

Purpose

The Environmental Sustainability Strategy commits Network Rail Regions to developing long term climate change 'Adaptation Pathway' strategies and investment plans by the end of CP7. In addition to this internal commitment, there are a number of external expectations for infrastructure operators to develop long term climate change strategies including from the Parliamentary Joint Committee on National Security Strategy, the forthcoming Resilience Strategy and the Third National Adaptation Plan. Regions are required to include funding for development of these strategies within their CP7 investment plans.

This document provides information to support the development of these long term climate change adaptation strategies by providing an overview of what adaptation pathways are, the benefit of undertaking this work within Network Rail and an overview of the broad development process. A second guidance note will outline the detailed methodology for undertaking the work.

1 Overview

Development of the long-term strategies should be done through stakeholder engagement and analysis to identify climate change impacts in the region over the next 100 years and options for managing the risk in different parts of the network. The work should be led by a project manager who can coordinate the workshops and internal/external input required. In some locations, detailed modelling of risk and options could be undertaken to inform choices for future management of the railway. The strategies should include high level economic analysis to give an indication of the likely cost of different options to inform future investment plans. The initial outputs of the work should be complete in advance of the start of CP8 planning in order that the early phases of work can be included in the strategic business plans for 2029 – 2034.

2 What are Adaptation Pathways?

Climate change is projected to have a wide range of impacts on the railway and there is no single solution to creating resilience across the network. The adaptation pathways approach allows decision makers to plan for, prioritise and stagger investment in adaptation options with trigger points and thresholds helping to identify when to revisit decisions or actions. It is considered to be global best practice in adaptation planning as it supports strategic, flexible and structured decision-making.

This approach enables Regions to take adaptation actions at the right time, avoiding the cost of acting too early or too late. The underlying concept is straight forward and based around two questions:

1. Are there climate change impacts that render current assets or services inefficient, ineffective, or redundant (i.e. the climate change relevant thresholds beyond which things do not work)?
2. At these thresholds, what are the best options for enabling the Region to continue to meet its objectives?

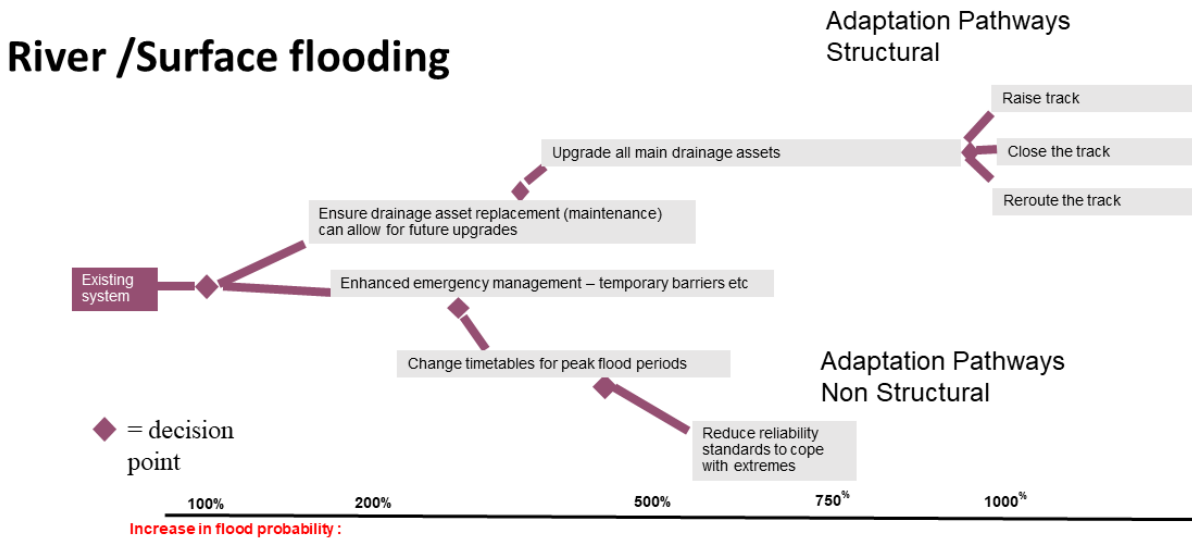
By repeating these questions at different levels of climate impact, the team can construct sequences of actions, or "pathways" that keep Regions on track to deliver their objectives through to 2100. This process produces a decision tree that offers managers options as they plan for action (see *Figure 2.1*).

Decision trees are designed to offer a range of credible options. Managers can choose a pathway option to follow based on their best judgement. As time passes, monitoring of changing climate impacts and the effectiveness of the pathway actions can support managers to review whether to continue with the chosen pathway or shift to an

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alternate one in order to maintain acceptable levels of risk and performance. This provides insight to support asset management and strategic planning activities today and in the future.

Figure 2.1 Example of pathways to manage flooding in a particular location



Case study: Understanding the impact of the Shoreline Management Plans on the railway across Wales & Borders

Wales & Western Region has done an assessment of the impact of Natural Resources Wales Shoreline Management Plans on railway assets. In some areas, particularly along the Cambrian Coast, the plans mean to discontinue maintenance of coastal defence assets. This will lead to sections of railway becoming the ‘first line of defence’ from the sea when current barriers area breached. The railway has not been built as a coastal defence and this leads to a series of questions and options for how we manage the railway in the future:

1. Rebuild the railway as a coastal defence – is this done reactively following storm damage or proactively to prevent future impacts?
2. Move the railway further away from the coast – this could potentially lead to communities at greater risk if no longer protected by the railway
3. Stop using sections of railway and transport people by road
4. Consider the need for a railway in the area if communities are forced to abandon towns such as Fairbourne.



These are complicated issues that the railway cannot make in isolation. It is important to bring together a range of stakeholders including local government, other infrastructure operators (e.g. power, roads, flood defences etc) regulators to consider the range of options and select a pathway to a future which achieves the objectives of all parties. Adaptation pathways is an approach which enables this to be done in a structured manner.

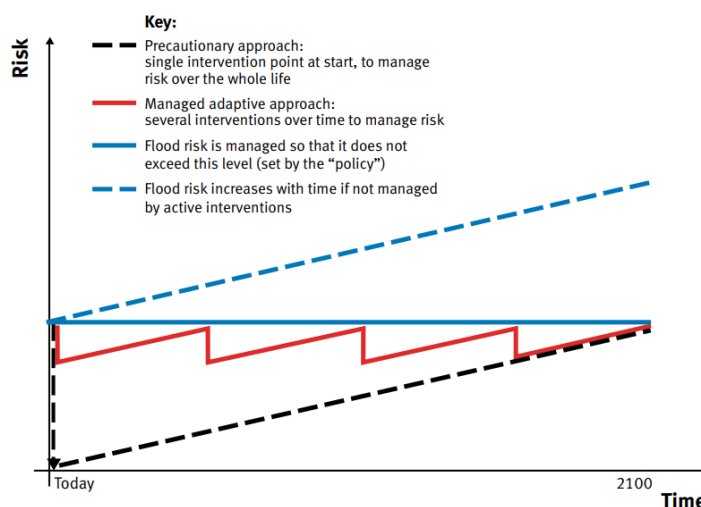
For further information see: [Understanding the impact of the Shoreline Management Plans on the railway across Wales & Borders \(networkrail.co.uk\)](http://networkrail.co.uk)

The adaptation pathways approach aims to help identify the most appropriate risk management options for a particular area.

Figure 2.2 shows how flood risk increases over time if not managed but it can be maintained at a chosen level through active intervention, either a single scheme to manage risk over the life of the project or a series of interventions over time.

The analysis to be undertaken during the course of the adaptation pathways development project will help identify these pathways for different parts of the network and the timing of future interventions.

Figure 2.2 Managing flood risk through active intervention (Environment Agency TE2100)



Developed by the Environment Agency through the [Thames Estuary 2100 project](#) which assessed options for the future of the Thames Barrier in London, the approach has been tested and expanded through projects around the world and is considered best practice in adaptation planning. The approach has been standardised in guidance from the British Standards Institute.¹

3 What is the benefit of adaptation pathways?

Some of the key benefits of an adaptation pathways approach include:

- These plans will lay out options for dealing with long term strategic challenges such as coastal realignment and will enable action to be taken at the optimum time, reducing the costs of acting too early or too late – not all decisions must be made immediately and options can remain on the table.
- By analysing vulnerability and options at a local/catchment level, this approach allows for a granular understanding of the priority and cost of weather and climate change resilience investment for CP8 and the longer term
- By setting out plans for infrastructure resilience in the long term (looking up to 100 years in the future), short-medium term actions can form the building blocks towards achieving long term goals.
- Helps focus and prioritise control period planning based on a solid evidence base and agreed priorities across a wide group of rail industry and external stakeholders.
- Enables a more joined-up, holistic, systems approach to railway, transport, infrastructure and economic planning as a range of relevant stakeholders come together to explore options
- It promotes adaptive management enabling adaptation plans to be ongoing by incorporating flexibility and adaptability into the decision-making process.

The Great British Railways Transition Team’s Long Term Strategy for Rail proposes broadening Regional level adaptation pathway strategies developed through this project to include wider discussions across the whole rail industry and to coordinate stakeholder discussions at a more strategic, system of systems level building on the local level analysis. This will ensure that development of these strategies is streamlined and efforts in individual organisations are brought together to deliver maximum benefit for the whole of Great Britain.

¹ [BS 8631:2021 Adaptation to climate change. Using adaptation pathways for decision making](#)

4 How to develop Adaptation Pathways

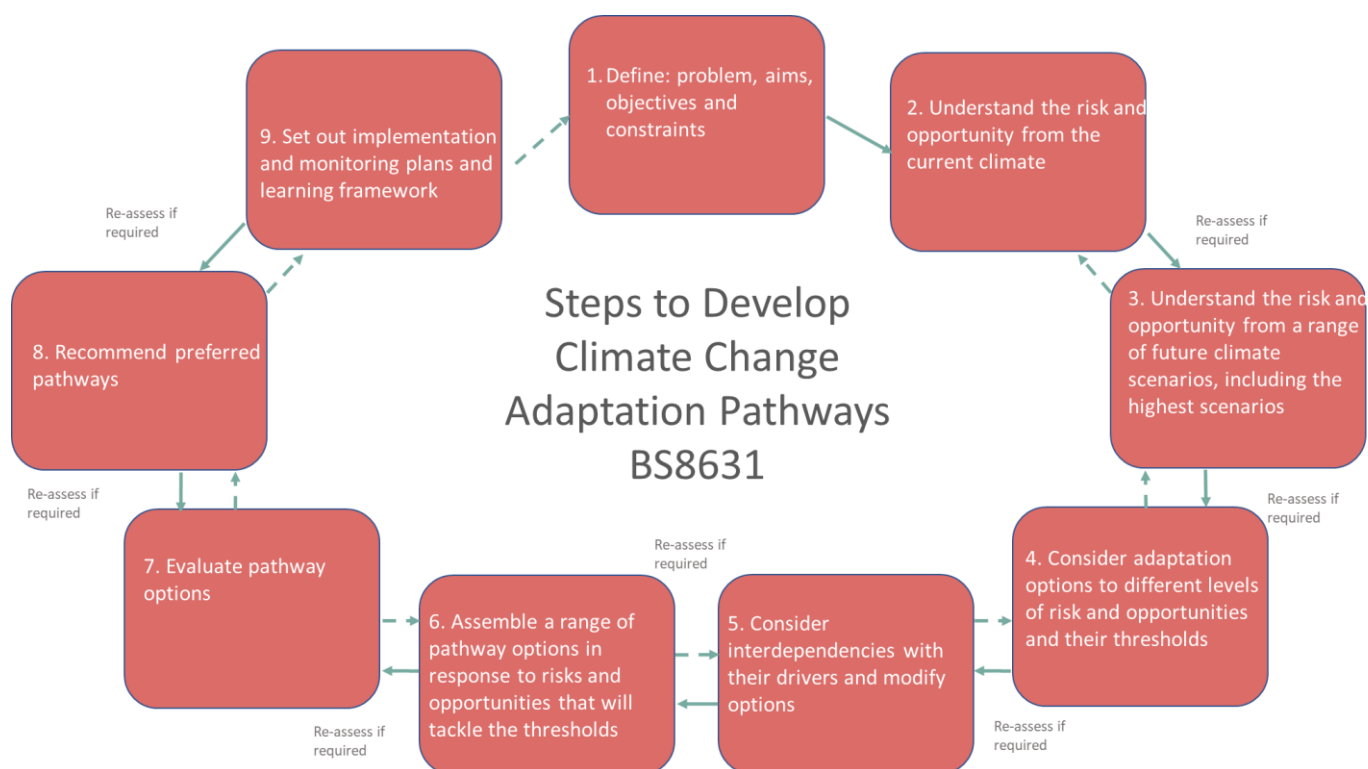
4.1 Overview of approach

The strategy will be developed using the Adaptation Pathways approach in line with standards:

- BS8631:2021 “Adaptation to climate change. Using adaptation pathways for decision making. Guide”
- ISO14090:2019 “Adaptation to climate change — Principles, requirements and guidelines”

An overview of the steps to develop the adaptation pathways as outlined in the Standards is in *Figure 4.1*.

Figure 4.1 Steps to develop climate change adaptation pathways



Network Rail Technical Authority is working with the authors of these standards to develop a railway specific methodology for screening and assessing risks and options. This detailed guidance will be available in the first half of 2023. The work involves the following broad steps which will be expanded on in a separate detailed guidance note on how to deliver the adaptation pathways project within Network Rail.

- **Step 1: Screening and prioritisation** – divide network into sections and screen for risk to prioritise segments of the network/lines of route including all associated activities and assets (referred to as route sections) requiring full adaptation pathway (AP) assessments and those needing only a high level review of risk.
- **Step 2: Regional AP workshop** – peer review of screening and prioritisation and agreement of the level of detail of analysis for different parts of the network

- **Step 3: Scoping and planning AP Assessments (APAs)** – detailed project planning to undertake the work required to undertake AP assessments for selected route sections including locations requiring detailed modelling
- **Step 4: Adaptation Pathways Assessments** - undertake APAs for individual route sections to the levels of detail agreed. Produce decision trees and supporting text for relevant hazards for each route section.
- **Step 5: AP results analysis** - assemble individual route section APAs into a coherent Regional whole and come up with strategic planning options. This includes view of all APA's from a systems perspective. The Step can also refine the options analysis and identify preferred options.
- **Step 6: Economic analysis and investment planning** - model costs associated with different preferred options to identify long term benefits.
- **Step 7: Engagement** - to discuss results and options with Government and ORR to share understanding of timing and cost of options and develop support for the investment plans so that they can be approved.
- **Step 8: Strategic Planning** - conduct a Regional network study to integrate preferred options into strategic plans including CP8 SBP and future iterations of whole industry strategies.
- **Step 9: Produce strategy document** - draft and agree report for publication

4.2 What analysis is involved in the Adaptation Pathways Assessment?

The adaptation pathways approach explores a wide range of options with a view to identifying the optimal solution for a particular area. This is done through extensive collaboration and stakeholder engagement to identify priorities in a local area and ensure that all organisations' objectives are considered. For example:

- Identification of strategic corridors that may be single points of failure and which need to be resilient to enable other strategic objectives to be delivered.
- Areas where transformation is required to maintain resilience can be identified e.g. coastal areas or low lying flood plains like Somerset Levels where maintaining services in their current location/form will be untenable.
- Interdependent risks can be addressed by looking at the rail network as a national infrastructure system of systems coupling with electricity, flood defences, roads and other infrastructure.
- Partnership opportunities with others looking to invest in resilience such as local councils and flood risk authorities (e.g. Environment Agency). This would share the cost of schemes and maximise the associated benefit.
- Horizon scanning to understand the challenges that are coming and enabling quicker responses to changes.
- Linking rail planning to spatial growth plans for sub-regions meaning new housing can be concentrated in locations that do not depend on cars for every trip and flood plains can be avoided.
- The future role of the railway can be considered with suitable alternatives such as bus rapid transit for rail routes that have less strategic value and are vulnerable to climate change.

5 Delivering the project

5.1 Project Management

In order to deliver the Adaptation Pathway strategies, the following action is required before the end of CP6:

1. Secure funding to support delivery of this work within the CP7 Strategic Business Plan

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2. Identify project management resource with the ability to lead this work for 2 – 4 years
3. Once the guidance on the methodology is available, prepare initial project plan for delivery of Steps 1 – 3 above ready for work to start in April 2024. The plan for Steps 4 – 9 will be developed during Step 3.

Depending on resource and time available, initial work on defining the scope and developing a stakeholder map can begin in advance of full project initiation.

The Project Manager will be responsible for the implementation of the project as a whole and running the Adaptation Pathways Assessment process for selected route sections. They should have the following capabilities:

1. Strong understanding of the Regional network and climate vulnerable assets and services
2. Good project management skills
3. Good communication skills with both internal and external Interested Parties
4. Able to generate enthusiasm in the group

Ideally they would have:

- Experience of commissioning and using expertise in: economic analysis, social & environmental impact analysis, climate modelling.
- Business case development experience
- An understanding of climate change and the adaptation pathways process

5.2 Stakeholder Engagement

The project will require a wide range of expertise and a significant amount of effort. It will require a clear strategic objective. Not all of the expertise or capacity to do this work lies within Network Rail. It will also require a governance structure which ensures that the wealth of expertise, detail and effort applied to the project remains focused on the strategic objectives of the Region and operates with the agreed resources. A summary of the different roles/groups is provided below, further detail will be provided in the methodology guidance note.

The dedicated Project Manager will be supported by four key groups:

Group	Role/participants
Steering Committee	<p>The Steering Committee will be responsible for ensuring that:</p> <ol style="list-style-type: none"> 1. The adaptation pathways assessment process is implemented in line with these guidelines 2. Climate change resilience matters of Regional significance are recognised and addressed 3. Climate change resilience matters of strategic significance beyond the Region are recognised and addressed <p>Its membership will include the following capabilities: senior Regional management from the following functions: asset management, operations, strategic planning and business planning. This committee will be able to draw on external advice where required.</p>

Internal Expert Group	<p>The composition of the Internal Expert Group will be agreed between the Steering Group and Project Manager.</p> <p>It should include asset managers and operations leads or their representatives with knowledge of weather impacts on the railway across all asset functions. The Group should also include a strategy specialist and a business planner.</p> <p>Group members will use their technical expertise and experience within the Region to advise on: vulnerable assets and services, climate risk levels, implications for safety and performance and initial thoughts on responses.</p>
External Advisory Group	<p>It is recommended that the Project Manager and Internal Expert Group is supported by an External Advisory Group. This would be made up of external specialists with complimentary skills to help understand how impacts can change with climate change. This group could include representatives from Environment Agency, SEPA, Natural Resources Wales, Lead Local Flood Authorities and Local Council flooding advisors, specialists in climate impacts on rail assets.</p>
Contracted specialists	<p>Much of the work to conduct the adaptation pathways assessments may require specialisms and time not available to Regional staff. Specialist areas may include: adaptation pathways planners; asset and service climate resilience specialists; modellers; economic, social and environmental impact specialists, along with other capabilities as required. The project manager should consider what additional expertise is required when setting up the stakeholder groups.</p>

5.3 Timing and funding requirements

It is expected that this project will take 2 – 4 years to complete. The amount of time required depends on the level of detailed analysis and modelling required to understand the vulnerability and adaptation options for different route sections within step 4 and subsequent analysis in steps 5 and 6. The level of analysis and modelling for each route section will depend on the funding available.

Work up to the end of Step 6 needs to be complete in advance of the start of CP8 planning (around 2026). The first five years of the long-term adaptation pathways strategies will be fully integrated into CP8 plans for 2029 – 2034. Discussions on options and agreement of the longer-term actions can take place during development of CP8 plans with a view to the final adaptation pathways strategies being published by 31 March 2029.

The cost of developing the strategy depends on the level of detailed modelling needed to evaluate options. A minimum of £0.5 – £1m should be allocated for project delivery (project management, workshop facilitators, expert climate change input, overarching economic analysis, meeting logistics, document design and publication etc). Any additional funding can be allocated to detailed analysis for individual route sections e.g. modelling of flood risk and different asset design options, coastal erosion risk and options to relocate the railway in particular locations etc.

The project manager and steering committee will define requirements based on the priorities within the Region and funding available.

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Appendix Further reading on adaptation pathways

Title	Author	Comment
BS 8631:2021 Adaptation to climate change. Using adaptation pathways for decision making. Guide	BSI 2020	A standard on the application of the adaptation pathways https://standardsdevelopment.bsigroup.com/projects/2019-00219#/section
Adaptationpathways.net		A website established by adaptation pathways practitioners from throughout the world to promote, inform and support those adopting the approach for climate adaptation planning https://www.adaptationpathways.net/
How do you adapt in an uncertain world? Lesson from the Thames Estuary 2100 project.	Reeder & Ranger, 2011	Journal article detailing the methodology developed and applied in the TE2100 Project. http://climatelondon.org/wp-content/uploads/2019/10/wrr_reeder_and_ranger_uncertainty.pdf
Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world.	Haasnoot et al., 2013	Journal article detailing the DAPP (Dynamic Adaptive Policy Pathways) approach. Although conceptual, it largely describes the approach used in the Dutch Delta Programme. https://www.sciencedirect.com/science/article/pii/S095937801200146X
A User's Guide to Applied Adaptation Pathways Version 1 (SEED Consulting Services and CIRSO)	Siebenritt & Stafford Smith, 2016	A clear and concise guide to adaptation pathways, with useful definitions and case studies. The focus of 'applied' adaptation pathways is the participatory process used. Focus is on coastal adaptation to climate change. http://climatelondon.org/wp-content/uploads/2019/10/User-Guide-for-Applied-Adaptation-Pathways.pdf
Adaptation Pathways: a playbook for developing robust options for climate change adaptation in Natural Resource Management.	Bosomworth et al., 2015	Useful guide, with good definitions and explanations. Focus is on natural resource management. Commissioned by Southern Slopes Climate Adaptation Research Partnership. file:///C:/Users/User/Downloads/SCARPAdaptationPathways-aPlaybookFINAL.pdf
Adaptation pathways in practice: current challenges and a way forward	Bloemen et al., 2017	One of very few post implementation reviews. Includes representatives from Delta Commission (Netherlands), Environment Agency (UK) and UNESCO-IHE

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Adaptation pathways in practice: Mapping options and trade-offs for London's water resources	Kingsborough et al., 2016	Adaptation pathways approach that complements existing water resource management approaches file:///C:/Users/User/Downloads/SCS-S-15-00539_Assubmitted_15.12.04.pdf
Urban climate change adaptation pathways: demonstration of an integrated risk based approach in London.	Kingsborough et al., 2017	Only example of a functional City analysis. Presents much of the London pathways examples.
Deltares Dynamic Adaptive Policy Pathways	Haasnoot & Jeuken	Introduction to Adaptive Pathways, Including 5 Minute video that uses a metro map as an analogy to explain adaptive pathways. https://www.deltares.nl/en/adaptive-pathways/
South West Climate Change Portal Adaptation Pathways page		Australian website with useful introductory text explaining how adaptation pathways are used in climate change adaptation. http://www.swclimatechange.com.au/cb_pages/adaptation_pathways.php
What is a Pathways Approach to Adaptation?	Coast Adapt, 2017	Helpful text and diagrams/graphs used to explain the concept and how it has been applied in various case studies, from Australian organisation CoastAdapt. https://coastadapt.com.au/pathways-approach
Adaptation Pathways – From Concept to Practice	ASSAR Project, 2016	In-depth 2-hour YouTube video from ASSAR Project, featuring presentations and discussion on Adaptation Pathways from experts. https://www.youtube.com/watch?v=WmRCCL6s7OM