



# High Speed Rail and Nature Networks

Connecting people, connecting wildlife

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**PERMEABLE FOR NATURE**  
WITH ITS GREEN BRIDGES, TUNNELS AND VIADUCTS,  
HS2 IS DESIGNED TO LET WILDLIFE MOVE.

# About

## High Speed Rail Group

Representing companies with relevant experience and an interest in high speed rail, the High Speed Rail Group (HSRG) is committed to supporting the successful delivery of a world-class high speed rail network in Britain.

Our members have helped deliver major infrastructure projects in the UK and around the world, including creating entirely new high speed networks and improving the UK's existing rail network.

This gives us a unique insight into both the shortcomings of the current network and the transformative capacity, connectivity, economic and environmental benefits that high speed rail brings.

Members support a national high speed rail network including the delivery of HS2, its extension to Scotland and integration with other rail investments such as Northern Powerhouse Rail and Midlands Engine Rail. This should go hand in hand with wider ambition to maximise the released capacity benefits HS2 brings and to catalyse change through supply chain. A full list of our membership can be found at [www.rail-leaders.com](http://www.rail-leaders.com)

This report would not have been possible without the assistance of all those who most generously gave their time to contribute to it, and both the author and HSRG are most grateful for this. Any inaccuracies remain the responsibility of the author alone.

## The author

Ralph Smyth is an independent consultant, who was formerly head of infrastructure and legal at CPRE, the countryside charity. Ralph's love of the countryside was kindled growing up on England's western edge, surrounded by some of the nation's most extensive ancient woodlands and rights of way.

Leading CPRE's engagement on HS2, including petitioning Parliament on the protection of hedgerow laws, he brought together twelve national NGOs through the Right Lines Charter to challenge HS2 to leave a positive environmental legacy.

After securing the largest ever release of environmental open data from HS2 Ltd and securing a commitment to an open data strategy, he worked with a tech start up to create interactive maps to enable communities to understand the scheme's environmental impacts better.

His experience of major infrastructure projects ranges from appearing as a barrister at public inquiries to advising Highways England on its Strategic Design Panel and commissioning the largest independent evaluation of the environmental impact of transport schemes in Britain.

# Foreword

**In November 2019 the High Speed Rail Group (HSRG) published a report from Ralph Smyth, an independent environmental consultant and the only person to be allowed to petition Parliament in relation to the climate change impacts of HS2 legislation.**

The report looked at the role that high speed rail can play in decarbonising transport and enabling the UK to reduce its carbon emissions to net zero, an area that had received little focus. It found that HS2 is essential to accelerate modal shift, support fewer car trips, decarbonise how we get our goods and reduce emissions from international travel – priorities now identified by the Government in its consultation for a Transport Decarbonisation Plan.

This report is a companion to that previous report, and focuses on a similarly under recognised area, how high speed rail can help move our transport system towards biodiversity net gain. With some of the strongest criticisms of the HS2 project focusing on its impact on woodlands, this report looks at these arguments as well as some common (mis)perceptions. What this report seeks to do for the first time is to explore in detail the project's impacts on nature across its lifecycle, from the planning of HS2 through its consenting and design processes to its construction and operation. This is set in the context surrounding a project of this scale, of the changing policy landscape, wider constraints such as the views and needs of land managers, and wider opportunities such as technological and social change.

With the first ever National Infrastructure Strategy seeking to protect and enhance England's ecosystems and to incentivise industry to deliver better outcomes<sup>1</sup>, this report sets out what HSRG's members are already achieving. Many HSRG members are at the forefront of developing ways to build with less impact, integrate ecological best practice into operations and deploying new technologies and ways of working. HS2 is both a driver for this innovation and a project through which to deliver it. The project's scale is catalysing innovations around surveying, protecting and enhancing nature. The scale of biodiversity losses forecast on a precautionary basis early on are now ebbing away, as detailed design and continuous improvement move towards no net loss and even net gain in places.

## HS2 is an environmental project

The overwhelming finding in this report is that HS2 is as much an "environmental" project as a "transport" and "economic" one. One fact highlights this clearly.

You are as likely to find environmental professionals working on the route as engineers, with the project creating more jobs for the sector than any other. It has not only provided green jobs, it has developed career paths with graduates working on a wide range of habitats and species at an early stage in their careers.

Of real significance is that this new generation of ecologists can spread their learnings to other schemes. Indeed the project is as much about green data as it is green jobs.

HS2's huge scale, passing across varied landscapes, offers opportunities to modernise the way we gather and manage from biodiversity data and gain wider value from it.

<sup>1</sup> Pages 78 & 86 of [National Infrastructure Strategy](#) (HMT, 2020)

# Foreword

## Connecting nature and connecting to nature

We know that high speed rail connects people and places, remaking the economic geography of the county and providing a green, low carbon way to travel.

What HS2 also does is connect nature. Originally conceived as little more than a green strip along the tracks, its 'Green Corridor' is being developed along the length of the line.

This involves creating, restoring and better connecting habitats, restoring linear features such as water courses and partnering with land managers at a landscape scale to maximise ecological connectivity.

HS2 also connects us to nature. As we have seen during COVID-19, access to the countryside has been cherished and valued, yet many of the larger and wilder areas are primarily accessed by car. HS2 can help change this.

As the backbone of a new national transport network providing a transformative uplift in capacity and connectivity, HS2 can transform access and catalyse upgrades to enable more city dwellers to reach national landscapes and rural visitor attractions by sustainable means.

## Providing a renewed focus ahead

As the National Audit Office (NAO) recently highlighted, the construction and operation of transport infrastructure have an important influence on wildlife habitats.

So there is a growing focus for transport projects to be planned and delivered in ways that deliver environmental net gain, in order to secure the Government's long-term ambitions<sup>2</sup>. As the country's largest infrastructure project, HS2 is very much at the centre of this thinking and practice.

Indeed the amount of funding it is providing to restore nature compares favourably with that provided nationally by the Government. Given the project's scale, it is growing and shaping the supply chain, and influencing how future projects can be planned and delivered too, including schemes promoted by Sub-national Transport Bodies.

Scientific knowledge and the level of ambition are increasing. Not every pioneering intervention will succeed first time. What does succeed will need to be improved upon, if HS2 is to continue to live up to its ambition of being the most sustainable railway of its type in the world. The NAO calls for clarity on the values and behaviours needed to support delivery of these environmental goals. These must include ambition, transparency, partnership and innovation.

HSRG wants this report to spur further improvement, with recommendations for industry and government to assist the delivery of HS2 and development of a wider high speed rail network, bringing forward the most transformative and long-lasting green legacy.

<sup>2</sup> [Achieving government's long-term environmental goals](#) (NAO, 2020)



# Executive Summary

## How can opinions about HS2 be so divided, with some calling it a superhighway for nature, others a Berlin wall for wildlife?

Biodiversity loss is now one of the greatest risks facing the world alongside climate change. Given the range of species and habitats in the natural world, it is far more complex to assess and set simple metrics for, however. In particular it is vital to look across different time and spatial scales, recognising that nature is dynamic.

So, after setting the context of the latest policy and research about the impacts of transport on biodiversity, this report takes a chronological approach, from planning to constructing and then operating a railway into the longer term, exploring the resilience and restoration of nature in a changing climate.

The report's focus is on nature and access to it, exploring this from the landscape level to that of individual habitats and species.

## Transport's impacts on biodiversity

Biodiversity is a key indicator for the health of ecosystems, and relates to the variability of living organisms and the habitats they live in.

It has been in serious decline for decades and is particularly depleted in densely populated countries like Britain. Traditional approaches to conservation, of focusing protection on areas of the highest value, have not stemmed this decline. In the last decade policy has shifted to tackling fragmentation between sites in addition to seeking to improve them, so as to restore ecological connectivity. An important element of this approach is seeking to offset unavoidable harm to habitats through seeking opportunities to deliver biodiversity net gain elsewhere.

Although railways have been around for almost two hundred years, railway ecology has only very recently emerged as a separate discipline. Furthermore there is very little research comparing the impacts of different transport modes at a system level. Even if there was, new evidence would be needed to understand impacts from technological, environmental and social developments, such as electric vehicles, climate change and ambition to restore nature.

Incremental changes, such as the near doubling since 1994 of traffic on minor rural roads, are far less visible than the construction impacts of major projects. Their indirect impacts, from higher traffic flows or microplastic pollution from tyre wear, have major impacts on our habitats, however. Likewise pressures from the resource inefficiency of private vehicle manufacture and usage impact on ecosystems globally.

Although a move towards Electric Vehicles addresses well-to-wheel carbon emissions and some forms of pollution, it simply does not tackle wider impacts on natural capital. There is no simple technological fix to solve biodiversity loss. Better planning and, crucially, operational management of transport networks are required, as well as behaviour change. Moving the transport system towards biodiversity net gain requires managing travel demand and, in particular, a large shift to rail for longer journeys and active travel for shorter ones.

# Executive Summary

## Planning

Environmental law and policy have evolved to require developers to consider a wide range of options and then set out the significant environmental impacts of proposed developments.

Carefully applying these processes is vital to minimise negative environmental impacts and will be even more important in future as we seek to move towards environmental net gain.

HS2 arose on the back of a national sustainable transport strategy and the Climate Change Act 2008. Although it had an Appraisal of Sustainability rather than a Strategic Environmental Assessment, the Supreme Court and academic experts judged its detailed assessment of a multitude of route options was compliant the relevant rules. The one exception relates to later stages of phase 2, now being explored again for the creation of the Integrated Rail Plan for the north and midlands.

The Environmental Impact Assessment for phase 1 produced the largest volume of environmental data of any project. Because it collated all of HS2's impacts in one place and had to take a precautionary approach, the project's impacts appear disproportionate. This is common for rail projects, for instance when HS1 was planned, concerns were expressed about its impacts on ancient woodland.

Detailed design is already reducing likely impacts and wider funding will enable compensation to help the project meet its objective, pioneering when it was made, to achieve no net loss. New environmental and agricultural legislation is set to provide the powers and incentives to help HS2 Ltd, the company responsible for developing and promoting the project, partner with land managers more effectively to help move towards net gain.

Where practice fell behind other countries was the lack of national mapping of wildlife corridors and agreed ambitions for restoring nature. HS2 Ltd could not start this conversation unilaterally, as it needs to be led by environmental and planning authorities at the national and local levels. This is now happening through Local Nature Recovery Strategies.

## Design and consenting

Rather than the railway and surrounding habitats being designed all at once, HS2's design process is based on a series of stages over a decade.

These involve gathering data, engaging with a wide range of people and iterating accordingly. With many criticisms alleging a lack of detail, better public understanding is needed of this design process, the level of detail required (or not) at each stage, and how early decisions might impact on subsequent opportunities to inject more biodiversity gains into the scheme.

HS2 has been taken forward through hybrid bills, a process dating from the early days of the railways. Focused on the needs of land owners, the adversarial nature of this process hindered the ability of HS2 Ltd to make the case for the land needed to deliver landscape-scale mitigation or build the necessary partnerships to influence land management further afield.

Nature is not readily reduced down to numbers. This poses a challenge when trying to guarantee good environmental outcomes at the same time as seeking to maximise value. A compliance culture focused on cost can get in the way of a vision to restore nature, but it is in no one's interest for environmental budgets to balloon out of control. HS2 Ltd has pioneered the use of BREEAM Infrastructure, part of the international BREEAM family of sustainability standards, of biodiversity units at scale for calculating compensation, as well as setting up its Independent Design Panel early.

Far from simply looking at designs, the Panel helped evolve the Green Corridor concept and ambition for long-term monitoring of soil translocation, to maximise the potential for HS2's green legacy. Assurance and aspiration are needed at different times and scales in a project's lifecycle and sometimes need to learn to dance together. This is a complex and largely hidden area but one that offers very important lessons for other schemes.



# Executive Summary

## Naturally innovating

The scale of the challenge to protect and restore our habitats requires innovation.

While hi-tech solutions help deliver more efficient and accurate desk studies and field surveys, when it comes to creating habitats and enhancing ecological connectivity, innovation is about delivering truly integrated design.

The huge volume of surveying of protected species required to build HS2 has helped the supply chain to roll out radio tracking of bats, eDNA for great crested newts and harness Artificial Intelligence to map habitat types. Managing the volume of biodiversity data obtained has been one of the biggest challenges faced, though the pace of technological change is helping tackle this.

In under a decade, the reliance on paper based surveys entered into spreadsheets is being superseded by handheld devices feeding into spatial databases. "Newt-counting" may hit the headlines but opportunities are being missed in the National Data Strategy to recognise the importance of biodiversity data and its potential value. All the more so as we move from agricultural subsidies to a system of rewarding environmental gain.

The companies building HS2 are striving to blend bigger, better and more joined up habitats into the patchwork of surrounding landscapes. Minimising the need for long-term management is crucial. This has been driving the design of the flagship site at the entrance of the Chiltern Tunnel that will deliver 130 hectares of new chalk grassland, connected to woods and wetlands. Elsewhere orchard trees that veteranise quickly, so creating nooks and crannies for bats, are being planted as medium term mitigation, filling the gap between artificial bat boxes and other tree species.

Phase 1 provides more green bridges than currently exist in the rest of Britain. These are part of HS2's Green Corridor that forms the spine of this network of new and enhanced habitats. It is seeking to make the connectivity HS2 delivers as much for nature as it is for people.

## Constructing

Although construction of HS2 only officially commenced in September 2020, tree planting and the creation of mitigation habitats started years before.

HS2 Ltd has committed to undertake all works lawfully and there is a complex regulatory web of national legislation, including species licensing, internationally recognised certification systems, such as ISO 14001, plus binding rules that are project specific, such as the Environmental Minimum Requirements. To comply with these, one contractor alone has had to carry out 20,000 surveys in the last four years. While comprehensive, these rules and their outputs are not simple for NGOs and communities to keep track of. There are surely opportunities to innovate and design better ways of reporting to reflect the needs of these important stakeholders, to foster more trust and improve outcomes.

Fragments of ancient woodland are spread across England's countryside and it is not possible in practice to build a new railway through it without affecting some of them. Techniques such as soil translocation, pioneered when building the Channel Tunnel, reduce the irreversible impacts of losing ancient woodland along the route. Most importantly, 50 years of monitoring will fill gaps in scientific knowledge about the technique and soil microbiology.

On phase 2a alone, HS2 has committed (as of September 2020) to 9.6ha of ancient soils translocation, 13.4ha of ancient woodland enhancement and 78ha of new woodland planting. HS2's wider environmental funding is now of a similar level to that announced in the Government's 10 Point Green Plan in 2020. The green jobs and skills that HS2 is generating as a result of all this investment are rarely recognised, compared to those in construction and engineering. This needs to change if we are to scale up our capacity and capability nationally to restore nature.

# Executive Summary

## Operating

Bringing the railway into operation does not mean “job done”.

Maintenance, intensive at first, and monitoring of new habitats will be essential, as lessons from other infrastructure schemes show. Although Highways England is well regarded for its evaluation of completed schemes, this evaluation has been very limited for biodiversity and other natural capital. What long-term monitoring there is shows gaps in maintenance and mixed ecological outcomes. By contrast HS1 has a comprehensive strategy with up to 170 landscape maintenance plans for habitats along its route, which sits along a necklace of urban green spaces and rural nature reserves. HS2's Green Corridor has similar aspirations to improve public access to nature along its route, although some habitats will need time to establish themselves first and the details of site ownership need to be agreed too.

As part of HS1's recent commitment to become the “green gateway to Europe”, it plans to go further by working with the Kent Wildlife Trust and move towards biodiversity net gain. Sharing its monitoring, best practice and emerging learnings widely with other operators and NGOs would be most helpful, as Swiss railways have done. Much of HS2's route is in tunnel or beneath the lie of the land, reducing severance, while the high frequency of its services should discourage birds perching on its overhead lines. Nonetheless there are risks of mortality for some species flying over or along the railway, which are being addressed through markers and bioacoustic deterrents and should be monitored by fitting cameras on some trains. There are important opportunities to develop machine readable standards for habitat management plans and to build in monitoring of how different British species are affected by trains.

Many people found solace in nature during the COVID-19 pandemic, though at times this highlighted the pressures of car based leisure travel on cherished countryside. Less visibly, those living car free, often in cities, had less access to wilder areas. HS2 is often described simply as providing access to cities, but it will step change accessibility of transport hubs to national landscapes. Extending high speed rail to Scotland could catalyse reopenings, such as extending the Borders Railway to Carlisle. It's time for government bodies, transport operators and tourism bodies to explore this agenda further.

## Transforming engagement

Creating coherent ecological networks around transport networks requires influencing land managers well beyond the boundary of a scheme: it simply is not possible to do so through purchasing land.

Fostering the necessary partnerships requires fundamentally different capabilities to managing contracts across supply chains. The clear lesson from world leading railway projects abroad is that innovation in engagement is as important as in engineering and ecology. This is as much about partnering with big land owners and NGOs as with local interests and community groups who may be the best “eyes on the ground”.

Although it has funded partnerships on sensitive parts of the route, HS2 Ltd has struggled in this area, partly due to the reaction to building a new railway but also due to its earlier approach. Its prior performance has not been dissimilar to other transport infrastructure companies and there have been successes, indeed its outsourcing of its environmental funding has worked well. Since it received Notice to Proceed for phase 1, HS2 Ltd has been further exploring this agenda, from hosting online ecology seminars and offering its experts for questions, to setting up a board level Environmental Sustainability Committee.

Going forward there is a need to tailor ecological information better to different user groups' needs and to share it in a more timely way. Because of repeated criticism of inadequate detail by stakeholders, often unjustified given the early stage, it is understandable why some working on the project have been reluctant to share ecological proposals with stakeholder until complete, missing opportunities for early feedback. To change this, movement is needed on both sides.

# Executive Summary

## High speed rail and nature in Europe

**GERMANY** For decades, Germany has used detailed ecological data to plan its transport infrastructure better. Its Federal Agency for Nature Conservation has mapped out nationally important habitat arteries and corridors as well as "unfragmented functional areas" with a low density of road traffic. This has enabled it to plan its nature networks as precisely as its transport ones. Its habitat network is made up of 4,550 links with a length of around 60,923 km and the transport infrastructure network in 2010 was found to sever these habitat arteries in 9,257 cases. This has enabled planners developing new railways to consider a wide range of interactions, whether potential conflicts or aspirations restore connectivity between habitat areas.

### GERMANY



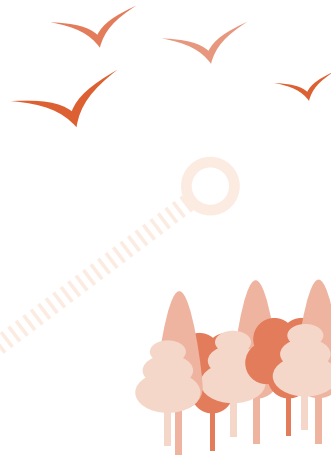
### SWITZERLAND

**SWITZERLAND** Swiss railways are known for being amongst the best in the world. Unlike its trains, the nature affected by construction of a new line did not run like clockwork, however. Long-term monitoring revealed that some target species around the Brunnmatte nature reserve, a haven of herbaceous meadows and wetlands that is home to endangered toads and damselflies, could not regularly be detected. Nonetheless, partnerships had been created through consensus-based reallocation of farming land to biodiversity compensation sites. Partnerships had been created before construction to enable consensus-based reallocation of farming land to biodiversity compensation sites. These were then able to explore landscape-scale action to tackle the wider factors affecting wildlife population levels.



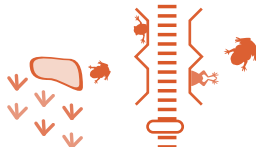
# Executive Summary

**FRANCE** France's famous TGV was one the earliest high speed railways, so it is no surprise the country has also been leading on reducing the environmental impact of its latest lines. The network extensions to Brittany and Bordeaux both opened in 2017 and were the first to seek to achieve no net loss of biodiversity. Engagement was front-loaded to build local partnerships as early as possible. A "general wildlife innovation agreement" between key stakeholders led to some tasks, such as evaluating the effectiveness of compensation measures, being delegated to respected national NGOs. At the core of this approach was the creation of genuine partnerships as opposed to supplier relationships.



**SPAIN** Spain now has Europe's most extensive high speed rail network, stretching through often sparsely populated areas that are biologically diverse. The scale of its network plus the cost and difficulty of fieldwork, such as along viaducts, makes monitoring difficult. In 2014, trains running between Madrid and Albacete were therefore equipped with the first ever on-board video recording system to monitor birdstrike. This improved understanding of risks to different species and enabled new ways to be trialled to discourage birds for perching on overhead lines, which was found to be strongly associated with bird mortality incidents.

SPAIN



**PEARLS** Spread across 21 mountain villages in six countries, the Alpine Pearls network offers car-free adventures across stunning scenery and sensitive habitats, whether in winter or summer. Offering guests an abundance of local eco-mobility options integrated with longer distance rail, the initiative seeks to foster sustainable tourism and transport, so as to be gentle on wildlife and the climate. By encouraging visitors out of their cars to be closer to nature, the initiative helps preserve the area's traditions, not to mention encourage a healthy appetite for local farmers' produce

ALPINE PEARLS

# Executive Summary

## Longer term thinking

Few things are built today with the intention of lasting as long as HS2, indeed thinking about such time periods is outside most people's experiences.

Average UK temperatures are expected to rise by 1.8°C in 2050 even if climate commitments are met. The Committee on Climate Change is calling for investments, especially in infrastructure, to be resilient to 2°C and for extreme warming scenarios of 4°C by 2100 to be considered. Arguably this should apply to the investment in biodiversity mitigation and compensation not simply the railway infrastructure. That could in places mean a different countryside to what we are used to.

The primary way this issue has arisen so far has been the origin of seeds chosen for tree planting. Although HS2 Ltd has promised to use many local species, it plans to seek up to one third of seeds from species 3-5° latitude south, so around the middle of France, in order to help future woodland adapt to higher temperatures.

There will inevitably be a lack of evidence now about climate impacts thirty years or more ahead, so a precautionary approach seems sensible. How to protect and adapt our existing species and habitats or consider providing a home for 'wildlife refugees' are complex issues, which should urgently move up the public agenda.

Nature was long viewed as an impediment to building railways or a risk, such as from falling trees, to operating them. A more balanced 'asset based' approach has taken hold, seeking safety alongside good environmental outcomes. Embracing the inherent dynamism of nature in the long-term and the resulting complexity may pose a challenge for traditional asset management mindsets.

Designing in resilience may require adding in features and areas that may be difficult to value. Just as HS2 provided a testing ground to pioneer the use of biodiversity units at scale, so it should be used to assess new ways being developed to value biodiversity.

Future phases of high speed rail development in northern England could go hand in hand with ambitious nature restoration. The region currently has a larger number of higher value habitats as well as greater potential to enhance biodiversity in the future different networks interface with each other.

# Executive Summary

## Conclusion

Inevitably a transformational project of this scale will cause harm and it will seem worst at this stage when clearance operations are at their peak.

We lack easy ways to compare the biodiversity impacts of journey choices let alone the metrics to contrast strategic transport choices in the long-term. Nonetheless, the case for a shift to rail is stronger than ever, as the ecological emergency worsens, the climate heats and the roads become busy again.

HS2 has been controversial because of its scale in a densely populated country and because it was born into a decade of fast changing policy. Land owners complained about the land take it sought to deliver no net loss of biodiversity, environmentalists objected to it not seeking more land in order to deliver a net gain.

The fact that infrastructure processes in Britain has become outdated, whether the adversarial consenting processes or being decades behind our neighbours in mapping wildlife corridors, have been a hindrance too. At times there have misunderstandings and exaggerations about HS2's impact, such as its land take, ignoring the value of the enhancements it will give back.

There is potential, even for phase 1 of HS2, to leverage new environmental powers and agricultural subsidies to improve biodiversity outcomes significantly. Seizing this opportunity requires all sides to generate mutual trust to build new partnerships. The illuminating international case studies of innovative engagement demonstrate that the benefits of taking a long-term view, even if not everything goes to plan initially.

While Britain is unlikely ever to be a biodiversity hotspot, it can take advantage of its long history of conservation and its leadership on open data. Through further pioneering efforts with HS2, it can lead the world on unlocking value from biodiversity data and partnerships to restore nature at scale.

## Recommendations

Explore how the transport system can deliver **environmental net gain** - through a study by the National Infrastructure Commission, and by using HS2's phases to trial new ways of valuing existing biodiversity and potential for restoring nature;

**Refine design and consenting processes to restore nature** - by learning from France how to front-load engagement and build cooperation early, and by further increasing the potential of design panels to set ambitious visions;

**Innovate around how to engage and partner** - developing new ways to share species data and licensing, emerging ideas to improve habitats and to build trust by outsourcing some monitoring to other sectors;

**Unlock the value of biodiversity data** - through including it in the National Data Strategy, improving availability and comparability of data (including the content of management plans) from building and operating HS2 and other transport infrastructure, and setting up competitions to find new uses for it;

**Enable comparison of transport's impacts on biodiversity** - such as through creating a new standard for Biodiversity Management in Infrastructure, aimed at companies, and new metrics to compare journey choices aimed at individuals;

**Leverage the green potential of HS2** - to show how HS2 is "more than a railway", it needs to communicate its role in delivering green data, green jobs and green travel to nature, widening its narrative beyond cutting carbon to wider environmental gains;

**Continue to improve HS2's environmental outcomes** - taking advantage of green reforms to deliver better, broader ecological networks around the route, apply learnings on future phases, integrating planning for a nature recovery network into extensions of high speed rail to Scotland and beyond.



# Introduction

## Shortly after it was proposed, High Speed 2 (HS2) was described as a superhighway for nature and a Berlin wall for wildlife.

More recently it has been described as the UK's biggest environmental project but also one that would leave a wasteland for one hundred years. Obviously a once in a generation scheme of this scale will create different opinions, indeed excite passions, but how can views be this opposed?

To try to find out, this report has had unprecedented access to those planning and building HS2 and those raising objections. It combines extensive desk-based research with interviews of 24 people, including from HS2 Ltd (the Government owned company building HS2), its Independent Design Panel, the companies building HS2, the environmental sector and Natural England, plus cycling through the landscapes along most of Phase 1.

Trying to work out impacts on the natural world is even more complex than assessing carbon across a transport project's lifecycle. A railway feature that could be a barrier for one species could be a habitat for another, which in turn may be prey for a larger, third species, risking luring it into being hit by a train.

Furthermore, how nature relates to a railway will change over time as planting matures and species become used to it. The increasing pace of climate change, which is expected to shift some species and habitats, adds more uncertainty to the mix.

## Time and space are of the essence

While weather extremes have hit the headlines last year, awareness about the ecological emergency has been growing alongside awareness of the climate emergency.

For the first time, environmental risks dominate the World Economic Forum's annual Global Risks Perception Survey, with "biodiversity loss" rated as the second most impactful and the third most likely risk for the next decade. This loss risks disrupting supply chains, indeed could lead to collapse of food and health systems. The extinction rate is already hundreds of times higher than the average over millions of years and is accelerating, even before the effects of accelerating climate change are really felt<sup>3</sup>.

The latest assessment by the Intergovernmental Policy Platform on Biodiversity and Ecosystem Services (IPBES) highlights the damage caused by infrastructure expansion opening up previously untouched areas of the planet as well as from large increases in aviation and shipping. It suggests, however, that well implemented and governed infrastructure can deliver environmental gains, concluding that better understanding of variation in impacts is critical.

In the UK, one of the world's most densely populated countries, there is a pressing need to make space for nature, if we are to protect and restore it. With increasing pressures to build new homes and give over land to bioenergy and tree planting to meet the net zero carbon target, land is our most precious resource. Besides transport corridors fragmenting land, transport patterns have a huge impact on how efficiently we use it, influencing the location and density of development. Few make the connection between transport policy and securing efficient use of land in this context, however.

While many are calling for a faster shift to electric vehicles to cut carbon emissions faster, emerging evidence suggests behaviour change is needed alongside technological change, that "lorries and aeroplanes must make way for railways"<sup>5</sup>. This is surely even more the case if we want to reduce our impacts on nature in addition to the climate.

# Introduction

## Continually learning to do better

HS2 aims to be the most sustainable high speed railway in the world.

HS2 aims to be the most sustainable high speed railway in the world. This requires comparing planning and performance in the UK with elsewhere, both recognising successes as well as identifying opportunities for continuous improvement, not least because other countries are striving to learn and do better too. The report has sought to learn from other major transport projects in Britain and beyond, including Highways England's evaluation of its schemes and HS1, the country's first high speed railway (HSR). Having opened fifteen years ago through 'the garden of England', it provides a useful example by which to judge the effectiveness of measures to manage impacts on nature and compensate for those that cannot simply be avoided.

The amount of attention focused on HS2 means that its successes in planning and delivering innovations at scale can and should flow to other projects. This is not simply about new ecological techniques but also evolving attitudes, concepts and processes. HS2 was drawn up in a decade of significant change in understanding about the decline of nature and the action needed to address this. Land managers as well as environmental NGOs viewed lobbying on this flagship government scheme as an opportunity to set new precedents to further their objectives.

Meanwhile HS2 has been hamstrung by old ways of working, whether consenting processes dating from the 19th century or survey techniques dating from the 20th. HS2's incredible scale, being a transect across England's varied landscapes, offers opportunities to modernise the way we gather environmental data, plan and monitor landscape-scale habitat creation, in order to increase knowledge and indeed public understanding.

## Scope and structure

This report explores the direct and indirect impacts on nature of constructing and operating high speed rail in the UK.

With HSRG's recent publications having explored in depth HS2's important role in delivering net zero carbon emissions and the need to adapt transport infrastructure for climate resilience<sup>6</sup>, climate change generally lies outside this report's scope.

The one exception is how a changing climate could impact on nature around HS2, whether the habitats it affects or those it seeks to enhance and create. Impacts on humans, such as from air pollution or severance, and aesthetic issues, such as landscape, are also outside its scope.

To understand impacts on nature it is important to look across different temporal and spatial scales. After explaining some key biodiversity concepts and challenges, this report takes a chronological approach regarding how HS2 was developed, from strategy, through planning, consenting and design to construction, operation and longer term questions.

The report ends by considering the potential synergies for integrative governance<sup>7</sup> between delivering a national Nature Recovery Network and delivering a national HSR network<sup>8</sup>. This includes for instance tackling the disturbance and severance caused by transport, while improving access to nature, including to wilder areas, particularly for those living in cities.

<sup>3</sup> [The Global Risks Report 2020](#) (WEF, 2020)

<sup>4</sup> Paragraphs 16 to 17 in [Summary for policymakers of the IPBES global assessment report on biodiversity and ecosystem services](#) (IPBES, 2019)

<sup>5</sup> [The unsustainability of the electric car](#) (The Ecologist, 2020)

<sup>6</sup> HSRG response to [Decarbonising Transport: Setting the Challenge](#) (HSRG, 2020) and [HS2 – towards a zero carbon future](#) (HSRG, 2019)

<sup>7</sup> Paragraph 35 in IPBES (2020)

<sup>8</sup> [Biggest ever nationwide initiative to restore nature in England set for launch](#) (Defra, 2020)

# The background to biodiversity

## Biodiversity is key for healthy ecosystems

Nature conservation became a movement in the mid 19<sup>th</sup> century at the same time as the first railways.

Opposition to the early railways was often more about visual impact or the social undesirables who might use it. For instance Ruskin's famous poem decried the now listed viaduct through Monsal Dale in the Peak District. The term biodiversity is far more recent, arising in the 1980s as a "conceptual innovation in creating a novel understanding of the human duty to protect nature"<sup>9</sup>. Concern over the increasing rate of extinction, as species were stranded on ever shrinking islands of nature while the extent of human activity increased, drove this concept.

In one sense the concept was remarkably successful. The Convention on Biological Diversity (CBD)<sup>10</sup>, drawn up following the 1992 Rio summit, came into force in 1993 with almost all States becoming signatories. The CBD defines biodiversity as the variability of all types of living organisms and the ecological complexes of which they are part. In essence this includes diversity within species (the genetic level), between species and of ecosystems.

Ecosystems are defined by the CBD as the "dynamic complex of plant, animal and micro-organism communities" interacting with their non-living environment. Because they are made up of living beings (biotic) and their non-living (abiotic) environment, it can be hard to draw a line where one ecosystem stops and another starts. Divisions can be drawn in terms of habitat type, such as woodland, or physical process, such as river catchment areas that are defined by contours. As the concept of biodiversity has matured, its focus has shifted from species more to stock and interactions<sup>11</sup>.

Biodiversity is the key indicator of a healthy ecosystem. Healthy ecosystems provide ecosystem services that underpin our society and sustain our economy. They clean our water, purify our air, regulate the climate, provide productive soil, recycle nutrients and provide us with food, raw materials and resources for medicines, and provide cultural benefits. Comparing biodiversity with climate change helps explain key differences. While the earth's atmosphere is a unified system, the biosphere is divisible whether in terms of geography, species or ecosystems<sup>12</sup>. Although there are clear solutions to tackle climate change and some successes

decoupling domestic emissions from growth (though less so when including 'imported emissions'), there is no straightforward way of expanding society's material basis without some impacts on the natural world. This is illustrated by differences in the mechanisms of the Paris Agreement<sup>13</sup>, covering climate and the wider objectives of the CBD's Aichi Declaration, which requires State parties to make wide ranging declarations as to how they intend to meet its ambitions<sup>14</sup>.

## Turning loss into gain

The traditional approach to nature conservation was to designate the areas with the greatest biodiversity through an alphabet soup of acronyms and focus protection through policy and resources on them.

While this approach has protected many important habitats, at a systems level it has failed, leading to the UK being one of the most nature-depleted developed countries in the world and trends continue to decline. Moreover, although some generalist species have thrived, 41% of all species here have decreased in the last 50 years and 15% are now threatened with extinction, with the UK set to miss 14 of the 19 Aichi targets it reports on<sup>15</sup>.

The Lawton Review was published in 2010 the same year HS2's route was announced and set out key principles to improve ecological connectivity through making habitats bigger, better and more joined up<sup>16</sup>. In a succession of Natural Environment White Papers since then, national policy has evolved, moving progressively from seeking No Net Loss to biodiversity net gain (BNG).

BNG does not change the usual "mitigation hierarchy" of seeking to avoid, reduce and compensate for impacts to habitats. Rather it provides a framework for measuring and reporting on impacts to most habitats through simplifying habitat types into building blocks of habitat units and connectors such as streams and hedges.

What could be described as a "SimCountryside" approach has been criticised for failing to recognise the spatial and context specific nature of assets. Likewise that they operate at different levels of scales, which in turn potentially creates a bigger risk of distortions if BNG is applied to the largest projects<sup>17</sup>.

# The background to biodiversity

The flagship Environment Bill, currently passing through Parliament, creates a “general biodiversity objective” for public bodies to help deliver a gain in biodiversity and a requirement for new developments to deliver BNG, which it sets as being at least 10% increase in biodiversity value over no net loss. Indeed HS2 has played an important role in testing the use of biodiversity units at scale, enabling improvements not least ensuring irreplaceable habitats like ancient woodland are excluded from them.

There are three key questions to consider here.

First, whether to focus on a biodiversity or more broadly environment net gain across a wider range of natural capital, for instance seeking to reduce risks of flooding and increase access to nature. The potential challenges of applying BNG in practice, particularly for large infrastructure schemes that passes through multiple landscapes, was highlighted by the Natural Capital Committee, which said “[a] net biodiversity gain might benefit some types of wildlife in England, but it could result in greater fragmentation of habitat types – which is a clear road to extinction for many species”<sup>18</sup>. It recommended a broader approach.

Another key question here is about how close compensation should be to habitats negatively affected by developments. Some believe as close as possible to the loss, whether to try to keep the ecosystems there as functional as possible or to give back to local people.

Others suggest that it is better to invest where the maximum gain could be, whether for biodiversity, such as by creating more functional ecological networks, or improving access to nature for those who need it most, such as by investing to enhance green spaces in, and Green Belts around, cities. Certainly for some species, such as barn owls, it is crucial that compensatory habitat is located a safe distance away from transport infrastructure to minimise mortality risks.

The challenge here is the lack of broader coherent plans to restore nature or indeed wider discussion, let alone agreement on national principles to inform decision-making at the local level.

The Government's ambition for a national Nature Recovery Network is to be delivered bottom up through the creation of Local Nature Recovery Strategies (LNRSs). With the first of five pilot areas only announced in August 2020, it could be many years before there is full coverage at a national level<sup>19</sup>.

The final question is how to approach “larger than local” developments being taken forward outside the local planning system, notably nationally significant infrastructure projects that fall within the scope of the Planning Act 2008 or those like HS2 taken forward through hybrid bills. The Government decided to leave these out for now pending further research<sup>20</sup>. On the one hand these large schemes cause the biggest impacts, on the other they will risk being hard cases for these emerging principles.

With one of the pilot areas being Buckinghamshire on Phase 1 and another Greater Manchester, on Phase 2b, there are opportunities to trial how major infrastructure like HS2 can add value to the LNRS process, just as it provided a test case for biodiversity units.

What is important this is not used as an excuse simply for delay and indifference. Instead there should be a detailed, time bound and transparent research programme run as a partnership between academics, NGOs, government and the construction sector.

<sup>9</sup> Haila, Y. (2017) [Biodiversity: Increasing the Political Clout of Nature Conservation, Conceptual Innovation in Environmental Policy](#). The MIT Press

<sup>10</sup> [Convention on Biological Diversity: Home](#)

<sup>11</sup> Haila (2017)

<sup>12</sup> Ibid

<sup>13</sup> [What is the Paris Agreement?](#) (UNFCCC)

<sup>14</sup> [Aichi Biodiversity Targets](#)

<sup>15</sup> [UK State of Nature 2019 report](#) (JNCC, 2019)

<sup>16</sup> [Making space for nature: a review of England's wildlife sites published today](#) (Defra, 2010)

<sup>17</sup> Page 3 in Natural Capital Committee (2019)

<sup>18</sup> [Net environmental gain: The Natural Capital Committee's response to Defra's commission](#) (NCC, 2019)

<sup>19</sup> [Five local authorities announced to trailblaze England's nature recovery pilots](#) (Defra, 2020)

<sup>20</sup> [Page 5 in Net gain: summary of responses and government response](#) (Defra, 2019). Although high speed rail schemes have been taken forward outside the Planning Act 2008 via hybrid bills.

# The background to biodiversity

## From fragmentation to restoration

Although the sight of individual trees being felled or ponds being filled in can receive the most attention, it is the wider habitat fragmentation that is most damaging in the longer term as it isolates populations.

The three main effects to consider are:

1. Parts of an ecosystem becoming more isolated through severance;
2. Size of an ecosystem decreasing due to land take; and
3. More of an ecosystem being closer to an edge, increasing exposure to external disturbance, whether physical conditions such as changes in wind or light, or other species alien to the ecosystem<sup>21</sup>.

Different species may 'see' a landscape in very different ways however, so what can be a barrier for one species could be essential habitat for another. This means assessing the degree of fragmentation is very context specific, it depends on the species in question and the naturalness of the landscape being judged, explaining why there is no agreed definition of fragmentation and in turn a lack of comparable data<sup>22</sup>.

Restoring nature is about restoring the quality of ecosystem functionality, through having core, high quality and connected areas with wildlife-friendly landscapes in between. Natural England has set out "a hierarchy of priority actions:

- (a) improve core wildlife sites;
- (b) increase the size of core sites;
- (c) increase the number of core sites;
- (d) improve the 'permeability' of the surrounding landscape for the movement of wildlife; and
- (e) create corridors of connecting habitat" alongside a need to develop a number of Large Nature Areas (c. 5-12,000 ha)<sup>23</sup>.

The challenge for Britain and particularly the lowland landscapes in England that HS2 will run through is the degree of human influence there has been over centuries. It is not just about scale, there is no equivalent to the Amazon rainforest, in fact there are few intact functioning ecosystems: there are no apex predators and very little herbivorous megafauna (e.g. auroch, bison, etc.) except for deer.

The Woodland Trust has stated that "from a practical point of view the highly fragmented nature of British woodland means that restoration of woodland on a landscape scale is unlikely to be feasible"<sup>24</sup>. There can also be trade-offs between speed of restoration and quality, for instance simply planting thousands of trees may not create good habitats.

As rewilding projects, like at the Knepp Estate in Sussex, have shown it is often better to let natural regeneration lead rather than planting, particularly where this takes place on arable land. This will usually result in more natural and resilient vegetation and habitats, although it can take more time.

<sup>21</sup> Geneletti, D. (2004) 'Using spatial indicators and value functions to assess ecosystem fragmentation caused by linear infrastructures', *International Journal of Applied Earth Observation and Geoinformation*, 5(1), pp. 1–15. doi: 10/fn8m7t.

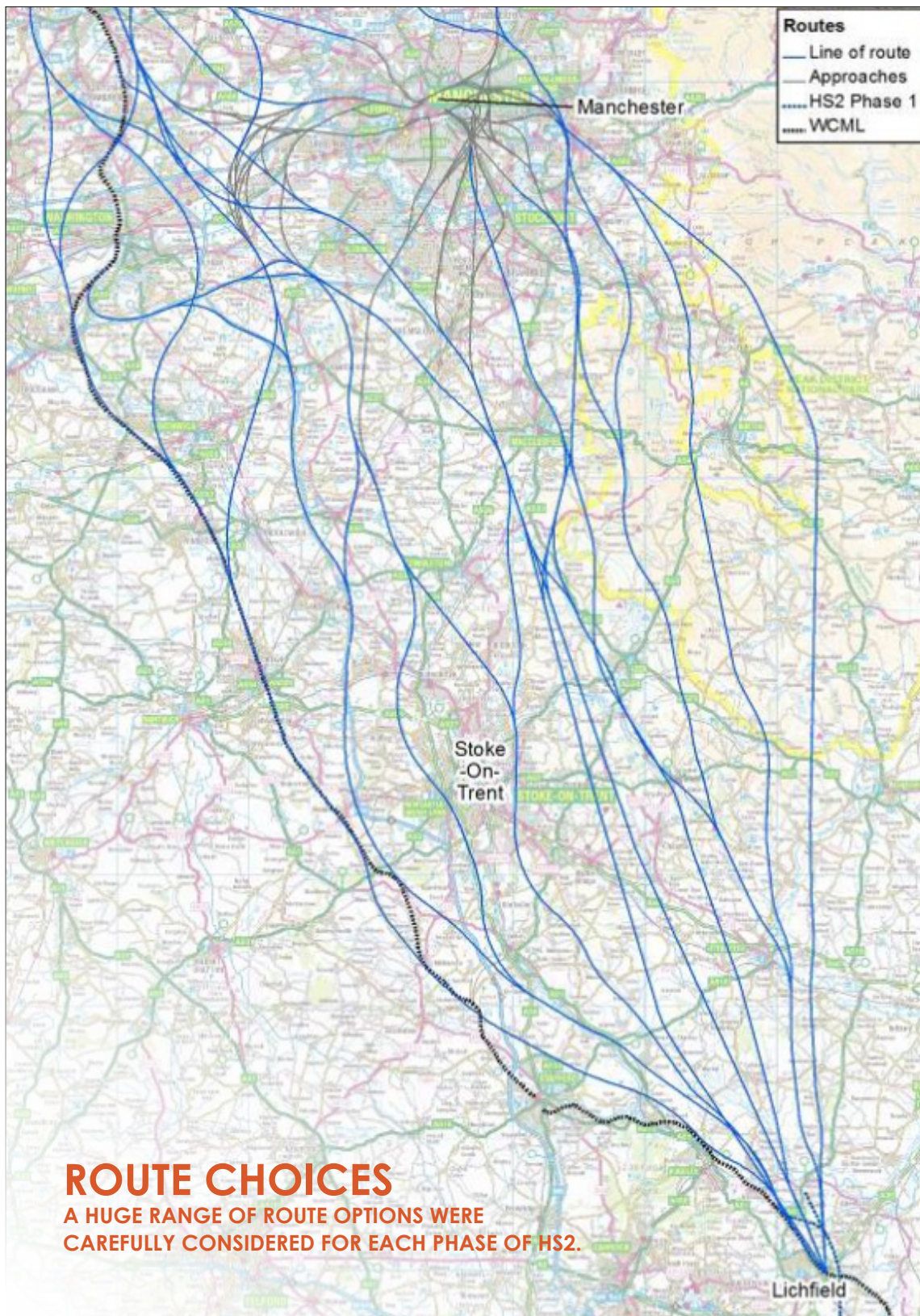
<sup>22</sup> Jaeger, J. et al. (2007) 'Time Series of Landscape Fragmentation Caused by Transportation Infrastructure and Urban Development: a Case Study from Baden-Württemberg, Germany', *Ecology and Society*, 12(1). doi: 10/ggmb2b.

<sup>23</sup> Page ii in *Nature Networks Evidence Handbook* (Natural England, 2020)

<sup>24</sup> *Impacts of nearby development on ancient woodland – addendum* (Woodland Trust, 2012)



# The background to biodiversity





# Comparing impacts of transport networks

Despite the transport sector having some of the greatest impacts on nature after agriculture, it is rarely identified as a major driver in domestic assessments on biodiversity loss<sup>25</sup>.

Environmental NGOs readily highlight new threats, such as new projects or new policies such as increasing the use of biofuels, whereas despite their scale, the ongoing impacts of our transport networks rarely receive the same attention. For instance, it is estimated that a third of young barn owls, one of the UK's most cherished species, are killed crossing roads<sup>26</sup>.

We know that transport is the largest single component of household spending in the UK<sup>27</sup> and likewise of national carbon emissions. By contrast there is no comparable data to enable us to understand what the component is with the greatest impact on biodiversity, though it is likely to be food due to the agriculture sector. Although there have been books and articles on road ecology for decades, the subject of rail ecology has only emerged in the last couple of years<sup>28</sup>.

Transport's impacts on the natural world can be assessed in different ways, with literature broadly taking the following perspectives:

- infrastructure approach: comparing direct, such as habitat loss and fragmentation, and secondary impacts, such as noise pollution, changes to water courses and wildlife mortality;
- lifecycle approach, as used for carbon, looking at the emissions from construction, operation and those from users; and
- systemic approach, considering particular locations, then a landscape or network scale before considering global impacts.

Here, impacts at the level of infrastructure projects are compared then at a system level before considering HS2's impacts and how the transport system should evolve.

## Infrastructure level

A scoping study of railway effects on biodiversity two decades ago<sup>29</sup> highlighted a lack of relevant studies specific to rail and no information at all regarding animal casualties from collisions with trains in Britain.

It found evidence that while roads and railways caused similar types of effects, suburban railways require an average of 13 times less landtake than roads to carry the same number of people. Although railways may have less ability to avoid sensitive sites due to horizontal and vertical alignment restrictions, they had greater potential to function as habitats and ecological corridors.

There were procedural differences too, with rail schemes often being considerably longer than road schemes, enabling a more comprehensive assessment of impacts but also making their effects appear worse. In particular regarding HS1, due to its length there were "many effects on ancient woodland along the route which cumulatively added up to a significant effect"<sup>30</sup>.

A decade later and shortly after HS2 was announced a literature review of over 100 papers produced compared carbon emissions from different transport modes but only biodiversity impacts of rail<sup>31</sup>. This was carried out before HS2's full Appraisal of Sustainability was published, let alone mitigation measures planned. It suggested the main effects of rail schemes were land take and fragmentation, similar to other linear infrastructure.

The study noted that high speed rail requires much less space than roads, but up to a third more land than conventional railways. As the actual trackbed is only a metre or so wider than a slower railway, most of this is slopes created by embankments or cuttings. This soft estate can provide valuable habitat with suitable maintenance regimes, or be reduced through retained cuttings or viaducts. It concluded there was a wide range of potential outcomes and there should be demand management of less sustainable alternative modes to maximise environmental benefits of high speed rail.

# Comparing impacts of transport networks

## Avoidance and mitigation potential

Although HS1 included many mitigation measures, there is a lack of available evidence about their effectiveness generally, let alone in relation to specific priority species. In any event, given much of its route is next to motorways, it could be difficult to assess the benefits of measures for ecological connectivity with such a significant barrier being close by.

Indeed more recent evidence focusing on how bats are affected by linear infrastructure found negative effects, both in terms of abundance and diversity, from motorways but that impacts from railways varied<sup>32</sup>. This may be because of different vertical alignment and features either side of a railway, such as whether it is wooded or not. Although sample sizes were small, the study suggested crossing structures are more effective if larger, similar to natural linear features and frequent, in terms of providing better connectivity across a route. Underpasses and green bridges were most effective for bats.

Green bridges are in fact a flagship element of mitigation for HS2, with 16 planned for Phase 1 alone, more than currently exist in the UK. A literature review on green bridges was unable to find any example of bridges just over railways<sup>33</sup>. With railways usually being narrower than roads, it is cheaper to provide more connectivity and it may be more appealing to wildlife because crossings are shorter.

<sup>25</sup> For instance in [State of Nature 2019](#) (State of Nature Partnership, 2020)

<sup>26</sup> [Barn Owl Hazards: Major roads](#) (Barn Owl Trust)

<sup>27</sup> [Family spending in the UK](#) (ONS, 2020)

<sup>28</sup> Barrientos, R. et al. (2019) 'Railway ecology vs. road ecology: similarities and differences', *European Journal of Wildlife Research*, 65(1), p. 12. doi: 10/gg37ff

<sup>29</sup> Pages 15-16 in [Rail construction and operational effects on biodiversity and geological interests - ENRR473B](#) (English Nature, 2002)

<sup>30</sup> Page 15 in *ibid*

<sup>31</sup> [A strategic analysis of the sustainability case for High Speed 2 - NECR085](#) (Natural England, 2011)

<sup>32</sup> [Development of a cost-effective method for monitoring the effectiveness of mitigation for bats crossing linear transport infrastructure - WC1060](#) (Defra, 2015)

<sup>33</sup> [Green Bridges: A literature review - NECR181](#) (Natural England, 2015)

# Comparing impacts of transport networks

## System level impacts of transport

The Dasgupta Review on the economics of biodiversity has highlighted the need for humans to live within a safe operating space of the biosphere<sup>34</sup>.

All the different pressures from intensive agriculture and extractive industries is leading to biodiversity loss, which is why the concept of resource efficiency has been gaining ground and is included in the Environment Bill. Many developed countries have reduced their headline carbon emissions by exporting manufacturing abroad. To prevent the same happening in relation to biodiversity, especially as Less Developed Countries often have more biodiverse areas, NGOs like the WWF are calling for action to prevent offshoring of impacts on nature through a global footprint target.

It is therefore important to consider all transport impacts at the systems level, such as considering the following elements:

- resource and energy efficiency for producing and operating vehicles;
- impacts from using vehicles, such as wildlife mortality and pollution; and
- secondary impacts such as land usage.

### Resource and energy efficiency

The continued dominance of driving in our transport system has led to the number of cars registered in the UK increasing by 50% between 1994 and 2019<sup>35</sup>.

With the average car only lasting 14 years, this has an enormous impact on resource use and is set to increase with further growth in car ownership forecast. The Dasgupta Review even highlights how these resource pressures not only cause biodiversity loss but also increase the risk of infectious diseases spreading. While the shift to Electric Vehicles reduces carbon emissions in use, it requires greater energy and rare earth metals, whether for batteries in vehicles or for renewable energy to power them. These minerals are often mined from the areas of greatest biodiversity and while clearly the shift to renewable energy and Electric Vehicles is crucial to tackle climate change, the impacts on biodiversity would be severe unless there is a high level of resource efficiency designed into the energy and transport systems<sup>36</sup>.

Innovation offers the promise of reducing resources required per new vehicle. Fuel efficiencies in the aviation sector have gone hand in hand with rising emissions because they have not been able to offset the level of growth, so there seems a high likelihood of a similar issue here. This illustrates the point that while the mitigation hierarchy is important in specific decisions, to tackle biodiversity loss we need to apply energy and transport hierarchies at the systems level, as discussed further below.

As a closed system, rail operators and indeed airlines can specify the highest recyclability levels across their fleet and ensure that this happens at end of life. Indeed HS2 Ltd has applied circular economy principles to its train specifications, requiring very high levels of recyclability and recoverability for its fleet<sup>37</sup>. By contrast this is more difficult to ensure where vehicles are owned by individuals.

Although evidence is limited, experience in the Netherlands suggest that improved long-distance train services can encourage households to reduce car ownership<sup>38</sup>, while good public transport enables patterns of higher density development and less car ownership.

### Usage impacts

Relevant studies often ignore the severance caused by all but the largest roads, even though a minor road with more than 1,000 vehicles per day can impact multiple species<sup>39</sup>.

This is particularly an issue in Britain, which has "one of the densest road networks in the world, with over 80% of land falling within 1 km of a road"<sup>40</sup>. Rural minor roads make up 52% of this road length, average 1,100 vehicles per day, having increased by 47% since 1994, with much of this increase occurring since 2012<sup>41</sup>.

This means many minor roads will recently have become impermeable for some species as traffic exceeds thresholds for what they can tolerate, an issue that has received next to no coverage.

This impact is not only ignored in Britain, indeed only 10% of countries make any mention of roads in their national biodiversity strategies. Besides landscape level issues of wildlife mortality and fragmentation, water run-off from roads pollutes water courses and evidence is emerging about the detrimental effects of microplastic pollution from tyre wear spreading further.

# Comparing impacts of transport networks

## Secondary impacts

In Less Developed Countries, new transport infrastructure opens up untouched areas for development. By contrast the landscapes in northern Europe have been shaped by humans for millennia. The issue is how transport and the development it fosters affects land use.

Pressure on land will increase from the need to adapt to sea level rises as well as mitigate emissions, such to give land over to nature based solutions like tree planting, so as to deliver the net in net zero. It will therefore be important to use land more efficiently, especially in light of to set aside space to help restore nature.

There is little research comparing the secondary impacts of transport, in terms of the impact on biodiversity of the development it unlocks or the policies needed to ensure modal shift maximises gains for nature in terms of these patterns of development.

Likewise there is a lack of evidence on the interaction between rail and road networks at a landscape scale<sup>42</sup>, including access to rail stations. With increased investment in railways, this is surely the time for more research into these wider impacts.

<sup>34</sup> [Interim Report – The Dasgupta Review: Independent Review on the Economics of Biodiversity](#) (HMT, 2020)

<sup>35</sup> [Cars \(VEH02\)](#) (DfT, 2020)

<sup>36</sup> Sonter, L. J. et al. (2020) 'Renewable energy production will exacerbate mining threats to biodiversity', *Nature Communications*, 11(1), p. 4174. doi: [10/ghmjm3](#)

<sup>37</sup> Paragraph 7.20 in [Train Technical Specification](#) (HS2 Ltd, 2018)

<sup>38</sup> Jonkeren, O. et al. (2019) 'The bicycle-train travellers in the Netherlands: personal profiles and travel choices', *Transportation*. doi: [10/gg2bgk](#)

<sup>39</sup> Jaeger (2007)

<sup>40</sup> Cooke, S. et al. (2020) 'Roads as a contributor to landscape-scale variation in bird communities', *Nature Communications*, 11(1), p. 3125. doi: [10/gg9nfr](#)

<sup>41</sup> [Road traffic estimates in Great Britain: 2019](#) (DfT, 2020)

<sup>42</sup> Barrientos, R. et al. (2017) 'What's Next? Railway Ecology in the 21st Century', in Borda-de-Água, L. et al. (eds) *Railway Ecology*. Cham: Springer International Publishing, pp. 311–318. doi: [10.1007/978-3-319-57496-7\\_19](#)

# Comparing impacts of transport networks

## How does high speed rail differ?

With the impacts of rail and road set out, it is time to consider the arguments made that HS2 is somehow particularly damaging.

These include that it is:

- very high speed: requiring it to be straight and making it harder to avoid habitats;
- wider: therefore requiring disproportionate amounts of land;
- high frequency: meaning more disturbance of wildlife;
- new rather than reopening or upgrading existing railways; and
- passing through sensitive areas.

Taking these issues in turn, speed has been the most prominent. Design refinement consultations since the route was first published have clearly shown how changing the alignment, including lowering the design speed, simply changes the types of impact rather than removing them.

More curves mean more landtake, in particular of features such as hedgerows that form important habitat as well as connectivity. The additional width requirement for a higher speed track is as little as a 10% wider trackbed. Most land take is used is mitigation, whether for biodiversity or to blend the route in with the surrounding landscape, thereby creating new habitats such as grassland.

If anything the high frequency of services is good, as it means movements are concentrated on infrastructure with the highest environmental standards, with large sections in tunnel, raised on viaduct or concealed in cuttings. As discussed in the operation section, the high frequency reduces mortality risk by discouraging birds perching.

The suggestion HS2 is worse because it is new ignores that some of the most sensitive habitats it passes through are by existing or disused railway lines, such as the Finmere Wood and Calvert Nature Reserve in Buckinghamshire; Brackley in Northamptonshire where the route was moved out of the cutting used by the Great Central Railway, which is now an SSSI, or by Burton Green in Warwickshire.

With most of HS2's trackbed being less than 15 metres wide and designed to the latest standards, it will present much less of a barrier than many other forms of transport infrastructure.

This will depend significantly on the infrastructure in specific places:

- Tunnels: minimal landtake of portals and headhouses, with no severance;
- Viaducts: again minimal landtake, while animals can pass underneath, some such as amphibians may be disturbed by noise however;
- Cuttings: where HS2 is below ground level, there is less risk of birds and bats striking passing trains and mitigation features such as green bridges may be easier to design in; and
- Embankments: although these are the greatest barrier, they do have scope for wildlife passages that can be effective for many species, even some birds if the size of an underpass rather than culvert.

As HS2's flythrough videos show, the line is not straight and passes through areas filled with fragments of woodland. It is simply not possible to avoid ancient woodlands unless adopting a very low speed route, which would then have greater impacts on other features such as hedgerows or one forever going into tunnel. Permanent impacts to nationally designated sites have largely been designed out, such as through using viaducts and tunnels.

# Comparing impacts of transport networks

## What would a biodiversity net gain transport system look like?

Although technological fixes like electrification can over time address carbon emissions from surface transport (though only wheel-to-wheel rather than life cycle), there are no technologies even on the horizon to fix transport's impacts on biodiversity.

Moreover, Electric Vehicles are forecast to significantly increase traffic levels by making driving cheaper, with the greatest effects likely to be felt on uncongested roads in rural areas. This means behaviour change is required alongside technological improvements, better planning and management of infrastructure<sup>43</sup>.

A system level hierarchy, the transport hierarchy, is therefore needed if we are to reverse biodiversity loss. Because biodiversity impacts are so spatially sensitive, it may need to be applied somewhat differently, as shown below.

Creating a nature-friendly transport system will have some adverse impacts on nature, just as ecological restoration can require picking and choosing some

habitats and species over others in order to create coherent nature networks. In urban areas, creating joined up cycleways can require felling trees, while in the countryside creating gaps in hedges and laying all weather surfaces on paths may be needed.

Reopening railways will mean old tracks and tunnels that have become havens for wildlife see trains again. Likewise, a shift from cars, planes and lorries or indeed land hungry housing development requires a step change in rail capacity that only HS2 can deliver between where most people live.

In the same way, building HS2 helps rather than guarantees carbon emissions will be cut and requiring wider modal shift policies to maximise its potential, the same goes for HS2's long-term biodiversity benefits.

Category	Actions
<b>Minimise demand</b>	Easier for work travel than for leisure. Incorporating full environmental costs into all transport choices would lead to shift to rail
<b>Enable modal shift</b>	More challenging in rural areas where biodiversity is higher
<b>Optimise system efficiency</b>	This requires minimising the number of intrusive movements in sensitive areas, as well as maximising benefits from infrastructure's soft estate to form coherent ecological networks for different species and habitats
<b>Increase capacity</b>	Question whether to expand existing infrastructure (potentially creating a barrier for some species, e.g. longer the culvert, less of a population may use it) and harder to mitigate. Or in some cases to provide new infrastructure where impacts from other transport networks can be reduced.

Table: Transport hierarchy for biodiversity<sup>44</sup>

<sup>43</sup> Page 12 in NAO (2020)

<sup>44</sup> Adapted from [Transport Hierarchy](#) (IMechE, 2013)



# Planning

The mitigation hierarchy has been the basis of minimising impacts on the natural environment for decades.

The first priority is to avoid causing impacts, such as through a different transport solution or a different route. The second is to reduce them, whether by designing them out by tweaking the design, construction method or adding in things like noise barriers. This could also be by repairing sites after construction, such as replanting trees felled for construction routes. The final is to compensate any remaining impacts in areas beyond those affected directly by a development.

It is easiest to understand what could be called the conservation NGO's "criticism hierarchy" of HS2's impacts on the natural environment by setting them out against each stage of the mitigation hierarchy.

The first objection is that HS2 never had a Strategic Environmental Assessment, in other words that a fundamentally different approach to transport investment or at least HS2's route should have been considered to avoid impacts to species and habitats, in particular irreplaceable ancient woodland.

The second is that the Environmental Impact Assessment relied on inadequate data, for instance that it would miss habitats that could, if surveyed, form potential Local Wildlife Sites. This could, it was argued, mean it would miss the opportunity to mitigate some of its impacts and, where it failed to do so, would not count their loss; so, in turn would not provide adequate compensation.

The third that HS2's compensation plans, or at least its headline target for no net loss rather than a net gain, is not good enough, with the Wildlife Trusts suggesting this will make it "impossible" to restore nature<sup>45</sup>. A final criticism relates to concerns about the monitoring and enforcement frameworks to guarantee the complex range of commitments are delivered, whether minimising harm during construction or delivering and maintaining everything promised afterwards.

Environmental law and policy have evolved over decades to require a structured process for developing and analysing programmes and projects that could have significant impacts on the natural world. This staged approach is designed to avoid closing down on a preferred solution too early on, as well as ensuring decision makers have all the detail they need to make

an informed final decision. It is important to examine these criticisms carefully. In fact, HS2 has been one of the most litigated projects in UK history, with legal challenges on these points proceeding all the way up to the Supreme Court but without success<sup>46</sup>.

## Compliance with environmental law

Strategic Environmental Assessment (SEA) applies to plans or programmes that set a binding framework for future decisions, in other words at an early stage before proposals have been worked up into detail.

It requires the production of an environmental report that identifies, describes and evaluates potential significant environmental effects. It also requires reasonable alternatives to the plan or programme to be set out, but only the alternatives that need to be considered those that would be relevant to achieving the plan or programme's objectives<sup>47</sup>.

A range of objectors brought a judicial review of the decision to proceed with HS2 on multiple grounds, one of them being that no SEA had been prepared. HS2 Ltd had instead prepared an Appraisal of Sustainability that also included economic and social factors as well as environmental ones.

The Supreme Court confirmed in 2014 that the Command Paper did not need to have an SEA since it did not bind future decisions. It found that even if HS2 had been required to have one, SEA requirements had been met for Phase 1, less so for later parts of Phase 2<sup>48</sup>. The shortcoming there was not about a failure to explore upgrades to existing railways but about the shape of the proposed HS2 network, specifically no comparison of the environmental effects of a reverse 'E' or 'S' shaped network as opposed to the 'Y' shaped one chosen.

An international study<sup>49</sup> comparing HS2's strategic appraisal to that used for other mega projects was also favourable. It found that HS2 had, "the assessment with the most strategic perspective [that] sought to integrate environmental and sustainability considerations early on and influence the route planning process in an iterative manner, with the enlarged participation of stakeholders as well as the affected public".

# Planning

It considered "different route alignments at different design standards in order to decide on a preferred route". This was particularly impressive given the risks from considering a range of options of blighting large areas of one of the most densely populated areas in Europe and compares most favourably to the lack of strategic options considered for the UK's road and air networks.

The study was not without criticisms, however, saying the DfT "was in too much of a hurry to get to the route alignment, rather than spend a little more time on getting the strategy right in the first place and wider consensus on the role high speed rail should play in the nation's transport policy". This reflects a wider criticism that HS2 should only have been considered as an element within a national transport strategy.

Regarding nature, DaSTS started well saying "[i]t is clear that a transport strategy that was predicated on a net adverse impact on the natural environment would be as unsustainable as one that failed to deliver greenhouse gas reductions"<sup>54</sup>.

It lacked any detail however, simply proposing mitigating adverse impacts of transport schemes and 'promoting' a healthy natural environment. 'Promoting cycling' has been the extent of many strategies' commitments to active travel, though has failed to lift its modal share, so its extension to nature could be greeted with similar scepticism.

## Delivering a Sustainable Transport Strategy

What is often forgotten is that HS2 arose on the back of a strategy by the DfT called Delivering a Sustainable Transport System (DaSTS) in 2008<sup>50</sup>.

This took an integrated approach using multi-criteria analysis that remains world class, indeed its carbon reduction pathways analysis is still used as being better than anything published since. With the benefit of hindsight, there are two areas where this strategy should have been more ambitious, the climate and ecological emergencies.

This strategy studied the strategic corridor between London and Manchester in the most detail, assuming as much as 3% annual rail growth for the 2010s<sup>51</sup>. In fact, even with a change in government leading to changes such as fuel duty being frozen, ever cheaper flights (leading to holiday travel and its emissions increasingly being exported) and rail fares increasing above inflation, average growth still exceeded 4%<sup>52</sup>.

By contrast while car mileage stalled by the middle of that decade it started rising again. In 2020 the DfT finally made a welcome admission that we need to use our cars less and shift further and faster to sustainable travel, in order to meet carbon budgets<sup>53</sup>.

<sup>45</sup> See <https://www.wildlifetrusts.org/hs2>

<sup>46</sup> Paragraphs 44-49 in [HS2 Action Alliance Ltd, R \(on the application of\) v The Secretary of State for Transport & Anor](#) [2014] UKSC 3

<sup>47</sup> [The Environmental Assessment of Plans and Programmes Regulations 2004](#)

<sup>48</sup> Paragraphs 46-48 in HS2 Action Alliance [2014]

<sup>49</sup> Carvalho, S., Partidario, M. and Sheate, W., (2017) 'High speed rail comparative strategic assessments in EU member states', Environmental Impact Assessment Review, 66, doi: [10.1016/j.eiar.2017.07.001](https://doi.org/10.1016/j.eiar.2017.07.001).

<sup>50</sup> [Delivering a Sustainable Transport System](#) (DfT, 2008)

<sup>51</sup> [Delivering a Sustainable Transport System Annex 1](#), (DfT, 2008)

<sup>52</sup> Table 1.2 in [Full business case High Speed 2 Phase One](#) (DfT, 2020)

<sup>53</sup> [Creating the transport decarbonisation plan](#) (DfT, 2020)

<sup>54</sup> Paragraph 1.20 in DaSTS (DfT, 2008)

# Planning

## HOW NATURE NETWORKS INFORM GERMAN TRANSPORT INFRASTRUCTURE

CASE STUDY

While Germany is also struggling to cut its carbon emissions from transport, the preparation of its Federal Transport Infrastructure Plan was developed through an SEA decades ahead of anything ever produced in the UK, thanks to the existence of detailed national ecological data.

The Federal Agency for Nature Conservation has mapped out nationally important habitat arteries and corridors as well as “unfragmented functional areas” that have important habitat functions and a low density of road traffic. The habitat network is made up of 4,550 links with a length of around 60,923 km and the transport infrastructure network in 2010 was found to sever these habitat arteries in 9,257 cases.

German authorities were therefore able to consider a wide range of interactions of transport with nature, including impacts on unfragmented areas (in particular those with a low density of traffic), traffic flows through water protection zones, overall landtake of the transport system, and potential conflicts with aspirations to reconnect habitat areas<sup>55</sup>. Nonetheless the final plan was still heavily criticised by NGOs given its attachment to road-building, which they believed would make Germany's climate and nature ambitions impossible to meet<sup>56</sup>.

## Environmental Impact Assessment

Much of the criticism of HS2's impacts has related to proposals in its Environmental Statements for its different phases.

Environmental Impact Assessment (EIA) requires the publication of an Environmental Statement describing a proposed development, setting out matters such as its location and design, the significant environmental effects and measures envisaged to reduce or offset them<sup>57</sup>. There were two types of potential shortcomings raised at this stage by objectors, relating to the extent of impacts and the comprehensiveness of mitigation.

### Extent of potential impacts

One of the salient reasons for HS2's reputation for causing significant harm is the EIA requirements to list and summarise potential impacts.

By contrast no other form of human activity, whether new homes, road expansion or intensification of farming, activities that have greater, albeit cumulative impacts on biodiversity, have a summary of their impacts gathered in one place. At the equivalent of 56,000 pages, the Environmental Statement for HS2 Phase 1 was the biggest in history. Because the precautionary principle requires assuming the reasonable worst case, these figures minimised the potential for reducing impacts through detailed design, restoring habitats after construction or wider innovation.

Figures in the media have suggested many more sites being destroyed, relying on a Wildlife Trust report that any designated habitat within 500m of the red line of HS2's route would be at “significant risk” of harm, for instance due to air pollution<sup>58</sup>. This is despite HS2 using electric trains, adopting the highest Euro 6 emission standards for construction, plus its contractors rolling out cutting edge technologies such as hybrid diggers.

While it is true that some effects on species or hydrology can extend far, these blanket assumptions go far beyond any reasonable worst effects. Even habitats on the path of the tracks may only lose a proportion of their area to construction and there may be potential to restore some of the losses.

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Another misunderstanding is the land take. As the map below shows of the Phase 2a route through the Trent Valley, the typical requirements for HS2's track are narrow, under 15m, but the Act limits (the land to be used, is illustrated in blue) are far wider. In some instances this larger area is needed for haulage routes and construction compounds, but much of the area is for ecological measures; while there has been public pressure to reduce this area fuelled by concern about how much land is to be taken, there has been less focus on the value of the land and habitats created to be given back.

## Comprehensive data and mitigation

Some objections related to a lack of up-to-date ecological data, for instance regarding habitats that could in future become potential Local Wildlife Sites. EIA rules only require significant impacts to be assessed and HS2 Ltd's surveys followed industry best practice (CIEEM guidance) regarding assessing non-designated habitats.

Others have related to inadequate mitigation or a lack of detail about proposals. As explained below, the ES is the earliest of five design stages and comes around seven years before detailed design for the mitigation that will actually be built. At the EIA stage, developers are only required to set out mitigation measures "envisaged" then, rather than final plans.

The lack of detail on ecological connectivity is a good example: the methodology for an EIA is about early identification of headline impacts using the best available existing data. The Wildlife Trusts have argued for mitigation proposals to consider a 1km buffer zone on either side of the track, equivalent to the black line on the scale above. Habitat corridors are however considered even before the EIA with opportunities for wider integration of habitats being appraised as the design evolves.

Where there does seem a gap in EIA is the interaction between schemes such as HS2, potential other development, whether infrastructure or other forms of development at different stages of development, and potential schemes for restoring nature. This is due to the EIA process, which focuses on approved developments and natural changes, so is for the Government to deal with rather than HS2 Ltd. It highlights how conservation has often attempted to fix habitats in time and space,

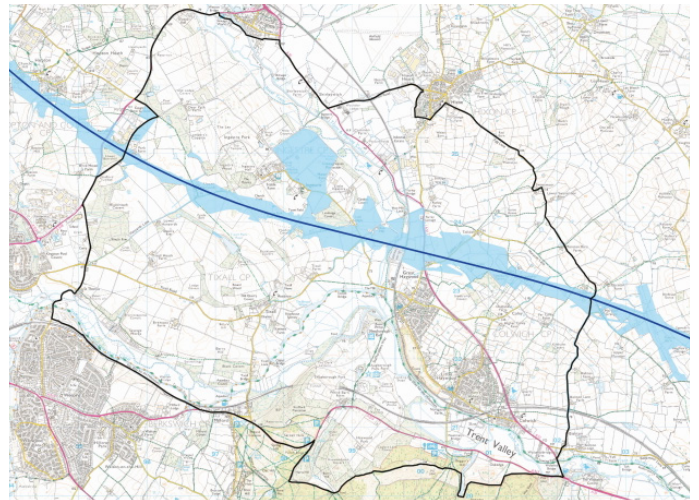


Figure: Map showing HS2 phase 2a in Staffordshire. Source: HS2 Ltd

<sup>55</sup> [Non-technical summary: English translation](#) (BMVI - Federal Ministry of Transport and Digital Infrastructure, undated)

<sup>56</sup> [Grünbuch nachhaltige Planung der Verkehrsinfrastruktur](#) (BUND, undated)

<sup>57</sup> [The Town and Country Planning \(Environmental Impact Assessment\) Regulations 2017](#). Changes to the Regulations mean there will be slight changes to terminology for HS2 Phase 2b

<sup>58</sup> [HS2: What's the damage: full report](#) (Wildlife Trusts, 2020)



# Planning



Credit: HS2 Ltd. 2020

## PIONEERING NEW STANDARDS

HS2'S INTERCHANGE STATION IS THE FIRST IN THE WORLD TO BE AWARDED "OUTSTANDING" RATING FOR SUSTAINABILITY BY BREEAM.



# Planning

## Mitigating and compensating for harm to biodiversity

The principles for compensating for loss of biodiversity have evolved considerably over the last decade and HS2 has pioneered applying these new approaches.

### Irreplaceable habitats

As outlined above, while loss of irreplaceable habitat such as ancient woodland requires specific measures to create or improve habitat of the same type, most habitats are dealt with through biodiversity units.

At times it has seemed HS2 has been an easier target than the evolving policy for compensation it has been seeking to apply. For instance, some have criticised HS2 on the basis that its pledge for no net loss is misleading because ancient woodland is irreplaceable, others on the basis it should aim for a net gain.

When HS2 was first announced few expected ancient woodlands to become the highest profile impact of its route<sup>59</sup>. It is important to appreciate that ancient woodland is not simply important for its biodiversity (below and above ground), but also its cultural and historic value.

National datasets generally did not record ancient woodlands smaller than two hectares though through carrying out heritage reviews about 100 extra ancient woodlands have been recorded along the route.

While these small fragments do suffer from edge effects, they can with suitable additional planting increase habitat connectivity.

### Moving from net loss to net gain

Beyond the attention on irreplaceable habitats, Parliamentary opposition to HS2 has been focused on setting a precedent for nationally significant infrastructure projects to be required to deliver net gain.

Bodies like the RSPB have stated there is no reasonable justification to exempt such schemes, not least as they can have profound fragmentation effects. Some schemes have voluntarily committed to net gain, such as East West Rail, indeed it will help make them pass

the “planning balance” test. Companies building HS2, such as Balfour Beatty, have called for a date to be set for large infrastructure to be included to provide the construction sector with more certainty<sup>60</sup>.

Linear transport projects are already treated differently by policy, in recognition of the greater difficulty of avoiding certain impacts<sup>61</sup>. This has a knock on effect in terms of land required for compensation, as if you lose a valuable habitat, you need a much larger area of land to compensate for it. The Government has decided to exempt major infrastructure projects from the Environment Bill's net gain requirements until it can carry out further research, on the basis that they have “fundamentally different characteristics to other development types”<sup>62</sup>.

Indeed HS2 is already a key contributor to this research, with a Parliamentary committee looking at Phase 1 concluding that “[t]here is no doubt a lot to be learned from experience on this project that can be used to improve the metric, and perhaps have the more ambitious aim of some net gain on future phases of HS2”<sup>63</sup>.

The Wildlife Trusts' key ask for Phase 2a was for a legal commitment to net gain and proposed a three stage process to deliver this. First, greater restoration and enhancement of habitats within the existing Bill limits (rather than reliance on creating new habitats), second incorporating more land within Bill limits and finally by establishing mechanisms to secure habitat improvements with nearby landowners.

As set out in the design section below, detailed design has just started for Phase 1, so there is still considerable scope to inject more biodiversity into what is finally to be constructed. Indeed, the teams and companies involved are keen to do so. Increasing the Bill limits, particularly at this late stage for Phase 2a, would mean a great delay and with it potential for HS2 to shift journeys off planes and HGVs to reduce transport emissions in the 2030s. Requiring much more land, would also mean significantly greater pushback from landowners along with additional cost.

In terms of establishing new mechanisms, the Environment Bill will provide a whole new suite of options, while the Environmental Land Management scheme created by the Agriculture Act 2020 will create incentives for land managers to deliver environmental gain alongside food production.



# Planning

Although there is scope for more voluntary agreements in the interim, this risks costing significantly more and making inefficient use of the environmental funding available.

While some may call HS2 a laggard, it is too easy to forget the huge ambition of its original commitment in 2013 for no net loss of biodiversity. This has never been delivered for a scheme of this scale in the UK and is a major step up for long linear projects that will inevitably have significant impacts.

Public expectations have moved on quickly, however. Already one section of Phase 1 is close to achieving the net gain target as a result of detailed design, with potential to improve this further through the additional funding available to land managers. This compares well to an earlier forecast of a net loss of about a fifth of replaceable habitat.

One issue arising here is how to track and monitor the mitigation and compensation across the route and in specific sections of it and beyond it through the wider funding pots. This is further complicated by the different stages of design different sections have reached, making comparisons challenging.

As an example, the initial £1.2m allocation of the woodland fund is expected as of September 2020 to lead to the creation of 105 ha of new woodland and restoration of 69 ha of plantation ancient woodland sites.

It is important to assess differently replaceable habitats, for which biodiversity units are the metric, and for irreplaceable habitats, which have a compensation ratio specific to their type. Natural England's suggested compensation ratio of 30:1 new woodland for every unit of ancient woodland removed<sup>64</sup> has repeatedly been criticised by Parliamentary committees for lacking a scientific basis<sup>65</sup>.

Restoration is better ecologically than creating new habitat as it delivers improved habitats faster, so is planting next to existing woodland, as it can reduce edge effects and improve connectivity, but these nuances are currently ignored by this crude ratio. Finally irreplaceable habitat often has multiple benefits besides biodiversity, such as cultural and carbon storage, and a single ratio oversimplifies these.

There is surely a need for a more evidence based approach to compensation ratios. One that still recognises the great importance of avoiding impacts to irreplaceable habitats in the first place and the challenges in mitigating any loss, but that provides decision-makers and designers with a greater steer on how to deliver the best outcomes from compensation.

<sup>59</sup> In 2017 the House of Lords Committee considering Phase 1 through the Chilterns concluded at paragraph 312 of its [report](#) that: "[a]ll ancient woodland is irreplaceable, but the loss of less than one [hectare] out of about 11,000 in the AONB is, we consider, a remarkable achievement."

<sup>60</sup> [A Better Balance: A Roadmap to Biodiversity Net Gain](#) (Balfour Beattie, undated)

<sup>61</sup> Paragraph 4.11 to 4.14 in [National Networks National Policy Statement](#) (DfT, 2014)

<sup>62</sup> Page 5 in [Net gain: summary of responses and government response](#) (Defra, 2019)

<sup>63</sup> Paragraph 293 in House of Lords (2017)

<sup>64</sup> Page 7 in [Review of HS2 Ltd's 'no net loss in biodiversity' metric](#) (Natural England, 2016)

<sup>65</sup> Most recently at paragraph 141 in [Select Committee on the High Speed Rail \(West Midlands - Crewe\) Bill - Special Report of Session 2019-21 - HL Paper 149](#) (House of Lords, 2020)

# Planning

## BIODIVERSITY OFFSETTING AND THE FRENCH TGV

CASE STUDY

France has led the world in offsetting HSR's environmental impacts, hardly surprising given its role as an early adopter of the technology.

Eiffage [HSRG], one of the companies building HS2, piloted no net loss on France's 182km Great Western High Speed Line to Brittany that opened in 2017. Conditions in France made this easier to achieve, for instance using a non-adversarial forum at the start of decision-making (the Commission for Public Debate), public familiarity with HSR and lower population density.

Indeed, because a much wider trace could be purchased without significant objections, the volume of sites available exceeded compensation needs and in turn making integration of the fuzzy edges of habitats easier<sup>66</sup>.

As a legacy of this 350km/h railway, 920ha of habitat compensation has been created across 242 sites that will be maintained and monitored as part of a Public Private Partnership deal until 2036<sup>67</sup>. France's Biodiversity Act of 2016 incorporated the avoid, reduce, compensate hierarchy into law<sup>68</sup>. Since 2018 French regulations require open data about offset sites to be added to a national database, so as to enable their integration with those from future developments.

In the same year, the Tours-Bordeaux high speed line commenced operation, only six years after that project's official start in 2011. What makes it particularly interesting is how it highlights the importance of building partnerships in innovative ways between companies, state bodies and local land managers early on. This did not mean everything went smoothly, with the chosen route affecting 14 Natura 2000 sites — the highest EU designation, by contrast HS2 affects just one minimally — and NGOs taking the construction companies to court for a pollution breach during construction.

After six months of negotiation, a "general wildlife innovation agreement" was drawn up between all key stakeholders, setting out the major compensation measures, mapping their locations, and allocating individual roles, such as ecological analysis and site identification. To build trust and guarantee impartiality,

coordination of some topics was delegated to NGO partners. For example, the evaluation of the effectiveness of compensation measures was delegated to the national Bird Protection League (Ligue pour la Protection des Oiseaux).

At the core of the strategy this approach was based upon was the recognition of how crucial the issue of acceptability is. Because it does not fit neatly into any particular legal category, bespoke governance arrangements will need to be agreed with stakeholders. So the construction consortia sought partnership early on rather than a supplier relationship, emphasising procedural transparency throughout<sup>69</sup>.

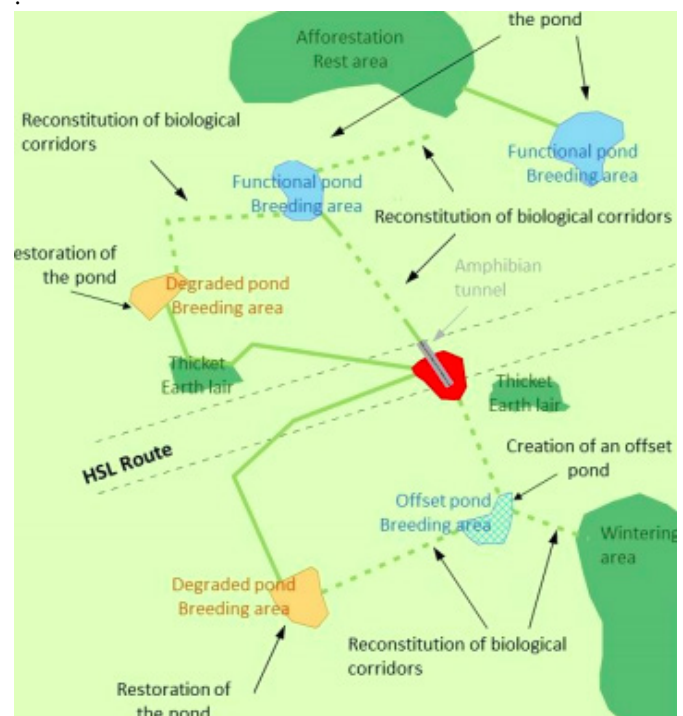


Figure: Planning ecological connectivity across French high speed line. Source: Eiffage, 2018.

<sup>66</sup> [The Ecological Offset on the BPL HSL, a French Linear Railway Infrastructure](#) (Eiffage, 2018)

<sup>67</sup> [Bilan final des mesures d'évitement, réduction et compensation: Département de l'Ille-et-Vilaine](#) [Final review of measures for avoidance, reduction and compensation: Ille and Vilaine Department] (Eiffage, 2017)

<sup>68</sup> [Article 230 of the Grenelle 2 law \(Loi n° 2010-788\)](#)

<sup>69</sup> Lorinquer C., (2016) [Management of measures to reduce and compensate for the environmental impact of the LGV Sud Europe Atlantique Tours-Bordeaux high-speed rail line project](#), Field Actions Science Reports

# Design and consenting

## Design stages

One of HS2's least well understood aspects of its design has evolved and gained detail over time.

It is as if a book had been launched with a title, theme and chapter headings in 2010 but without characters nor dialogue, with these being progressively added and refined by different teams of professionals over a decade. While that approach would be unlikely to create a best selling novel, this iterative process makes sense for a scheme the size of HS2.

Following the selection of an initial route and identification of a concept design, the design process for HS2's civil engineering has five stages:



Figure: HS2's five design stages (Source: HS2 Ltd)

## Design and consenting

Although it includes what would appear to be very detailed maps, the Parliamentary design is in fact simply a high level concept design. It is enough to work out maximum land take and a "reasonable worst case" of impact for the accompanying Environmental Statement. That in places assumed generic designs of structures like bridges and that habitats within the scheme's land take would simply be destroyed.

Some of those working on the project readily acknowledged it contained mitigation proposals that were simply indicative, particularly where a lack of land access had at that stage restricted surveys to inform the design.

The Specification Design incorporates the various changes made to the Bill in order for it to become an Act. These include Additional Provisions, amendments that contained significant changes and increases in land take, as well as bilateral commitments made to individual petitioners, which are then integrated together into a coherent whole.

The Employers Requirements Design (ERD) has a greater level of maturity but is still essentially an example of how HS2 could be built based on a few rules related to the limits of land set out in bills, rather than an agreed way how HS2 would be built. This means it was still too early to be sure that there can be savings guaranteed in terms of land take.

From the Scheme Design stage, work is carried out by the appointed civil contractors and can take up to two years. The ERD is checked to see if it is fit for purpose, to assure costs and find ways to reduce them, then to enable Schedule 17 applications, where planning consent from local authorities is required for specific elements such as bridges.

Detailed design only started after Notice to Proceed was granted in April 2020, with just the southernmost section of the route outside London, the area around the Chilterns nearly complete at the time of writing. So long as the final proposals are within the scope of the consent, they can change.

It is only at this stage the most detail around ecological planning is agreed as further tests may be required, such as checking for protected species and pumping tests to understand the behaviour of groundwater.

Despite this long process, some objections as far back as in 2014 were on the basis there was a lack of detail regarding the route or how impacts to biodiversity will be mitigated and compensated and concerns about a failure to reduce land take from the 'worst case'.

Realistically it is difficult for anyone to comment without knowing if not objecting to something early on could prejudice their position in future. What would be helpful here is to set out a couple of diverse locations and explain the level of detail, whether for ecology, landscape or certainty of temporary and permanent landtake, can evolve at each stage.

There are valid questions about the flexibility of the design processes to add in extra or realign existing connectivity improvements. Further information would be helpful from the experiences emerging along Phase 1. Creating additional wildlife culverts should not be difficult, upgrading an overbridge into a green bridge may not require additional land take in normal circumstances, by contrast moving a green bridge to align better with a bat commuting corridor would be likely to require additional planning consent.

After the design stages of HS2's lifecycle there will then be construction, testing and commissioning then operation, including constant review of ecological plans. After Royal Assent, some elements around railway systems, including signalling, track and power are taken forward in separate processes and these need to be integrated back in.

# Design and consenting

## Consenting process

The largest rail projects in the UK receive development consent via a special process known as hybrid bills.

This dates to the early days of the railways in the nineteenth century, when railway barons sparred with aristocracy as they sought to construct new railways through often ancient estates. A review following the Phase 1 Bill resulted in a shift to more modern language and electronic filing of petitions, the objectors' statements of their cases, in time for the Phase 2a Bill.

It did not, however, recommend more radical changes on the basis that Parliamentarians "given their experience dealing with their constituents [have] an understanding of the needs of petitioners". The focus remains on Parliamentarians hearing petitioners, i.e. those who can prove their interests are specially and directly affected, in fact because there was "too much repetition of the same issues" further limits on who could appear was proposed<sup>70</sup>.

There seem to be two major issues between aspirations to improve consideration of the natural environment and the hybrid bill process used in practice. These are who is heard and then how they are heard. First the requirement to show particular effects meant to have a voice means that the Parliamentary committees examining the proposals hear most from property owners and land managers. By contrast there are few representatives of habitats and species that can be heard to balance this out, indeed some more vulnerable species may have no one speaking up specifically for them, let alone able to obtain the media coverage to amplify their needs.

Many petitioners objected to the scale of land take HS2 required, particularly for ecological mitigation, as it can be harder to argue against space needed to engineer a railway through a landscape. Farmers had particular concerns that reducing the size of fields could make their farms economically unviable and Parliamentarians did not want to be seen to be putting families out of business unnecessarily.

With no net loss being a new concept, few of those involved had a particular understanding of it, making it hard to balance farmers' needs with the need to ensure new and proposed habitats were a viable size.

It was even harder to judge how much land is required in particular places along the route for HS2 to achieve no net loss at a project level overall.

It is fair to say the pushback from landowners was painful for HS2 Ltd in Parliamentary committees, the media and forums like the ministerial HS2 environment roundtable. Strong advocacy by different stakeholders has had influence, for instance HS2 Ltd evolved its approach and acquired woodland through the Phase 2a Bill that it could improve as compensation for unavoidable losses of ancient woodland. This has however deflected resources and attention from species and habitats without their own advocates and led at times to an oversimplified view of environmental impacts.

The second issue was the very nature of the adversarial process and discussions then undertaking and assurance being made between HS2 Ltd and particular petitioners. First this can hinder sharing of information or trust building, such as where bodies involved in multiple phases want to preserve their position. Second it has led at times to proposals being agreed that were made in reaction to individual interests rather than offering holistic and multi-functional mitigation.

On the one hand landowners and communities want to be treated as individuals with their own specific needs and impacts, on the other there can be a case for applying general principles sensitively but also coherently. In particular, landowner objections can hinder nature recovery when they lead to mitigation being moved. Though replacement habitat is still being provided it may no longer be in a good location to improve the functioning of natural processes and ecological connectivity.

## Beyond bills

Once a hybrid bill receives Royal Assent and becomes an act, it is not the end of the matter. This stage simply amounts to deemed (outline) planning permission, meaning detailed applications are then required for matters such as building works and earthworks, which local planning authorities decide upon. The Court of Appeal recently confirmed these local authorities, rather than HS2 Ltd<sup>71</sup>, should take the lead in evaluating local interests and so require sufficient detail to make considered decisions. The grounds they can refuse an application are limited, for instance, local authorities can reject proposals for earthworks that fail to preserve



## Design and consenting

a site of nature conservation value but not those that miss a reasonable opportunity to enhance nature connectivity<sup>72</sup>, such as a proposal contained in an emerging Local Nature Recovery Strategy. As set out below, impacts on protected species require separate licensing from Natural England.

Using the Planning Act 2008 instead of a hybrid bill for development consent could offer advantages by being more inquisitorial, with the process led by expert planning inspectors. While it does require more upfront work around design and environmental assessment, recent changes enable more flexibility after consent is granted. That said, the National Policy Statements schemes are judged against are showing their age, particularly in relation to climate and biodiversity.

Other countries have very different approaches, in France for instance after an independently run public debate, there is a one stop process that leads to a Declaration of Public Utility, with no further licensing or other consents required. Germany has recently passed a new law to accelerate its consenting processes for environmentally friendly transport projects (all rail and water) to help meet its climate objectives<sup>73</sup>.

Environmental bodies there have called for broader reforms, including recruiting more transport and planning specialists familiar with environmental issues and following the French model of early engagement. This is viewed as helping replace the conflict and mistrust that often characterise large projects with cooperation and partnership<sup>74</sup>.

### Aspiration versus assurance

Nature is too complex to be readily reduced to numbers.

Although people from different sectors and professions expressed it in their own ways, a consistent theme was the challenge of how best to guarantee environmental outcomes while taking appropriate opportunities. One approach is design-led, using holistic visions to aim for a positive legacy, another is more technical, focusing on mitigating and compensating negative impacts identified in EIAs.

If we are to restore nature at scale, the lessons from HS2, the UK's largest environment project, will be important to gather and share. Ambition can still be difficult to translate into delivery, however. For instance, the Varley Review found that previously Network Rail had not "truly embedded" environmental considerations as they were not implemented consistently due to skills gaps plus "pressures of cost, compliance and culture"<sup>75</sup>.

Its lack of ecological understanding inhouse limited Network Rail's ability to act as an 'intelligent client' where work is outsourced and in particular a narrow view of compliance meant opportunities to meet multiple objectives, such as for natural capital, were missed. Network Rail welcomed the Review and the opportunity provided to set out a more ambitious vision on biodiversity<sup>76</sup>, which it has now done.



Figure: HS2 runs through a sliver of Crackley Wood in Warwickshire (shown in grey), meaning most of the wood is unaffected. To mitigate the impacts of this loss, trees will be planted in the dark and light green areas. Source (HS2 Ltd)

<sup>70</sup> Hybrid Bills: House of Commons Background Paper (House of Commons Library, 2018)

<sup>71</sup> London Borough of Hillingdon Council, R (on the application of) v High Speed Two (HS2) Ltd [2020] EWCA Civ 1005

<sup>72</sup> High Speed Rail (London - West Midlands) Act 2017

<sup>73</sup> Wichtige umweltfreundliche Verkehrsprojekte werden beschleunigt (BMVI, 2019)

<sup>74</sup> Fünf-Punkte-Programm des BUND zur Beschleunigung der Planung und Genehmigung großer Verkehrsinfrastrukturprojekte [BUND's five point programme to accelerate planning and consenting of large transport infrastructure projects] (BUND, 2019)

<sup>75</sup> Page 7 in Network Rail vegetation management review: valuing nature, a railway for people and wildlife (DfT, 2018)

<sup>76</sup> Response to vegetation management (Network Rail, 2019)

# Design and consenting

## PUSHING BOUNDARIES IN HS2'S DESIGN PANEL

### CASE STUDY

When it was first announced in 2012<sup>77</sup>, the focus of HS2's design panel proposed to be ensuring its engineering was sensitive to the setting of the places it passed through. By the time the panel was set up in 2015, this had expanded to securing utility. In going far beyond the typical focus design panels have on commenting on designs but also exploring processes and mindsets, HS2's independent design panel has been a vital influence here. Through engaging early on in the design process, the risk of trying to retrofit solutions when designs are largely complete is reduced.

By supportively challenging HS2's wider vision and processes relevant to ecology, panel members have sought to infuse the needs of nature as well as passengers and communities throughout<sup>78</sup>. Its advice has helped rapidly evolve the Green Corridor concept from being just about the land next to the route to a wider network of habitats. It has encouraged greater aspiration about the length of the monitoring period for translocation of soil from ancient woodland. HS2 Ltd has acknowledged the massive value added by having peers from industry and beyond providing a fresh perspective and acting as a critical friend.

The companies building HS2 have welcomed its design insight and philosophy as helping unify different disciplines and secure multi-functional interventions. The strategic vision the panel members offer is viewed as important to shift the focus beyond site specific mitigation in the shorter term to landscape scale nature recovery in the longer term.

Nonetheless as the Government's ambitions on restoring nature grow, it does seem time to ask how the panel and its vision can evolve to keep pushing the boundaries around biodiversity. Although its Design Vision calls for "[d]emonstrating commitment to the natural world"<sup>79</sup>, the focus is largely on human benefit. Some feel that the panel is largely landscape led, lacking ecological drive at times, with many landscape architects but no ecologists amongst its many expert members. This has led to a perception that it emphasises enhancing views more than biodiversity, with ecological enhancements promoted so long as human benefits are identified.

The focus in the National Infrastructure Strategy on design and enhancing England's unique ecosystems provides an opportunity for the panel to provide further leadership and case studies.

Although it is overseeing Britain's largest infrastructure project, HS2 Ltd is far from the largest infrastructure company, so it uses standards, contracts and assurance to ensure the work, whether planning, construction or monitoring, is carried out effectively by much larger supply chain organisations. Due to the scheme's scale, it has attracted the leading engineering companies and through them ecologists and consultancies wanting to make their mark on a flagship national project.

What really comes across is how its processes integrate ecology and engineering when designing the route, compared to a generation ago when the environment could feel tacked on as an afterthought. HS2 Ltd can only bring the railway into use on demonstrating it has delivered on its environmental as well as safety obligations, such as showing the mitigation sites delivered in enabling works remain effective and in good condition. So, although there are stage gates when mitigation assets are created, there is no single point in time or single hurdle, after which these commitments can be forgotten. Given the project's scale, HS2 Ltd must apply its attention in a focused manner, concentrating assurance on legally required mitigation for habitats of principal importance or protected species, such as ponds for great crested newts. Ecology's integration with engineering also means that the programme management tools and mindsets can dominate. Wider enhancement, whether of art or nature restoration struggles in a culture of compliance not one of opportunity, however.

The ambition to secure no net loss of biodiversity could be seen to change this, through rewarding the identification of opportunities, yet the perception of some contractors is that it can lead to a focus on point-scoring rather than creating lasting habitats of high ecological value. Simply changing the target to biodiversity net gain would not necessarily resolve this issue either. More detail is needed in HS2's ecology technical standard on overarching principles of habitat creation, such as to be ambitious and innovative; always create the highest value habitat possible using the most cost-effective methods, plan in perpetuity in terms of maintenance, and agree plans through thorough consultation with stakeholders. There is a wider need to transform principles, professions and processes from mitigation to regeneration. While delivering compliance with legal requirements for protected species is a core competence for ecologists, as this has been the core requirement of projects up to now, fewer can deliver complex habitat creation projects, in which the need for long term management is minimised.

# Design and consenting

## Delivering value through sharing lessons

Managing costs and schedule is an important element of assurance, which ultimately is about providing strategic delivery confidence. If HS2 Ltd cannot show the costs of ecological mitigation and compensation can be forecasted and kept under control, that is likely to impact on the ambitions of future projects to build on HS2's environmental commitments.

Not least given HS2's increase in budgets, there is always tension around value for money and avoiding platinum plated solutions. Simply minimising costs can miss opportunities to maximise value. HS1 Ltd has been grappling with how to mature its thinking and demonstrate the value of biodiversity to its board and wider stakeholders.

While HS2 is sponsored by DfT, it describes itself as "more than a railway". It is already a significant environmental project and the proportion of infrastructure budgets devoted to environmental elements, such as incorporating flood storage and carbon sequestration, can only increase. Some have suggested needing to fund natural capital gain in large projects more explicitly from the start, as multi-functionality is hard to retrofit.

A major review of lessons from mega projects highlighted the need for working across "Departmental boundaries to ensure that wider benefits beyond the direct control of the delivery organisation are realised"<sup>80</sup>. Recognising there is no such thing as simply an engineering project will surely require continuing evolution in matters as diverse as government leadership, governance arrangements, procurement processes, internal communications, down to recruitment and induction.

The innovations HS2 Ltd can share here will be valuable not just at the national scale but also for schemes led by emerging Sub-National Transport Bodies, in particular given the lack of environmental governance at the sub-national scale.

The lesson here is that we need both a robust and progressive assurance process that operates at the local and scheme level, as well as a strategic vision for the scheme and local aspirations. It is as if assurance and aspiration will be needed at different times and scales in a project's lifecycle, and they must learn to dance together at times.

Assurance is of crucial importance for surveys, construction programmes and monitoring, aspiration when setting vision and pushing the boundaries of what can be done. HS2 has not just pioneered the use of BREEAM's infrastructure standard and Biodiversity Units at a very large scale, its Independent Design Panel was set up early and has pushed boundaries. This is a complex area that few have a bird's eye view of but that's essential to build confidence in HS2 Ltd delivering on its promises, not to mention pushing its ambitions to leave a world class legacy.

<sup>77</sup> [Campaign to Protect Rural England annual lecture: on transport and the countryside](#) (DfT, 2012)

<sup>78</sup> [Design at HS2](#) (DfT)

<sup>79</sup> [HS2 Design Vision](#) (HS2, 2017)

<sup>80</sup> [Page 11 in Lessons from transport for the sponsorship of major projects](#) (DfT, 2019)

# Naturally innovating

The Government's response to the Lawton Review recognised the need to "work together to find innovative ways to protect and enhance our wildlife habitats".

As the UK's largest environmental project that is aiming to be the most sustainable railway of its type in the world, innovation will be vital to live up to these ambitions. When it comes to delivering benefits for nature, innovation does not necessarily mean new technology, however.

The trend so far is for the hi-tech to relate surveying and monitoring. By contrast in terms of habitat creation and enhancement, the innovation relates more to the huge scale (in terms of time as well as area), working with natural processes and combining multiple objectives to deliver truly integrated design.

## Surveying

HS2 is helping change the way surveys are carried out in three ways, in terms of how:

- habitat characteristics and species are identified efficiently yet also accurately;
- operations that impact protected species, such as moving habitats; and
- how the huge volume of environmental data collected is managed.

## Seeking out species

Previously surveying for species largely relied upon sight. The trouble with that approach is the effort required to minimise false negatives; simply because an ecologist did not spot a particular species or its traces on a site visit does not prove its absence<sup>81</sup>. Jacobs [HSRG] helped roll out the use of eDNA for great crested newts for HS2 Ltd's surveys from 2016. Testing water bodies for traces of this species' DNA enables greater confidence in a negative result while dramatically improving the efficiency of surveying.

Where traces are found then further detailed surveys can be carried out to assess population levels. In 2020, the restrictions introduced due to COVID-19 posed new challenges for ecologists and accelerated changes in the way surveys are carried out.

According to Laing O'Rourke, this included further automation and mechanisation, such as using thermal imaging drones to survey watercourses for water voles and new equipment to install newt fences faster.

With plans for Phase 2b less advanced and not having been approved, there are no legal powers yet to carry out surveys where the landowners' consent is not forthcoming. HS2 Ltd's supply chain has been developing solutions to harness Artificial Intelligence to combine different data sources to derive habitat types.

Predictions can be generated from existing mapping with the addition of data from remote sensing. Where landowners voluntarily provide access, this can then be ground truthed, increasing the accuracy of the model in each area.

## Licensing

Managing impacts on protected species can be one of the biggest environmental challenges for constructing infrastructure projects, as any activities that would impact on them need to be licenced by Natural England wherever they may take place.

Each licence can require dozens of emails and lengthy forms to be completed and agreed<sup>82</sup>. HS2 Ltd, its contractors and Natural England work in partnership, formally through a Service Level Agreement and practically by building trusting relationships, with full investigations involving senior executives if there are any hiccups on the ground.

This has led to the creation of a new linear approach to licensing, with route wide licences for great crested newts and badgers plus larger scale licences across woodlands for bats.

Taking a holistic view in this way can enable looking at species at a population rather than site specific level, making it easier to determine impacts at a population level and consider larger scale, longer term mitigation. It also avoids multiplication of documents and reinventing the wheel for each individual site.

<sup>81</sup> [Guidelines for Preliminary ecological appraisal](#) (CIEEM, 2017)  
<sup>82</sup> For instance this [bat licence](#).

## Naturally innovating

### TRACKING BATS IN THE TREES

#### CASE STUDY

Just as days of preparation and work go into each scene in a wildlife documentary, likewise a great deal of work goes on behind the scenes when trees need to be felled to build HS2.

Behind what might look to the naked eye like just cutting a tree down, is a newly developed process that produces much higher quality data, whether to ensure bats are not harmed during felling or improving knowledge of bat populations. This new approach cuts carbon and disturbance from ecologists' driving to sites as well as delivering a cost saving of 60%.

To avoid a build up of faeces and parasites, some species of bats can move roosts as much as every two or three days and have special maternity roosts for their young. Led by a leading bat ecologist and using the latest technologies, HS2 Ltd has very carefully developed a methodology to minimise any risk to bats from its operations to clear woodland for the railway. Previously every single tree would need to be surveyed for bats. For those trees with potential, perhaps about a third of trees in a woodland, then a series of dusk and dawn bat surveys would be required, a couple of hours for each. Extrapolating that out for a woodland of 700 trees is a monumental effort but, even with a series of five surveys, there would be low confidence in a negative result.

Companies such as AECOM have, with HS2 Ltd and Natural England, developed a radically new approach to surveying bats and obtaining the licenses required where rare species or maternity roosts are potentially affected. Harp traps are being used as a harmless means of capturing bats to gather a proportion of those in an area. If a bat is fit and healthy, and from a relevant species, a transmitter is put on them.

Through tracking their movements the important roosts can quickly be found and, by an ecologist then standing underneath and observing, the important roosts can be characterised. Understanding the pattern of movement of bats in an area enables ecologists to gauge their numbers more precisely and their foraging routes, affording better mitigation design.

After several rounds of radio tracking to understand where all key roosts are, the ecologists can apply for a single licence. Every tree will be thoroughly inspected with endoscopes again before felling and, if there is a risk bats may be present a one-way exclusion device fitted over potential roost features, enabling bats to leave, with any bats found allowed to leave of its own accord.

If there is a risk that bats could be present, trees are felled progressively from the top, giving bats time to leave. To mitigate for bat roosts that are found, two to three roosts will be provided before felling for every one lost. Through landscape-scale design, commuting and foraging routes can be retained and, where possible, incorporated into a more joined up ecological network.



# Naturally innovating

## Biodiversity data management

The last decade has seen major changes in how data is gathered and shared.

While almost all sectors have moved forward, in some, such as health and criminal justice, the pace of change has been slower. When HS2's surveys started in 2012, ecology had not moved fully into the 21st century. Results from surveys were written down on paper, far from ideal in wet conditions, then entered into spreadsheets. Many working on the environmental side of HS2 readily acknowledge that managing the enormous amount of data obtained from some of the largest and most detailed ecological surveys ever carried out has perhaps been their biggest challenge. The biodiversity data gathered can be divided into four types covering species, habitats, designated nature conservation sites and reports of other sites<sup>83</sup>.

This is a complex area and the findings are divided into:

- resolving the legacy of past ways of doing things;
- ongoing challenges in the present; and
- opportunities to maximise future potential of biodiversity data from infrastructure.

## Fixing the plumbing

The phrase "fixing the plumbing" was popularised by the 2018 Local Digital Declaration between the Ministry of Housing, Communities and Local Government and a few dozen pioneering local authorities<sup>84</sup>.

This concept is about tackling the often hidden constraints of the past, such as inflexible and expensive technology, by moving to open standards and modular solutions that use a common structure.

Independent reviews have found that other infrastructure managers, such as Network Rail and Highways England, had limited environmental data, whether for asset condition or baseline biodiversity data, and that where data existed, it was badly managed, being held in a range of places<sup>85</sup>.

There was also a skills gap, perhaps as previously few people that were happy getting knees deep in ponds, also enjoyed getting knee deep in code. As one HS2 contractor said: "Usually people say it's an ecological issue, give to the ecologists, when actually you need to get IT people in to help. Finding people who combine IT database development and ecological skills is very difficult however."

HS2 Ltd as a new company started with a clean sheet without ancient databases and has pioneered the use of Building Information Management (BIM), required for all government funded schemes from 2016. While this enables a digital model to be built for engineering, with every bolt and length of track represented digitally, there are no common digital standards for nature. While HS2 Ltd drew up technical requirements for standardised proformas, they did not include requirements for these to include written reports that include the background to the surveys, the aims, methods and results of the surveys among other more bespoke information.

To interpret ecological data this contextual information is vital, which is why it is normally required on other projects and in British standards for carrying out such surveys<sup>86</sup>. Although these standards are about the way surveys are carried out and their contents, there are also standards emerging for digitalising ecological data, such as produced by the National Biodiversity Network, that could have been used.

<sup>83</sup> [Guidelines for accessing, using and sharing biodiversity data in the UK](#) (CIEEM, 2020)

<sup>84</sup> [What is the Declaration?](#) (Local Digital - MHCLG, 2018)

<sup>85</sup> Varley Review (2018) and [Post-opening project evaluation \(POPE\) of major schemes: meta report](#) (Highways England, 2016)

<sup>86</sup> [Guide to Ecological Surveys and Their Purpose](#) (CIEEM, 2017)

# Naturally innovating

## Managing the present

The shift to using handheld digital devices in field surveys is more efficient and robust. With GPS an accurate location can be captured to the level of individual trees, which is very useful for bat surveys. Although there have been huge changes since the first surveys seven years ago, the process is not entirely digitised as HS2 Ltd's contracts require keeping data on domestic servers, something that key supply chain providers cannot guarantee yet.

The way the work was parcelled up between initial surveys, enabling works then the main contractor has created numerous interfaces between different teams and companies through which survey results need to be passed through.

This requires issues of risk and responsibility to be managed carefully. Ecological data has a shelf life on average of two years, though as this depends on professional judgement as well as the habitats and species concerned<sup>87</sup>, it can be challenging to manage programming of surveys between multiple parties.

While the NHS or Ministry of Justice can coordinate data standards in health or the courts, there is less central control for environmental data in construction, while Defra or Natural England, who could have potentially orchestrated this, have been struggling with reductions in finances and constraints on their roles. Contractors working on HS2 have their own GIS systems, indeed many reported that the project's scale forced them to rapidly upgrade them.

They are not integrated, and it can take months for data to be added to HS2 Ltd's web-based viewer system, even then only containing a limited amount of detail. Just as the lack of integration between transport providers' ticketing systems and real time information means missed opportunities to deliver better outcomes for passengers, a lack of integration between contractors' and HS2 Ltd's systems appears to have meant missed opportunities for nature.

HS2 Ltd certainly recognises the importance of transparency and faith in data if it is to win the war on misinformation generated by opponents and build more collaborative relationships. It is planning to publish survey results as open data and also a new online tool for the Green Corridor. Recently it developed a bespoke GIS

specification for ecology surveys and monitoring, which has been rolled out for Phase 1. This lays the ground for automated data assurance and reporting and, by relying on a relational spatial database structure, enables efficient analysis of ecological data across locations and scales.

A remaining challenge is that it is difficult to check data against the Environmental Statement presented to Parliament as no consolidated version has been produced: instead anyone, whether an NGO or contractor, wishing to look up commitments for a particular habitat or species, has to look through the multiple Environmental Statements produced as a result of amendments during HS2's passage through Parliament. This all suggests that a more user-focused data system would be secure efficiencies and be of benefit to all.

## Future potential

There are important opportunities for the data HS2 Ltd has collected to inform future EIAs, whether for rail projects or more broadly. A major review looking at opportunities to digitalise the EIA process found that existing law is holding back full digitalisation however<sup>88</sup>. Digitalisation would offer many advantages for all. For instance, to understand HS2 Phase 1's impacts on a particular species currently, you would need to look through all the different versions of the Environmental Statements for the Bill and subsequent amendments.

A digital version could enable this information to be regenerated into one view on demand. The report described post-application monitoring as a "'must-do' process that will improve the quality of mitigation and data". With HS2 Ltd committing to world leading monitoring, it is important the opportunity is taken for there to be line of sight now in relation to more precise impacts calculated from detailed design, and in future between its Environmental Statement and the outturn impacts, so as to inform future EIAs and indeed not modernisation of the process.

The ideal situation where everything is collected in tablets, immediately quality assured then passed to survey authors is coming closer. A move away from managing projects by email would be another way to increase efficiencies and clarify survey scope earlier.

## Naturally innovating

Though this might also require third parties, such as Natural England to modernise its processes, for instance moving its licensing processes to an application programming interfaces (API) model that developers could build upon.

Consensus is needed within the sector on how to store the huge amounts of environmental data being generated, whether centrally or the distributed model now used for bus services, for example. Unlike the tech sector with fast clock cycles and where apps can "fail fast", infrastructure projects like HS2 require much longer term contracts and a stable development environment, making swift iteration harder.

Natural England's species licences require survey and monitoring data to be submitted to the Local Biological Record Centre and to the relevant national recording scheme regularly. The more this can all be done using consistent data standards, the more synergies and gaps between different developments and their mitigation plans can be identified.

Together with plans for a Nature Recovery Network, it should make monitoring of newly created and restored habitats easier in future and integration with habitats outside of the direct control of the scheme to deliver compensation.

Digital standards need to be created for habitat management plans too, this is another area where HS2 Ltd could add significant value through leading the sector. With farming subsidies being reformed to reward higher environmental standards in land management, sharing HS2's monitoring data could help inform land managers as to what styles of management work best in different areas.

It could also help HS2 Ltd build bridges with land managers for future phases. There will be other, as yet unidentified opportunities, so HS2 Ltd should create competitions to reward the best ideas and foster new collaborations.

Looking into the future, better environmental data management will play an important role in tracking and ultimately tackling the ecological emergency. The difficulties faced by those working on HS2 managing environmental data are reflected in the wider sector. Despite the potential, there is no mention of ecological data in the latest National Data Strategy<sup>89</sup>.

Although "newt-counting" may hit the headlines for the wrong reasons, opportunities to increase accuracy and efficiency of surveying by "fixing the plumbing" of the underlying processes still appear overlooked.

There is surely a major opportunity here for a "Nature Digital Declaration" to build on the efforts and learnings of all those involved in projects like HS2 and ongoing conservation efforts.

<sup>87</sup> [On the lifespan of ecological reports & surveys](#) (CIEEM, 2019)

<sup>88</sup> [Digitising the Environmental Impact Assessment \(EIA\) Process](#) (Digital EIA, 2019)

<sup>89</sup> [National Data Strategy](#) (DCMS, 2020)

# Naturally innovating

## Restoring nature along HS2

While surveying may be fertile ground for new technologies, creating and enhancing habitats requires different approaches to innovation, not least because that takes place over far longer timescales.

Short term and smaller scale elements of measures to improve HS2's environmental footprint tend to be simpler to communicate. Biodegradable tree guards made from composite cardboard have been introduced by the Fusion joint venture, as part of its efforts to design out plastic<sup>90</sup>. With the product's effectiveness proven at scale, there are now opportunities to innovate it further by applying circular economy principles. For instance, by reusing trees felled to make way for the railway to create tree guards, biodegradable badger setts and reptile hibernacula as mitigation.

A bluetooth connected bat box or a solar power pumped pond might sound enticing, but they are unlikely to stand the test of time and provide replacement viable habitats for decades. To be effective mitigation for species affected by building infrastructure, measures need to last for decades but be suitable immediately. Providing replacement roosting sites for species such as bats can be difficult as artificial features such as bat boxes only have a lifespan of around 15 years.

By contrast new broadleaf woodland may take 50 to 70 years to develop features suitable for bats to roost in. AECOM is trialling the use of fruit trees as medium-term roosts for bats along the middle of Phase 1. Although they have a shorter lifespan than other trees, dying within 70 to 100 years, they veteranise much faster. This means they develop the types of holes that can be useful for bats and indeed birds to use, filling the time between the end of life of artificial features and when larger trees mature<sup>91</sup>.

How watercourse crossings are now treated illustrates how design is increasingly environment rather than engineering led. Previously these would largely have been on embankments, other than a viaduct over a water body itself, now longer viaducts are the default to reduce severance. River meanders, bat friendly culverts and mammal ledges are introduced to maximise opportunities for different species.

Nonetheless, in the past mitigation for linear infrastructure schemes risked creating a series of fragmented lineside pockets. What is really needed is a concerted effort at key locations to increase permeability in multiple directions at the same time as considering different spatial and temporal scales. The Lawton principles of creating 'more, bigger, better and joined up' habitat inform how designers are responding.

Challenges include:

- The focus of the consent process being on a narrow trace for the route;
- The balance between restoring nature and respecting existing landscape, including its character and current biodiversity; and
- The long term viability of measures.

Much English lowland countryside is a patchwork or mosaic of different habitats, so a focus of designers working on the project has been to blend the ecological mitigation into the surrounding landscape, as well as tying it in with the nodes, such as hedges and ancient woodland to improve connectivity. Sometimes this means not simply replacing like-for-like, but analysing what was there earlier and pursuing opportunities to reduce fragmentation at a larger scale in diminished landscapes.

A challenge here is the need for designs to perform better ecologically but also to look and feel the part, so they fit in with residents and visitors. This is particularly important in designated landscapes like the Chilterns to respect its special landscape character and requires integrated working between multiple disciplines, including landscape architects.

Natural England's advice is that "England is a densely populated country with strong historical and contemporary cultural influences on the landscape. There are considerable constraints on how far natural ecosystem function can be restored, and there are potential adverse consequences for our remaining biodiversity"<sup>92</sup>. In agricultural landscapes this means habitats should look managed to reflect their established semi-natural character.

# Naturally innovating

## EMERGING HABITATS ALONG HS2'S ROUTE

CASE STUDY

ALTHOUGH DETAILED DESIGN IS STILL AT AN EARLY STAGE, EXCITING PROPOSALS FOR NEW AND IMPROVED HABITATS ARE GROWING ALONG THE ROUTE. MANY OF THESE IDEAS HAVE EVOLVED AND BEEN WORKED ON BY MULTIPLE CONTRACTORS. HIGHLIGHTS INCLUDE:

### Grassland arising

On the edge of the M25, the construction site for the Chiltern Tunnel, at 16km the longest on HS2's route, is taking shape. Align, the consortium delivering this section is seeking to create the largest new area of habitat along the route in the arable area used for construction of both the tunnel and Colne Valley Viaduct on the western slopes of the valley.

The design team has developed a unique landscape and ecological enhancement proposal that aims to reuse construction materials to create over 130 hectares of new chalk grassland, connected woodland belts, wood pasture and wetland habitat, contributing substantially to local nature conservation as well as wider health and recreation benefits for neighbouring communities.

Land that is needed for construction will be reinstated and transformed through the re-use of existing soils, chalk from the tunnel excavation, as well as concrete and limestone aggregate materials used in the construction process.

New planting and seeding will create an extensive mosaic of habitat that will potentially be colonised by hundreds of species of fauna and flora including invertebrates, birds, mammals and herpetofauna (reptiles and amphibians) and would be managed through use of extensive, free-roaming cattle and potentially other grazing animals over time. In the Colne Valley itself, along the route of the Viaduct,

Align have designed-out impacts on ancient woodland and targeted creation of new wetland (grassland, ponds, and woodland) and grassland/scrub habitat that will diversify both species and the existing habitat mosaic, which is largely deep lakes and mature woodland.

At the Chiltern Tunnel headhouse sites Align intend to create 'stepping stones' of habitat across the Chilterns, through creation of calcareous grassland hay meadows with boundary woodland and scrub planting.

Throughout this network of habitat creation sites Align will also target creation of micro-habitats for a range of species, such as hibernacula (for reptiles and amphibians), invertebrate and basking banks, reptile egg-laying heaps (from haymeadow cuttings), bat/bird and barn owl boxes etc. to complement the macro scale habitats.

### Bigger spaces for butterflies

Although changes to plans have reduced the impact, under a hectare of the Helmdon Disused Railway SSSI still needs to be reused to build HS2.

Until the 1960s this was the route of the Great Central Railway but since then it has become a habitat for rare butterflies. Contractor Eiffage Kier [HSRG] is planning to create an area of lowland calcareous grassland and scrub about seven times bigger, together with a green bridge to maintain connectivity for both wildlife and the local rights of way network.

### Skewing green bridges

The landscapes around Ingestre and Tixall in Staffordshire have significant cultural and historic value, as well as having rich habitats. This means this area on Phase 2a is one of the most sensitive sections along the whole route. Arup [HSRG], who are responsible for designing the proposals here, have had to avoid the severing of an important existing wildlife crossing, while seeking to improve connectivity between ancient woodlands.

They have tried to respond sensitively to historic parish boundaries and a landscape, including canal and gardens designed by Capability Brown with many cherished views. A key element of the considered design has been a skew green bridge across HS2's route, aligning with an important route for bats and a historic boundary.

<sup>90</sup> [Cardboard Tree Guards Leads Charge to Plastic-Free Work Package](#) (Fusion, 2020)

<sup>91</sup> Harper, S. et al. (2020) Fruit Trees and Their Potential as Medium-Term Mitigation for Roosting Bats. In practice

<sup>92</sup> [Nature Networks Evidence Handbook](#) (Natural England, 2020)



# Naturally innovating

## Masterplanning a Green Corridor

The idea for a green corridor running along HS2's tracks was already shared in 2012, but although it included a reference to biodiversity offsetting, it seemed largely focused on tree planting.

While the Wildlife Trusts asked for a 1km wildlife buffer either side of the railway, HS2 Ltd has made funds available for environmental enhancements over an even wider area, up to 40 km away via its Woodland Fund.

Fitting well with nature policy, the Environment Bill and Agriculture Act 2020 that have emerged since, it might be more accurate to term the corridor as a nature gain zone. Some of the greatest opportunities to restore nature will be from improving watercourses that have been damaged by agriculture and road run-off, in other words blue as much as green. Moreover, rather than simply being a linear corridor providing wildlife connectivity along a railway line, it aims to improve it in multiple directions.

Because it reaches far beyond the land being compulsorily purchased for HS2, the corridor concept requires the consent of landowners. The proposed Environmental Land Management scheme should incentivise this from 2024, as tier 2 and upwards is designed to reward those who collaborate to deliver local environmental objectives<sup>93</sup>.

Choices will need to be made about priorities, whether maximising ecological gains, providing benefit closest to where HS2 has negative impacts, prioritising communities with the least access to nature or providing coherent habitat networks<sup>94</sup>. The Natural Capital Committee has advised these decisions are taken locally against a national framework.

HS2 Ltd is using opportunity mapping to be strategic and consider key species at a larger than local level. The Green Corridor concept and associated funding should be the enabler of a broader conversation with local stakeholders who are the natural delivery agents. Many appear sceptical given controversy around HS2, the question marks until April 2020 about whether it would proceed, and bad engagement experiences. There is a lot of pressure on HS2 Ltd to deliver an integrated Green Corridor now before most of the disruption to habitats arises from construction. On the

other hand, the wider policy and funding framework is in a greater state of flux than in the last fifty years, HS2 is not due to open for a decade, and rushing in could waste resources.

The ecological data HS2 Ltd has been gathering could be extremely valuable in helping farmers and other land managers plan how to adapt best to the changing subsidy regime in their local areas.

More broadly explaining how ecologists are seeking to enhance and create new habitats and connectivity at different scales and for different species can be difficult. Indeed, this is one area where new approaches to sharing and visualising environmental data is really needed to bring HS2's efforts alive, because they are designed to work at different scales and over different time periods.

This is all the more important now when designs for mitigation along the route have not been finalised but impacts of clearances are visible. Up to now HS2 has been about connectivity for people, it's time to share the story of how it is being designed to improve connectivity for wildlife too.

<sup>93</sup> [Environmental Land Management](#) (Defra, 2019)

<sup>94</sup> Page 5 in [Net environmental gain: The Natural Capital Committee's response to Defra's commission](#) (NCC, 2019)

# Constructing

## Restoring nature along HS2

Although construction of HS2 only officially started in September 2020, tree planting to mitigate its biodiversity impacts has been in progress since 2017, a sign of the efforts to deliver environmental benefits long before the railway starts operating.

By creating biodiversity features for wildlife to sleep, bask, forage, breed and hibernate as early as possible, the best chances are given for nature to move. In Staffordshire, LM is constructing a diverse range of features including: habitat piles; roost spaces in new buildings for brown long eared, Daubenton's and common pipistrelle bats; new hedgerows; marshy grassland, and ponds.

HS2's construction is subject to a wide range of legal and project specific controls. Any impact on protected species triggers a legal requirement to apply for a license by Natural England, setting out why the works are needed, how they will be carried out and how any impacts on protected species will be mitigated. A key element of this is providing replacement habitats in advance of construction. Unless these can be shown to be completed and adequate, consent for the next stage of works will not be granted.

A key element of HS2's own controls are the Environmental Minimum Requirements, which in relation to biodiversity can apply generally or for specific habitats or species. An important part of this are the Ecology Site Management Plans, prepared for each statutory and non-statutory site of nature conservation importance and ancient woodland affected by construction, as well as for each ecological habitat creation area. These plans specify ecological objectives for each site, the measures to be taken to establish and maintain them, the detailed planting requirements, and the monitoring regime

Contractors operate a "Permit to Clear" system, with licenced ecologist hand checking areas due to be cleared. This includes hand searches in scrub and hedgerows and physical searches in trees. If the ecologist mainly gives permission, they may mark any ecological constraints will be marked on the ground and also in digital maps, potentially with an appropriate buffer zone will be put in place so that work can continue safely in the surrounding area. Companies delivering the enabling works contracts

therefore have to carry out a wide range of work, including surveys, provision of new habitats and preparation of soil for translocation. In turn this requires extensive surveys: LM the joint venture covering these initial works on Phase 1's northern end, has alone carried out 20,000 ecological surveys over its four year contract, with almost half of those being in 2020. This explains why it describes its work as an environmental project with a railway coming through later.

The huge amount of scrutiny HS2 Ltd is under means those working on the project are acutely aware of the responsibility they have been entrusted with to deliver a scheme that lives up to its ambitions of being the most sustainable railway of its type in the world. Mistakes will inevitably happen and opportunities for better outcomes missed; so there will be a need for continuous improvement and learning, not least to inform future infrastructure projects.

Delays caused by an unexpected election, the new Prime Minister wishing to review HS2, and then an unsuccessful legal challenge meant the main works started later than planned. In turn this meant certain works on some sites could not start at the best seasons to optimise environmental outcomes, without seriously adding to delays. It will be important for HS2 Ltd to show this was a one-off due to unique circumstances in order to rebuild trust. Because of the detailed monitoring in place there will be opportunities to quantify any loss of outcomes.

Although HS2's systems in place have been certified to ISO 14001 and the new BREEAM infrastructure standards, they are complex and not readily understandable by the public. There is surely an opportunity to provide the information and learnings collected more transparently and simply, in order to explain to the public, land managers and NGOs about the degree of care to which the work is being carried out and any learnings being applied.

# Constructing

## Habitat relocation and creation

Thirty years ago, four hectares of Biggings Wood, an ancient woodland, stood in the way of the Channel Tunnel.

Although there had been an increasing number of attempts to transplant habitats such as grassland and heathlands there had been no attempt to transfer woodland soil at scale. Although the proposed receptor site was not a good match, all but 16 of the original 99 species were recorded five years later<sup>95</sup>. No information was provided about soil microbiology, indeed the approach of dousing the receptor site in herbicide was unlikely to have helped preserve it.

Much has been learnt since then but the level of controversy has increased. While ancient woodland is irreplaceable and cannot be recreated, that should not affect the case for translocation where it is being removed. On Phase 2a alone, HS2 is planning (as of September 2020) 9.6ha of ancient soils translocation, 13.4ha of ancient woodland enhancement and 78ha of new woodland planting. The siting of the compensation measures has been carefully designed to make parcels of existing ancient woodland more resilient.

The long-term monitoring proposed will add to scientific understanding, particularly around knowledge gaps in relation to soils. Veteran trees are important too and their loss can sometimes be avoided at the detailed design stage. Where not, such as for the Cubbington Pear tree in Warwickshire, cuttings were taken and propagated to create new trees.

With the last few years being some of the hottest on record, this poses challenges for tree planting. In 2018 as much as 38% of trees planted on one section of HS2's route did not survive the heatwave so had to be replanted. HS2 Ltd has committed to bring the loss rate to the industry norms of the past. With March and April becoming drier and warmer, it is now seeking to plant at the end of the year, though this poses challenges for the supply chain as warmer autumns mean saplings need to be lifted later. Changes to the ways trees are brought onto sites and their root balls are protected are helping too. As the Government's national ambitions for tree coverage grow, the learnings and increases in supply chain capacity from HS2's tree planting will be valuable.

Besides protected habitats and individual specimens, a great deal of thought has gone into safeguarding soils, to help maximise the land that is productive for agriculture. Agricultural Liaison Officers work with farmers along the route and designers have sought to reuse soil and carefully profile landforms to enable food to continue to be grown.

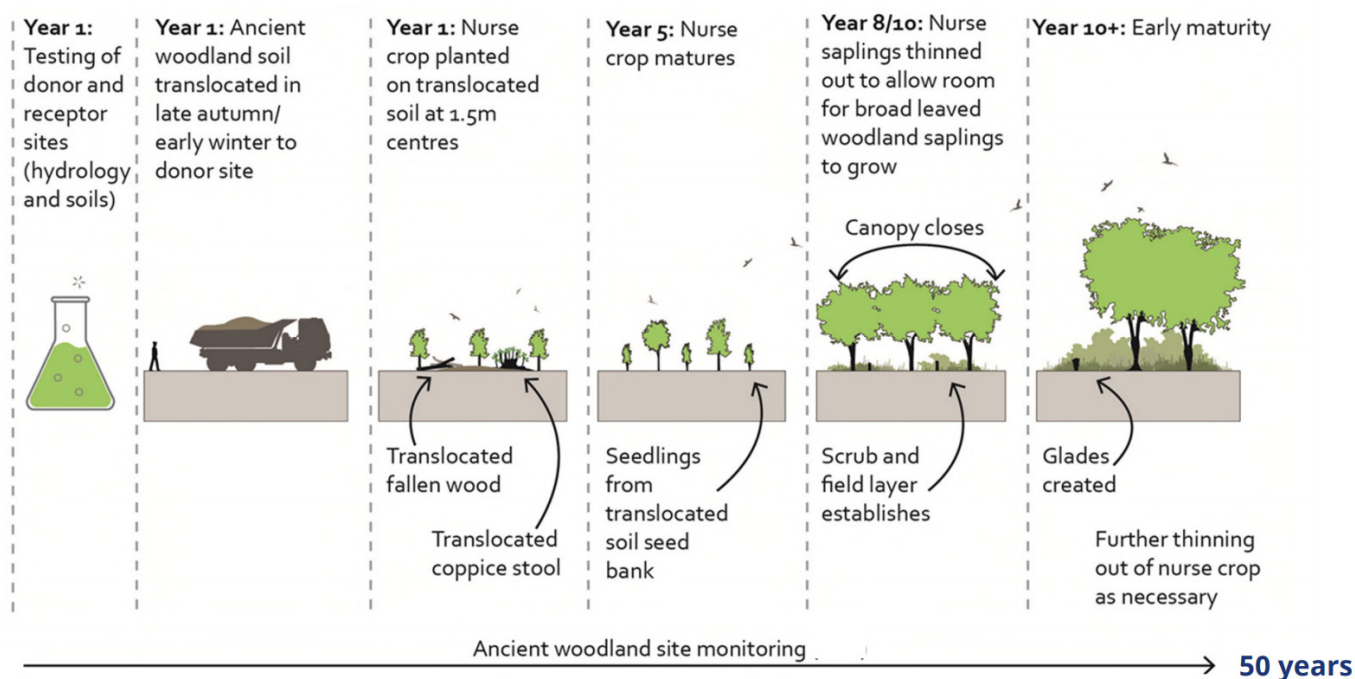


Figure: Ancient Woodland [Source: HS2 Ltd ]<sup>96</sup>

<sup>95</sup> Helliwell, D. et al. (1996) 'Vegetation succession on a relocated ancient woodland soil', *Forestry*, 69(1), pp. 57–74. doi: [10/c3f9c](https://doi.org/10.1093/forestry/69.1.57)

<sup>96</sup> Page 3(38) in [Phase 2a - Control of Environmental Impacts Briefing to House of Lords Select Committee](#) (HS2 Ltd, 2020)

# Constructing

## ENVIRONMENTAL FUNDING

CASE STUDY

WHEN THE RAILWAY NOW CALLED HS1 WAS BEING BUILT, A CHARITY CALLED THE RAIL LINK COUNTRYSIDE INITIATIVE WAS CREATED WITH £2 MILLION OF FUNDING TO PROVIDE COMMUNITY BENEFITS AND AN ENVIRONMENTAL LEGACY.

This was very successful, leveraging greater match funding along HS1's route for a range of community, landscape, heritage and biodiversity schemes. An early demand of NGOs was for HS2 to build on this success by providing a bigger fund. For Phase 1 alone, £40 million has been shared between the Community and Environment Fund and the Business and Local Economy Fund. This was opened for bidding in 2017 and will continue to operate until the first year of HS2's operation, with further funding being made available for HS2's future phases.

Management of the funds has been contracted out to Groundwork, a charity specialising in community-led environmental action, with an interactive map showing projects<sup>97</sup>. Although it is too early to judge the funds' impacts, this approach of letting independent specialists receive and judge applications is working far better than Highways England's in-house environmental funding that was launched in the same year. Some of that fund has remained unspent and the organisation's relationships and engagement with local bodies was criticised by an independent review. This found that while there were responsive individuals, Highways England struggled to deliver a partnership approach<sup>98</sup>. The largest single award has gone to improve the visitor experience at Wendover Woods. Of over 100 projects granted funding there have only been a small number of bids for environmental funding, three for wildlife and four for improvements to green spaces.

Some have suggested that given the controversy over HS2 within the environmental movement, many local groups are not ready yet to take HS2 funding, in case this gives the impression they are supporting it. Fortunately, the funding is split across years but with the main construction having started, there is a real risk that projects to improve biodiversity could miss out. Further specific funds have been created, with £5 million for woodland and £30 million for road safety both for Phase 1 and, for Phase 2a, a further £2 million woodland fund and £5 million towards the business and environment funds.

## Delivering ecological skills and jobs

A key element of the case for HS2 is often about the construction skills and jobs that it will create.

Its latest business case refers to up to 30,000 jobs and 2,000 apprenticeships in construction, with over 9,000 already working on the programme<sup>99</sup>. One interviewee commented that if you go onto the line of the route now, you are likely to find more environmental professionals on site than engineers. While precise data is not available as to the professional status of those working across the supply chain, the large number of environmentalists working on the project has been unrecognised until now and reflects wider changes. A letter marking the tenth anniversary of his seminal report, Professor Sir John Lawton noted that "[i]n the USA, ecological restoration activities employ more people than logging, coal mining and steel industries combined"<sup>100</sup>.

Companies working on HS2 have had to recruit and upskill an army of young ecologists. The volume and scale of the work has been an incredible challenge but also an opportunity for companies to grow their teams' size and capabilities. Likewise, few graduates would otherwise have the opportunity to work on such a wide range of habitats and species so early on, enabling them to move up a structured career path to become highly skilled and chartered faster.

At a time when conservation has suffered from large reductions in funding and staffing, this new generation of ecologists can spread best practice in biodiversity to other schemes and also through voluntary membership of wildlife groups. One challenge here is that ecologists working on HS2 have faced criticism because of the suggestions the scheme is not living up to high environmental standards. Ecologists working on the scheme are accredited through professional bodies, such as CIEEM with independent standards and conduct requirements, meaning that any action bringing their profession into disrepute could be heavily sanctioned and lead to loss of professional status. Clearly the uncertainty and controversy over the project has meant batten down the hatches at times, rather explaining its wider benefits. With the DfT funding HS2, it seems as if the positive story about the environmental jobs being created has been underplayed compared to the engineering ones. More could be done to positively engage this growing green workforce to explain their roles and tell their stories about the nature they are finding and the habitats they are seeking to create along one of the country's largest ever environmental projects.

# Constructing

## MANAGING INVASIVE SPECIES

### CASE STUDY

INVASIVE AND NON-NATURAL SPECIES, INCLUDING DISEASES, ARE A GROWING THREAT TO OUR NATIVE WILDLIFE.

HS2's construction provides an opportunity to manage them better and reduce the risks of further spread. Himalayan balsam, Japanese knotweed, giant hogweed and rhododendron are all present along the route, meaning there are special legal requirements for those working on the ground. Just south of the site of the proposed Birmingham Interchange station, contractor LM has been tackling invasive species within its contracts to clear the route. It has been applying the latest research plus Environment Agency and Defra guidance to minimise risks, costs and wider impact such as arisings being sent to landfill or pesticide use.

In many places, it was possible to use a biosecurity protocol to take simple precautions to work around knotweed sites. In three sites with greater risks, LM prepared detailed rhizome assessments, using historical satellite images, GI, on site observations and the latest research to quantify the likely rhizome spread below ground. This overall effort reduced knotweed excavation to two sites. The contractors also focused on rhododendron, which in nearly all instances grows within woodlands. They put together a technical note with advice from specialists explaining the excavation of rhododendron soils is pointless for the following reasons:

- Rhododendron seeds can spread for up to 1km, therefore trying to mitigate a 10m buffer is pointless since a far wider area is contaminated;
- Rhododendron seeds are very selective about where they germinate, after all its spread would be far greater if this were not the case;
- Rhododendron seeds don't have long term viability and can normally only germinate within about twelve months; and
- If a seed does germinate, it can take twelve years to be mature enough to start producing more seeds, giving enough time for removal of the young plant to prevent further spread.

HS2 Ltd forwarded the resulting technical note to the Forestry Commission, who agreed with the proposed approach. This enabled de-scoping 25 excavation sites, generating significant cost, time and programme savings.

<sup>97</sup> [hs2funds.org.uk](https://hs2funds.org.uk)

<sup>98</sup> Page 3 in [Review of Highways England's engagement approach with local and regional partners](#) (ORR, 2020)

<sup>99</sup> Paragraph 1.110 in [Full business case: High Speed 2 Phase One](#) (DfT, 2020)

<sup>100</sup> [Making Space for Nature – 10 years on: letter](#) (2020)



# Operating

When Phase 1 of HS2 is brought into operation around 2030 it will not be “job done” for three reasons:

- Intensive monitoring and maintenance of the new habitats and biodiversity features created along the line will be essential to ensure they deliver on their potential as well as wider learning;
- While construction is the most disruptive stage, the commencement of trains operating will pose new challenges for wildlife; and
- Opportunities available for people to access nature along the route and using HS2 will require careful promotion and support.

## Maintaining and monitoring habitats

HS2 Ltd will set new records by committing to periods of monitoring up to 15 years for grassland and as much as 50 years for woodland and soil translocation that mitigates loss of ancient woodlands.

Shorter monitoring is proposed for features that do not have specific biodiversity objections, including planting for purposes such as screening.

This should help fill gaps in existing scientific knowledge, in particular around bacteria and fungi in woodland soils, as well as helping monitor the impacts of a changing climate on our countryside.

## Learning from major road schemes

The importance of monitoring and management of transport infrastructure post opening is illustrated by Highways England's experiences. Although it is recognised as one of the best bodies in the public sector for its commitment to evaluation<sup>101</sup>, its monitoring of environmental impacts of schemes has been minimal.

First, there is simply a lack of environmental data being gathered. Highways England's 2015 meta evaluation of its major schemes found that in 72 of them (89%) less than half of the environmental information requested had in fact been available. Worse still, where information was available it was limited to outputs, such as whether trees had been planted as planned in scheme drawings, rather than outcomes, such as whether those trees were likely to survive in the longer-term or helped create coherent ecological networks<sup>102</sup>.

This lack of information and care is not just about small schemes far away but includes some of the country's highest profile and most controversial road schemes. In the 1990s the road protest movement reached its peak at the Newbury Bypass, with the tiny Desmoulin's Whorl snail becoming a symbol of resistance.

To enable the road to be built through the protected snail's habitat, a replacement site was created as part of a flagship environmental scheme. Ten years later the pipes feeding water to the artificial site had become silted and blocked, leading to the snail dying out in the area<sup>103</sup>.

More recently, the A3 Hindhead Tunnel, the longest non-estuarial road tunnel in the UK, was cited during the creation of Highways England to prove that there need not be a trade-off between road-building and the environment. Opened in 2011, it removed a road from the Devil's Punchbowl, enabling an SSSI and National Trust land to be reconnected.

A 'Five Year After' report revealed that carbon emissions from usage of the road had risen by 70% after opening, that the success of planting was “considerably worse than expected”, with most initial planting on its iconic green bridge failing. Although dormice numbers were stable, the outcome for species monitored was “mixed”.

Grassland and heathland require maintenance and minimal disturbance to establish but overall “marked deterioration in the quality of habitat” was observed as “maintenance appears patchy...leading to further deterioration of seeded areas” and due to disturbance by people and off-road vehicles<sup>104</sup>.

The A11 dual carriageway through Thetford Forest that opened in 2014 was another missing link road scheme that had been long delayed due to concerns of environmental impact on a neighbouring Special Protection Area and its birdlife.

Its evaluation published in 2019 was unable to come to specific environmental conclusions.

# Operating

The monitoring was largely desk based plus a site visit to take photographs to compare with scheme photomontages. No information on animal mortality or disturbance was available nor was data on carbon emissions, while no feedback was obtained from local conservation bodies<sup>105</sup>.

The missed opportunities for biodiversity exist across project lifecycles, relating to the choice of scheme as opposed to potential reasonable alternatives, a lack of mitigation measures being identified, a failure to implement potential mitigation measures, ineffective implementation and a lack of ongoing maintenance.

An independent review in 2017 recommended "post-scheme environmental surveys for all schemes that affect any locality with a national or local designation for landscape, biodiversity or heritage, undertaken by impartial and appropriately qualified professionals"<sup>106</sup>.

Despite the environment initiatives being promoted as part of "largest ever" roads programme announced in 2020, Highways England still has not announced plans for a robust approach to monitoring and managing environmental impacts of its major projects<sup>107</sup>.

<sup>101</sup> Pages 30-31 in [What's wrong with infrastructure decision making?](#) (Institute for Government, 2017)

<sup>102</sup> [Post-opening project evaluation \(POPE\) of major schemes: meta report](#) (Highways England, 2016)

<sup>103</sup> [End of the road for protected snail](#) (The Guardian, 2006)

<sup>104</sup> [POPE of major schemes: A3 Hindhead](#) (Highways England, 2019)

<sup>105</sup> [POPE of major schemes: A11 Fiveways to Thetford Improvement](#) (Highways England, 2019)

<sup>106</sup> See paragraph 3.2 in [The Impact of Road Projects in England](#) (TfQL, 2017)

<sup>107</sup> [Reviewing Highways England's Evaluation of Benefits](#) (ORR, 2020)

# Operating

## LESSONS FROM HS1

### CASE STUDY

IT IS EASY TO FORGET THAT BEFORE IT WAS BUILT, THE CHANNEL TUNNEL RAIL LINK ATTRACTED A LARGE AMOUNT OF OPPOSITION.

The UK's first high speed rail line was authorised by an Act of Parliament in 1996 and is now known as HS1. After tunnelling under London, its 110km route travels through the 'Garden of England', including the Kent Downs Area of Outstanding Natural Beauty. The scale of the environmental mitigation can only be described as impressive, with the scheme delivering:

- 7,900,000m<sup>3</sup> of surplus excavated material re-used in landscape mitigation schemes;
- 1.2 million native trees planted
- 230 ha of woodland created
- 25 ha new woodland on translocated ancient woodland soils
- 370 ha of grassland and 80 ha of new wildflower meadow created
- 40 km of hedgerows planted
- 3 land bridges to act as wildlife corridors
- 7 ponds created and 2 wetlands created<sup>108</sup>.

[In addition, attempts were made to translocate a number of species]<sup>109</sup>

HS1 Ltd, which operates the line, is a thin client with most of its activities contracted out to Network Rail (High Speed) Ltd and most of the habitats created now managed by third parties. Of the 469 hectares leased by HS1, only about 144 hectares are occupied by track and other operational structures, the rest being grasslands and planted areas. Its Annual Environmental Review checks the condition, effectiveness of recent operations and environmental developments alongside a more detailed tree survey that also covers any safety risks to the track.

A Landscape Management Plan was produced in 2014, ten years after initial planting and seeding of the initial section south of Ebbsfleet. Over one hundred pages long, it sets out detailed requirements for the six different types of planting along the route. This is backed up by 179 landscape maintenance plans, each with landscape and ecological objectives for specific areas. With the route passing through a range of sensitive

habitats, including seven SSSIs, this amount of detail is needed to deliver landscapes and habitat to provide a home for different species. While the balancing ponds are being managed to provide a habitat suitable for great crested newts, these are not necessarily there yet but rare orchids have been unexpectedly found elsewhere.

For the first five years after construction there was an intense period of management, now there is a watching brief. The 2019/2020 winter has seen the first big phase of activity, including safety management and coppicing needed to steer the habitat to the objectives set for it. In October 2020 HS1 Ltd published its sustainability strategy that sets out a vision of being the "green gateway to Europe"<sup>110</sup>.

HS1's route was designed before the concept of biodiversity net gain, so no comparable data is available to indicate the net impact of construction. It is working with the Kent Wildlife Trust to carry out the surveys necessary to create a baseline to then deliver biodiversity net gain, in terms of its operations, by 2030.

Because of the very high environmental standards it was designed to, there are fewer impacts than for other transport networks, potentially making it harder to deliver gain. For instance, all track drainage was kept separate from land drainage, by contrast the adjacent M2 discharges road runoff into the River Medway. There is however no specific monitoring of wildlife mortality other than for safety purposes. That would pick up a train hitting a deer but not birds or small mammals, for instance.

HS1 Ltd's recent increase in environmental ambitions has partly been driven by its unique ownership structure. A 30 year concession to run HS1 was awarded in 2010, with a new consortium taking over in 2017. Besides the broader shift in financial markets, the investment funds behind the consortium have strong Environmental and Social Governance agendas, leading to an interest in biodiversity at board level. This has been mirrored with sustainability being elevated from a sub-committee to the main board agenda.

<sup>108</sup> Channel Tunnel Rail Link - Delivering Environmental Excellence (London & Continental Railways, 2006)

<sup>109</sup> Pages 21-22 in Natural England (2011)

<sup>110</sup> HS1 Ltd Sustainability Strategy (HS1 Ltd, 2020)

# Operating

## Disturbance and mortality from passing trains

While many species are not affected by noise and vibration from trains, or quickly become used to it, there is still a lack of knowledge about the impacts on those that are.

Most of the areas that HS2 runs through are already subject to high levels of road noise. An issue for a wider range of animals is mortality. One of the route's highest profile structures, the 3.4km viaduct through the Colne Valley, is a site posing higher risks given the density of insects and other food sources in the lakes it runs over.

Align-D has proposed additional mitigation and the latest design with noise barriers should minimise the risk zone in the path of trains that birds could fly into. Catenary markers are being considered along the wires above too. There is also a risk of birds that are unfamiliar with the area flying into the viaduct at times of very poor visibility, though given its large size this should be minimal.

Bats are potentially a bigger issue because they may fly straight in to explore the structures looking for roost sites and food, including going along the track. Bioacoustic deterrents, essentially ultrasound to deter bats, are now being considered and will be the subject of an innovation proposal to HS2. With eight years before the first test trains are likely to start running, there will be plenty of time to refine and learn from the latest evidence around the world.

Access to the viaduct will be difficult to monitor any mortality, so cameras with an ability to gather thermal imaging at night should be fitted to some of HS2's trains to help gather data. Compared to those locations where around 18 trains operate per day and at full speed, the risks here should be less as the frequency of trains here will be some of the greatest of any high speed railway in the world while the speeds will be lower as the location is so close to Old Oak Common station. This means train movements are less likely to startle wildlife while giving them more time to avoid impact.

## FILMING BIRD-TRAIN INTERACTIONS IN SPAIN

CASE STUDY

SPAIN NOW HAS EUROPE'S MOST EXTENSIVE HIGH SPEED RAIL NETWORK, STRETCHING THROUGH OFTEN SPARSELY POPULATED AREAS THAT ARE BIOLOGICALLY DIVERSE.

The scale of its network plus the cost and difficulty of fieldwork, such as along viaducts, makes monitoring of operational impacts challenging.

In 2014, trains running between Madrid and Albacete, a route passing close to Special Protection Areas of steppe and marshland of great ornithological interest were therefore equipped with an on-board video recorder to monitor birdstrike. Almost half the birds at risk of collision were found to be resting on railway infrastructure moments before trains arrived<sup>111</sup>.

This study, the first to use on-train cameras, improved understanding of risks to different species and enabled new ways to be trialled to discourage birds from perching on overhead lines and flying under them. The cameras used were not able to operate at night, due to the glare of train lights. The researchers involved proposed the use in future of Artificial Intelligence software to automate what was a labour intensive process of sorting through footage.

# Operating

## Managing soft estate

For reasons such as safety, transport infrastructure operators manage a swathe of largely unused land alongside.

This soft estate if managed well can be a haven for nature<sup>112</sup>. In 'Enhancing Biodiversity and Wildlife on the Lineside'<sup>113</sup>, Network Rail committed to manage its estate made up of 20,000km of track and 52,000 hectares to become one of the UK's most environmentally responsible landowners and help achieve the government's wider environmental goals.

It aimed to achieve no net loss in biodiversity on each of its routes by 2024 and net gain by 2040, though has now brought that date forward to 2035<sup>14</sup>.

Making these targets route based should drive ambition - so one route cannot simply bank another's success - as well as encourage different approaches locally. Going forward it will be critical for different transport bodies to share learnings with each other and in particular to cascade best practice from high speed railways to operators of existing infrastructure.

It is easy to focus on new infrastructure over the incremental impacts of increasing travel on existing infrastructure, even though this can be greater. Metrics like Biodiversity Units are primarily used to assess the impact of new development but are increasingly being applied to assess how static estate is run. Highways England's operations between 2020 and 2025 are expected to result from impacts such as runoff into watercourses in the loss of even more Biodiversity Units than its road-building<sup>115</sup>.

In 2020 it set out a new target to deliver no net loss from its operations by 2025 alongside an ambition for no net loss across all its activities by 2040. The former is likely to be through better management of its extensive existing estate, which will require a radical change in progress. For instance, despite its 2015 promise to deliver 3,500 hectares of grassland, it only managed to deliver 575 by 2020<sup>116</sup>.

All of this further emphasises not just the need for management to be secured in perpetuity but also for management inputs to be designed out as much as possible when drawing up plans for habitats.

Monitoring is not nearly as important as ongoing monitoring linked with management that is delivered by suitably qualified land managers, who know how to manage sites for wildlife conservation.

On the Colne Valley Western Slopes, construction consortium Align has been working with the local Wildlife Trust and Natural England for two years to agree specifications and design habitats which will require minimal effort to manage using appropriate methods like cattle grazing.

This is in recognition that it is very difficult to maintain sites managed for wildlife if the right managers are not willing and able to be responsible for them.

<sup>111</sup> García de la Morena, E. L. et al. (2017) 'On-Board Video Recording Unravels Bird Behavior and Mortality Produced by High-Speed Trains', *Frontiers in Ecology and Evolution*, 5, doi: [10/gfamb9](https://doi.org/10/gfamb9).

<sup>112</sup> Davies, H., et al., (2014) [Review of literature - how transport's soft estate has enhanced green infrastructure, ecosystem services, and transport resilience in the EU](#), Natural England Commissioned Reports, Number 169.

<sup>113</sup> [Network Rail vegetation management review](#) (DfT, 2019)

<sup>114</sup> [Environmental sustainability strategy 2020-2050](#) (Network Rail, 2020)

<sup>115</sup> Figure 10.9 in [RIS2 Efficiency Review – ORR's advice on Highways England's Draft Strategic Business Plan for the Second Road Investment](#) (ORR, 2020). It is unclear if this excludes the impacts from users of the road network, for instance Highways England does not monitor carbon usage.

<sup>116</sup> Paragraph 2.55 in ORR, 2020



# Operating

## NATURE DOESN'T RUN LIKE CLOCKWORK: SWISS RAILWAYS WATCH NEARBY WILDLIFE

CASE STUDY

SWISS RAILWAYS HAVE A WELL-DESERVED REPUTATION FOR BEING AMONGST THE BEST IN THE WORLD, AND THEIR ENVIRONMENTAL MONITORING SEEMS IN THE SAME LEAGUE.

The 45km new line between Mattstetten and Rothrist designed for 200km/h operation was the longest line built in Switzerland since 1926. Required to reduce the travel time between the country's biggest cities and unlock a regular interval timetable, it opened in 2006, passing through several sensitive habitats.

As part of consensus-based measures to reallocate farming land to biodiversity compensation sites, operator SBB proposed voluntary monitoring to report on success back to key stakeholders. The development consent required a report back ten years after the line's opening of the results of regular surveys around the Brunnamatte nature reserve. This haven of grassland, reed areas, herbaceous meadows and streams is managed by Pro Natura, a local NGO, and home to many species including endangered toads and damselflies.

The mitigation and compensation strategy included:

- Small structures: ledges and piles of branches that were well accepted by lizards and slow worms.
- Cross-linking culverts: while foxes, badgers and deer cross regularly, there were limited observations of brown boar and brown hares seemed to avoid the crossings. Although the culverts were used by fish as habitat and migration route, and by amphibians too, no amphibian mass migrations were observed yet.
- Longitudinal network: dry habitats along railway embankments and species-rich meadows attracted warmth-loving butterflies and grasshoppers.

The monitoring of the green corridor along the line focused on the concept of target species and found that 37 out of 52 of them could be detected in at least one survey year. Other factors in the surrounding landscape affecting population levels included falling groundwater levels, urbanisation and agriculture. Because of the long-term financing and partnerships created by the development of the scheme, further landscape-scale action could be planned to continue to improve outcomes<sup>117</sup>.

# Operating

## Access to nature

Our relationship with nature, indeed our very conception of it, has evolved over the centuries.

As humanity urbanises, our emotional attachment to it and understanding of it has declined<sup>118</sup>. Nonetheless, 85% of adults recently agreed that being in nature makes them happy and half are spending more time in it than before COVID-19, feeling this is more important than ever<sup>119</sup>. Landscapes and smaller green spaces in built up areas provide, in the language of natural capital, cultural services, improving physical and mental health.

Potentially, though the evidence is still limited, they can increase environmental awareness and behaviour<sup>120</sup>. In some cases the benefits are driven more by spaces being close to where people live, more than their level of biodiversity.

The loss of wildlife from constructing a new railway for people living along the route is mentioned frequently by the public in consultations on HS2 and NGOs have suggested it will be faced “for generations to come”<sup>121</sup>. Major infrastructure projects have for many years acknowledged the disruption their construction causes and sought to offset this by leaving a positive legacy locally.

As explained above, within a decade of opening HS1 helped deliver new urban green infrastructure close to where people live as well as larger sites in the countryside. Through the rise of the concept of environmental net gain, there is an increasing desire for infrastructure schemes to deliver net gain for people through access to nature, as well as gain for nature itself.

Not all areas can be open to the public, in particular the railway itself. Some specialist species are sensitive so are best largely left undisturbed, while some habitats such as grassland and heathland (see ‘Learning from major road schemes’ above) need time to establish before they can be opened up.

It is not yet possible to know how much of the habitat creation being proposed by HS2 will lead to new meaningful public access land as the models of long term ownership have not been set and will need to be negotiated.

In particular the Environment Bill and changes to farm subsidies from 2024 will provide new opportunities. Joining up mitigation and compensation sites beyond the railway boundary with local paths, local people and local partnerships will be critical if they are to become community assets rather than just an island of “mitigation planting”, for instance.

The environmental funding HS2 offers is an important glue to bring different interests together, and to unlock wider fundraising and more enhancement projects, especially given recent local authority cuts. There has been particular activity in the Colne Valley Park, Chilterns and River Trent, on the edge of Cannock Chase, as well as in more built up areas such as Camden and Birmingham.

<sup>117</sup> [Neubaustrecke Mattstetten-Rothrist, Erfolgskontrolle im Grünbereich 2006 - 2016](#) [Green corridor monitoring of Mattstetten-Rothrist new line: final report], (SBB Infrastruktur, 2016)

<sup>118</sup> Paragraph 2.84 Dasgupta Review (2020)

<sup>119</sup> [The People and Nature Survey for England: Monthly interim indicators for July 2020 \(Experimental Statistics\)](#) (Natural England, 2020)

<sup>120</sup> [Connection to Nature: evidence briefing - EIN015](#) (Natural England, 2016)

<sup>121</sup> [HS2 threatens a host of rare habitats in Nottinghamshire and will damage people's quality of life](#) (Nottinghamshire Wildlife Trust, 2018)

# Operating

## Taking the train to wilder areas

The rush of people driving to popular scenic places after the COVID-19 lockdown highlighted the pressures of car based tourism on our most cherished countryside. The challenges to reach it faced by those living car free, more likely black, Asian or minority ethnic communities in urban areas, was less visible as public transport was cut back further. Acknowledging this, Defra's recent Landscapes Review called for new sustainable ways to access our national landscapes<sup>122</sup>. Its focus however was sustainable transport in these landscapes rather than improving connectivity to them.

Although there are standards setting out how much accessible natural greenspace there should be near where people live<sup>123</sup>, there is nothing similar about the provision of larger, wilder areas. As part of calls for restoring nature, some charities are encouraging the public to visit and spend time outside in wilder areas. With most of the population living in big cities, this often requires a longer journey, but with many of these cities encouraging a reduction in car ownership, for instance by reallocating space from car parking to deliver more housing and green infrastructure, this risks making the countryside less accessible for many.

The majority of distance travelled and transport carbon emissions from transport are from leisure travel<sup>124</sup>. If the emissions from holidays abroad are included, then the contribution of leisure travel to average individual emissions is even more marked. Both proponents and opponents of HS2 have focused on business use however, even though only a small proportion of travel on HS1 is actually made up of business trips. For instance, HS2's latest business case focuses on "the inter-city connectivity that is needed to maximise the future success of knowledge-based sectors" while opponents still claim HS2 will simply be a train for "rich businessmen". Future trends, such as increases in home working and the proportion of the population that is required, are likely to increase the share of leisure travel further.

As the backbone of a new national transport network, providing a transformative uplift in capacity and speed, HS2 should play an explicit role in enabling seamless access to our national landscapes and rural visitor attractions. Greening leisure travel has fallen off the agenda in England since the demise of the Countryside Agency. By contrast, initiatives abroad such as the Alpine Pearls<sup>125</sup> guarantee high environmental

standards and a premium level of car-free mobility to rural leisure destinations. Spread across 21 Alpine villages in six countries, the Alpine Pearls network offers car-free adventures across stunning scenery and sensitive habitats, whether in winter or summer. Offering guests an abundance of eco-mobility options that are integrated with longer distance rail, the initiative seeks to foster sustainable tourism and transport that is gentle on wildlife and the climate. By encouraging visitors out of their cars to be closer to nature, the initiative helps preserve the area's traditions, not to mention encourage a healthy appetite for local farmers' produce.

Ensuring rural transport networks are better integrated into HS2 would help city dwellers reach the landscapes of the Midlands and the North at a time when land managers need to diversify their income. It would also level up our regions, rebalancing the international tourism deficit that currently favours London over everywhere else. There may be new opportunities in decades to come when those in the south of Europe may want to escape heat waves for cooler climes.

To start the conversation, HS2 Ltd should emphasise its potential in improving access to the great outdoors in its communications around the project. Together with the DfT and West Coast Partnership<sup>126</sup>, it should seek partnerships with more rural local authorities and national landscapes to explore how HS2 could unlock wider transport upgrades beyond cities, just as it has been doing within them.

For instance, extending high speed rail to Scotland could increase rail usage, thereby catalyse reopenings, such as extending the Borders Railway to Carlisle<sup>127</sup>. This could improve the accessibility of Kielder Forest and Water Park, home to England's darkest skies and a place with some of the greatest potential for rewilding through introducing keystone species<sup>128</sup>.



# Operation



Credit: HS2 Ltd. Internal Asset No. 14203

**GREENER OPPORTUNITIES**  
NEW ENVIRONMENT AND FARMING LAWS CAN HELP  
HS2 INTEGRATE FURTHER INTO THE LANDSCAPE.

<sup>122</sup> [Landscapes review: National Parks and AONBs](#) (Defra, 2019)

<sup>123</sup> ['Nature Nearby' Accessible Natural Greenspace Guidance](#) (Natural England, 2010)

<sup>124</sup> [Response to Decarbonising Transport: Setting the Challenge](#) (HSRG, 2020)

<sup>125</sup> [Alpine Pearls: Network of Charming Villages in the Alps Offering Green Mobility](#)

<sup>126</sup> The [West Coast Partnership](#) is the operator of rail services on the West Coast mainline and will be shadow operator for HS2 services, helping design them before they start.

<sup>127</sup> [Cross-border high-speed rail and the Borders Railway project](#) (HSRG, 2020)

<sup>128</sup> [Rewilding Northumberland](#) (Tracing Green, 2015)

## Transforming engagement

Simply focusing on ecology and engineering would not be enough for the transformative change needed to restore nature.

As the case studies show, focus on a third 'e', engagement, is essential for this agenda too. Creating coherent ecological networks requires influencing land managers to coordinate change well beyond the boundaries of transport infrastructure. Fostering the necessary partnerships requires fundamentally different capabilities to managing contracts across supply chains. There are three steps to better outcomes:

- Better communication with local people and land managers;
- Using examples to explain the scale of HS2's environmental ambitions; and
- Building local partnerships in sensitive areas as early as possible.

### Communicating with local people and land managers

For those living along the route, the first sign of change can be the survey work.

It is the ecological surveys in particular that can require frequent visits to screen for protected species and then, if present, to obtain enough information to prepare a licensing application. Some landowners have been concerned about the number of visits. This requires proactive stakeholder engagement to ensure there is clear and positive communication in advance about the legal requirements for surveys, what will be done, and the equipment used. With new survey techniques now having been pioneered and fine-tuned, practices are now easier to explain than when they were being developed.

Integrating HS2 ecologically at a landscape scale may require surveying habitats further from the route without legal powers, which can only take place with a landowner's consent. This could be difficult without building a culture of trust, to help prevent misunderstandings about motives for surveying. For instance, avoiding the perception that a survey means HS2 Ltd wants to take land permanently, such as for a realignment of the route, rather than for maximising opportunities for ecological connectivity by encouraging changes to land management.

Just as some smaller species can gain less attention despite their importance to ecosystems, leaving out smaller players, such as individual landowners, parish councils and "friends of" groups, can mean missing out a critical local dimension and with it invaluable local eyes on the ground. While councils and national NGOs may be more used to engaging with large developments, it can be harder for smaller ones and take more resources for all sides involved. Finding relevant, up-to-date information is a particular challenge given the scale of HS2 and its environmental reports. Better tailoring of information for different audiences, whether regularly updating environmental open data for large NGOs or creating non-technical summaries for residents, is vital. The creation of dedicated websites<sup>129</sup> to engage local communities does reduce the need to trawl through large reports. There is still limited ecological information on them so far beyond a generic video, missing the opportunity to explain HS2 Ltd's early work and ecological ambitions at the local level.



# Transforming engagement

## Explaining transformational change for nature

Even where HS2 Ltd has tried to share its examples, the controversy the project has grown up into has been an impediment.

Plans to publicise flagship ecological enhancements at one site had to be put on hold as negotiations with the landowners took longer to finalise than anticipated. A major contractor said: "we have fantastic examples of mitigation sites but they are all hidden away as people are nervous". Elsewhere ecologists wanted to present a "complete package" rather than just a few elements, because they were worried they would otherwise be attacked by those who had become simply "sceptical about anything HS2 Ltd might say".

Waiting for everything to be wrapped up before sharing with external stakeholders makes it harder to build confidence and understanding. It is in sharp contrast to the digital world, where the concept of rapid stakeholder feedback from "show and tells" of design iterations has become the norm.

Now that the main construction works have started there should be an opportunity to reset relationships to focus on getting the best out of the scheme. However, with Phase 2a still before Parliament and proposals for Phase 2b held up on the western leg and on pause for the eastern leg, there is a reluctance to risk sharing or agreeing things in case it is used by the other side as a precedent for these future phases.

Because of the lack of positive examples out there of the mitigation already being delivered, few of those working on the project have been willing to stick their heads above the parapet more publicly. There was a strong desire by many to change the script to tackle the perception HS2 Ltd could be faceless.

One contractor wanted to take his ecology team to walk around its section of route to understand its relationship to surrounding landscape and habitats but was advised against it because of local controversy; again, there is a vicious cycle that needs breaking by movement on both sides. Recent initiatives show genuine change from HS2 Ltd, such as an ecology webinar with presentations from people from both HS2 Ltd and supply chain plus wide ranging questions<sup>129</sup>. Despite the huge investment in the natural environment

when building HS1, there is very little information publicly available for it. As one ecology lead interviewed said, "I would be really interested to learn from HS1 and learn how successful it's been".

This is starting to change as HS1's new owners seek to demonstrate their environmental and social governance credentials. HS1's record of success has not simply been about building and restoring habitats but doing the same for relationships locally, as its construction becomes a distant memory.

This includes small scale projects with farmers, leading to word getting around locally of the opportunities, as well as a partnership with Kent Wildlife Trust to deliver a new biodiversity strategy (see HS1 box above).

<sup>129</sup> [HS2 In Your Area](#) (HS2 Ltd, 2020)

<sup>130</sup> [HS2 in Focus Webinar: Ecology - habitats and wetlands in the West Midlands](#) (2020)

# Transforming engagement

## Building local trust and partnerships

HS2's Green Corridor could provide a similar means to build synergistic relationships between its design teams and local communities as is happening along HS1.

With the concept of HS2 still controversial, some key bodies like NGOs and local authorities are struggling to ride two horses; to hold out on issues of principle but negotiate on practicalities. Better engagement should not be seen as each side having to meet halfway to compromise and avoid any conflict, as the act of overcoming conflict and constraints can lead to more creative solutions.

Multi-stakeholder groups were set up for the Chilterns Area of Outstanding Natural Beauty (AONB) and Colne Valley on Phase 1 relatively late, so for Phase 2a a review group around the Cannock Chase AONB was set up in 2018 before the proposals were considered by a parliamentary committee<sup>131</sup>. This approach was widely commended as a good way forward for the most sensitive areas and the group has produced excellent design principles that carefully integrate multiple objectives, such as biodiversity, access and landscape.

Although HS2 Ltd has given assurances to provide £1.5 million of funding, the group is still in a formative stage with terms of reference and membership not finalised. This potentially could put off organisations joining up to similar partnerships for Phase 2b, hindering opportunities for earlier, deeper engagement in key locations. The two challenges here seem to be about terms of reference, perhaps due to a concern to learn from and do things differently to groups established on Phase 1 and membership, with HS2 Ltd expressing a desire to ensure the group is fully representative.

HS2 was born into a culture of engineers wanting to build something from A to B, but HS2 has now become something much broader. This manifests not just in terms of HS2's wider environmental objectives but also the Green Corridor that is much wider than the actual trace of the line. The language of mitigation and the "mitigation mindset" that has grown up around infrastructure processes now needs replacing if it is to engage other sectors. HS2 Ltd has been criticised for its communications by many, including the Prime Minister, but it is far from alone in needing better, wider relationships. For example

in 2018, the Varley Review of Network Rail's lineside management said the company "needs to improve its engagement with stakeholders and the public, listen more, explain why things are done, and seek new partnerships and collaborations...in the end, it will be human and cultural factors that will determine whether Network Rail can capture and execute this new agenda"<sup>132</sup>.

If anything, it is harder for HS2 Ltd than incumbent infrastructure operators. After all, it is building something new, indeed the largest project in generations, through a densely populated country, which will inevitably involve disruption. Moreover it is doing this without existing positive relationships to start from. As the consenting section above explained, the hybrid bill process can instead lay the ground for adversarial and bilateral relationships. Especially at the most sensitive sites, collaborative partnerships between a wide range of parties are needed to build relationships across wider areas rather than simply the scheme boundary, better reflecting the ecological connectivity on the ground.

One new opportunity is the Environmental Sustainability Committee, which HS2 Ltd is establishing as a sub-committee of its board, and which will be headed up by HS2 Ltd's Chair. The Committee is intended to provide strategic direction on environmental policy, consider topics of concern to NGOs or local communities, and oversee an annual environmental sustainability report<sup>133</sup>.

As the case studies featured in this report demonstrate, the most sustainable railways elsewhere in Europe have achieved this through partnership with NGOs and land managers. For this committee to make a real difference and ensure HS2 excels on sustainability, it will need to role model a changed approach to partnerships, such as through delegating coordination of some tasks to stakeholders.

## Transforming engagement



Credit: John Zammit, Absolute Photography Ltd Fusion Internal Asset No. 15020

**DESIGN FOR RESILIENCE**  
HOW TO HELP HABITATS AND SPECIES ADAPT TO CLIMATE CHANGE IS A DIFFICULT AND COMPLEX ISSUE: HS2 IS HELPING BY ADDING ECOLOGICAL CONNECTIVITY AND GENETIC DIVERSITY.



## Longer term thinking

HS2 has a 120 year design lifespan, though the railways that run between some of our largest cities are nearly 200 years old.

Although the great cathedrals were planned to last for centuries, very few things built today are intended to last for such a long time. Thinking about such long periods is outside most people's experience. Moreover, the pace of change and uncertainty is expected to increase. For example, Europe's first high speed line is just 40 years old but, with the pace of climate change increasing, is likely to experience great change in weather over the next 40 years.

### Helping nature adapt to a changing climate

THE COMMITTEE ON CLIMATE CHANGE ESTIMATES THAT EVEN IF THE AMBITIONS OF THE PARIS AGREEMENT WERE FULLY MET, AVERAGE UK TEMPERATURES WOULD RISE BY 1.8°C IN 2050 FROM THE LONGER TERM AVERAGE.

It therefore is calling for all investments to be resilient to a minimum of 2°C but for extreme warming scenarios of 4°C by 2100 to be considered, stating this is particularly important for infrastructure investment<sup>134</sup>. Climate adaptation is often forgotten about, the poor relation of climate mitigation, but when it is considered, it is about the resilience of transport infrastructure itself for climate extremes<sup>135</sup> rather than the resilience of existing and potential ecological networks alongside it.

It is surely vital to consider and design in adaptation of existing habitats along HS2 as well as investments in proposed biodiversity compensation, to 2°C and 4°C scenarios if we are to be consistent with the approach taken to risks to transport infrastructure. Some of the appraisal for HS2 looks as far as 120 years ahead so arguably we should consider potential temperature rises to 2150 and beyond. Engineering infrastructure to operate at 4°C higher temperature would not pose special difficulties, after all, Spain and now Saudi Arabia have HSR networks operating in far hotter climates.

It would, however, mean fundamentally different species, ecosystems and landscapes surrounding it. This is an incredibly difficult conversation to have and one that illustrates vividly what a different planet we could be about to bequeath to future generations.

So far the main example of this question that has come to light has been about the species of trees selected for planting. The Woodland Trust has argued before Parliamentary Committees that HS2 Ltd should only plant local tree species, as the Trust itself does. By contrast HS2 Ltd is seeking to manage the uncertainty through breaking down tree seed provenance by degrees of latitude. A third of trees are chosen from the same latitude, a third for 1-2 degrees south, and a third 3-5 degrees south.

That means for Phase 1, a third of tree seeds will be selected from the middle of France to match the future climate in the middle of England. Besides changing the landscape character, the Woodland Trust argues this increases the risk of importing plant diseases, even though only seeds not saplings are being brought in. On the other hand, by increasing genetic diversity of the stock, the risk of species all being affected by diseases such as Ash dieback should be reduced. It is almost as if an NGO is opposing a precautionary approach to planting on the basis there is not the evidence yet to justify it.

While temperature is expected to increase, rainfall is expected to be much heavier at times, and absent leading to droughts at others, posing challenges for those designing and constructing environmental mitigation. Construction firm Laing O'Rourke has been careful to ensure replacement badger setts are not positioned in what could soon become a floodplain, while Jacobs has been exploring how to design pond features that will function and be useful for different species even in drought.

More broadly, the detailed surveys that HS2 Ltd has been carrying out from London to the north, which will be followed up by detailed monitoring, should be very valuable for tracking how different species manage. This is not just about helping species move as it is important to prevent invasive alien species taking hold that could dominate landscapes and squeeze out rarer, more specialist plants and animals.

## Longer term thinking

### From impediment to asset to network

THE VARLEY REVIEW'S CALL TO VALUE LINE SIDE 'VEGETATION' AS AN ASSET, NOT A LIABILITY WAS A MAJOR CULTURE CHANGE.

It called for "the right vegetation in the right place, reflecting a 'balanced scorecard' which optimises the need for a safe and reliable railway with positive environmental outcomes".

The challenge with treating lineside habitats the same way as assets such as track and signalling, is that the former is a living system, the latter is a mechanical one. This may not be rainfall, as these can be calculated in a similar way to the reliability of a set of points. It is however when it comes to the functioning of a habitat, an assemblage of different species and natural processes, let alone the ecological networks lineside habitats form part of.

Challenges here include:

- The different temporal and spatial scales at which habitats exist, meaning they are dynamic not static;
- The importance of location for biodiversity for it to deliver benefits and, at a different scale, to form part of coherent networks, unlike carbon sequestration from trees for instance; and
- Significant uncertainty, whether due to this being at the cutting edge of science or the difficulty of predicting impacts of climate change in the longer term.

Natural England has summarised many of these issues in an important new handbook,<sup>136</sup> though its recommendations, which include embracing dynamism and encouraging diversity, may not sit easily at scale with traditional asset management mindsets. Designing in adaptability requires adding in space and habitats that may not be used by target species for many years if at all.

Time period	Concept of nature	Goal for nature through infrastructure
2020 onwards	Nature as complex networks	Net gain
Early 21 <sup>st</sup> century	Nature as asset	No net loss
19-20 <sup>th</sup> century	Nature as impediment between A & B	Mitigation to obtain through consent

Table: Nature's relationship with infrastructure over time.

<sup>134</sup> [Progress in preparing for climate change - 2019 Progress Report to Parliament](#) (CCC, 2019)

<sup>135</sup> E.g. paragraph 1.107 in [Full business case High Speed 2 Phase One](#) (DfT, 2020)

<sup>136</sup> Crick, H. et al. (2020) [Nature Networks Evidence Handbook](#). Natural England Research Report NERR081. Natural England, York.



## Longer term thinking

### Valuing nature

It is easier to value the cost of improving biodiversity benefits, whether of additional land or extra features such as green bridges, than it is to value the benefits.

Some have therefore argued that HS2 Ltd should attach financial costs to biodiversity compensation to give it greater weight in its decision-making<sup>137</sup>.

In its most recent rail study, the National Infrastructure Commission is seeking to value how ecosystem services might be lost through construction by different schemes, using a map based approach that combines different data sources (such as for flooding, landscape and nature) for different grid squares<sup>138</sup>.

This appears to fail to value the network benefits of nature or consider the potential for gain.

Recognising the challenges of uncertainty, the DfT is moving away from providing single ratios of Benefit Cost Ratios to the use of wider scenarios and unpacking impacts on the natural environment<sup>139</sup>. Challenges here include:

- relying on instrumental ways to value biodiversity through ecosystem services like carbon sequestration, may ignore more intangible, complex and under appreciated aspects such as soil microbiology;
- different scenarios are needed to account for changes to farming and other land management as well as climate change but these will need to be spatially specific; and
- choices need to be made about the balance between protecting current landscapes and securing resilience in the longer term, and the ways in which to restore nature.

Just like trying to forecast the benefits of HS2 as a Benefit Cost Ratio (BCR) sixty or more years ahead, so trying to manage habitats and ecosystems along the line as an asset oversimplifies the scale and complexity.

BCRs or asset management approaches can be valuable at small physical scales or shorter time periods but not at these greater scales for a living, dynamic system.

Once the Dasgupta Review reports back, HS2 could provide an incredible opportunity to pilot new approaches to help the wider infrastructure sector value the benefits of biodiversity and ambition to restore nature at a landscape scale.

## Longer term thinking

### Integrating National Nature Recovery & HSR networks

While it is important to learn lessons from HS2, its future phases and other rail projects will traverse different habitats and landscapes.

Northern England has a disproportionately large amount of wetlands, peatlands, moor and heathlands, but also post-industrial landscapes. As the IPPR's Nature in the North report argues, there is a strong case for integrated planning between transport, statutory and local authorities<sup>140</sup>.

While HS2 is not proposed to run through the upland areas, much of which are nationally designated landscapes, there will be more opportunities to integrate environmental gain from flood management and carbon sequestration as part of its Green Corridor than in the south. This is a fantastic opportunity for combining the "levelling up" agenda with IPBES's call for integrative governance.

The countryside on the west of the Pennines is as different to the east as both are to the south. This means different potential impacts from high speed rail as well as potential opportunities. While along Phase 1, the vast majority of agriculture was arable, the Cheshire plains are dominated by dairy farming.

Although the field boundaries and their hedges are much older, leading to smaller more intimate fields, there are fewer field margins so less space set aside for many species. The geological diversity creates a different feel of habitat and landscape too, with thousands of ponds and designated wet grassland for the HS2 spur.

Phase 2 often runs close to existing transport corridors built at a time when ensuring permeability for nature was less important. Without improving permeability across them, the benefits of measures proposed across HS2 such as green bridges would be stymied, as Derbyshire County has pointed out in relation to the parallel M1.

Less obviously, the potential for Phase 2 to deliver ecological connectivity could be hindered by traffic growth on surrounding minor roads.

Opportunities to address these issues include making joint bids to Highways England's Environmental and Wellbeing Fund to retrofit existing roads and through ensuring associated HS2 funding reduces road danger for wildlife as well as for vulnerable road users.

By reducing the journey time to Scotland and freeing up freight bottlenecks in the Midlands, HS2 will increase pressure for upgrading the already congested West Coast Mainline to Scotland.

This will not need new track all the way but nonetheless extensive sections will be required around upland areas of high biodiversity with great potential for restoration. Strong vision and ambitious design will be critical, as will a joined up approach with other infrastructure providers and other land managers.

<sup>137</sup> Recommendation 15 in Ecology Technical Group (2017)

<sup>138</sup> Page 44 in [Rail needs assessment for the Midlands and the North](#) (NIC, 2020)

<sup>139</sup> Paragraphs 2.10 to 2.14 and 2.36 to 2.40 [Appraisal and modelling strategy: a route map for updating TAG](#) (DfT, 2020)

<sup>140</sup> [X](#) (IPPR, 2020)

## Conclusions

Inevitably when constructing a project the scale of HS2 there will be negative environmental impacts, particularly at this early stage of construction when they will be most visible. Does the evidence show proceeding with HS2 as the right decision or committing to a project that would make overall environmental loss inevitable?

If anything, the ecological emergency strengthens the case for rail because of the far greater land take of roads (plus the resulting road oriented development) and the fragmentation from increasing traffic on what is already one of the densest road networks in the world.

Since HS2 saw the light of day, motor traffic has grown faster on minor rural roads than any other type, with untold consequences for our wildlife. It is easy to view the negative consequences of HS2 due to the detailed tables aggregating impacts in its reports. By comparison, others are much harder until exceptional events such as the pandemic, when the reduction in driving reminds us how much more nature can thrive when there is much less traffic on the roads.

At the strategic level, the case for a big shift to rail, which HS2 is the foundation of, is stronger than ever. The Government carefully explored all options before choosing HS2. There simply was no alternative route or specification just waiting to be found that would have had better overall environmental impacts. Where the UK fell short was in integrating strategic planning for nature recovery with its transport strategy.

It was visibly a decade behind other countries such as Germany that had detailed maps of habitat corridors to compare schemes against. Nonetheless with extensive tunnels, viaducts and green bridges, HS2 is already designed to be one of the most permeable surface transport corridors in the world.

In terms of other impacts such as fragmentation or habitat loss, there are a lack of agreed metrics let alone comparable data on other schemes. Nonetheless, HS2's permanent landtake is only fractionally higher than a normal railway and, with such high usage, means minimal land take per passenger kilometre travelled, lower than any other form of long distance surface travel.

### Why has HS2 been so controversial environmentally?

The obvious answer is its length in such a densely populated country.

Nothing has been built of this scale since the motorways and, with the fastest growing rail traffic of any major European country, the railway network needs to grow again. HS2 was born into a decade of significant change, with ambitions for restoration of nature stepping up, along with the pace of climate change. This report has highlighted interest groups that have used advocacy around HS2 as a convenient way to influence policy.

There has not been a wider debate about how much society accepts changing long established land rights to improve biodiversity or to change landscape character to adapt habitats for a changing climate. Indeed, such conversations can be difficult in the abstract until specific proposals come forward. HS2 as England's largest nature restoration project as well as its largest transport project has inevitably brought these issues into play. There have also been many misunderstandings. The biggest has been confusion about the extent of land needed to construct HS2 and its extensive environmental mitigation versus the small amount of land permanently required for the railway itself. This is particularly surprising as it is not difficult to compare the width of HS1 with neighbouring motorways, for instance.

The second is about the iterative way HS2 is being designed. Its reports have set out in great detail the reasonable worst case of its impacts, so many have assumed this is a starting point. There is a lack of clear information here about the design process or indeed examples as to how impacts are likely to be reduced in practice. Despite HS2 being ahead of the crowd in committing to no net loss of biodiversity overall (treating irreplaceable habitats separately), the question of whether or not there should be a biodiversity net gain commitment is now the biggest sticking point. Not only is there still scope for environmental gain even for Phase 1, there are credible arguments to await finalisation of reform to agricultural subsidies and net gain regulations before deciding what the appropriate level of biodiversity compensation for earlier phases should finally be. Nonetheless, in the meantime HS2 Ltd does need to demonstrate how it will raise ambition on injecting more biodiversity into the route during detailed design and in building relationships with landowners either side. Environmental bodies have won changes to policy due to their advocacy around HS2 and related issues, but this focus has hindered a shift away from more damaging forms of transport.

# Conclusions

## How are HS2's outcomes likely to compare?

There are no metrics, let alone simple ones, to compare the impacts of transport projects or travel choices on biodiversity.

By comparison, even when comparing how Greenhouse Gas Emissions from transport affect the climate, there are challenges as to how to account for the timescale, such as for global warming potential<sup>141</sup>. Numbers of sites affected can be a proxy at the earlier stages of planning a route, less so for long-term impacts on the coherence of ecological corridors or viability of priority species and wider assemblages.

In any event, focusing on new threats to habitats risks ignoring the cumulative impacts on habitats and connectivity between them of incremental changes, such as increasing traffic on existing roads, which are more spread out.

The Select Committee considering Phase 2a concluded that "HS2 was doing a reasonable job with respect to biodiversity and habitat"<sup>142</sup> but really in terms of long term impacts it is still far too early to judge even for Phase 1. The care in selecting from a massive range of route options and the amount of mitigation, from the longest ever rail tunnels under land to the most green bridges, and the landscape-scale compensation across half of England can only be described as game-changing.

For a project of this scale there will inevitably be hiccups and a risk these distract from more subtle and behind the scenes transformation in processes, skills and jobs. Offsite construction methods for instance are not only cutting costs, carbon and resource use, they will also soon start to enable less construction activity to take place next to nature, compared to previous infrastructure schemes.

Finally, there is still scope, even for Phase 1, to increase the levels of compensation for biodiversity through detailed design, wider funding and partnerships with local land managers as agricultural subsidies change.

Already with detailed design completed on only small sections of the route, the signs are positive that contractors are outperforming on reversing biodiversity loss in places.

The amount of environmental funding provided by HS2 Ltd and green jobs created compares most favourably to that announced nationally by the Government for the natural environment in its Ten Point Plan<sup>143</sup>. As the pace of the project increases, more detail about outcomes as well as outputs would be helpful.

<sup>141</sup> Lee, D. S. et al. (2021) 'The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018', *Atmospheric Environment*, 244, p. 117834. doi: [10.1016/j.atmosenv.2021.117834](https://doi.org/10.1016/j.atmosenv.2021.117834)

<sup>142</sup> Paragraph 148 in House of Lords (2020)

<sup>143</sup> PM outlines his Ten Point Plan for a Green Industrial Revolution for 250,000 jobs (Prime Minister's Office, 2020)

# Conclusions

## How is HS2 innovating?

With all the criticism it is easy to miss just how much ecological innovation HS2 Ltd has been delivering.

Besides helping pioneer new metrics for biodiversity, it is changing the way we survey wildlife, licence impacts on protected species and collect environmental data. scaling up delivery of everything from biodegradable tree guards to green bridges. The shift to looking at the conservation status of species rather than isolated habitats and the resulting landscape scale approach to ecological connectivity is the most ambitious of any infrastructure project in Britain.

HS2's scale has been helping bring ecology into the 21<sup>st</sup> century, providing opportunities to accelerate the pace of change and leverage new ways of working. It has been creating a new generation of environmental professionals for whom these innovations are the norm.

HS2 Ltd has made great strides innovating around engineering and ecology, less so around engagement. Though its external communications have noticeably stepped up since Notice to Proceed in April 2020, more fundamental changes in sharing information at the right scale for different environmental audiences, plus collaboration with land managers and other stakeholders are now required.

For HS2's environmental ambitions to maximise their potential, a reset of these relationships is required, and the shift from agricultural to environmental subsidies provides a new opportunity for partnership. There are significant wider gains for Britain here, whether in terms of creating new markets for green technology or for showing global leadership in the run up to crucial biodiversity and climate summits.

Although much has been said about how HS2 delivers low carbon connectivity for people, now is the time to explain how it can deliver connectivity for nature.



# Recommendations

## Explore how the transport system can deliver environmental net gain

- The National Infrastructure Commission should commission a study to explore opportunities to deliver environmental net gain within the transport sector, to inform its next National Infrastructure Assessment due in 2023. Its scope should include the ongoing impacts from users and operations of existing infrastructure, not simply the construction of new infrastructure. It should consider impacts and opportunities at the local, landscape and system levels, thereby incorporating impacts globally.
- HS2's different phases should be used as a case study for implementing the Dasgupta Review on valuing biodiversity, not simply in terms of its negative impacts and mitigation but also for valuing how best to allocate resources to landscape-scale restoration in the context of a changing climate and society.

## Refine design and consenting processes to restore nature

- The Government should reform engagement processes and consenting mechanisms for nationally significant infrastructure projects, to move us from adversarial processes dating from the 19th century, to ones fit for the 21st. Learning from schemes and processes in France, engagement should be front-loaded through deliberative processes to build the cooperation with local communities and land managers needed to increase ecological connectivity.
- The Government should expand environmental assessment rules so that planning of schemes considers the strategic potential for restoring nature, not simply minimising harm to what is currently there. Greater focus should be given to impacts on and potential benefits for key species.
- HS2's Independent Design Panel should build on its successes by expanding its membership, recommendations, and case studies to engage further with the ecological sector and opportunities for biodiversity net gain.

## Innovate around how to engage and partner

- HS2 Ltd, in particular its new Environmental Sustainability Committee, should harness the experiences of its supply chain abroad as to how innovation around partnerships and bespoke governance arrangements can improve stakeholders' acceptance and involvement.
- HS2 Ltd and the supply chain should improve stakeholder understanding about its design process, such as through case studies on how design of biodiversity mitigation and compensation evolves from EIA to detailed design stages. This is critical to build understanding and trust, as well as share learnings and knowledge from what is Britain's biggest environmental project.
- HS2 Ltd should develop new ways of communicating and sharing its data, such as through dashboards, to track environmental works, species licences and finds, upheld complaints and biodiversity units.

## Unlock the value of biodiversity data from surveys and longer term monitoring

- The Government should explicitly include biodiversity data in the National Data Strategy<sup>144</sup>, aiming to improve collaboration and transform outcomes for ecological protection and restoration as much as BIM (building information modelling) is delivering for construction.
- HS2 Ltd should continue to expand and promote the availability of its environmental data, ensuring its standards are aligned with existing ones or develop new ones where appropriate, such as for habitat maintenance plans.
- HS2 Ltd should set up competitions offering funding for the most innovative uses of its biodiversity survey data. This could help the public understand nature near them, land managers prepare for new environmentally focused subsidies and public bodies appreciate the value of natural capital.
- Rail infrastructure operators should improve monitoring and dissemination of operational impacts on wildlife. This should include measures such as incorporating cameras into some trains to monitor mortality impacts, as trialled in Spain, and share reporting on long-term monitoring, as in Switzerland and France.

## Enable comparison of transport impacts on biodiversity

- The construction sector should produce the world's first standard for Biodiversity Management in Infrastructure, as it did so successfully for carbon management<sup>145</sup>. This could assist efforts to create science-based targets for nature<sup>146</sup> that are meaningful for infrastructure.
- The Government and transport providers should commission user research to develop simple ways to communicate relative biodiversity impacts of different travel choices, just as is being proposed for climate impacts.

## Leverage HS2's green potential

- The Government and HS2 Ltd should explain better how HS2 is "more than a railway" in terms of how it can deliver green travel to nature, not simply between cities, as well as green data and green jobs. This means widening the environmental narrative beyond simply cutting carbon and the Green Corridor, to strategic opportunities for wider environmental gain.
- The DfT, HS2 Ltd and West Coast Partnership should plan to promote and cater for city dwellers to access the UK's wilder areas by HS2 catalysing integrated public transport services and offers.

## Continue to improve HS2's environmental outcomes

- HS2 Ltd should seek opportunities for existing phases of HS2 to deliver additional ecological benefits, building stronger partnerships with local land managers, as the impacts of legal and subsidy changes resulting from Brexit and the Agriculture Act 2020 become clearer.
- The Government and HS2 Ltd should explore how future phases of high speed rail could adopt a twin track approach to deliver connectivity for nature as well as people. They should seek to build broader partnerships early and where possible and integrate or at least influence a wider band of land along the route. Some integration of Environmental Land Management subsidies with infrastructure planning might assist this.
- The Government should connect up ambitions for the two national networks, for High Speed Rail and nature recovery, exploring integrated sponsorship, governance and funding to deliver net gain for HS2 Phase 2b and beyond.

<sup>144</sup> [National Data Strategy](#) (DCMS, 2020)

<sup>145</sup> [PAS 2080 Carbon Management in Infrastructure](#) (BSI, 2016)

<sup>146</sup> For instance, [Science-based targets for nature](#) (The Biodiversity Consultancy, 2019)

## Acronyms

<b>BNG</b>	Biodiversity Net Gain
<b>BREEAM</b>	Building Research Establishment Environmental Assessment Method
<b>CBD</b>	Convention on Biological Diversity
<b>CIEEM</b>	Chartered Institute of Ecology and Environmental Management
<b>Defra</b>	Department for Environment, Food & Rural Affairs
<b>DfT</b>	Department for Transport
<b>EIA</b>	Environmental Impact Assessment
<b>HSRG</b>	High Speed Rail Group
<b>IPBES</b>	Intergovernmental Science-Policy Platform on Biodiversity & Ecosystem Services
<b>LNRS</b>	Local Nature Recovery Strategy
<b>SEA</b>	Strategic Environmental Assessment

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