

10

YEARS  
AND COUNTING







[Melbourne skyline, Australia]

# INDEX

---

## FOREWORD

### **Peter, Lord Hendy of Richmond Hill, Chair Network Rail**

Celebrating the achievements of  
Network Rail Consulting so far..... 04

## INTRODUCTION

### **Welcome by Nigel Ash**

Global Managing Director of Network  
Rail Consulting reflects on the  
previous 10 years ..... 06

## CASE STUDY

### **Reshaping the Harbour City**

Sydney Metro, Australia's largest  
public-transport project ..... 08

## CASE STUDY

### **Nerves of Steel**

A look at Saudi Arabia Railways most  
ambitious construction project ..... 14

## FEATURE

### **Next Stop Modernising Maintenance**

How progressive methods are  
providing successful solutions ..... 18

## CASE STUDY

### **Golden Ticket**

Connecting urban, suburban and  
rural communities with fast,  
frequent trains ..... 24

## CASE STUDY

### **The Reimagining of Massachusetts**

Modernising one of the oldest  
transport systems in the US ..... 28

## CASE STUDY

### **A Multi-Platform Approach**

How Amtrak's Northeast Corridor  
stations are being upgraded ..... 32



[SAR freight train, Kingdom of Saudi Arabia]



[Anaheim Regional Transportation Center, United States of America]





[CN Tower and Toronto City, Canada]

FEATURE

**The Future of High Speed Solutions**

Exploring how the global need for speed is impacting the industry ..... 36

CASE STUDY

**Building New Connections**

Elevating the Long Island Railroad ..... 40

CASE STUDY

**Making the Link**

Connecting Northern California with a supersized network ..... 46

FEATURE

**Forward Thinking**

How the future of rail in Australia looks brighter than ever ..... 52

CASE STUDY

**Transforming the Digital Landscape**

Future-proofing the Sydney rail network ..... 56

CASE STUDY

**Redefining the District**

The operational overhaul of Washington Metro ..... 60

THE FUTURE ..... 66

DISCLAIMER ..... 68

CREDITS ..... 69







# CELEBRATING TEN YEARS OF NETWORK RAIL CONSULTING

# FOREWORD

---

In September 2012, Network Rail launched our international consultancy business in Berlin at InnoTrans, an international trade fair for transport technology. Initially, Network Rail Consulting was established to not only deliver industry-leading consultancy advice, but to enhance Network Rail's reputation by winning and executing high-profile international commercial consultancy contracts, support the UK export agenda and, as an industry leader, help other nations improve their railways. Since then, we have won – and successfully executed – more than 150 consultancy contracts around the world, consistently receiving glowing feedback from our clients on both the quality of the expertise provided and the collaborative way in which it is delivered.

Indeed, while travelling across continents to support our international consultancy business, I have felt proud to receive heartfelt appreciation for the value our railway experts have provided to clients across the globe. From the California High-Speed Rail Authority (p24) and Long Island Railroad projects in America,

to Saudi Arabia Railways in the Middle East (p14) and Transport for New South Wales in Australia (p56), the feedback has been effusive and unwaveringly positive.

To mark this brilliant achievement, our 10 Years and Counting anniversary book describes some of the great railways we have helped to develop, improve, maintain and operate since our inception. The breadth of the projects we've undertaken in the past decade is staggering and their ambition and complexity serve to demonstrate why Britain's railway expertise is still so highly valued around the world. I hope you find it as enjoyable to read as I did.



**Peter**  
Lord Henty of Richmond Hill  
Chair  
Network Rail

# WELCOME TO NETWORK RAIL CONSULTING

---



When we launched Network Rail Consulting in 2012, I knew there would be challenges to overcome: Would other railways be interested in listening to Britain's railway story? Could we be competitive and deploy Network Rail's expertise internationally? Would we be able to deliver on time and budget? Thankfully, we have successfully navigated all of these concerns and built a brand to be proud of. Year after year, our expertise has been highly sought after by clients from as far as Australia and North America, demonstrated by contract awards in competitive markets and outstanding client feedback.

Indeed, our experience of enhancing maintenance processes, improving operating performance, and building significant new rail-infrastructure capacity to cope with increasing demand has impressed clients facing similar challenges. Our success in winning work on mass rapid transit systems, including Massachusetts Bay Transportation Authority, New York City Transit and Sydney Metro, demonstrates that Network Rail's expertise in commuter, high-speed rail is directly transferable to metro systems, too.

Our first significant international contract was in Sydney, Australia, so it's fitting that the first project to be featured in 10 Years and Counting details a project in the harbour city (p8). Since that win in 2013, our business in Australia has grown, particularly in Sydney, Melbourne and Brisbane. It's a privilege to have worked on some of Australia's largest new railways, including the Sydney Metro, as well as support the modernisation of infrastructure to increase capacity on the city's rail network.



Meanwhile, in the Middle East, we have been a close partner of Saudi Arabia Railways for more than seven years, providing expertise on the North-South line and, more recently, on the East-West line to deliver technical assistance, interim management and training. It's been heartening to see our client's capabilities develop with Network Rail Consulting's guidance, and I'm particularly proud of the support our Knowledge Transfer Programme has provided Saudi Arabia Railways' team, allowing us to step back from day-to-day management into the role of trusted advisors.

In North America, our focus has turned to the west and east coasts, notably providing systems advice on the California High-Speed Rail Authority project (p24) since 2015. Now, our experts are working on the Link21 crossing and delivering signalling renewal guidance for San Francisco's Bay Area Rapid Transit network (p46). Over on the east coast, we have been engaged with all the major metro authorities – from Toronto in Canada and Boston, New York, to Washington DC in the US – with clients most interested in Network Rail's experience

of improving maintenance and operational practices to improve performance and reduce costs.

The progress of Network Rail Consulting over the past 10 years is testament to the value that clients place on the expertise of Network Rail's professionals, Britain's own rail-industry journey, and the dedication of Network Rail Consulting's staff show in utilising real-world knowledge to help meet everyday challenges.

To celebrate this, our 10 Years and Counting anniversary book highlights some of the railway and construction projects we've worked on over the past decade – revealing not only the technical complexities we've overcome, but also how these feats of modern engineering have served to transform people's lives.



**Nigel Ash**  
Global Managing Director  
Network Rail Consulting



[Sydney Harbour Bridge, Australia]



# RESHAPING THE HARBOUR CITY

---

Opening in May 2019, Sydney Metro remains Australia's largest public-transport project. Here, we look at the next phase of its construction and reveal the role Network Rail Consulting has played in its innovation and impact.

When stage one of the Metro North West Line – a Public Private Partnership with an \$8.3 billion (AUD) budget – was completed, the north-west suburbs of Sydney embraced their newfound connectivity. Eight new stations and 23km of fresh track joined five updated stations and 13km of converted track to offer a fast-speed line between Tallawong and Chatswood for the first time. Operated by Metro Trains Sydney, the project was also responsible for the award-winning Windsor Road railway bridge at Rouse Hill – Australia's first ever cable-stayed bridge to be constructed on a curve, and a feat of modern engineering.

It's no surprise, then, that stage two is highly anticipated. Indeed, City & Southwest – a line extending the Metro North West Line from Chatswood under Sydney harbour to the Sydney central business district and beyond – has secured funding of \$12.5 billion (AUD), with opening during 2024.



This exciting new phase will involve extensive tunnelling from Chatswood to Marrickville; construction of new stations integrated with over-station developments; conversion of the Bankstown line to metro standards and operation; as well as significant development of Central Station to provide an additional underground concourse. In total, there are seven new stations planned: Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Central Station and Waterloo.

To support its scale, the project has been split into a number of separate contract packages, which include Tunnel and Station Excavation; Sydenham Station Junction; South West Metro; Integrated Station Developments; Central Station Main Works; Line Wide Works; Sydney Metro Maintenance Facility; Expansion and SMTF South; and Trains, Systems, Operations and Maintenance.

#### **A project of planning and purpose**

Integration of these packages requires detailed planning, collaboration, innovation and robust processes to be implemented to ensure a fit-for-purpose, safe metro system. To assist in this, Network Rail Consulting (NRC) was appointed to conduct an Independent Safety Assessment (ISA) for North West Metro

in 2013, and extended to include review of the City & Southwest Reference Design.

Commendably, NRC then became the winning tenderer for City & Southwest's own ISA contract in October 2017. Now ongoing until the end of 2024, the scope of NRC's contract is extensive, comprising the infrastructure works being delivered under Sydney Metro's Rail Infrastructure Maintainer accreditation, Independent Safety Assessment of the Sydney Metro Project Safety Assurance deliverables, and supporting evidence through design, construction, testing and commissioning stages.

It's a complex undertaking, which is why in addition to local partners, NRC works alongside a number of experts from its UK parent, Network Rail. Together, they cover a range of infrastructure disciplines, including civil engineering and structures, tunnels, geotechnical, railway systems, mechanical, electrical, signalling, railway operations, and human factors and security.

#### **Economic and societal impact**

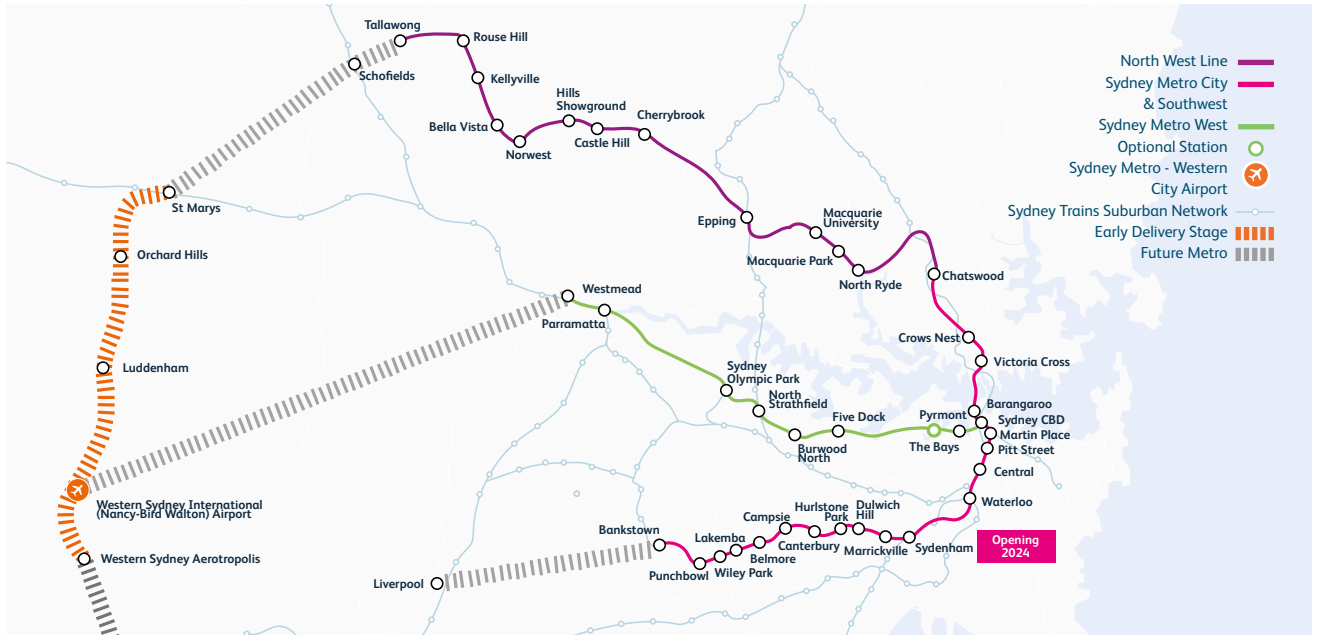
Operating a sustainable Sydney Metro system means planning, building and delivering a metro service that not only benefits current



NOV



Nigel Ash appointed to develop business plan and governance for an international railway consulting business.



[Sydney Metro route map]

and future generations, but also optimises environmental, social and economic outcomes. After all, Sydney's population is predicted to approach 6.5 million by 2036, which means an additional 1.5 million people, 750,000 jobs and 600,000 homes. By positively impacting on energy security, land use, liveability, employment, diversity and inclusion, and environmental and social

responsibility, Sydney Metro will boost economic productivity by bringing new jobs and educational opportunities closer to home. Stations will be easy to navigate; trains will be fast, safe and reliable; and technology will connect customers at every step of the journey, ensuring the integration of new communities while continuing to develop effective responses to climate resilience.

Timeline of key events:

- APR**: Network Rail Board approves NRC Business Plan and establishment of Network Rail Consulting Ltd
- MAY**: Network Rail Consulting Ltd incorporated. Simon Kirby appointed Chair and Nigel Ash Global Managing Director
- JUL**: London hosts the Olympics.
- SEP**: Network Rail Consulting launched at InnoTrans.



[Saudi Arabia Railways Phosphate train leaving Al Jalamid Phosphate mine, Kingdom of Saudi Arabia]







[Riyadh at night, Kingdom of Saudi Arabia]

# NERVES OF STEEL

---

**When Saudi Arabia Railways completed one of the world's most ambitious construction projects, Network Rail Consulting was on hand to help them bring new services into operation using the latest signalling technology.**

Inhospitable temperatures, shifting geography, mountainous terrain: Saudi Arabia isn't exactly short of construction challenges. Which is why the kingdom's North-South Railway line is all the more impressive. Stretching from Al Haditha to Riyadh, it is not only recognised as one of the world's largest railway projects, but also the longest route to adopt the European Train Control System (ETCS). Now, Saudi Arabia Railways' (SAR) goal is to provide a one-network approach to rail management.



[Saudi Arabia Railways route map]





Indeed, having first come on board with the project in February 2015, NRC has since worked collaboratively with Saudi Arabia Railways to develop the company’s approach to infrastructure management, providing more than 45 key members of personnel to work alongside SAR’s team. Utilising the knowledge and experience of experts in the UK, Network Rail Consulting’s focus is developing efficient practises, processes and procedures that are specific to the Saudi Arabian environment, which can then be adopted or adapted by the Saudi workforce.

It’s proven to be a winning formula: over the past seven years, NRC has been part of several key achievements for the North-South Railway, including the successful launch of the first commercial passenger service in 2017, which runs between Riyadh and Al-Qassim; the commencement of molten sulphur services from Umm Waal (Wa’ad Al-Shamal); and the following additional passenger services in Ha’il, Al Jawf and Qurayyat respectively.



What’s more, these achievements coincided with the commissioning of Level 2 European Rail Traffic Management System (ERTMS L2) across the network, which was implemented in phases from 2015, starting with the introduction of interlocking and ending with the full commissioning for passenger services in 2017. As a result, NRC also assisted the migration of the operating contract centre from Ha’il into the ERTMS’ purpose-built operations control centre in Riyadh, and, up until July 2022, has supported SAR with the operational readiness of new sections currently being constructed for new lines linking Jubail and Dammam and the new Jubail Industrial City. In total, it has worked across three different contracts for SAR so far, with the North-South Railway remaining a project to be proud of.

### A modern feat of engineering

A nationally important infrastructure project, the North-South Railway was always designed to support the growth and diversification of the Saudi Arabian economy. From the outset, the aim was to deliver a mixed-traffic railway that could provide a heavy-haul freight network for the movement of bulk minerals (principally sulphur, bauxite and phosphate), facilitate freight (containerised and general), and operate long-distance, high-speed passenger services.

The result was a modern feat of engineering, comprising 11 intermodal freight terminals; six passenger stations; 24 maintenance facilities; 2,750km total network length (built or under construction); the implementation of ERTMS and Level 2 European Train Control System; plus design speeds of 100km/hour for bulk minerals trains, 120km/hour for freight trains and 200km/hour for passenger services.

In due course, the North-South Railway will be integrated with other rail projects in Saudi Arabia – notably the Saudi Landbridge, which is currently being designed – to finally deliver SAR's one-network approach to rail management in the kingdom.

### Extending NRC's scope

During construction of the North-South Railway, SAR recognised its primary challenge was to develop the capacity for world-class railway operations, and looked to experienced international partners to assist. In 2014, it commissioned a UK consortium comprising Network Rail Consulting, Serco and Freightliner

to provide technical assistance in managing and operating the railway, initially for a five-year period with an option to extend for a further two years.

Eight years on, NRC continues to provide managerial and technical assistance on infrastructure management, operations and maintenance under a new framework agreement with SAR. Indeed, one of its unique selling points is the ability to draw on Network Rail's experience and success in owning, operating and maintaining the UK's rail network. It's certainly a benefit that has served SAR well, with a highly skilled, multi-disciplinary NRC team deployed to Saudi Arabia on a long-term basis to help the company achieve its vision and goals.

By sharing its global knowledge on everything from safety and network planning, to operations, maintenance and asset management, Network Rail Consulting has been able to provide advisory services to support organisational growth, while also extending its scope to the development of infrastructure-management systems and business processes; technical assistance and interim management; and the delivery of a comprehensive training package.

In short, it's a strong partnership and, with the future goal of achieving a one-network approach in the pipeline, one that looks destined for even greater successes.

# NEXT STOP: MODERNISING MAINTENANCE

---

**The future of rail lies in the industry's ability to adapt, develop and decarbonise its services, but forward-facing maintenance is also a must. Thankfully, progressive methods are providing successful solutions.**

Whether you're a daily commuter, occasional day tripper or international freight forwarder using the network to transport valuable goods, the purpose of railways has always been to deliver people and products to their designated destination safely and reliably (being comfortably seated next to a scenic view is generally considered a bonus). To deliver this, railways depend on a vast array of physical assets to perform critical functions day after day, year after year. And that, in turn, requires fastidious maintenance – after all, equipment failures can lead to serious safety or environmental consequences, as well as delays, cancellations and ongoing disruption.

For most of its history, the railway has depended on a methodology of 'find and fix' as the foundation of its maintenance regimes; time or asset usage prevailing as the driving factor in determining the frequency of inspection or preventative intervention, with tasks often qualitative and ill-defined.

Such practices have often proved inefficient and ineffective. However, the following range of targeted techniques is redefining how practices are delivered – and finally bringing maintenance into the 21st century.

## Reliability-centred maintenance

In his book on the topic, author and engineer John Moubray describes Reliability Centred Maintenance as “a process to determine what must be done to ensure that a physical asset continues to do what its users want it to do in its present operating context.” In other words, the technique prioritises elevating maintenance from simply repeating things that have 'always been done' or tasks that the designer thought might be useful, to a formal process that determines the value maintenance activities will bring to the goal of delivering reliability and asset life.

For example, knowing how the failure mode manifests itself makes it possible to define mitigating inspections and identify deteriorating conditions robustly and consistently. Likewise, studies of repeatability and reproducibility can identify and remove sources of variability in inspection results.



### Risk-based maintenance

A key element of the reliability-centred maintenance process is the assessment of whether a task that mitigates a failure mode is worth doing. The assessment is based on whether the task reduces the consequences of a failure mode enough to justify the direct and indirect cost of doing it. In a railway system, it is not uncommon to use similar assets in different parts of the network. Being similar, these assets have the same failure modes, but the consequence of failure can vary widely depending on where the asset is situated. This opens the possibility to vary the maintenance regime depending on how much disruption a failure causes to the delivery of the train service, thereby optimising maintenance spend against the risk of failure and, crucially, improving overall efficiency.

### Remote condition monitoring

Devices to monitor the performance or condition of assets have existed for more than a quarter of a century, but simply purchasing new technology isn't the whole

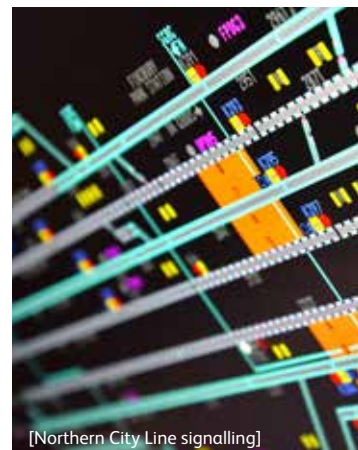
answer. To maximise their potential benefits, these systems also need to be integrated into the business processes that govern asset management and the maintenance operation – and people need to understand not only how to use them, but also their definitive role in the maintenance process. That's why Network Rail Consulting always seeks to determine how technology will integrate into a client's existing business before embarking on a project.

### RCM<sup>2</sup>

Having real-time data on asset condition creates the possibility to move away from manual inspection. Using the formal process of reliability-centred maintenance, remote measurement and even remote inspection can now be built into the maintenance regime, an approach we call RCM squared. Compared to manual measurements, the frequency at which it is possible to acquire automated measurements means that values can be trended over a much shorter timescale, providing earlier indication of deteriorating asset condition and impending failure.



[East Coast digital programme]



[Northern City Line signalling]



[California High Speed Rail Fresno trench/state route, United States of America]



**MAR**  Mike Prager appointed as Finance Director

**APR**  Boston marathon bombing

**SEP**  Peter Koning appointed Regional Director, Australia

**NOV**  Mark Smith appointed Global Head of Human Resources

**2013**

Andy Murray wins Wimbledon

## Industry 4.0

It has been suggested that we are now in the midst of the fourth industrial revolution, also known as Industry 4.0. Although usually applied to manufacturing, the term is equally applicable to maintenance in that it refers to the use of sensors to gather data that is processed using machine learning and artificial intelligence to provide insights that were previously unavailable. By studying the progression of asset condition, it is possible to begin to make predictions about when it will reach the point of failure and hence look to plan repair interventions at times of minimum disruption. Network Rail Consulting is already sharing the tools and techniques learned in the UK with international clients, championing a 'predict and prevent' approach over 'find and fix'.

It isn't always necessary to acquire new data, either: intelligent use of data that is already collected can also deliver maintenance dividends. Indeed, modernising maintenance should be considered much more than a technology project. It is a business-change project that is enabled by technology.

First identifying the project objectives, which could range from improving reliability and reducing maintenance costs, to delivering the same level of reliability in less maintenance time, is paramount. But whatever the aims, considering the people and process changes alongside new technology will deliver a sustainable shift towards modern maintenance; that will stay with us for decades to come.







[Commuters wait for train at Washington DC subway station, United States of America]







[California High Speed Rail Central Valley, United States of America]

# GOLDEN TICKET

---

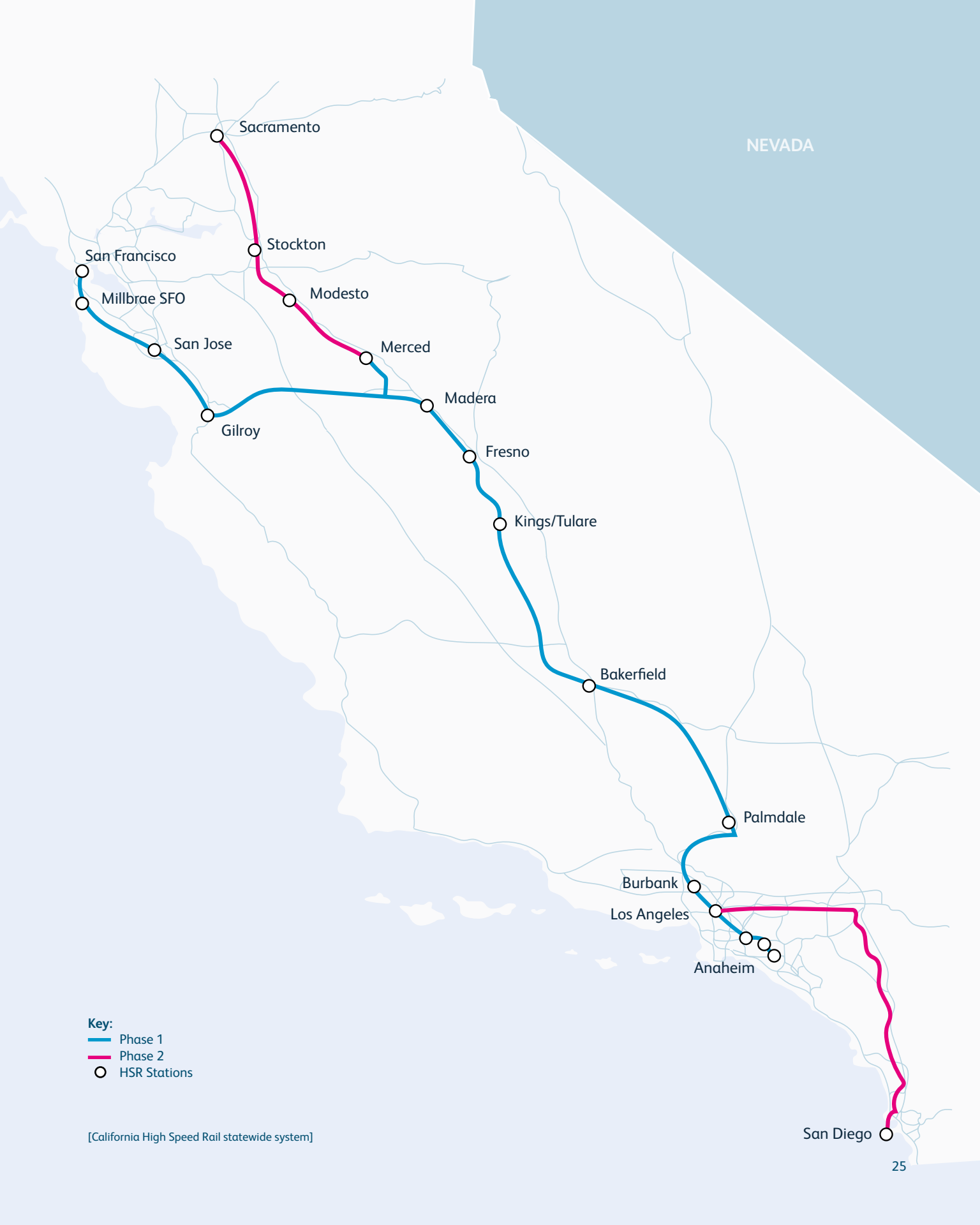
**High-speed rail is set to connect some of California’s most celebrated counties – and get America’s ambitious infrastructure plans on track in the process.**

With its sun-drenched coastline and notoriously gridlocked roads, taking the train in California just makes sense. However, getting each region’s railway lines up to speed to deliver an advanced network across the state is no mean feat, which is why California High-Speed Rail Authority (CHSRA) first

engaged with Network Rail Consulting (NRC) back in 2015. Since then, NRC has supported the authority’s mission to plan, design, build and operate the United States’ first high-speed rail system, as part of WSP’s CHSR Delivery Partner team.

Forming the backbone of the State Rail Plan, this new system will comprise a modern, integrated state-wide passenger rail network connecting urban, suburban and rural communities with fast, frequent trains. It’s a





Key:  
— Phase 1  
— Phase 2  
○ HSR Stations

[California High Speed Rail statewide system]



[San Francisco Golden Gate Bridge, United States of America]

vast project that requires precision planning. After all, just adding the San Francisco to Los Angeles/Anaheim high-speed rail system is the equivalent of adding a major airport and six-lane highway between San Francisco and Los Angeles.

NRC's remit has always been clear: to provide strategic advisory support in service specification, operations planning, engagement with existing operators, engineering, maintenance and asset management. With a 17-strong team, progress is promising. Phase one is a \$90 billion (USD) undertaking, but once the 805km-long line is complete, it will connect

two of the state's largest cities – San Francisco to Los Angeles – in approximately three hours. The route itself will connect Central Valley to Merced and Bakersfield, followed by an extension north through the Diablo mountain range and Silicon Valley to San Francisco. The final stage of phase one will then extend south from Bakersfield, connecting through the Tehachapi and San Gabriel mountains to Los Angeles and Anaheim. Phase two, meanwhile, envisages extending the high-speed system to Sacramento and San Diego. There are also plans for a Los Angeles to Palmdale to Las Vegas high-speed route, which will be interoperable with the California High-Speed Rail network.

Where there are existing commuter railroads (from San Francisco to Gilroy, and from Burbank to Anaheim, for example) high-speed trains will share the tracks with existing operators. In the Central Valley section, which currently connects the cities of Merced, Fresno, Bakersfield and Palmdale, trains will operate on dedicated high-speed tracks, delivering speeds of up to 354km/hour. In turn, this will create new job opportunities and boost economic development in some of the poorest parts of California. To date, the project has already generated around \$5 billion (USD) in labour income and \$13 billion (USD) in economic benefits, with 10,000 full-time roles created in the 2021 fiscal year, plus opportunities for more than 600 small businesses.

Indeed, in the seven years that Network Rail Consulting has been working in partnership with the California High-Speed Rail Authority, huge progress has been made. The preferred alignment has been confirmed and five of the seven project sections have achieved full environmental clearance. As a result, civil-engineering construction work is now progressing on the 192km Central Valley segment, which will form the high-speed test track to prove the rail infrastructure and new rolling stock.

The authority has also invested in the railways that will be sharing tracks with other operators, too. This includes more than \$700 million (USD) to provide overhead line electrification from San Francisco to San Jose, enabling Caltrain (the local operator) to procure a new fleet of zero-emission trains. Meanwhile,

in southern California, the authority is also investing in the redevelopment of Los Angeles' Union Station to support the through running of services, as well as a major grade separation to close a dangerous level crossing and improve safety and reliability.

### **Building a greener future**

Crucially, the project will create a cleaner environment by helping to reduce greenhouse-gas emissions – specifically in Central Valley, which has some of the poorest air quality in the state – while also preserving California's agricultural lands and natural habitats.

What's more, the system will be operated on 100 percent renewable energy, including all train services, stations and maintenance vehicles. Network Rail Consulting was instrumental in generating this solution, helping to devise several large-scale solar generation and battery-storage systems to reduce reliance on traditional utilities, while also improving rail resilience, reducing operating costs and, ultimately, achieving the authority's admirable environmental goals.

Now, passengers can look forward to riding California High-Speed Rail Authority's high-speed services by the end of the decade, enjoying the views, speed and convenience with a thoroughly clear conscience.

# THE REIMAGINING OF MASSACHUSETTS

**Why modernising one of the oldest transport systems in the US will ultimately boost state morale as well as public services.**

Affectionately known as the Bay State, Massachusetts is a popular place to live. According to the US Census, nearly 7 million people currently reside there and the state's public transport system – one of the oldest in America – is positively heaving.

Indeed, the Massachusetts Bay Transportation Authority's (MBTA) Commuter Rail System is now the sixth busiest in the United States. Extending out from North and South Stations in Boston, it operates 398 route miles, 14 lines and 141 stations, with the MBTA as a whole also providing subway, bus, commuter rail, ferry, and paratransit services to eastern Massachusetts and parts of Rhode Island.



[Faneuil Hall Marketplace in Massachusetts, United States of America]

JAN



Ron Hartman appointed Regional Director, North America

SEP



Peter Koning passes away

➤ 2015

JUL



James Hooker appointed Regional Director, Australia

DEC



World leaders reach landmark agreement on climate change at summit in Paris





[Red Line Massachusetts Bay Transportation Authority trains in Boston, United States of America]

That’s why, in 2018, the authority committed to an \$8 billion (USD), five-year capital-investment plan to not only modernise the system, but also maintain a state of good repair; renovate stations; modernise fare-collection systems; upgrade services for buses, subways, and ferries; and improve the accessibility of the entire network. Formed as part of the MBTA’s vision of ‘Building a Better T’, its two key projects are now the Red Line/ Orange Line Transformation and Commuter Rail Transformation – and all eyes are on the latter’s forecasted completion date of 2050.

In the meantime, Network Rail Consulting (NRC) is working with MBTA to construct and deliver a set of desired program benefits to ensure best practice at every stage. These benefits include the use of discontinuous electrification, together with Battery-hybrid Electric Multiple Units (BEMUs), to increase the overhead catenary system’s (OCS) efficiency by 50 percent; tailoring the infrastructure using traction-power modelling and conceptual operational analysis to balance service performance; and introducing systemwide integration and governance at

**2016**

**FEB**



Susan Cooklin appointed as Chair

**JUN**



UK votes to leave the European Union

**OCT**



Barney Daley appointed Global Technical Director

**NOV**



Donald Trump wins the US presidency



[Boston subway train crossing Longfellow Bridge, United States of America]

the earliest possible stage to reduce both costs and risk. Here, we take a closer look at each project in more detail.

### Putting passengers at the forefront

The Red Line/Orange Line Transformation focusses on updating both MBTA's Red and Orange rapid-transit lines, which are operated as part of the overall transit subway system. These critical corridors link communities into and out of the city of Boston, and provide key transfer connections to Amtrak as well as MBTA Commuter Rail services. For example, the Red line runs from Alewife in North Cambridge to South Boston, where it splits into two branches to Ashmont and Braintree, while the Orange line extends from Forest Hills in the south, through Downtown Boston, to Oak Grove in the north.

This transformation project will increase service frequency, improve reliability, and result in faster, more comfortable trips for customers with less crowding. Achieving these outputs, however, requires significant infrastructure upgrades, as well as the introduction of a new train fleet, plus refinements to existing business practices and processes across the MBTA's organisation.

To this end, MBTA has invested significantly in improving its organisational business practices to not only achieve the outputs of the project, but to sustain the benefits for customers for years to come. Indeed, after leveraging outputs from the Red Line/Orange Line Transformation, organisational changes

have now been expanded to all lines across the system, including Green, Blue and Silver. These changes related to asset management, engineering and maintenance, railroad project and program management, and transit operations.

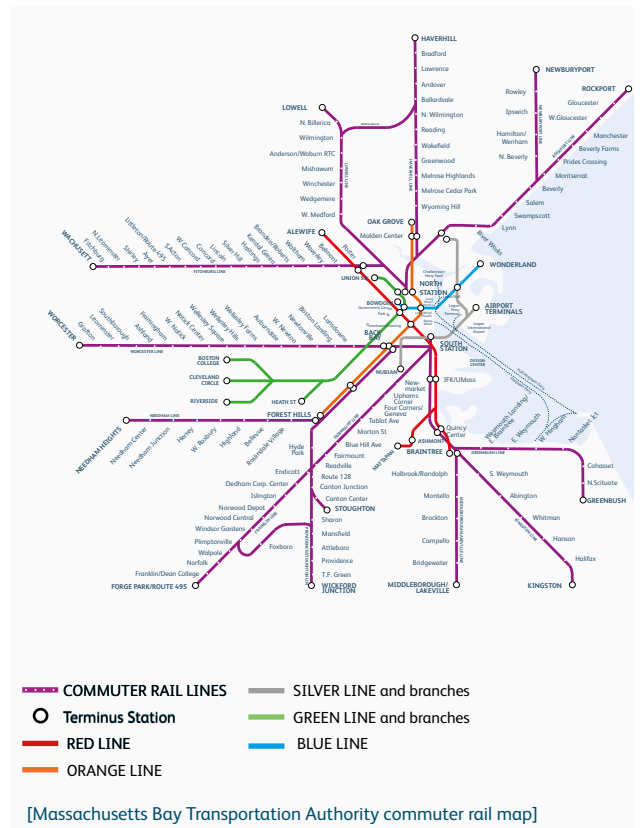
### Leading the charge for decarbonisation

The Commuter Rail Transformation’s busiest line is Providence/Stoughton, which runs from South Station through to Providence and Wickford Junction. It is also the only MBTA line currently electrified with an overhead catenary system (OCS), in order to run electric powered Amtrak Northeast Corridor services. (All other locomotives are all powered by diesel, hauling a mix of single and bi-level coaches, seating between 400 and 1,400 passengers.)

However, MBTA is now seeking to transform the current Commuter Rail into a more frequent, all-day, decarbonised (fully electrified) service. These outputs are to be achieved through the MBTA’s Rail Transformation program, with the aim of increasing ridership, inclusivity, accessibility, and net-zero carbon emissions by 2050.

Of course, MBTA recognises that the best time to influence program outcomes is during the early planning stages, which is why innovation and international best practice provides the cornerstone of every key decision made. This, in turn, will also reduce future capital and operating costs; lower the risk profile

of delivery, operations, and maintenance; and enable alternative contractual and delivery mechanisms to be explored. More importantly, adhering to ‘best practice’ helps to boost frequency, passenger satisfaction and, ultimately, trust in the Massachusetts transport system.





# A MULTI- PLATFORM APPROACH

---

From Washington DC to Midtown Manhattan, Amtrak's major Northeast Corridor stations are being upgraded one terminal at a time – and delivering elevated levels of vision, planning and pride.

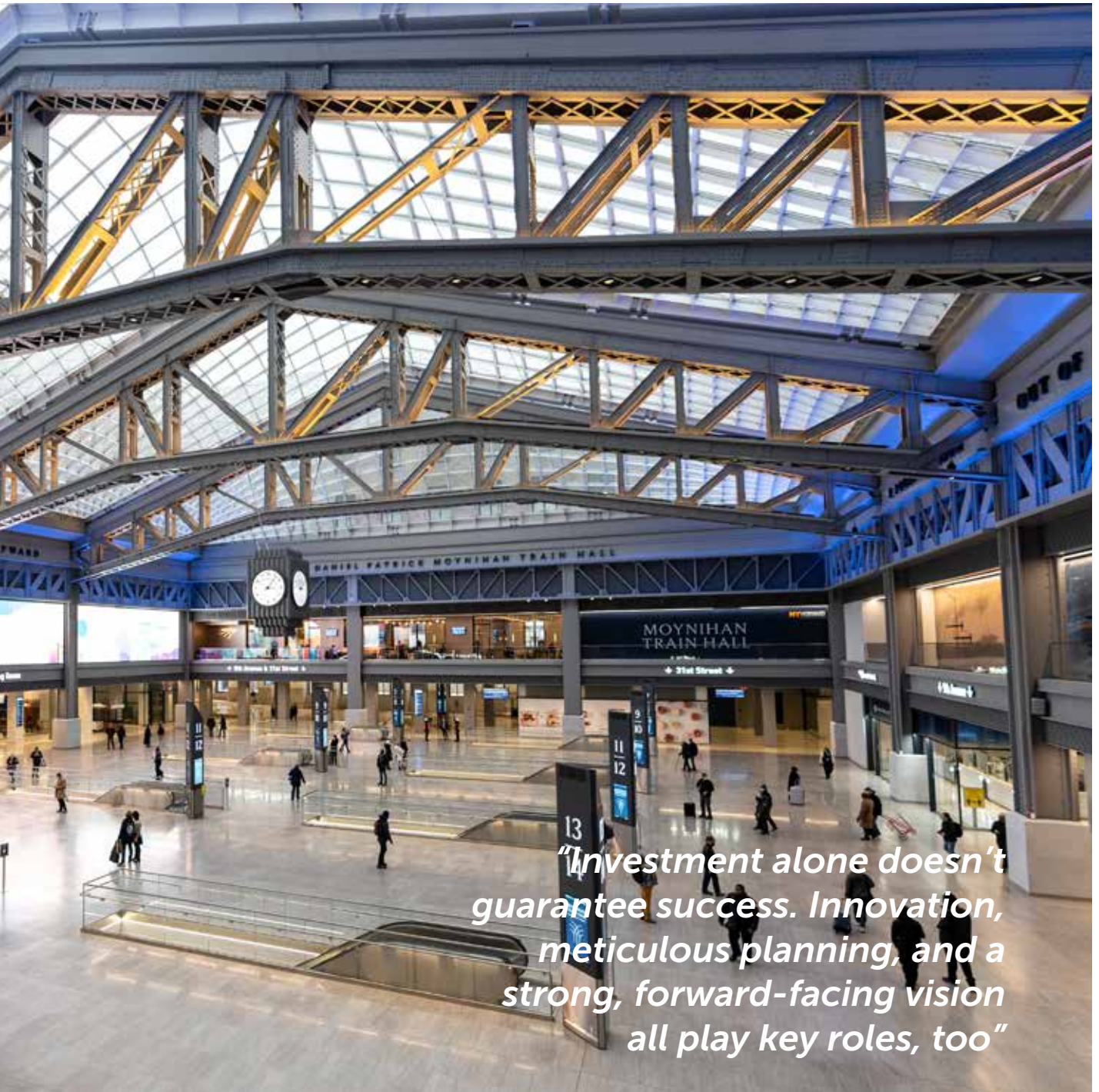
Since its establishment in 1971, Amtrak – an independent agency whose shares are largely owned by the US government – has pioneered itself into a unique position: it is currently the only passenger railroad service that operates throughout the continental United States. What's more, its Northeast Corridor (NEC) remains one of the busiest, most complex, and economically important transport systems in the world, stretching from Washing DC to Boston and carrying more than 750,000 passengers each day.

Unsurprisingly, an operation of this scale requires constant investment and Amtrak has started to spend significant amounts on station-development projects, including Moynihan Train Hall – Amtrak's impressively lofty new home in New York City. This \$1.6 billion (USD) project, delivered in partnership



[Moynihan Train Hall, United States of America]





*“Investment alone doesn’t guarantee success. Innovation, meticulous planning, and a strong, forward-facing vision all play key roles, too”*





EMPIRE STATION COMPLEX

MOYNIHAN TRAIN HALL



MOYNIHAN TRAIN HALL



EMPIRE STATION COMPLEX

PENNSYLVANIA STATION



TO TRAINS



[Moynihan Train Hall, United States of America]

with Empire State Development, expanded Penn Station into the historic James A. Farley Post Office building to relieve crowding and improve passenger comfort and security. Opened in December 2021 to much fanfare, the elegant new terminal now offers enhanced passenger facilities and retail offerings in a grand train hall setting that boasts a sky-lit atrium nearly the size of the Grand Central Terminal's main concourse.

The original Penn Station, meanwhile, continues to service an annual passenger flow of more than 100 million, but has historically suffered from a lack of joined-up thinking and investment – resulting in a run-down transit centre that's ill-equipped for moving passengers through one of the busiest cities in the world. The Metropolitan Transportation Authority, in partnership with Amtrak and NJ Transit, is currently developing a \$7 billion (USD) reconstruction project to transform Penn Station into a world-class transit hub, providing taller ceilings and new entrances to improve passenger interchange by 2032.

But investment alone doesn't guarantee success. Innovation, meticulous planning, and a strong, forward-facing vision all play key roles, too. That's why, in 2017, Amtrak invited Network Rail Consulting (NRC) to become a trusted advisor. The objective was clear from the outset: to provide expert insight into all elements of station redevelopment across Amtrak's vast Northeast Corridor, including its flagship projects in New York. Since then, NRC has supported taking a 360-degree approach to transformation, comprising vision, planning

regimes, respect for stakeholders, and a thorough understanding of both back-of-house functions for train and pedestrian movements and front-of-house features that are unique to the facility.

Throughout this process, NRC's extensive experience of improving stations in the UK has been shared to help shape everything from concept design to operations, supporting Amtrak in areas such as operational interfaces, accessibility activation planning, retail-space planning and operational readiness.

Indeed, alongside actively working on the transformation of Baltimore Penn Station – a \$150 million (USD) redevelopment project that aims to remodel the existing site into a mixed-use, transit-oriented terminal with new office, residential and leisure space – NRC is also advising Amtrak on development projects in Philadelphia, San Francisco, Los Angeles, Boston, and California.

Critically though, NRC continues to put customer experience at the forefront of every station transition. After all, providing Amtrak passengers with the world-class transportation hubs they have long deserved should always be the starting point.



# THE FUTURE OF HIGH SPEED SOLUTIONS

---

**With demand for faster services booming, we explore how the global need for speed is impacting the industry.**

As of June 2021, there was 22,563km of high-speed rail lines under construction around the globe. Leading the charge is China, which is currently adding another 14,900km to its 40,000km-strong network. Yet China is far from alone: many countries across Europe, Asia, North America, Africa and Australia are also waking up to the wider social, environmental and economic benefits associated with advancing rail travel.





But what defines 'high-speed rail'? According to the International Union of Railways (UIC), high-speed rail is infrastructure "equipped for speeds generally equal to or greater than 250km/hour"; others consider "specially upgraded high-speed lines for speeds of 200km/hour" to qualify.

Whichever version you adhere to, several countries have recently joined the high-speed rail club, including Saudi Arabia, Morocco and Denmark. Many more desire high-speed lines, but projects have proven difficult. Nevertheless, Sweden, the Czech Republic, Baltic states, Russia, Egypt, South Africa, Australia, Canada,

Brazil, Iran, Israel, Indonesia, Malaysia and Singapore are all among potential applicants right now.

With that in mind, it's worth examining some of Network Rail Consulting's key target markets more closely. In the USA, for example, the Biden administration has big plans for the expansion of high-speed rail amongst a \$2 trillion (USD) infrastructure proposal, which includes a budget of \$80 billion (USD) to revive the dilapidated US railroad system. There are also a number of proposals envisioned in multiple states, including California's high-speed rail program (see p24), which has been underway for more than a decade but is still the closest project to completion.



[Inside AMTRAK Acela, United States of America]

Elsewhere in North America, the Canadian Government launched the next phase in its procurement process for a high-frequency rail project earlier this year. The aim? To transform rail in Canada by creating a faster, more frequent and sustainable service among the major urban centres of Québec City, Trois-Rivières, Montreal, Ottawa, Peterborough and Toronto.

NOV



Mohammed bin Salman remakes Saudi Arabia





Meanwhile, the Australasian Railway Association (ARA) has concluded that Australia's regional lines are, quite literally, not keeping pace. The ARA's Faster Rail Report published in 2021 identified investment is needed to improve the speed, reliability and frequency of regional services connecting to larger cities. Of course, significant improvements could be achieved in the short term with immediate investment in existing networks. Upgrades such as passing loops, curve easing, track upgrades and level-crossing removals would all help to support speeds of up to 160-200km/hour. But dedicated rail lines capable of achieving speeds of 200-250km/hour will, ultimately, be needed to meet demand in the future.

Hyperloop, however, may prove key to the global expansion of high-speed networks. Using elements of current high-speed rail, trains or 'pods' run underground in low-pressure tubes, achieving predicted speeds of up to 1,200km/hour. Tests are still ongoing, but it's possible that some form of this technology will be adopted in the coming years – and we may well see high-speed rail operations and Hyperloop models co-existing in the future.



[AMTRAK Acela Express passenger train, United States of America]

2018

MAY Mark Pettigrew appointed Regional Director, Australia

MAY Prince Harry marries Meghan Markle

JUN Women in Saudi Arabia are allowed to drive

SEP Andrew Noble appointed Finance Director

# BUILDING NEW CONNECTIONS

---

**Chartered in 1834, the Long Island Railroad remains one of America's most iconic heritage railway lines. Now, Grand Central Madison is set to give this historic track a new lease of life.**

Predating the Statue of Liberty and American Civil War, the Long Island Railroad – or LIRR as it's known locally – has certainly earned its title as America's oldest railroad still operating under its original name. It's an accolade made all the more impressive when you consider that LIRR is also one of the busiest commuter railroads in North America: pre-pandemic, it shuttled more than 354,000 commuters and holidaymakers between Montauk and Manhattan each day, delivering a 24-hour, 365-days-a-year service to 124 stations across 700 track miles. Now, post-pandemic numbers are once again rising and predicted to return to similar levels.

To satisfy this growing demand, the LIRR – which operates as part of the New York Metropolitan Transportation Authority – has set the wheels in motion for its next chapter. From 2023, Grand Central Terminal, located

under the existing Grand Central Terminal in the east side of Manhattan, will utilise new lines created by the East Side Access project. This project will finally establish a direct link for the urban communities on Long Island to the business districts in East Manhattan. It's an exciting addition to an operation that demands constant innovation and maintenance, which is why Network Rail Consulting (NRC) was invited to advise on LIRR's operational and infrastructure improvements back in 2018.

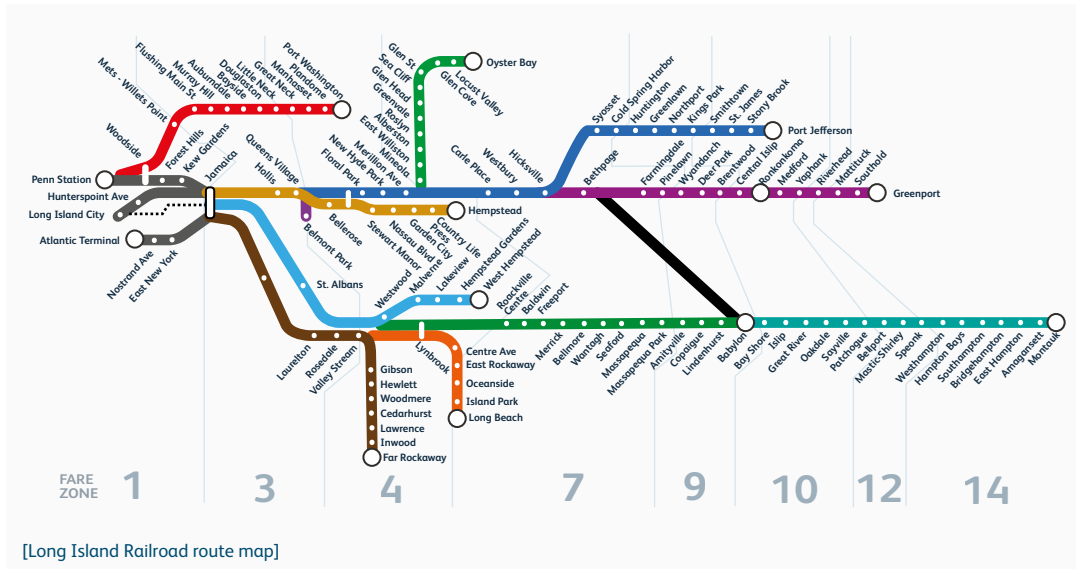
Led at the time by one of NRC's operational specialists, the team began to build a portfolio of initiatives that would improve on-time performance, focusing on lessons learned from operating an extensive railroad system in the UK and demonstrating how its recommendations would enhance passenger experience. Network Rail Consulting understood that by providing LIRR with enhanced decision-support tools, it could focus on even greater aligned service operations, and the team's input continues to positively impact the East Side Access project today.



A photograph of the Statue of Liberty in the foreground, holding a torch aloft. The background features the New York City skyline across the water, with the sun setting behind the buildings, creating a warm, golden glow. The sky is filled with soft, colorful clouds.

*“A mix of expert observations,  
interviews and document  
reviews highlighted a number  
of areas ripe for development”*





### Elevating LIRR's service

From reviews on track-outage management and seasonal preparation, to low-emission locomotive procurement and infrastructure maintenance, the broad range of services delivered by NRC has enabled the Long Island Railroad to continually improve its infrastructure and operational standards.

The Track Outage Review, for example, was initially commissioned by LIRR as part of a wider Operations and Maintenance Improvement Support project. Once completed, Network Rail Consulting provided a thorough diagnostic of the planning and implementation of track outages, identifying areas for improvement that resulted in the reduction of outages and a boost in overall passenger experience. Meanwhile, a diagnostic study into seasonal management led the NRC

team to identify key areas of improvement in planning, coordination and implementation of seasonal delivery. Its three-stage process to gain a full understanding of the processes and challenges during the different seasons included a focus on leaf-fall treatment train management, vegetation management, conductor rail heating and the proactive use of weather forecasting.

Network Rail Consulting also completed a diagnostic study into LIRR's current management of incidents to identify opportunities for improvement. Indeed, a mix of expert observations, interviews and document reviews highlighted a number of areas ripe for development. These included incident prevention; communication during incidents; incident-response capability; management during incidents; command

and control; and post-incident learning. This work enabled LIRR to greatly improve its response to, and reduction of, incidents across its service.

Similar projects have seen Network Rail Consulting coordinating with LIRR's subject-matter experts to create operational risk categories to mitigate impact following a bridge strike. In this instance, NRC worked with the team to classify Long Island Railroad bridges. This enabled them to ensure that, prior to an engineer arriving on site, a pre-strike risk assessment determining the safety of an impacted bridge would already be in place.

Developing a database of signalled routes across 63 interlockings was another forward-facing project. Before the route card database was created, train dispatchers would have to determine the position of each switch for the chosen route from the entrance to exit signal. Now, the NRC-developed database lists the position of all switches for primary and alternative routes. With more than 1,400 unique Long Island Railroad routes identified and recorded, it was a project that ultimately created a more efficient, safe and technologically advanced system.



However, all eyes are now on completing the ambitious East Side Access project, which has now officially been renamed Grand Central Madison. Located hundreds of feet below Grand Central, the gateway will handle an estimated 162,000 passengers per day through a 350,000 square foot terminal. There will be spacious waiting areas to lounge in, retail units and restaurants to visit, plus real-time departure information and free Wi-Fi available to access. To achieve this, Network Rail Consulting has been tasked with identifying its operational readiness status, and continues to support LIRR in delivering a thoroughly modern terminal for one of America's most historic lines.



[Subway Train Crossing Bridge into Boston, United States of America]





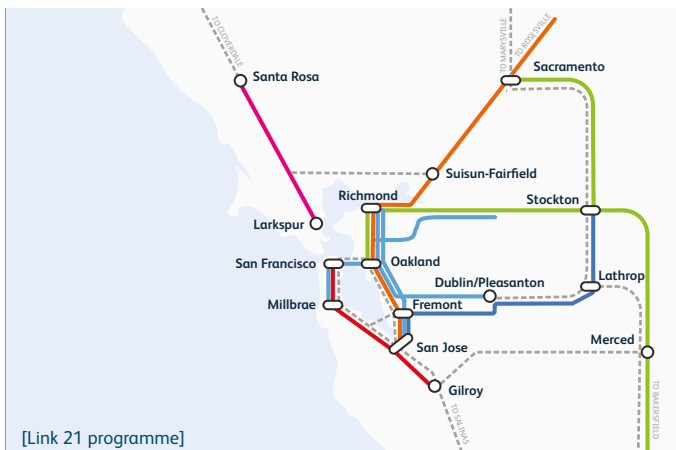
# MAKING THE LINK

**Northern California is in need of a supersized network that will finally unite its ‘megaregion’. It’s a pioneering project that hinges on strategic, joined-up thinking.**

Comprising 21 counties spanning the San Francisco Bay Area, Monterey Bay, Sacramento Area and Northern San Joaquin Valley, the northern California ‘megaregion’ is in growing need of enhanced connectivity. With its increasing population lacking the appropriate amount of supportive infrastructure, these counties face economic, social and environmental challenges, as well as transportation struggles – which is where Link21 comes into play.

Devised for the Bay Area’s Rapid Transit network (BART) and Regional Rail, Link21 is a program of rail-system improvements that will utilise both wide-gauge, bespoke infrastructure alongside standard-gauge commuter and intercity rail services to transform passenger journeys across the region.

The program centres on the keystone Transbay Rail Crossing – a project connecting San Francisco to Oakland that aims to relieve the existing road and BART crossings of their capacity and maintenance constraints. Without similar development, the megaregion faces significant connectivity and access challenges, with many journeys remaining entirely car-dependent, congested, slow, or poorly integrated.



As a result, Link21 is tackling these issues head on and is currently in the early stages of development. Indeed, there are still several key issues to be decided on, such as which rail technology will best serve the new crossing – standard-gauge rail, the wide-gauge BART system, or both? – as well as what new service routes should be implemented beyond the crossing itself. Each choice has complex systemic implications, including operational and engineering feasibility challenges that will need to be addressed.

To help resolve these challenges, Network Rail Consulting (NRC) is playing an important role by providing strategic advice on service planning and operations. Situated within the Program Management Consultants team, NRC advises the client on issues identification, technical-consultant scope specification, and informs the definition of service plans to test and evaluate different program options. This leverages the local NRC team’s deep knowledge of operations across several clients in the northern California megaregion, including Caltrain and California High-Speed Rail Authority (see p24), to offer both an integrated and informed perspective.

Importantly, the program is focused on resolving these challenges, and spreading benefits and costs not just geographically but socially, too. Like many transit and rail projects currently in development in the US, Link21 has objectives that future delivery and operation will need to advance equity. As such, NRC works with colleagues on the program to identify service improvements enabled by



[San Francisco skyline, United States of America]

Link21 that will help to significantly improve access and connectivity between communities across the megaregion, offering affordable and sustainable alternatives to car transport in the process.

Comprehensive cost estimates to bring Link21 from design to construction have not yet been developed, but preliminary estimates provided



*“Without development, the megaregion faces significant connectivity and access challenges, with many journeys remaining entirely car-dependent, congested, slow, or poorly integrated”*



[BART train towards the airport, United States of America]

within the Regional Plan for 2050 forecast the crossing project to cost approximately \$29 billion (USD) by 2040. However, this amount is likely to fluctuate through the phases of the program's lifecycle.

Organised into three distinct stages, the project begins with Program Identification at phase one, before moving to Project(s) Selection in phase two, and ending with Project(s) Delivery in phase three. Currently in phase one, Link21 aims to enter phase two in early 2024, and although comprehensive delivery schedules have not yet been developed, preliminary estimates place conclusion of phase three – and entry into operation – in or around 2040.

Meanwhile, NRC's second major role on the program has been to support this lifecycle with a bespoke application of Governance for Rail Investment Projects (GRIP) Stage Gates, which are essentially key decision points that determine if the project is fit to advance to the next stage or not. So far, a total of five Stage Gates have been identified. The first was held in early 2022 and comprised a hierarchy of focused review meetings, while another included the issue of a draft Environmental Impact Review requiring transit-board endorsement. Whatever the content though, each Stage Gate has proven effective for managing strategic risk, and recommends options to the agency boards before formalising any key decisions consequently made. This bespoke structure helps to broaden inclusivity to stakeholders beyond the project and, as a result, each review meeting adds confidence and assurance to the next.

It is hoped, therefore, that the rigour of taking a Stage Gate approach throughout will mitigate strategic risks that often plague mega-projects, including scope and schedule creep. Importantly, the Stage Gate approach also 'locks in' decision-making to ensure that challenges aren't made to revisit areas of development that have already been discussed, debated and decided upon. Rather promisingly, NRC is now developing a framework for Stage Gate two, which will commence in 2024.

Time alone will tell if the program will be completed on schedule, but with Network Rail Consulting steering the drive for efficiency and formalised processes every step of the way, it looks certain that enhanced connectivity will provide a much-needed boost to northern California's 21 counties in the decades to come.





[Queensland Rail commuter train, Australia]









[Melbourne, Australia]



[Flinders street Station in Melbourne. Australia]



[Train travelling over the Sydney Harbour Bridge, Australia]




# FORWARD THINKING

---

**With record investment and a focus on climate resilience taking centre stage, the future of rail in Australia looks brighter than ever. Here, we unpack some of the key trends reshaping the sector.**

The rail industry in Australia is currently experiencing an unprecedented level of infrastructure investment and, according to Australasian Railway Association, more than \$155 billion (AUD) is forecast to be ploughed into the sector over the next 15 years. This huge financial pipeline provides an exciting platform for driving positive change, and opens up a wealth of growth opportunities for companies to both boost national productivity and meet growing demand. Indeed, with Australia's climbing population set to rise to more than 30 million people in the next decade, record investment is critical – particularly when you consider that this rise in population will not be evenly spread. By 2060, Sydney and Melbourne are expected to grow by around 3 million each, and the majority of Australians will continue to reside in major cities across the continent. Of course, lowering carbon emissions has to sit at the heart of new development, which is why an increasing shift from car and truck to passenger and freight rail is set to provide greener transport solutions, while simultaneously lowering the cost of congestion in Australia's major cities.



But climate change isn't the only trend set to dominate the next decade: increasing technological reliance; expansion of Light Rail networks in mid-size and major cities; faster passenger rail between cities and regional growth centres; and a focus on rail freight will all feature prominently, too. Here, we take a closer look at five trends set to transform the Australian network.

## **The rise of digital solutions**

Increasing the use of digital technologies has enabled existing and new rail networks to maximise the use of infrastructure – and a new wave of tech will help to further that efficiency. At a national level, for example, the development of the Advanced Train Management System will increase the capacity of the Australian rail freight network. Meanwhile, at a major city and regional level, the development of other digital solutions, including European Train Control System technology and Communications-Based Train Control (CBTC) systems, will increase safety, capacity and performance. However, the integration and interoperability of these systems will require expertise to ensure it works as a whole. Additionally, the number of driverless trains will continue to grow as metros in major cities, including Melbourne, Sydney, Brisbane and Perth, move increasingly toward automated solutions.



### The Light Rail revolution

Essentially a modern tram system, Light Rail helps to reduce congestion, increases mobility in cities and suburbs, boosts residential and commercial investment, and reduces carbon emissions. Consequently, Light Rail networks in Sydney, Melbourne, Gold Coast, Adelaide, Newcastle and Canberra will continue to grow to supplement heavy rail, bus and car use in major and regional cities, while plans for expansion to Perth, Sunshine Coast, Darwin and Hobart are also in the pipeline.

### The fast-track experience

With a growing need for better connectivity between major cities and neighbouring regional areas, investment in faster passenger rail solutions is critical. That's why plans for line upgrades in Victoria, New South Wales, Queensland and Western Australia are important to ensure regions are increasingly better connected and affordable to travel to.

Of course, these faster rail corridors must also fit into long-term planning for high-speed rail in Australia. For instance, the Sydney to Melbourne and Sydney to Brisbane connections are corridors that have been in various stages of consideration, and will increase in importance as Sydney and Melbourne continue to grow.

### The freight-rail focus

Freight growth in Australia is predicted to more than double between now and 2050, which means heavy-haul rail will need to do more to meet demand. Projects including the 1,700km Inland Rail project, which is now underway between Melbourne and Brisbane, will be significant contributors to increasing the capacity, reliability and resilience of current freight networks. In addition, new and improved intermodal facilities and better direct accesses to ports will be key facilitators of success in realising major productivity and safety benefits.

Meanwhile, possible extensions to Inland Rail – and new lines at the right time, like Mount Isa in Queensland to Tennant Creek in Northern Territory – could improve the national network, while simultaneously improving road safety through the transfer of road freight to rail. But major programs of renewals and strengthening existing networks are key, and ongoing reviews remain a government priority.

### The low-emissions drive

One of the greatest challenges faced by the world today is climate change and the need to drastically lower emissions. However, replacing heavy-emission diesel trains with electrification is costly, requiring extensive upgrades on



networks that were often never designed for electric traction. There is also a need to balance this cost with customer benefit and the goal of achieving zero-carbon emissions – which is where green traction technologies come in. Used as an alternative to diesel, these technologies comprise everything from sustainably produced bio-fuels and electric batteries, to on-board hydrogen systems that can generate electricity.

Australia’s response to these challenges is still in its infancy, but collaborations between road and rail associations, plus industry partners, has accelerated efforts to shape the national agenda. Within the next decade, it’s now expected that significant progress will be made by introducing green traction technologies. In the meantime, Network Rail Consulting is sharing leading work already completed in the UK with clients to give greater visibility on what can be achieved in the sector today in order to improve our climate tomorrow.



[Train crossing the Merivale bridge over Brisbane river, Australia]

**2020**

**JAN** Start of the Covid-19 pandemic and lockdown

**JAN** Bushfires cause devastation in Victoria and New South Wales, Australia

**FEB** Chris Heald appointed Regional Director, USA

**DEC** Covid-19 vaccine rollout

**DEC** Jeremy Westlake appointed as Chair



[Sydney, Australia]

# TRANSFORMING THE DIGITAL LANDSCAPE

---

**Future-proofing rail networks is imperative, and the digitalisation of systems is leading the charge for positive change. Here's the inside track on how one advanced technology project in Sydney is helping to increase capacity.**

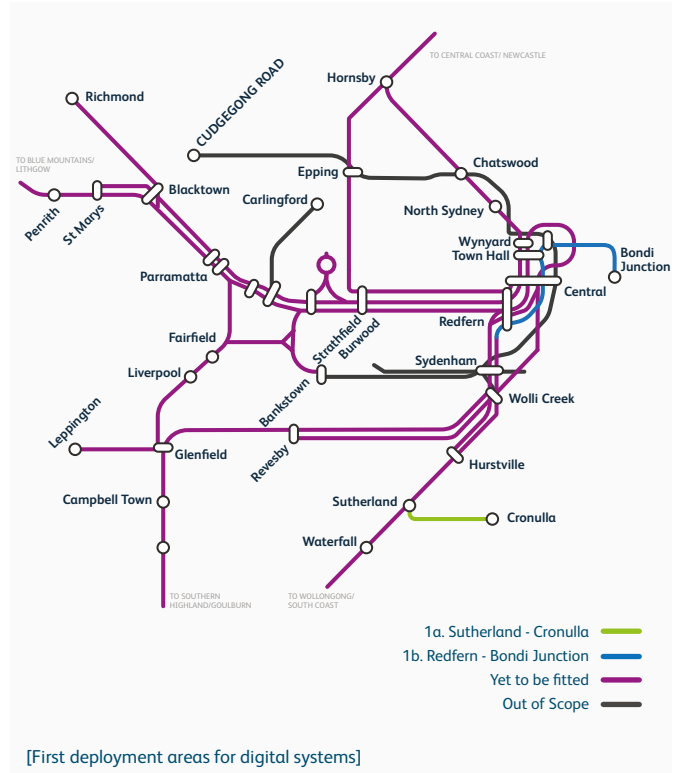
Today, the Sydney population stands at more than 5 million people. By 2036, this number is

predicted to pass 6 million. It's a picture echoed around the world: citizen numbers are rising at a rapid rate and the demand for rail services across cities is soaring. System advances, therefore, are required to simply keep up – and new technology proffers some proactive solutions. The Digital Systems Program (DSP) is a particularly good case in point. Offering world-class technology, this dynamic system





[Sydney Trains, Australia]



[First deployment areas for digital systems]

will transform Sydney’s rail network and provide customers with more reliable, high-capacity, turn-up-and-go services.

Indeed, over the coming years, DSP is set to replace all conventional signalling and train-control technology currently in place with modern, intelligent, internationally proven systems. This includes the introduction of Level 2 European Train Control System (ETCS L2) and a Traffic Management System (TMS), which have been designed to significantly improve reliability, increase capacity, and enhance the overall customer experience on Sydney’s railways.

In 2018, the NSW Government allocated more than \$800 million (AUD) towards the first stage of the program, which involves developing, testing and validating digital systems on parts of the T4 Line from Sutherland to Cronulla and Bondi Junction to Redfern. Construction commenced in the early 2020s, with ETCS L2 due to be progressively deployed to the rest of Sydney Train’s network over the next 10+ years.

Network Rail Consulting (NRC) was appointed the first major supplier on DSP, taking the reins as Systems Integrator. This made NRC directly responsible for integrating the new ETCS L2 and TMS systems into the existing Sydney

Trains network, as well as complementary works, including upgrades to the Digital Radio system and a new fixed telecommunication network.

As such, NRC provides Transport for New South Wales (TfNSW) with program engineering, operational readiness, systems engineering, system assurance, and testing and program-management expertise. It's an intricate operation, requiring a team of 50 specialists led by NRC, who are wholly integrated with the client-delivery team and supported by NRC's parent company, Network Rail.

At the beginning of the project, three distinct program phases for the first deployment areas were constructed, starting with System Definition. This included drafting project definition documents in collaboration with Sydney Trains (the operator) in preparation for the procurement of six or more separate sub-contract delivery packages. The procurement of these suppliers was then undertaken via a collaborative, early contractor-involvement process. This phase is now complete and System Implementation – which involves working as an integrated team with TfNSW and selected suppliers to develop and deploy operational standards – is underway. The final

phase will be Testing and Commissioning, which includes undertaking rigorous system integration and testing and operational readiness activities before going live with the new systems on Sydney's network.

It's a technically complex project with multiple suppliers and interfacing systems to navigate. As a result, significant effort is required to achieve true integration of all subsystems at both design and delivery phases, as well as involving multiple parties – including delivery partners and Sydney Trains – to implement the DSP. Ultimately, however, success will only be achieved if the entire system works as one.

Meanwhile, the in-cab ETCS L2 System will be the first of its kind in the country. Although operating successfully elsewhere in the world, it has not yet been implemented on any passenger railway in Australia, which is why TfNSW was understandably keen to draw on experience from across the globe. Consequently, today's project team is truly global, comprising suppliers from Europe, Asia and Australia. The benefit of this international approach ensures an 'off-the-shelf' solution can be configured for Sydney's network, creating a bespoke fit for the client. However, it also presents challenges associated with





[Melbourne train station, Australia]

the multiple languages and working cultures. These challenges have been overcome by focussing on collaboration at every stage in the lifecycle of the project – an effort recognised in 2021, when NRC won The Institute for Collaborative Working’s International Award for its role in bringing together all the partners on the program to successfully achieve their collective goals.

There are, of course, many more challenges ahead in the delivery and integration of DSP. However, the program principles developed

by TfNSW, and implemented by NRC and other suppliers, provide a vision for delivery that will transform the way trains operate in Sydney. What’s more, the passengers of the harbour city’s network won’t experience any disruption during the delivery phases of this largely technology program. What they will experience is the increased capacity, reliability and real-time information that the program provides – benefits that will be enjoyed by Sydney’s growing number of residents and tourists for decades to come.

NOV



Biden signs \$1 trillion bipartisan infrastructure bill into law

➤ 2022

JUN



Queen Elizabeth II's platinum jubilee – 70 years on the throne

FEB



Russia Invades Ukraine

SEP



The passing of Her Majesty the Queen Elizabeth II and Prince Charles ascension to the throne.



# REDEFINING THE DISTRICT

---

**With a wish list including the implementation of Automatic Track Inspection and an operational overhaul, Washington Metro looked to Network Rail Consulting's expertise to streamline its system.**

Only New York City Transit handles more passenger trips than the Washington Metropolitan Area Transit Authority (WMATA). Indeed, on 20 January 2009 – the day of Barack Obama's presidential inauguration – the network handled a remarkable 1.12 million passenger trips. It was a record for the system.

Yet, even outside of those extraordinary numbers, an average day is no small operation, with WMATA (more commonly known as the Washington Metro) servicing a ridership of more than 117 million people in 2021, equating to approximately 450,500 passengers per weekday.

And the figures stack up when you consider that the network was created by the United States Congress as an interstate compact between Washington DC, the state of Maryland and the commonwealth of Virginia. Today, WMATA provides a rapid-transit service under the Metrorail name, as well as a fixed-route bus service under the Metrobus brand

and paratransit service under the MetroAccess title – an impressive portfolio given it was a one-line service when it first launched in 1976.

Since then, however, the Washington Metro has grown to include six lines and 91 stations spanning a 190km route. The rail network is designed according to a spoke-hub distribution paradigm, with rail lines running between Downtown Washington DC and its nearby suburbs, while also making extensive use of interlining by running more than one service on the same track. In total, WMATA now operates six lines, including the Red Line (opened in 1976), Blue Line (1977), Orange Line (1979), Yellow Line (1983), Green Line (1993), and Silver Line (2014), plus 47 underground stations. It's a healthy expansion, but when Network Rail Consulting (NRC) first began its relationship with WMATA in 2018, it was clear further development was required. Namely, Washington Metro needed to improve safety and reduce revenue-hour disruption by introducing cutting-edge Automated Track Inspection (ATI) across its system.

## **Delivering transformative technology**

Drawing on NRC's experience in developing and implementing world-leading automated track inspection vehicles for more than 32,000km of



[Washington DC Metrorail system map]



[Washington Monument and Capitol Building in Washington DC, United States of America]



[Sacramento, United States of America]



[Washington Metro, United States of America]



railroad in the UK, WMATA wanted to deliver a complex set of project outputs. These included defining the required data collection methods to augment and replace existing visual inspection requirements; generating a scope of work for the ATI vehicles; and compiling extensive specifications and requirements for the entire ATI system, including whole-life calibration and maintenance.

In response, NRC built a linear referencing tool to identify key elements of the infrastructure to support ATI implementation, which also allowed for display of chainage-based data. This enabled NRC to complete several tasks, including map geometry data collected by WMATA's existing track; geometry vehicle and reported defects from the agency's asset-management system to justify the inclusion of specialised measurement tools; validate the ability to cover the system in five individual 'runs', allowing WMATA the flexibility to survey the system at increased intensities; and provide a report on location, tagging requirements to correct location-data drifts in underground sections. Today, Network Rail Consulting's ATI work is still ongoing and, following a number of scopes of work changes, it is now anticipated that ATI will be introduced on the Washington Metro system at some point in 2025.

### Updating the Rail Control Centre

In other engagements, NRC has provided operational subject-matter expertise, with a team drawn from both its local and UK resources to assist WMATA on its journey to overhaul the Rail Operations Control Centre

(ROCC) – a two-year project now nearing completion. Starting the project in 2020, NRC became heavily engaged in five key areas of focus, including leadership and performance, roles and accountability, process culture, training, and talent management – each one considered a building block to transforming the ROCC into a high-performing unit in a safe, efficient manner that, crucially, also had team buy-in. Indeed, this undertaking had previously been the focus of a number of Washington Metrorail Safety Commission (WMSC) reports, which necessitated a radical change to how the ROCC was structured and operated.

Elsewhere, NRC's experts have helped to establish key metrics to ascertain performance, outlined clear incident management and response protocol, and overhauled ROCC documentation as part and parcel of the transformation effort. Providing subject-matter expertise around other areas within the operational environment at Metro has also become part of NRC's remit, with additional activities including the review and creation of new operating procedures for the introduction of a new Power Desk, as well as critical support for Roadway Worker Protection and Exclusive Track Occupancy processes.

When combined, these varied elements of expertise enable Network Rail Consulting's teams to truly demonstrate their extensive railroad experience, as well as provide the support that Washington Metro deserves as it continues to develop its operational control and deliver outstanding passenger service.



[GO train passes through downtown Toronto Ontario, Canada]







# FUTURE FACING

---

The impact of COVID-19 has been widespread and devastating, with more than 6.5 million deaths recorded globally and a significant economic shock still gripping international markets. One of the biggest sectors to be affected is travel, particularly public transport, resulting in huge financial losses for rail and transit operators, necessitating government interventions around the world. In the UK alone, the financial support is estimated to be more than £18 billion.

Understandably this has resulted in many questioning the need for additional rail capacity, whether that be new high-speed rail or metro systems. However, while the pandemic may have dented travel demand – and potentially permanently changed commuter patterns – the need for frequent, reliable and cost-effective public transport will not diminish in the medium term due to the urgent need to address climate change. Lockdowns may have given our oversubscribed public transport systems a temporary respite, but it would be foolish to think that improved public-transport solutions implemented at scale will not help to tackle the environmental challenges now facing every corner of the globe.

Nevertheless, this enforced pause – and the associated financial pressures – give transport authorities the opportunity to reassess working practices to improve efficiencies, reduce costs and improve customer experience through improvements in reliability and punctuality of services. The impact of evolving travel patterns can also be addressed, with less demand for peak services and greater demand for off-peak options becoming a trend to be considered. Overall, implementing key practice changes may allow for better economic use of the infrastructure and rolling stock, as peak-hour demand is spread across the day, but may impact current maintenance practices requiring more innovation and greater use of technology.

Increasingly, use of automation – both above and below rail, rolling stock and throughout stations from payment to platform – will also improve efficiencies by making greater use of technologies to improve safety and service. This does, of course, require a commensurate increase in security – after all, cybersecurity domains with improved levels of visible and invisible surveillance are critical to the success of automation. Artificial intelligence in both domains will also need to evolve further than ever imagined to assist the most

effective application of responses to physical or virtual breaches. However, given the high volumes of data being collected that require interpretation, this will ultimately lead to even greater innovation.

Major new rail construction projects with their inherent potential for massive overruns will no doubt come under increased scrutiny as never before as politicians seek to balance the books. These issues will undoubtedly push the debate to, “how do we increase capacity to accommodate future demand and improve customer experience at a lower cost”. The benefits of digitization of the rail system, particularly enhanced signal control systems such as ETCS Level 2 and 3, will be obvious.

Another trend that is gathering pace is the recognition of the need for robust Systems Integration. With the disaggregation and scale of projects growing, the interdependencies between different elements of the project, separated by contractual or discipline boundaries, are becoming more critical to

delivery of the final outcomes. Most of our clients around the world are realising that failing to do this well places their projects at risk of cost and time overrun, and invariably turn to our experience and expertise to ensure overall project success.

Network Rail Consulting will continue to develop and evolve to bring the very best of British rail expertise to international clients, by not only utilising our unique relationship with Network Rail experts in the UK, but combining that knowledge with local specialists who can offer regional context and strong local networks. What’s more, we’re committed to becoming a more diverse company that reflects the diversity of the cities we work in, and we will continue to invest in our graduate programme, champion new talent, and support the railway professionals of the future.



[Rendering of future California High Speed Rail Train, United States of America]

THANK YOU TO ALL NRC STAFF PAST AND PRESENT, WHO  
CONTRIBUTED TO OUR GLOBAL SUCCESS STORY.



#### DISCLAIMER

Due to the historical nature of many aspects of this book, we have been unable to fully verify some content. We appreciate all the help and support we have had to ensure accuracy wherever possible.

The views expressed in this book are not necessarily those of Network Rail Consulting (NRC). On no account may any part of this book be reproduced without the permission of the copyholder and publisher, application for which should be made to the publisher.



# CREDITS

---

## **Network Rail Consulting:**

Adam Boughton, Andrew Hutton, Andrew Noble, Andrew Mitchem, Barny Daley, Cameron Downey, David Ramsbottom, Derek Friend, Graham Beal, Helen Speirs, Janey Bell, James Heron, Joseph Chroston-Bell, Maegan Bell, Mark Pettigrew, Nigel Ash, Paul Hebditch, Ryan Scott, Simon Whitehorn and Steven Ivey.

## **Special thanks to:**

Peter, Lord Hendy of Richmond Hill

## **Written words - additional editorial:**

Nicola Moyne

## **Design, project management and production:**

Chantel Angland-Banks (Luna Creative Communication)

## **Pictures:**

Adobe Stock, Dreamstime, iStock, Network Rail Consulting archive and Shutterstock

## **Printed by:**

Gavin Martin Colournet

## **More information:**

[www.networkrailconsulting.com](http://www.networkrailconsulting.com)

# Our Offices:

Boston  
Brisbane  
London  
Melbourne

New York  
Riyadh  
Sacramento  
San Francisco

Sydney  
Toronto  
Washington D.C.

