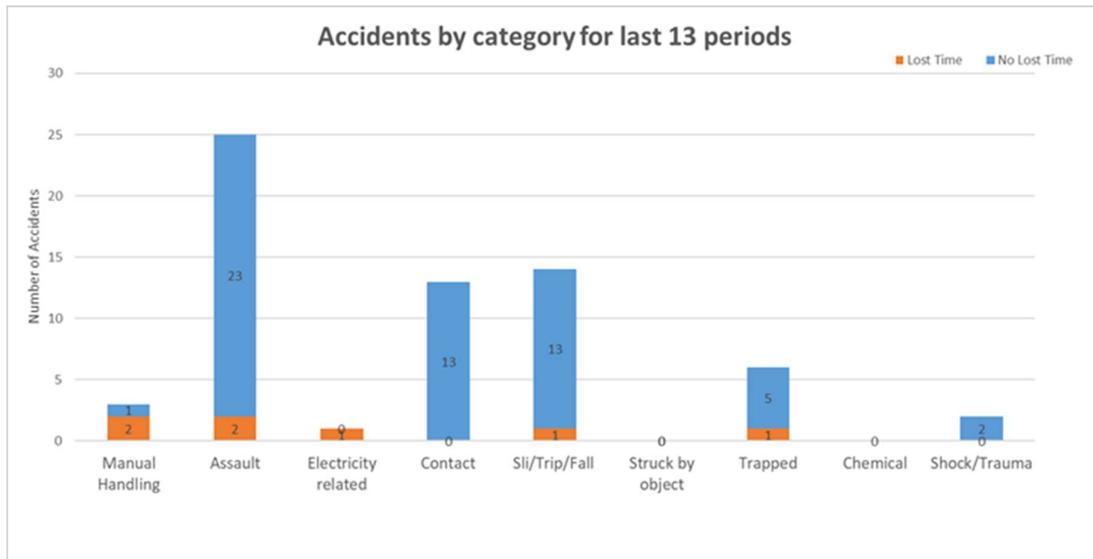


Figure 23 – Accidents by category for the last 13 periods

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

M_u = Minutes Unavailable (Taken from "total time to repair measure")

Figure 24 – 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).

In 2021/22 there was a total of 427,440 minutes of availability $((20 \times 5 + 18 + 19) \times 52 \times 60)$ and 3,485 minutes of delay on HS1, 2,416 of which were linked with infrastructure. This represents a network availability of 99.2%, in line with the 2020/21 network availability (99.5%).

Network Availability

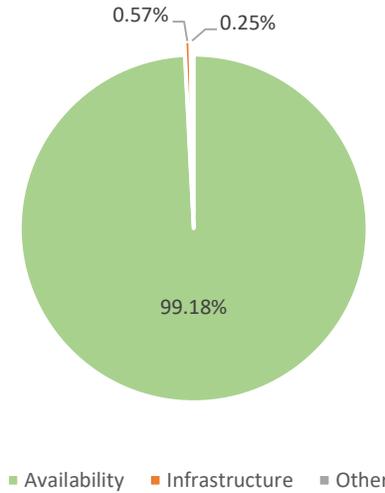


Figure 25 – HS1 Route Operational Availability

Power Availability

Month	Available Mins	UKPNS Fault (Unavailability) Mins	UKPNS Availability
Apr-21	43,200	0	100%
May-21	44,640	0	100%
Jun-21	43,200	0	100%
Jul-21	44,640	21	99.9530%
Aug-21	44,640	0	100%
Sep-21	43,200	0	100%
Oct-21	44,640	0	100%
Nov-21	43,200	0	100%
Dec-21	44,640	0	100%
Jan-22	44,640	0	100%
Feb-22	40,320	0	100%
Mar-22	44,640	0	100%
Year to date	525,600	21	99.9960%

Figure 26 – UKPNS Asset Availability

Power availability requirements are defined by TSI and are reported to HS1 periodically as defined in the UKPNS distribution agreement. As shown in Figure 26, UKPNS assets continued to perform well with availability of 99.9960% for the year, beating the target of 99.9885%. There was one interruption of power on 18 July 2021 at Choats Road; the report identified that the most likely root cause was a spurious overvoltage event which caused a circuit breaker at Choats Road to trip affecting the up power cable feeding the HS1 railway.

Other notable incidents: On 3 May 2021, an incident occurred at Ashford Nadir HV/LV substation which supplies the Ashford West B Site IT substation and the Ashford Nadir pumping station. The investigation was concluded and shared with HS1 at the regular monthly meeting. The affected LV circuit board has been repaired and refitted. The site is now fully operational.

Maintenance: 83% of sites have had the required maintenance completed against the original UKPNS maintenance plan for the year. The eight sites not completed are Singlewell Yard, Rainham Wennington (two sites), Ashford Nadir (two sites) Stone Street AT, Rainham AT and Choats Road feeder station. This is as a result of the issues with Sellindge SGT 5B (see Section 6.3.6) and the fitment of the new SCADA system. Maintenance at these sites will be actioned in the next year.

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 27 shows the results over the last year.

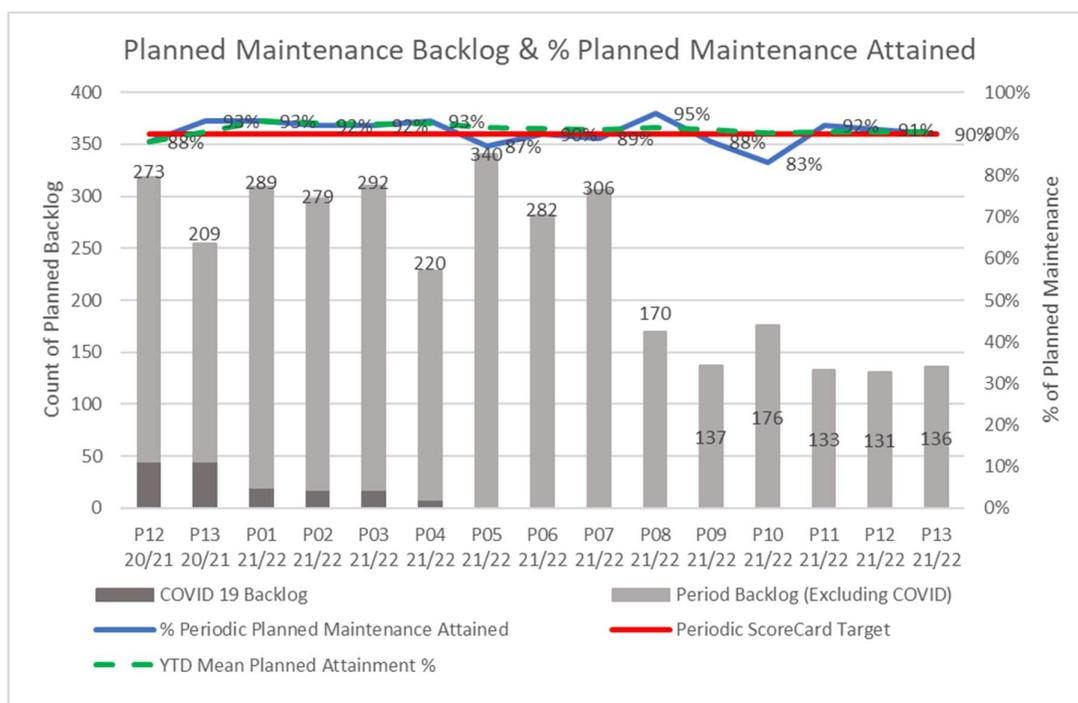


Figure 27 – Planned maintenance attainment

Asset Performance

Seconds Delay per Train

This section shows performance against stretch targets agreed between HS1 Ltd and NR(HS) which, along with current performance, substantially exceeds the requirements of the Concession Agreement.

Figure 28 shows the ‘Line of Sight Report’ which maps delay against incidents that arise due to faults on HS1 route infrastructure and other factors (internal or external) in the management of train services.

Overall, NR(HS) has exceeded the stretch target for seconds delay per train (4.00s against a stretch target

of 6.55s). The green boxes indicate the areas where stretch targets have been exceeded and this has been the case for all infrastructure.

Line of Sight Report - Delay/Train MAA

2021/22_P13

Network Rail (High Speed)		
Target	Actual	Var
6.55	4.00	-2.55

External - Infrastructure			External - Operations			Train Planning			Internal - Operations			Commercial & Performance			Other & Unknown		
Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var
0.53	0.08	-0.45	2.15	0.83	-1.32	0.11	0.08	-0.03	0.32	0.12	-0.20	0.33	0.12	-0.21	0.18	1.89	1.89

Infrastructure Failures		
Target	Actual	Var
3.11	0.88	-2.23

Internal GSMR			CCS			M&E			S&T			Civils & Environment			Track			External GSMR		
Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var	Target	Actual	Var
0.01	0.00	-0.01	0.10	0.00	-0.10	0.32	0.00	-0.32	1.27	0.84	-0.43	0.06	0.00	-0.06	1.15	0.04	-1.11	0.01	0.00	-0.01

| Delay Minutes (13 periods) |
|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| 0 | 0 | 729 | 0 | 37 |

NOTE: Values are rounded to 2 decimal places; consequently a summed actual may differ by +/-0.01 to the stated aggregated Network Rail (High Speed) Actual

Figure 28 – Route ‘Line of Sight’ mapped delay against incidents

Figure 29 shows the moving annual average delay per train for all NR(HS)-related performance-affecting incidents, against the stretch target agreed between HS1 Ltd and NR(HS).

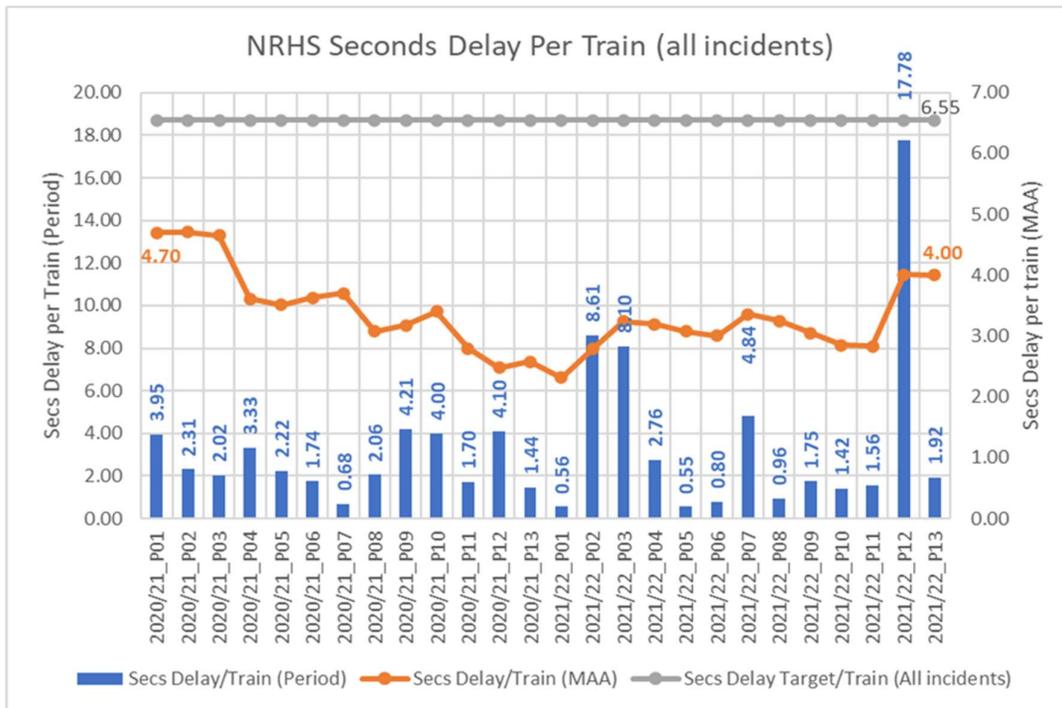


Figure 29 – NR(HS)-related route delay per train for all incidents (including non-infrastructure)

Figure 30 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 Ltd and NR(HS).

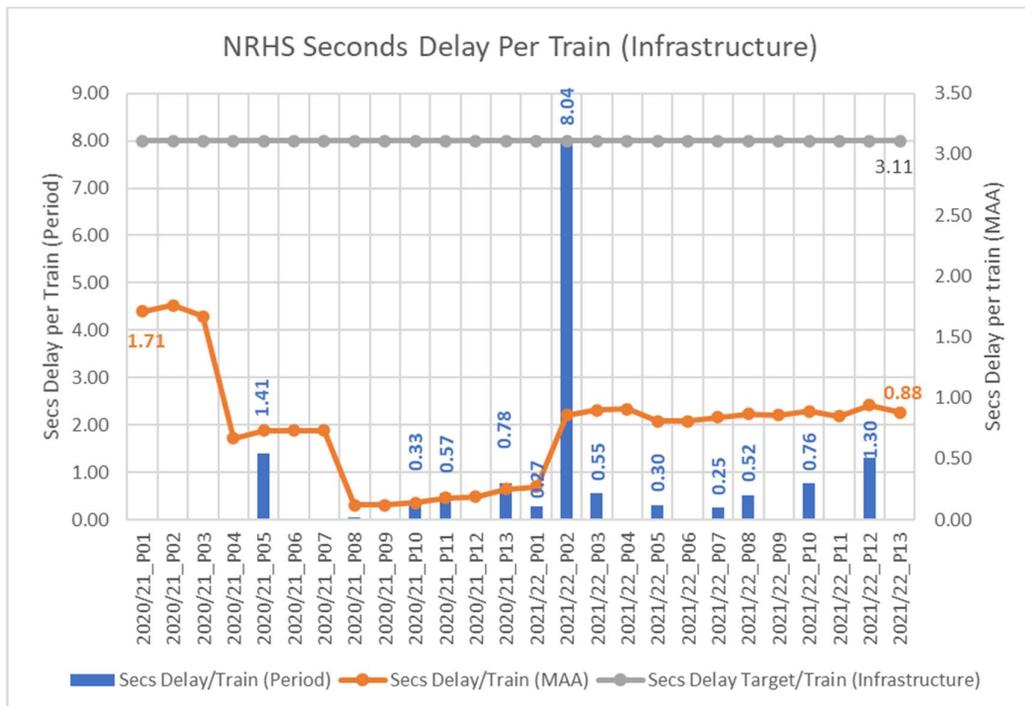


Figure 30 – Route delay per train for all infrastructure incidents

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 Ltd and NR(HS).

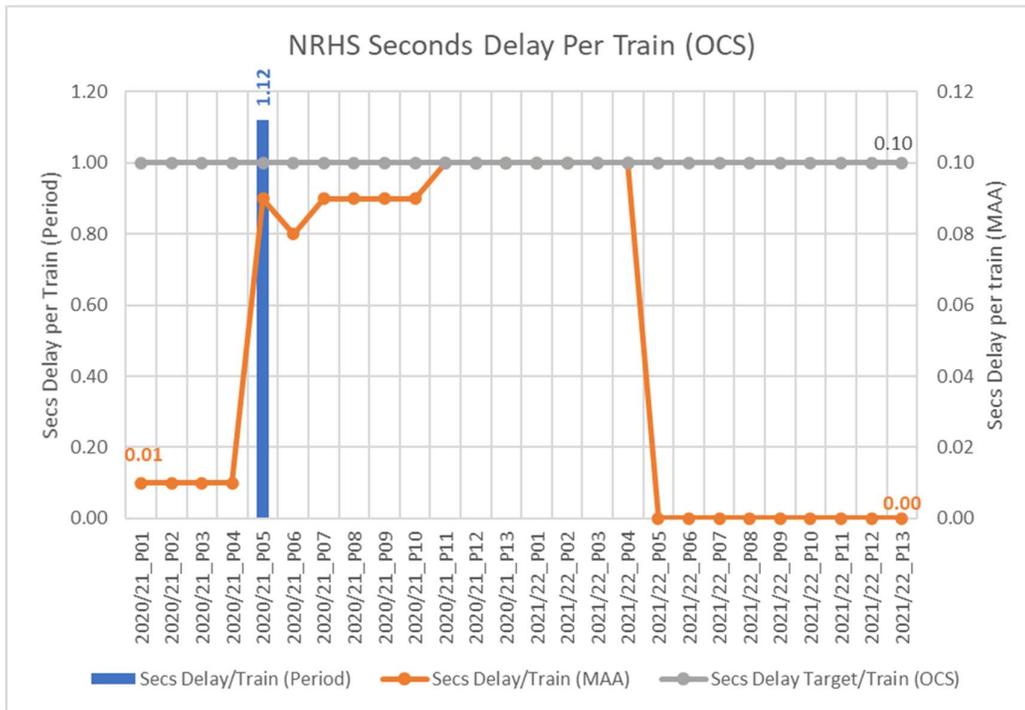


Figure 31 – Route delay per train for all OCS incidents

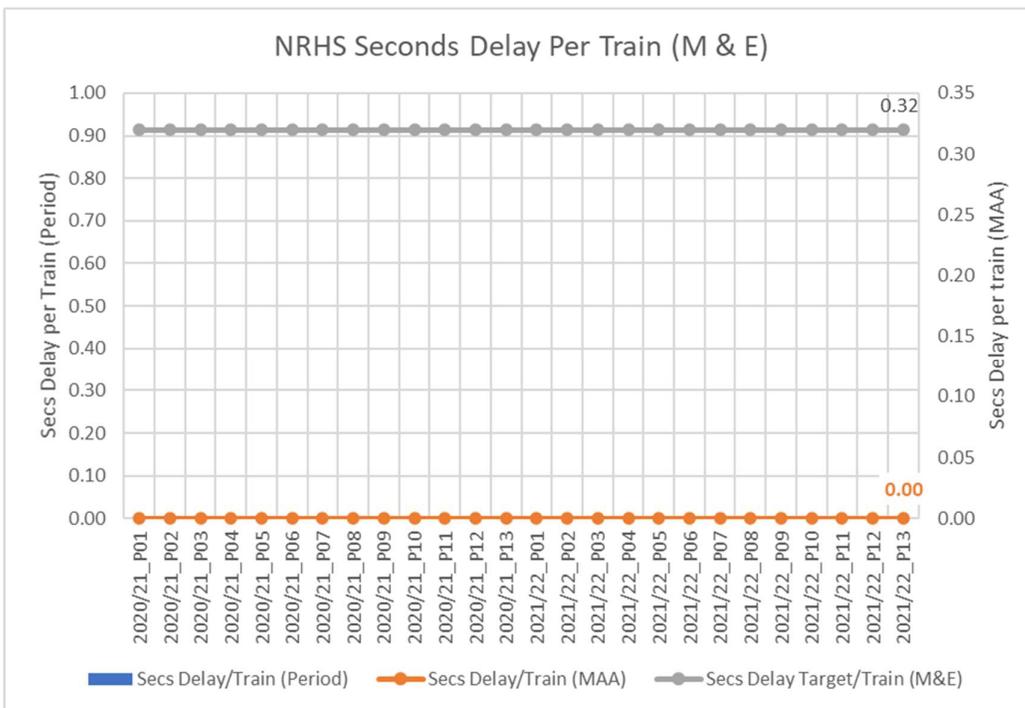


Figure 32 – Route delay per train for all M&E incidents

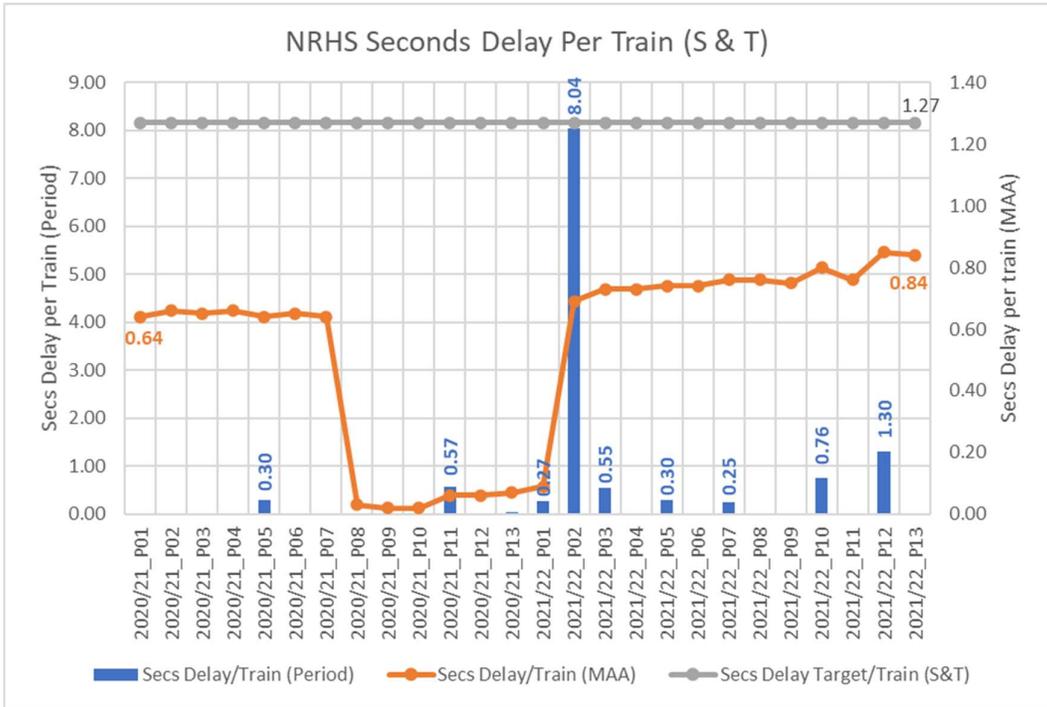


Figure 33 – Route delay per train for all S&T incidents

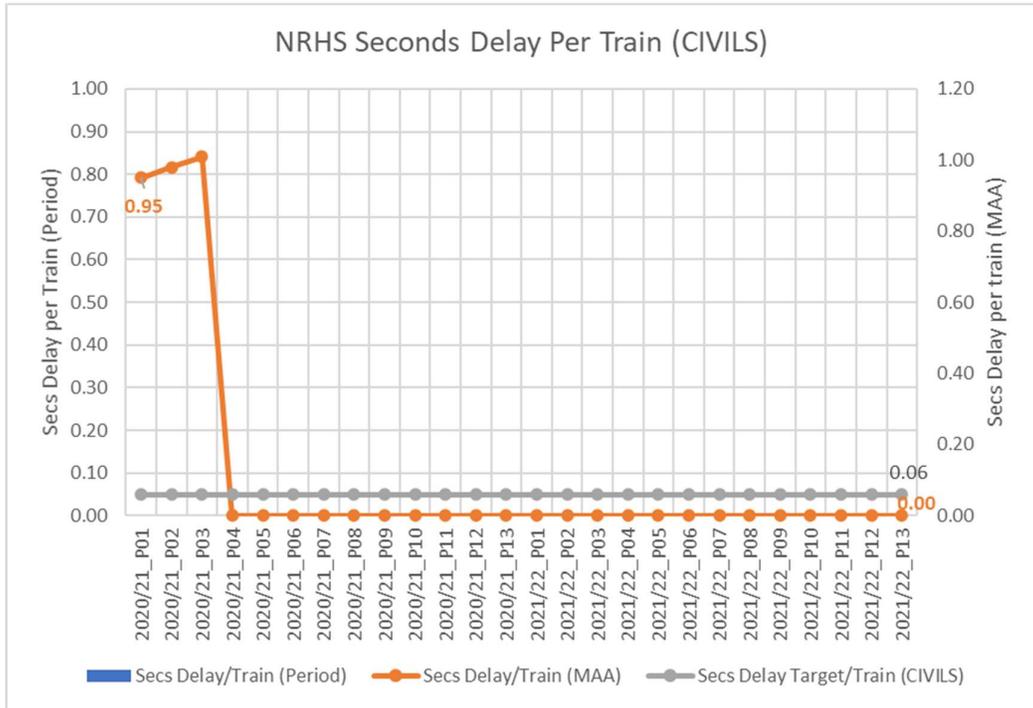


Figure 34 – Route delay per train for all civils & environment incidents

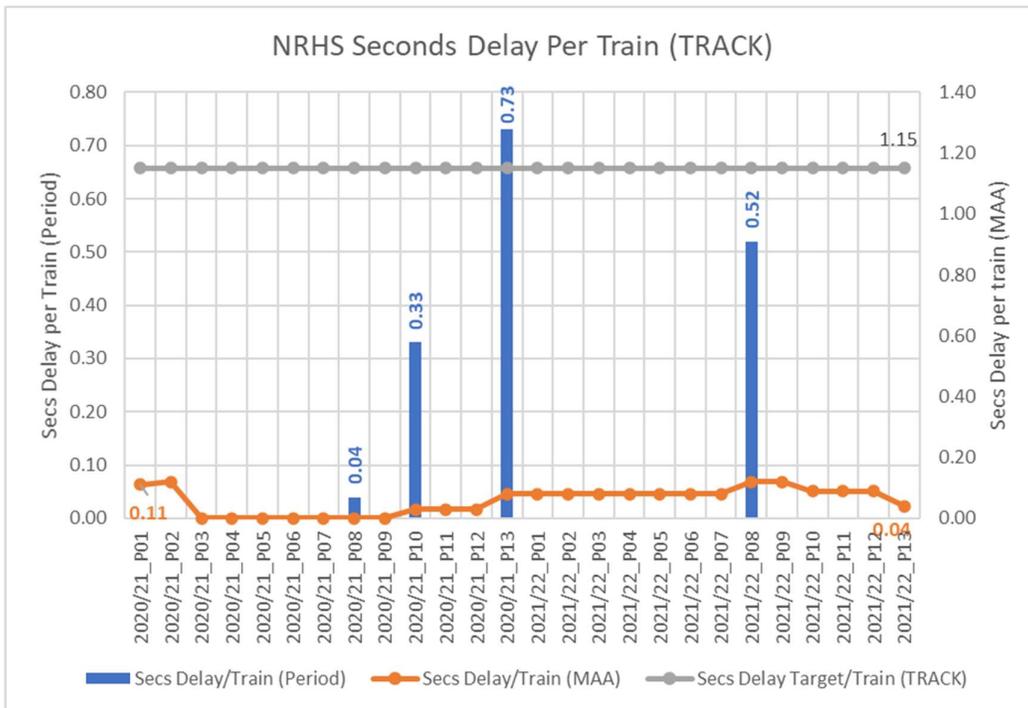


Figure 35 – Route delay per train for all track incidents

Fault Rates by Asset Group

Figure 36 shows faults for each asset group against the targets in the CP3 regulatory submission. With the exception of track, HS1 assets were performing well within targets.

Asset Group	Category	CP3 Target Ave/Period	2020/21 Actual Ave/Period	2021/22 Actual Ave/Period
Signalling	Fault Level	18.00	2.08	2.69
	Service Affecting	1.00	0.46	0.85
Telecoms	Fault Level	4.00	0.00	0.15
	Service Affecting	1.00	0.00	0.15
M&E	Fault Level	9.00	0.15	0.00
	Service Affecting	1.00	0.08	0.00
OCS	Fault Level	2.00	0.15	0.08
	Service Affecting	1.00	0.15	0.00
Track	Fault Level	0.20	0.77	0.38
	Service Affecting	0.10	0.15	0.38
Civil	Fault Level	2.00	0.62	0.08
	Service Affecting	0.00	0.08	0.00

Figure 36 – 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, maintenance interventions are continuously moving from reactive (severity 1 and 2 faults) to planned (severity 3, 4 and 5 faults). This demonstrates a trend of improving maintenance effectiveness and the ability to be more proactive than reactive.

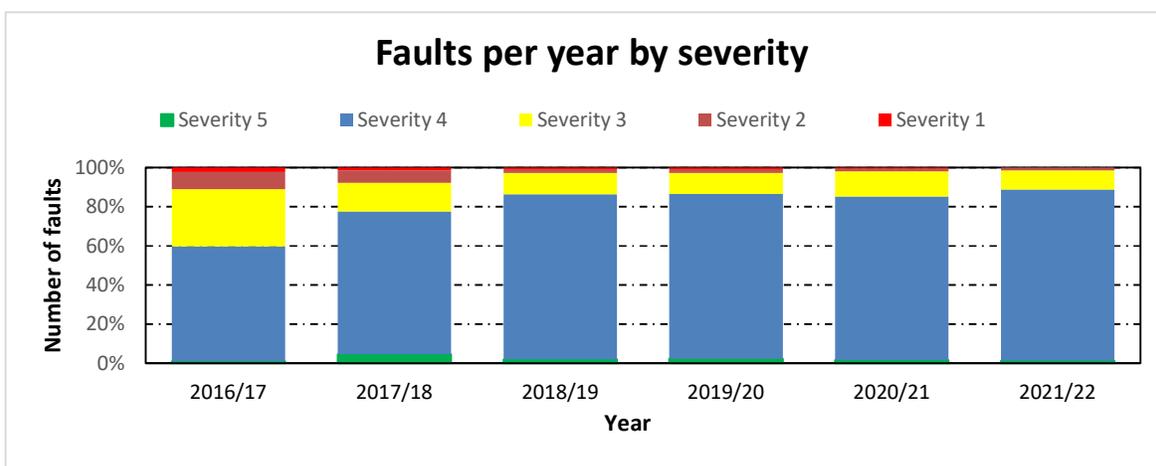


Figure 37 – Breakdown of faults by severity

Route Mean Time Between Service Affecting Failure (MTBSAF)

The figures below show examples of reliability data provided by the High-Speed Infrastructure Reliability Group. The results show that the MTBSAF, and therefore the reliability, for two S&T critical asset classes, HPSS points operating equipment and HVI track circuits, has steadily increased.

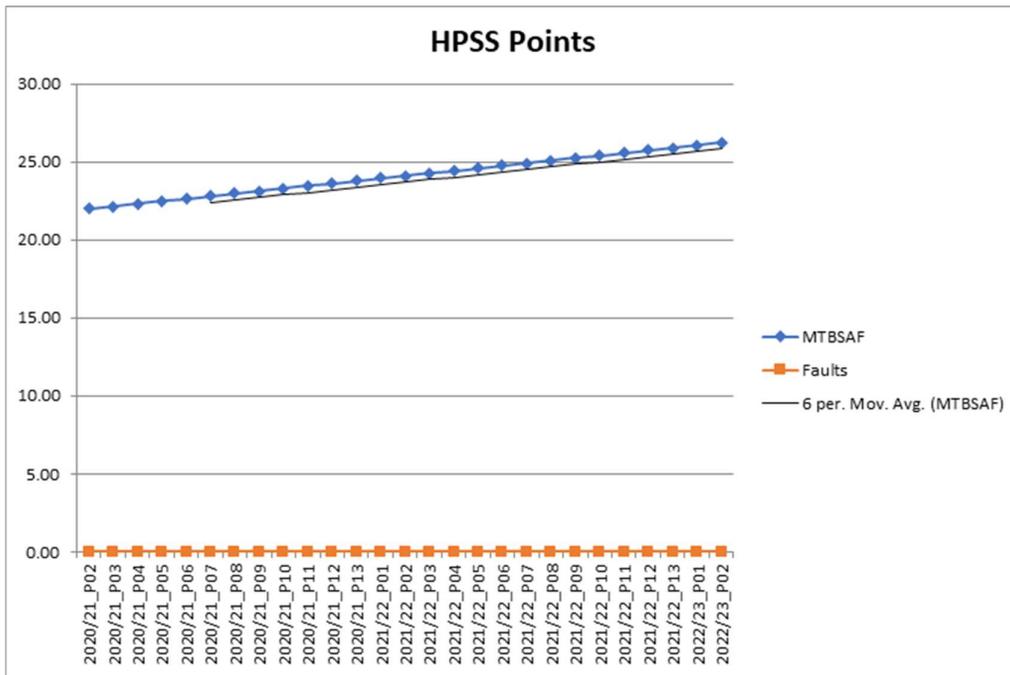


Figure 38 – MTBSAF for the HPS point operating equipment

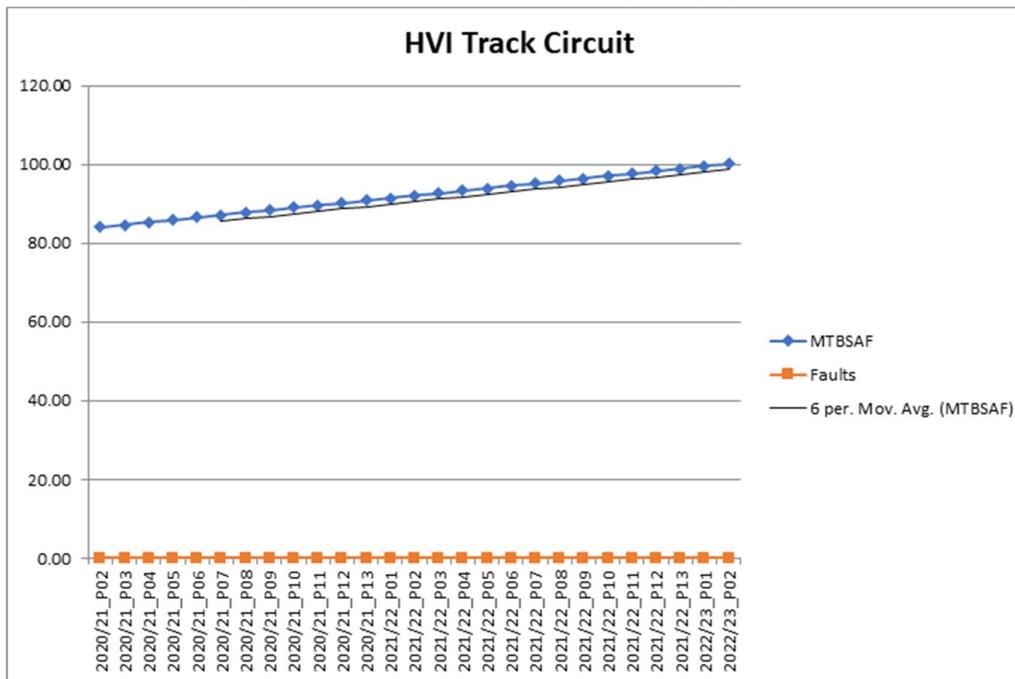


Figure 39 – MTBSAF for the HVI track circuits

Appendix 3. Asset Management

HS1 Asset Management Policy



Our Asset Management Policy

High Speed 1 Ltd operates the UK's only highspeed railway. We strive to provide best in class asset stewardship and adopt a pioneering approach to problem solving and development. HS1 has a 30-year concession let by the government to operate, maintain, and renew the route and stations. This policy reflects our commitment to deliver sustainable operational performance and asset availability through world leading asset management.

The HS1 Asset Management System includes an Asset Management Policy, Strategic Asset Management Plan, Asset Management Objectives and the processes to achieve those objectives. HS1 will engage with its strategic partners and suppliers to ensure the Asset Management Objectives are cascaded, and that the approach to asset management is consistent. HS1 will define asset management roles and accountabilities between HS1 and suppliers in its contracts.

Our Approach

We will deliver our shareholder requirements, comply with our contractual obligations, and endeavour to outperform stakeholder expectations.

HS1 is a private company limited by shares, with institutional investors committed to long term sustainable financial return. HS1 adds value by being an intelligent client through three strategic themes, to **Protect, Evolve and Grow**:

- **Protecting our concession agreement** by keeping our asset base compliant with current regulations, interoperable for international train operators and fit for the future
- Working with HS1 suppliers and adjacent infrastructure managers **evolving how the balance of risk, cost and performance is delivered** to keep maximising the value generated by our assets
- Delivering sustainable **growth** of HS1 services and the environmental, social and economic benefits this generates to our stakeholders by meeting the targets set in our Sustainability Strategy

We all contribute to the HS1 Asset Management System, coordinating our activities to maximise the value from the assets and balance the whole life cost with the benefits that our assets generate to the environment and local communities.

We will continue to build a customer orientated culture within HS1. We will have a structured approach to stakeholder engagement. We will use the Asset Management Objectives to anchor asset intervention decision making to be consistent with customer expectations

We will continually improve Asset Management Capability in line with other leading industry practitioners. This will follow the principles of ISO 55000 asset management best practice. We will measure asset management capability through a series of key performance indicators, these are defined in document reference HS1-AMS-004.

Figure 40 – HS1 Asset Management Policy

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.

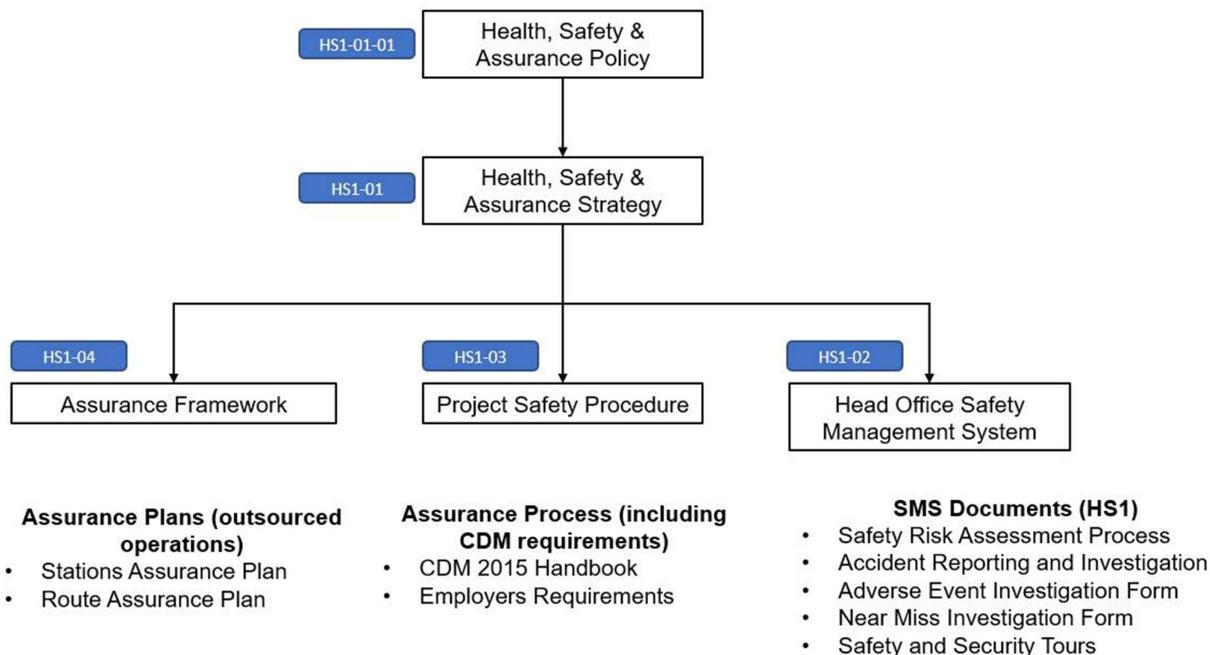


Figure 41 – HS1 Health, Safety and Assurance Management System

Update on CP2 5YAMS ‘promises’

This section provides an update on the ‘promises’ made in Table 33 of the CP2 Five Year Asset Management Statement, for the two initiatives that were still open at the end of 2020/21.

Both of these initiatives are part of our wider R&D programme. In future versions of the AMAS, we propose to close the remaining CP2 promises and report progress on these two themes under R&D.

Assets	CP2 key initiatives	RAG status
Track	Plain line pattern recognition software to reduce resource and improve information	A
E&P	Pantograph mounted CCTV to help with OCS inspection	A

Figure 42 – Progress against CP2 ‘promises’

Plain line pattern recognition software to reduce resource and improve information. Last year we reported that PLPR was found to be incompatible with the sleepers and fastenings installed on the HS1 route. After trying an adaptation of the system to record different parameters, it was concluded that there was no business case to proceed with the project. The track team is currently approaching the challenge through two initiatives:

- **Unattended Geometry Measurement System (UGMS):** NR(HS) has validated the recording software and demonstrated comparable results to the Network Rail Track Recording Coach. The priority location for introduction of this technology is St. Pancras, where we have limited dynamic condition data. NR(HS) is currently discussing the frequency, routes, data processing, servicing and calibration required to bring this equipment into routine service.
- **In-service monitoring of Eurostar trains:** Phase 2 of this project demonstrated that the monitor could provide reliable and repeatable data collection, presented to the user in a meaningful format. A Gate 4 paper and report will be completed to close this phase. The project is now in Phase 3 which will continue to develop the system and expand to multiple vehicles to calibrate algorithms before looking at a transition to a commercial product. This is currently being delayed by electronic component shortages and associated lead times with installation now expected in late 2022.

Pantograph mounted CCTV to help with OCS inspection. This year work on this theme has continued under two initiatives in the R&D programme. Under the OLErt project (see Section 5.1.8), NR(HS) has now sourced an alternative system (PANDAS V) and is working towards trialling this in Q2 2022/23. The Cordel project (see Section 5.1.6) is a new R&D project to help with OCS inspections and monitoring. The system uses high definition video and lidar imagery and is now being trialled on the HS1 route. If the trial is successful the system will be able to flag potential OCS and track defects/failure prior to actual failure occurring and will provide data for asset condition trends.

CP3 Commitments/Recommendations

Seven of the ORR's 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 Ltd 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 Ltd 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 Ltd-tier 1 contractors' RM3 tracked over CP3	HS1 Ltd stated it had commenced implementation of RM3 across "key" tier 1 suppliers. Results of suppliers' RM3 self-assessment will be consolidated in HS1 Ltd RM3 self-assessment. HS1 Ltd 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 Ltd 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 will be picked up particularly as we plan to use RM3 as the criteria for the 2021/22 annual audit plan. 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. For more details please see Sections 4.2.1 and 4.2.2.	Completed
5	Greater distinction needs to be made between activity required for legal compliance and that delivering above legal compliance.		HS1 Ltd 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 Ltd 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 Ltd 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 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	2021/22 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	<p>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.</p> <p>HS1 has produced an Asset Information Vision, Policy, Strategy and associated Improvement roadmap (action plan) setting out clear objectives for CP3.</p> <p>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 (see Section 4.1.2).</p> <p>HS1 is also working with main suppliers to maintain / develop ISO 55001 asset management systems which include improvement deliverables.</p>	<p>Completed</p> <p>Recommendation for a plan to be developed has been achieved. Plan now being implemented over the duration of CP3.</p>
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 and risk. NR(HS) has achieved ISO 55001 accreditation for route. NR(HS) stations has produced a roadmap for accreditation targeting the end of 2023. We are on track for certification by the end of CP3.	Ongoing
3	Future 5YAMS to document and demonstrate the assurance activities HS1 has undertaken on NR(HS).	In advance of the CP4 5YAMS submission	<p>HS1 provided ORR with the Assurance Framework, Health Safety and Assurance Strategy, and Health Safety and Assurance Audit Standard in October 2021.</p> <p>Assurance Plans are in place for route and stations, which are reviewed quarterly (see Section 4.2.1).</p> <p>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.</p>	Ongoing

ORR Ref	Description of ORR recommendation	Action by date	2021/22 progress update	Comment on delivery
4	HS1 to update Asset Management Policy with current status, what will be improved and CP3 targets/milestones.	By end January 2020	<p>HS1 has reviewed the Asset Management Policy to best align it to current areas of focus during CP3 and in preparation for CP4.</p> <p>A new iteration of the SAMP was finalised in December 2021 and issued to HS1 by NR(HS) in January 2022. The new SAMP, however, does not include the summary consolidating the O&M approaches for each asset system outlined in the SASs, as per the NR(HS) deliverable. We have issued comments back to NR(HS) and they will review and implement by December 2022.</p> <p>NR(HS) has the following as a deliverable: <i>Section 1, Figure 3 in the NR(HS) SAMP provides an overview to the objectives and the outcomes for the next control period. The SAS documents explain in detail the maintenance and renewal approaches to ensure these objectives are met. NR(HS) will create a summary that consolidates this in the next iteration of the SAMP.</i></p>	Completed – objective to be met through meeting recommendation 6
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	<p>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:</p> <ol style="list-style-type: none"> 1. The review of the AMOs as part of the HS1 portfolio-level Strategic Asset Management Plan work; and 2. Current re-baselining of the renewals delivery and future plans to drive workbank prioritisation during both planning and delivery through AMOs and asset risk. <p>We will issue the HS1 SAMP and the revised AMOs by the end of June 2022.</p>	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	<p>HS1 has reviewed the Asset Management Policy to best align it to current areas of focus during CP3.</p> <p>The NR(HS) revised SAMP was delayed due to COVID-19 priorities. A new iteration of the NR(HS) Route SAMP was finalised in December 2021 and issued to HS1 in January 2022.</p> <p>The new SAMP however does not include the summary consolidating the O&M approaches for each asset system outlined in the SASs, as per the NR(HS) deliverable. We have issued comments back to NR(HS) and they will review and implement by December 2022.</p> <p>NR(HS) has the following as a deliverable: <i>Section 1, Figure 3 in the NR(HS) SAMP provides an overview to the objectives and the outcomes for the next control period. The SAS documents explain in detail the maintenance and renewal approaches to ensure these objectives are met. NR(HS) will create a summary that consolidates this in the next iteration of the SAMP.</i></p> <p>HS1 SAMP to be issued by the end of June 2022.</p>	Not yet complete. We expect to have met this recommendation with the NR(HS) SAMP by the end of December 2022.

ORR Ref	Description of ORR recommendation	Action by date	2021/22 progress update	Comment on delivery
7	Specific Asset Strategies (SASs) should present the expected asset condition at end of control period, handback and end of the 40-year plan.	At next revision or no later than 31 December 2020	NR(HS) updated the SASs in July 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) is working with a new whole life cost (WLC) tool supplier on a plan to deploy the tool on route assets. The target is to have WLC scenarios from the updated asset conditions and AMOs by the end of July 2022 as this is one of the key enablers of PR24. We will share the scenarios 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 described in Section 5.1. Examples are: <ul style="list-style-type: none"> • 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
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. Development of the NR(HS) Target Operating Model is ongoing.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2021/22 progress update	Comment on delivery
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	<p>We are working on a number of improvement areas for asset information capability (see Section 4.1.3 for more detail).</p> <p>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.</p> <p>For route, asset hierarchy is defined for each discipline in the SASs, and will be reviewed through the PR24 process. NR(HS) Route is planning to complete the write-up of its Enterprise Asset Management System (eAMS) data governance standard, which will be complemented by a route Asset Data Dictionary by October 2022. NR(HS) Route is due to be audited on its asset information/data state in Q3 2022/23.</p> <p>NR(HS) has been unable to prove the use of the eAMS mobile app as a viable option, owing to limitations of the eAMS system. NR(HS) now intends to progress a replacement for eAMS to deliver NR(HS)'s future asset management requirements.</p>	Not yet complete. As discussed with the ORR, we expect to complete for route by Q3 2022/23.
12	HS1 to review operations and maintenance risks ownership with funders.	Plan & programme to be developed and agreed by 31 March 2020	<p>This commitment was postponed to focus on COVID-19 response actions.</p> <p>HS1 has agreed a plan to stocktake the treatment of risk with NR(HS).</p> <p>Completion of the survey has been delayed due to resource being occupied on other issues and illness in the team (COVID-19) and NR(HS) being focused on the Target Operating Model. We plan to undertake the survey by end of July 2022.</p> <p>We will use this as the basis for considering options with funders to better manage risk in CP4. We plan to engage with funders from end July 2022.</p> <p>NB: this commitment was inaccurately stated as completed in the 2020/21 AMAS.</p>	Not yet complete. Survey to be undertaken by end of July 2022
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	<p>The recommendation to provide a resource programme was achieved.</p> <p>The onset of COVID-19 in 2020 meant that implementation of the NRIL Business Continuity Management (BCM) Standard was put on hold as BCM resources across the country were redeployed to assist with the management of the pandemic.</p> <p>The project recommenced in June 2021 and good progress has been made. We had originally planned to have a fully developed Business Continuity Plan by November 2021, however due to the large number of asset recovery cards that were identified through the business impact analysis process in September/October, and some business resources being prioritised elsewhere, we were unable to meet this date.</p> <p>An updated Business Continuity standard with additional requirements was published in September, 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.</p>	Completed

ORR Ref	Description of ORR recommendation	Action by date	2021/22 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. This year, 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.	Ongoing during CP3
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 (see Section 7.7.2). 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 has been undertaking a structure of charges review which includes consideration of the cost level/affordability of HS1’s services and we have been engaging funders on this. We expect to conclude the structure of charges review shortly (see Section 5.5.2).	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

ORR Ref	Description of ORR recommendation	Action by date	2021/22 progress update	Comment on delivery
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 (see Section 4.2.1).	Completed
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 (see Sections 5.4.1 and 6.2.1 for more details). 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. See Section 6.3.2 for more detail.	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 and we are anticipating we will review this again in the summer of 2022 and will consult with the ORR again on forecasts for PMO costs for the remaining years. We are currently running close to the target and we are working to keep PMO costs as low as possible. (See Section 5.2.1 for more detail). 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. See Section 5.1 for more details.	Completed

ORR Ref	Description of ORR recommendation	Action by date	2021/22 progress update	Comment on delivery
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. See Section 6.4.2 for more details. We will provide updates on this project in each AMAS.	Completed
26	HS1 Ltd 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
27	HS1 to agree business case with stakeholders for CP4-10 PMO model	Plan & programme to be developed and agreed by 31 March 2020	<p>The issue of the correct project organisation is being addressed through the CP4 project delivery capability improvement programme.</p> <p>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.</p> <p>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.</p> <p>See next item ORR ref 28 for more information.</p>	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	<p>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.</p> <p>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).</p> <p>HS1 has received a letter of no objection from the Government.</p>	Completed

Appendix 4. Key Initiatives and Improvements

CP3 Route Innovation, Research and Development Projects

Project	Business Case	Status
Tunnel vision – development of a technology-based solution for tunnel inspection	More efficient inspection methodology Workforce safety improvement Data quality improvement	Completed
Tunnel vision – development of a technology-based solution for tunnel inspection Stage 2B	As above	In progress
Fault prediction using AI/machine learning – for POE and S&C assets	Improve safety Increase infrastructure reliability Support long-term renewal strategies	Gate 2 approved
St. Pancras station operations - real-time passenger monitoring to optimise operations (OpenSpace digital twin)	Improved customer and staff experience Reduced costs Increased revenues	In progress
OCS monitoring using PANDAS wireless remote condition monitoring system - combines 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 in the pantograph	Gate 2 approved Hitachi plans to refurbish the trains in 2022. SE Trains will fit the cameras; this is currently planned for December 2022. NR(HS) has requested this be accelerated for a sample set if possible.
Under sleeper pads – trial extension	Extend sleepers asset life Improve reliability and performance Reduce costs	Scope confirmed Gate paper to be submitted
Remote condition monitoring on point operating equipment – benefit assessment	Improve data quality Increase asset deterioration rate knowledge Improve reliability	Contracts with suppliers are being agreed

Project	Business Case	Status
5G Integrated Railway Augmented Reality Digital Twin	Improve reliability and fault diagnosis Provide a means for multi-directional flow of information and improve decision-making	Completed
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
In-service monitoring on Eurostar (Phase 2) (Birmingham University/MoniRail)	As Phase 1	Completed
In-service monitoring on Eurostar (Phase 3) (Birmingham University/MoniRail)	As Phase 1	Continuation of Phase 2
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.	Development
Infrastructure monitoring using multi-purpose vehicles (MPV) (Cordel)	Reduction in number of staff lineside, improved safety and significantly reduced access requirements. Automating inspection will allow for better utilisation of staff in addressing the risks identified or more detailed targeted examination.	Development
Digital bridge inspections (Waldeck)	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
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 better use of resources and would increase the life of assets where maintenance is more frequent than required.	Development

Figure 43 – CP3 R&D projects

Appendix 5. Renewals Cost Tables

The Excel spreadsheet which accompanies this AMAS shows 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.

Appendix 6. 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 2021/22

STATEMENT 1: ANALYSIS OF O&M FINANCIAL PERFORMANCE			
	Actuals YTD	CP3	Variance Fav/(Adverse)
Income			
Operations and Maintenance	43.1	57.2	-14.1
Pass through	19.2	19.8	-0.5
Total O&M income	62.3	77.0	-14.6
Cost			
NRHS	44.5	44.5	0.0
Subcontract	3.4	3.9	0.5
Internal	9.8	9.4	-0.4
Sub total: Controlled costs	57.7	57.9	0.2
Pass through costs	19.2	20.1	0.9
Freight	0.3	0.3	0.0
Total O&M Costs	77.2	78.3	1.1
Net Performance Regime Cost	-0.0	0.0	0.0
Net Position			
Net income / (spend)	-14.9	-1.3	-13.6

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OMRC Collection and Application

As at Period 13 2021/22

STATEMENT 2: ANALYSIS OF O&M INCOME												
	Actuals YTD				CP3				Variance Favourable / (Adverse)			
	EIL	SETL	Freight	Total	EIL	SETL	Freight	Total	EIL	SETL	Freight	Total
	Operations and Mtce	6.3	36.2	0.6	43.1	20.1	36.8	0.2	57.2	-13.9	-0.6	0.4
Pass through	1.9	17.3	0.0	19.2	5.8	14.0	0.0	19.8	-3.9	3.3	0.0	-0.5
Total O&M income	8.1	53.6	0.6	62.3	25.9	50.9	0.2	77.0	-17.8	2.7	0.4	-14.6

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OMRC Collection and Application

As at Period 13 2021/22

STATEMENT 3: ANALYSIS OF O&M COSTS

	Actuals YTD	CP3	Variance Fav/(Adverse)
NR(HS)	44.5	44.5	0.0
BTP	0.9	1.1	0.2
NGC Connections fees	0.4	0.5	0.1
NRIL costs	1.6	1.6	0.0
GSMR	0.3	0.3	0.0
ORR regulatory and Safety	0.2	0.4	0.2
<i>Total Sub-contract</i>	3.4	3.9	0.5
Staff Costs	4.8	4.9	0.0
Technical Support/Consultancy	1.9	1.2	-0.7
Office running costs	0.9	1.1	0.2
Other Costs	1.7	2.0	0.3
R&D	0.4	0.3	-0.1
<i>Total Internal</i>	9.8	9.4	-0.4
Total Controlled Track Costs	57.7	57.9	0.2
Insurance	3.2	3.2	-0.0
Power non EC4T	1.3	1.9	0.6
Rates	8.7	9.0	0.3
UKPN Fees and Renewals	6.0	6.0	0.0
<i>Total pass-through</i>	19.2	20.1	0.9
NR(HS)	0.1	0.1	0.0
NRIL costs	0.2	0.2	0.0
HS1 costs	0.1	0.1	0.0
<i>Total Freight</i>	0.3	0.3	0.0
Upgrades	0.0	0.0	0.0
Total OMRC	77.2	78.3	1.1
Performance regime net cost / (income)	-0.0	0.0	0.0

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Period ending 31 March 2022

Statement 4: Analysis of the Escrow Account

	Actual	CP3 *	Difference
A) Reconciliation of movements in period to 31 March 2022			
Opening balance	11.6	88.2	(76.6)
Transfer In	20.6	28.9	(8.3)
Interest	0.1	1.2	(1.1)
Deposits Maturing	160.7		160.7
Total transfers in	181.5	30.1	151.4
Drawdowns	(9.4)	-17.4	7.9
Service Charge	(0.0)		(0.0)
Deposit Placed	(166.7)		(166.7)
Total drawdowns	(176.2)	(17.4)	(158.8)
Closing balances	16.9	0.0	6.0
Investments	84.9		84.9
Closing balances	101.8	100.9	0.9

* Data relates to Year 2 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 Stations, which is in line with the concession agreement

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

Period ending 31 March 2022

Statement 5: Upgrades Actuals 21/22

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 2022			Cumulative since 01/04/2020			Total CP3
	Actual	CP3	Difference	Actual	CP3	Difference	
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 following the Review Year							
in £m nominal	Period Ending 31 March 2022			Cumulative since 01/04/2020			Total CP3
	Actual	CP3	Difference	Actual	CP3	Difference	
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

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OMRC Collection and Application

Period ending 31 March 2022

Statement 6: Net Debt

in £m

	Actual	CP3	Difference	Total CP3
A) Reconciliation of net debt at 31 March 2022				
Opening Net Debt	0	0	0	0
Income				
	0	0	0	0
Expenditure				
Total Expenditure	0	0	0	0
Financing				
Total financing costs	0	0	0	0
Closing Net Debt	0	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.

HS1 Limited

Asset Management Annual Statement

OMRC Collection and Application

Period ending 31 March 2022

Statement 7: Escrow account summary in Current Account £m

Route	Account
Opening Balance	14.60
Receipts	11.8
Withdrawal	(6.4)
Interest	0.1
Service Charge	(0.0)
Deposits Matured	81.8
Deposit Placed	(84.9)
Closing Balance	16.9

St Pancras	Account
Opening Balance	9.7
Receipts	1.7
Withdrawal	(2.6)
Interest	0.0
Service Charges	(0.0)
Deposits Matured	24.8
Deposit Placed	(28.2)
	0.0
Closing Balance	5.4

Stratford	Account
Opening Balance	1.6
Receipts	0.3
Withdrawal	(0.2)
Interest	0.0
Service Charges	(0.0)
Deposits Matured	5.2
Deposit Placed	(5.7)
	0.0
Closing Balance	1.2

Ebbsfleet	Account
Opening Balance	2.0
Receipts	0.4
Withdrawal	(0.3)
Interest	0.0
Service Charges	0.0
Deposits Matured	6.0
Deposit Placed	(6.6)
	0.0
Closing Balance	1.5

Ashford	Account
Opening Balance	1.2
Receipts	0.2
Withdrawal	(0.0)
Interest	0.0
Service Charges	(0.0)
Deposits Matured	4.2
Deposit Placed	(4.6)
	0.0
Closing Balance	1.1

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OMRC Collection and Application

Period ending 31 March 2022

Statement 8: Analysis of HS1 Efficiency							
Detail	Type	5YAMS	Actual	5YAMs	Variance	Commentary	
Consultants costs	OMRC	Consultancy	Costs-HS1 Internal costs: Technical support/consultancy	765,969	11,708	-754,261	(2) Staff & interim costs
Post - Hendricks Costs	Projects	#N/A	Covid Related Costs - Project Hendricks - Finance Projects	526,129	-	-526,129	(1) Covid Recovery
Post - Hendricks Costs	Projects	#N/A	Covid Related Costs - Project Hendricks - Finance Projects	499,525	-	-499,525	(1) Covid Recovery
Insurance Cost	OMRC	Insurance	Costs-Pass through costs: Insurance	4,403,584	4,196,006	-207,579	A
Regulatory	OMRC	Other Overheads	Costs-HS1 Internal costs: Technical support/consultancy	280,213	101,115	-179,098	(2) Staff & interim costs
Other - environmental initiatives	OMRC	Other Overheads	Costs-HS1 Internal costs: Other costs	194,232	26,396	-167,836	B
Software and Support	OMRC	Office Running & IT	Costs-HS1 Internal costs: Office running costs	146,079	17,998	-128,080	C
Recruitment costs	OMRC	Other Overheads	Costs-HS1 Internal costs: Other costs	221,490	108,565	-112,925	(2) Staff & interim costs
Cyber Resilience	OMRC	#N/A	Costs-HS1 Internal costs: Other costs	99,271	-	-99,271	D
NGC Fees	OMRC	Other Contractual	Costs-HS1 Subcontract costs: NGC Connection Fees	393,668	515,651	121,983	H
Control Period Consultants Costs	OMRC	Consultancy	Costs-HS1 Internal costs: Technical support/consultancy	84,012	212,873	128,861	E
Ashford IECC	OMRC	Other Overheads	Costs-HS1 Internal costs: Other costs	-10,000	135,281	145,281	F
Control Period Consultants Costs - Route	OMRC	Consultancy	Costs-HS1 Internal costs: Technical support/consultancy	23,909	170,298	146,390	E
Commercial (Route)	OMRC	Other Overheads	Costs-HS1 Internal costs: Technical support/consultancy	43,139	199,569	156,430	G
ORR - Regulatory Fees	OMRC	Other Contractual	Costs-HS1 Subcontract costs: ORR Regulatory and Safety costs	91,993	295,815	203,822	I
Rates - Infrastructure	OMRC	Business Rates	Costs-Pass through costs: Rates	8,502,389	8,719,558	217,170	See Rates
Specialist Support - Route	OMRC	Consultancy	Costs-HS1 Internal costs: Technical support/consultancy	145,042	452,355	307,313	L
BTP Fixed Charge	OMRC	BTP	Costs-HS1 Subcontract costs: BTP	4,243,036	5,015,032	771,996	K
Non Traction electricity	OMRC	Non Traction Electricity	Costs-Pass through costs: Power non EC4T	4,558,827	7,875,665	3,316,838	J
						<u>2,841,379</u>	

Overspend vs 5YAMS**A. Insurance costs: £0.2m over 5YAMS budget overall (flat for Route)**

Cost driven up by cyber security, which is covered by very few insurance policies

For the last renewal HS1 was faced with a hard market and also coming out of LT Agreements which held costs throughout the hard market during 2019 to 2022.

The Global Benchmark set for Q3 2022 was 15% increase in premium averaged across all categories of insurance. HS1 working closely with its broker Marsh, managed to limit the increase in premiums to less than 8% across its portfolio of insurance.

B. Environmental initiatives: £0.2m over budget

Focusing on sustainability and raising HS1's profile has been a focus for the company.

Investment in the control period to date has been on:

Developing a robust and competitive sustainable energy procurement strategy (£80k)

Attending COP26 (£60k),

developing our ESG reporting (£40k)

C. Software & Support: £0.1m over budget

Significant increase in software & IT support costs, with a shift to home working and Covid impacting permanent staff

£60k of interim support, £85k of better virtual communication tools

D. Cyber resilience: £0.1m with no budget

As a key piece of UK infrastructure, and with the rising risk of Cyber attacks, HS1 has invested to ensure our IT systems are robust and secure.

This investment was not included in the 5YAMS submission.

Underspend vs 5YAMS**E. Control Period Consultants: £0.3m of savings**

The CP3 budget expected CP4 preparation to begin, with a benchmarking exercise forecast for 2021/22 (£0.1m) and development of 40yr plan (£0.15m)

The focus for this control period in the short term has been investing in the structure of charges model rebuild

supporting the regulatory environment during the Covid recovery. The strategy behind CP4 approach is being assessed

F. Ashford IECC: £0.15m of savings

Agreed with NRHS we would never be charged for Integrated Electronic Control Centre as long as NRHS are the supplier.

This was not the view when the CP3 budget was set

G. Commercial Route: £0.15m of savings

Route insurance revaluations (£50k) not completed due to covid, will be completed in control period.

CP3 plan to procure a new 'Ashford Station Management Agreement' has yet to begin, with EIL temporarily not stopping at Ashford.

Procurement scheduled for September-22, £100k of legal fees expected.

H. NGC Fees: £0.1m of savings

This accounts for the UKPNs connection charge. Savings as there was lower power usage as the demand for trains was impacted by Covid.

I. ORR Reg Fees: £0.2m of savings

The 5YAMS budget assumed ORR costs to rise given the high risk of litigation from EIL

This hasn't yet materialised but remains a risk.

J. Non-Traction energy: £3.3m of savings overall of which £0.6m on Route

Through smart purchasing and hedging HS1 has protected its customers from market volatility and soaring price increases in electricity.

This has been achieved throughout FY22 and remains the case up to 30 September 2022, having purchased electricity ahead at lower prices than those available at current times.

K. BTP Contract: £0.8m of savings

HS1 negotiated efficiency out of BTP contract but holding them to account.

Resource which wasn't needed (or duplicated elsewhere) was taken out of the contract and we ensured we were charged an appropriate price for the remaining resource.

This is expected to be an ongoing cost saving.

L. Specialist Support - Route: Savings of £0.3m

Asset information works delayed pending responses from Supply Chain facilitators. Intelligent Client work involves travel to other European high-speed lines and this was difficult due to COVID.

£0.3m budgeted for the development of asset management system and standards, outside of what NRHS has (i.e. a digital twin)

This remains a focus but the strategy is to work closely with NRHS and ensure their processes and standards are appropriate, to ensure costs are not duplicated.

(1) Covid Recovery

The Covid recovery costs are non-OMRC lines. They have been included here to demonstrate the amount absorbed by the company to ensure liquidity and operations.

Over £1m (note, need to include BHL - waiting on figure) incurred on specific projects to maintain financial stability over the Pandemic. There's costs were mainly relating to lender support and obtaining waivers over our covenants. (also Byron)

(2) Staff & interim costs

The Global Pandemic significantly increased the complexity of the HS1 business, with a significant focus on maintaining financial stability and recovery.

Over 21/22 HS1 relied heavily upon interim support to meet the new requirements and only increased headcount once the work was concluded as medium-term.

Given this, salary costs for 21/22 are aligned to the 5YAMs budget. HS1 managed costs but freezing pay for the year, reflective of the business pressures and aligned to the wider market. No staff were furloughed during lockdowns, with no roles being deemed redundant.

Staff were repurposed where appropriate.

Bonuses from the year were calculated based the budget set at the beginning of 2021 and were aligned to the 5YAMS budget.

An unbudgeted £0.8m was spent on interim and specialist support costs (mainly in Finance & Regulation) in response to the Global Pandemic (therefore, no included in the 5YAMS) and support with the additional business complexities:

annual reopeners,

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 meant,

added audit complexities and prolonged sick leave from Covid-19.

An additional £0.1m was spend on recruitment in order to service the need to find interim support

(3) Other efficiency initiatives: Maintaining costs/Preventing overspend**Systems**

HS1 has invested in system upgrades to increase efficiencies and prevent further requirements for interim support/additional headcount.

Invoice Capture - allowing the finance team to process invoices virtually and semi-automatically

People HR - allowing the company to manage HR items

Working from home opportunities

HS1 responded quickly to working from home, investment was required in equipment and software but savings were found through virtual training and savings on some office costs.

Rates

Savings of £0.2m arising from the Business Rates multiplier being frozen for 2021/22. We are also engaging CBRE to assist us in influencing the next rateable value.

Customer Relationships

HS1 continues to maintain strong relationships with suppliers, through this we were able to limit cost rises for example no RPI has been charged on the cost of the Krupp Rescue Locomotive service over the last two years.

HS1 also negotiated more flexible payment terms with key suppliers, allowing the company to manage liquidity over the Pandemic without requiring more costly initiatives.

HS1 Energy Procurement Strategy development (Note, to coordinate with Jon if more information needed for the AMAS)

Through its Energy Procurement Strategy HS1 is enabling TOCs to be renewably sourced through Corporate Power Purchase Agreements (CPPAs) at an efficient system cost.

HS1s Strategic Energy Procurement Plan is to strengthen its green credentials by progressively increasing the proportion of Renewable energy sourced through CPPAs.

CPPAs provide stronger links to green energy than general REGOs with traceability to specific UK renewable assets and provide price certainty protecting against the extreme volatility

that is currently present and likely to remain in UK power markets.

HS1's first CPPA is contract ready to accommodate 10 MW of renewable volume. The first 5MW trade has been transacted in April 2022 securing energy from operational UK

onshore wind assets from 01 October 2022 to 30 September 2032. This CPPA provides both financial and sustainability benefits. A second CPPA will be introduced in 2023 and will include locking in with "new to earth" assets at lower prices which will bring down HS1's Weighted Average Price (WAP) of electricity.

The fine tuning of the balance of PPA v residual flexible supply is to be determined through further discussions with TOCs (EIL and SETL) regarding volume forecasts.

Baseload purchased through PPAs will be such that the volume is forecasted to be required in the long term.

Whilst PPA's are on boarded into the HS1 Energy portfolio there will be a transitional period from April 2022 to October 2023 in which general REGOs will not be sourced on affordability grounds (the price of REGOs having risen by 1600% between April 2020 (£0.45 MWh) and April 2022 (£7.50 MWh). Once the PPA implementation is complete (October 2023) general REGOs will only be required for the residual volume (c. 5MW) of electricity not sourced by PPA's for which flexibility of demand is required.

Two main strands of the EPS: Cost efficiency and Renewable sourcing

The strategy is to progressively introduce renewable PPA volume so that the majority of Baseload Power requirements are sourced through efficiently priced PPAs by 2025. This is against a demand reduction target of 30% by 2030. The residual volume will be REGO backed subject to affordability. The Strategy is illustrated on slides 2 and 3 and the Hedging position on slide 4.

1. Cost efficiency

The Electricity Supply Contract between HS1 and Npower presents significant risk and opportunity for cost mitigations on what will become a c. £50m p.a. spend – these are passed through to TOCs.

There is a specific hedging and risk management strategy in place to deliver the required volume at an efficient price in volatile market conditions. This is executed by Npower acting on behalf of HS1 using its Optimisation Desk team securing energy volume for the contract duration. As part of the strategy around 80% of volume is purchased seasonally up to two years ahead of delivery to minimise risk. The hedging strategy has protected HS1 from the soaring energy prices that are being experienced in the market. HS1 is fully hedged for Summer 22 and over 90% hedged for Winter 22 with only marginal open volume to be purchased in line with forecast demand, post COVID train path recovery.

The Electricity Supply Contract is being market tested in 2022 with a potential next generation Supply Contract in place for forward purchasing from April 2023.

2. Renewable sourcing

As discussed, REGOs have been in place for reporting of FY21 and FY22 and have become unaffordable for renewal in April 2022.

HS1's first Corporate Power Purchase Agreement (CPPA 1) has been entered into and offers dedicated REGOs from UK renewable assets and additional price certainty for the fixed volume of 10 MW for 10 years. The first 5MW trade has been activated and will apply from October 2022.

The Strike Price for the first 5MW trade was £138.14MWh. Against comparative wholesale prices on the date of the trade: 13 April 2022 the CPPA 5 MW trade provides £4.85m of cost mitigation for the first three seasons from October 2022.

The 10MW volume under CPPA 1 has been split deliberately, into two 5MW trades rather than one 10mw trade. This spreads the strike opportunity across two points in time in the market. We will continue to monitor prices on a regular basis and have negotiated an extended timeframe to 31 March 2023 in which to Strike the price for the second 5MW trade. Further plans are in motion for CPPA 2 which provides the opportunity to secure renewable PPA energy from "New to Earth" assets at lower prices than operational assets.