WRCCA decision making tool
User Guide

Draft

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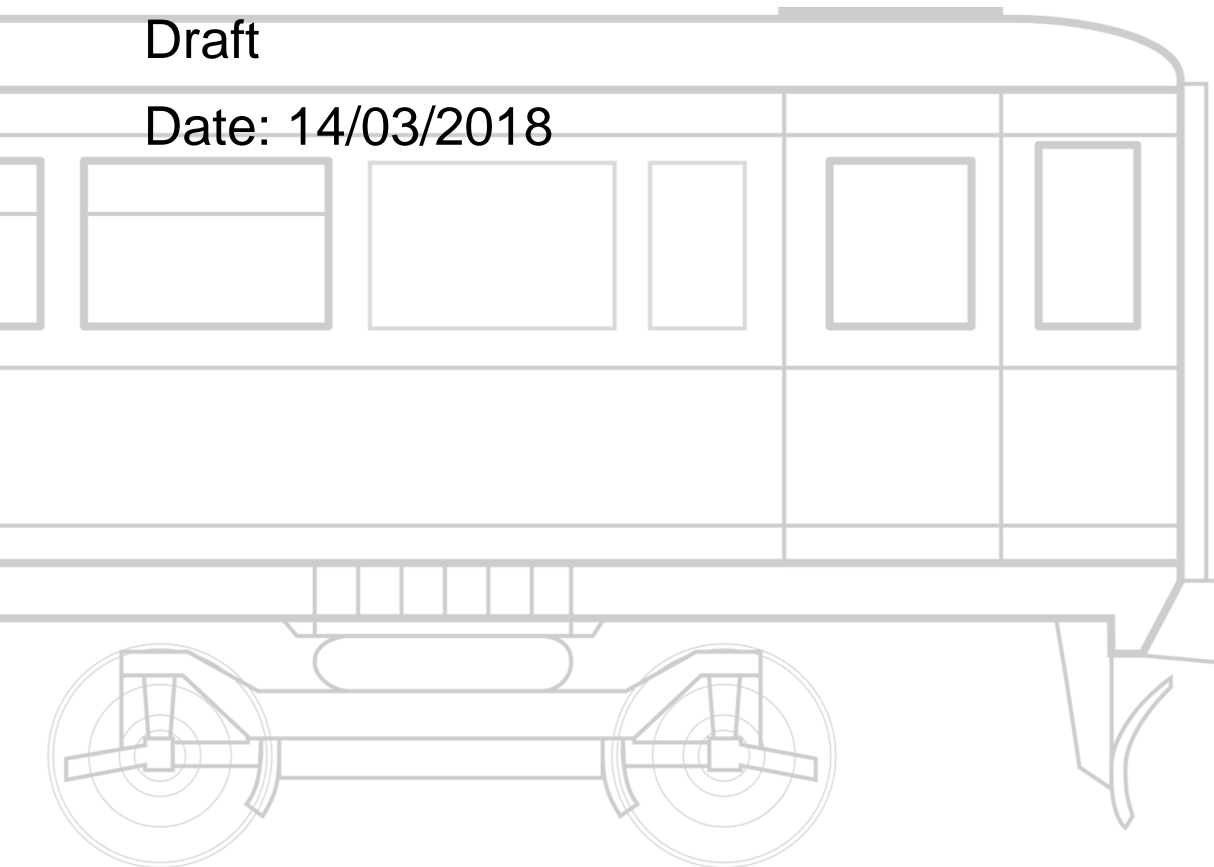
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Part A: **Introduction**

A.01   Model overview

The Weather Resilience and Climate Change Adaptation (WRCCA) decision making tool is an economic appraisal tool to be used for prioritising schemes which have an impact on the weather resilience of Network Rail assets and therefore the delivery of the planned rail services. The tool uses scheme cost, schedule 4 & 8 payments and maintenance & repair cost inputs to generate measures of financial rate of return and social welfare.

Social welfare impacts are measures of non-financial benefits of train service reliability which are included in the appraisal of investment by public sector bodies such as DfT. These include the willingness to pay for travel time savings, impacts on other modes and the environment. It is expected that some initiatives that do not have a case financially within their implementation control period may have a case across their asset lives financially or in social welfare terms.

The tool will prompt users to state the 3rd party contributions to Network Rail scheme costs/Network Rail contributions to 3rd party scheme costs.

A.02   Model usage

The tool will be used by Network Rail's route teams to sift and prioritise potential schemes according to likely value for money, and submit to funders, copying the central WRCCA team for review. This should take place at the option selection phase, but could be used at any grip stage to prioritise/sift options. It is expected that route asset manager, sponsors or designers would complete the inputs for the tool.

The decision making tool assesses schemes that improve reliability of the train service. The table below sets out examples of types of scheme and whether the tool is appropriate for assessing them:

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	Scheme outputs	Examples	Decision making tool appropriate?
A	An improvement to the punctuality, reliability and resilience of the timetable to adverse weather	Infrastructure upgrade/renewal which could improve weather resilience	Yes
B	Other outputs (e.g. capacity, journey time), but with incremental variations that improve reliability (as per **A**, above)	A capacity scheme with variations that could improve weather resilience of assets	Yes, but only to be applied to the incremental cost and outputs associated with resilience
C	Large transformational schemes that have significant other impacts in addition to resilience	New routes that avoid flood prone areas, but also impact journey times Schemes that enable significant train service changes as well as improving scheme reliability	No, use a boutique appraisal
D	Schemes which have no reliability benefit	Pure capacity or journey time scheme	No

Scheme owners should assess the potential for weather events to impact on their scheme (the assets it affects, its design and delivery and asset operation) to identify which is the most appropriate type. It should not be assumed that type D is the default.

Schemes should be targeted at all assets on a route of a similar life/level of degradation. Schemes should not be targeted at just the assets that happen to have failed in the past and weather impacts divided over only the assets that did fail, if the similar assets would have the same ex ante probability of failing.

The case for a scheme does not, and is not intended to, depend on the economic case alone. Therefore the case for investment in weather resilience measures should be based upon a multi-criteria assessment of the scheme which also includes further considerations such as safety and reputation.

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Part B: **User Inputs**

The 'Scheme inputs' sheet contains all of the fields that a user must complete for the appraisal. The fields are separated into 4 sections:

- Scheme details

- Years

- Scheme Capital cost

- Weather Event expected impact

Input fields are highlighted yellow and calculated fields are highlighted in white. Explanations of the input fields and error checks are shown to the right.

B.01   Scheme details

This section includes details about the scheme and appraisal that are shown on the output sheet, but not used in calculations:

- Scheme name

- OP number

- Route

- Date of appraisal

- Appraisal name

- Appraiser email address

B.02   Years

In this section, users enter the opening year of the scheme and the scheme's asset life. The benefits of the scheme are appraised over the asset life of the scheme, so these inputs determine when the benefits occur.

The end year of the model is 2170, so no benefits are counted beyond this year.

A formula looks up the control period that the scheme opens in. The output sheet reports the financial impact of the scheme in its opening control period, as well as over its asset life.

B.03   Scheme costs

In this section, users enter the capital and maintenance costs of the scheme. It is important that only the costs of the scheme that relate to weather resilience or train service reliability are entered. The decision making tool will not calculate benefits for non-weather

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resilience/reliability elements of the scheme. For example if there is a capacity scheme that has an incremental variation that also improves weather resilience, only the cost of the weather resilience variation should be input. The table below sets out the input fields with explanations:

Input field	Explanation
Scheme capital cost input price base	The price base for the capital and maintenance entered by the user. Note, for example, that a scheme estimated in 2015Q3 prices should be entered as "2015"
Mid-point year of scheme construction	The middle year of scheme build. The model will inflate costs and discount from this year
Anticipated Final Cost - Public Sector (i.e. DfT/Network Rail) contributon (excluding risk/contingency and escalation)	DfT/Network Rail contribution to the Anticipated Final Cost of the weather resilience portion of the scheme. The cost entered should exclude risk/contingency, which will be looked up by the spreadsheet based on the GRIP stage entered below. This cost entered should exclude escalation. The model will inflate costs to the mid-point year of construction in line with Webtag.
Anticipated Final Cost - 3rd party contribution (excluding risk/contingency and escalation)	3rd party (non-government transport budget) contribution to the scheme. This will be reported on the output sheet but will not be used in calculations.
Grip Stage	Enter the grip stage of the estimate
Contingency (Optimism bias applied)	The spreadsheet looks up contingency rates base on the grip stage, in line with Webtag.
Capex estimate document name	Enter a document reference for the capex estimate, for the audit trail/future reference.
Annual scheme maintenance costs	Incremental annual asset maintenance cost associated with the weather resilience component of the scheme, for the input price base year.

B.04   Weather Event expected impact

In this section, users enter the impact of the resilience scheme on schedule 8 & 4 costs, maintenance and repair costs and other costs. There are two types of input methods - the anticipated cost input and the event based input and inputs that are common to both input methods.

B.04.01   Common inputs

These inputs need to be completed regardless of whether the event of anticipated cost based input is used. The table below sets out the input fields and an explanation:

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Input field	Explanation
Weather input price base	The prices base for the weather impacts – schedule 4 & 8 costs and other costs
Affected train service group	Schedule 4 & 8 costs need to be entered by train service groups. This table should be completed with the train service groups that schedule 4 & 8 costs will be input for. Up to 5 different train services can be entered. For example, a scheme affecting the Bromsgrove corridor in Birmingham may split the schedule 8 costs between EJ03, EJ04 and EH01. The train service groups and TOCs can be seen in more detail in the 'Benefit per Revenue All Trains sheet'. This sheet contains a library of ratios of user and non-user benefits to revenue for different train service groups, which has been compiled by the economic analysis team. User benefits relate to the 'willingness to pay' or consumer surplus from train service improvements, while non user benefits relate to indirect benefits of a train service impact including road decongestion, greenhouse gases and accident reduction.
Passenger demand growth rate	Select a rail industry sector to return the appropriate demand growth rate for benefit and revenue extrapolation. The growth rates have been produced using PDFH 5.1 elasticities at the sector level.
Average annual growth rate selected (over 20 years from scheme opening)	Formula returns average growth rate selected
Input method	Selects the weather impact input methodology to be used (discussed further below).
Schedule 4&8 estimate document name	Enter a document reference for the estimates, for the audit trail/future reference.
Cost saving estimate document name	
Weather likelihood document name	

B.04.02   Anticipated cost input method

The anticipated cost input method contains two inputs:

- a weather event "frequency factor", representing the combined increase in both likelihood and severity of weather events in the future

- expected annual costs with and without the scheme based on the current year's event likelihood and severity

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It is expected that this input will be used for weather events that are relatively frequent, so annual average costs are readily available.

Frequency factor

For each future year, enter a factor to represent the combined increase in frequency and severity of weather events (mitigated by the scheme) as a result of climate change.

For example, if by 2080 the frequency of weather events is anticipated to double (relative to today's rate), and each single occurrence is anticipated to increase in severity/duration by a factor of 50%, then enter "3.0" (1.00 x 2.00 x 1.50)

Two guidance notes are currently being produced by the Network Rail climate change adaption team which should be referenced when determining the value of the frequency factor to be used:

- Impact assessment guidance – sets out how to consider weather resilience in asset design/renewal and option selection
- Climate Change scenario guidance – sets out which climate changes scenarios to use in weather impact forecasts

Expected annual cost

In this section the schedule 4 & 8 and other costs should be entered with and without the scheme. If the scheme does not fully mitigate the weather resilience risk, there will remain costs in the with scheme inputs. If users prefer to enter cost savings rather than with and without scheme costs, enter the cost savings in the without scheme cost and set the with scheme costs to zero.

In the current year column, enter the expected annual cost scheme (based on the current year's likelihood and severity of weather events). Costs should be entered in the weather impact price base selected above. Formulas in the future year columns will uprate this cost based on the weather event frequency factor entered above, and the calculation sheets within the model will uprate the costs for demand growth and the pricing of rail fares.

For schedules 4 & 8, costs need to be entered by train service group (as this is used in the estimation of economic benefits). Leave the box blank is the train service group is ""N/A"".

The Network Rail climate change adaption team are investigating the creation of a schedule 4 and 8 cost library and how this can be linked to asset failure.

B.04.03   Event based input

The event based input allows likelihood and anticipated cost per weather event to be input separately. Up to 10 different Weather Events of different likelihoods and costs can be input in the columns, rather than a single annual cost figure. This allows the differentiation

between more frequent less severe and less frequent more severe weather events that are mitigated by the scheme.

There are two key inputs for each weather event:

- expected cost per weather event

- likelihood in the current and future years

It is expected that this input will be used where there is a detailed understanding of the probability and severity of weather events in the 1/X event format.

Expected cost per weather event

For each event, input the expected cost per weather event occurrence with and without the scheme. If the scheme does not fully mitigate the weather resilience risk, there will remain costs in the with scheme inputs. If users prefer to enter cost savings rather than with and without scheme costs, enter the cost savings in the without scheme cost and set the with scheme costs to zero.

Costs should be in the weather input price base, excluding escalation. The model will multiply this by the event likelihoods (entered below) and will uprate for inflation.

For schedules 4 & 8, costs need to be entered by train service group (as this is used in the estimation of economic benefits).

The Network Rail climate change adaption team are investigating the creation of a schedule 4 and 8 cost library and how this can be linked to asset failure.

Leave the box blank is the train service group is ""N/A"".

If a column is not used, leave blank.

Likelihood

For each weather event, enter the likelihood (1 in X year event) for the current year and future years. For example, 5 events per year would be a 1 in 0.2 year event

If a column is not used, leave blank.

Two guidance notes are currently being produced by the Network Rail climate change adaption team which should be referenced when determining the value of the the most appropriate future year likelihoods:

- Impact assessment guidance – sets out how to consider weather resilience in asset design/renewal and option selection

- Climate Change scenario guidance – sets out which climate changes scenarios to use in weather impact forecasts

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Part C: **Outputs**

The model outputs can be found in 4 sheets to the right of the "Outputs >" divider:

- Output sheet
- Chart_NPV stream
- Chart_Revenue growth rate
- Chart_benefits growth rate

C.01.01   Output sheet

- **Scheme details** sets out the details of the scheme entered on the input sheet, including name, opening year and costs
- **Scheme category** assigns one of the four financial/welfare categories to the scheme being appraised:

1. Positive financial return to NR within Control Period

2. Negative financial return to NR within Control Period, but positive financial return to rail industry over asset life

3. Negative financial return over asset life, but Medium/higher value for money (BCR>1.5) based upon DfT's socio-economic appraisal criteria

4. Poor/Low value for money (BCR<1.5) based upon DfT's socio-economic appraisal criteria

Schemes that fall into category 1 should be considered for funding by Network Rail as they are financially positive within the control period they open. In practice there are unlikely to be many of these schemes given the proportion of a control period taken in developing and implement schemes before they open.

Schemes that fall into category 2 will generate a financial return to the rail industry over the life of the asset and should be considered for investment. However, Network Rail is not currently incentivised to invest because (a) some of the financial return is in the form of additional fares revenue or cost savings accruing to TOCs / DfT, and/or (b) the financial return to Network Rail is over a period longer than the current Control Period, which would lead a shortfall within the existing Control Period. As a result Network Rail requires the agreement of funders to invest in such schemes.

Schemes that fall into category 3 general a positive return to society in social welfare terms. These schemes require agreement with funders as the rail industry is not incentivised commercially to deliver these schemes.

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Schemes that fall into category 4 deliver poor value for money in the social welfare appraisal. However, this appraisal does not take into account impacts on safety and the rail industry's reputation, which may be as or more important than financial and social welfare measures. It may be that a case can be made for these schemes through a multi-criteria assessment.

- **Network Rail Financial Measures** sets out the total discounted schedule 4 & 8 costs over the asset life of the scheme as well as financial surplus and rate of return to Network Rail within the control period. These measures exclude TOC opex costs and the indirect tax affect (which accrues to HMT).

- **Network Rail Financial Measures** sets financial measures to the whole rail industry – including TOC operating costs. Measures include pay back period, financial surpluses and rate of return.

- **Social Welfare measures** include user and non-user benefits in addition to the financial impacts.

Transport user benefits, resulting from the reduction in lateness/rail closure time caused by the resilience scheme can be separated into two categories, both of which we propose to quantify in the proposed decision support tool:

User impacts: Impacts to rail users. These equal the difference between passengers' willingness to pay for travel and ticket revenue. For business travellers, willingness to pay is related to the difference in productivity between the workplace and when travelling. For commuters and leisure travellers this is related to non-work value of time.

Non-User impacts: Impacts caused by mode shift to/from rail. These include reductions/increases in road congestion, emissions and other impacts on other modes.

The benefit cost ratio is the ratio of benefits to net cost to government (revenues minus costs).

C.01.02 Chart_NPV stream

This chart sets out the present value benefits, costs and revenues of the scheme by year.

The macro button shows years within the schemes asset life and hides other years.

C.01.03 Chart_Revenue growth rate

This chart shows the rates that contribute to discounted revenue growth. It is intended to show the impact of climate change in relation to the factors that affect revenue for a typical rail scheme – inflation, demand growth and discounting.

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The macro button shows years within the schemes asset life and hides other years.

C.01.04 Chart_benefits growth rate

This chart shows the rates that contribute to discounted benefit growth.

The macro button shows years within the schemes asset life and hides other years.

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Part D: **Calculations and locked inputs**

The locked inputs and calculation sheets are between the User Input and Output sheets of the model. The flow diagram below represents the model's calculations:
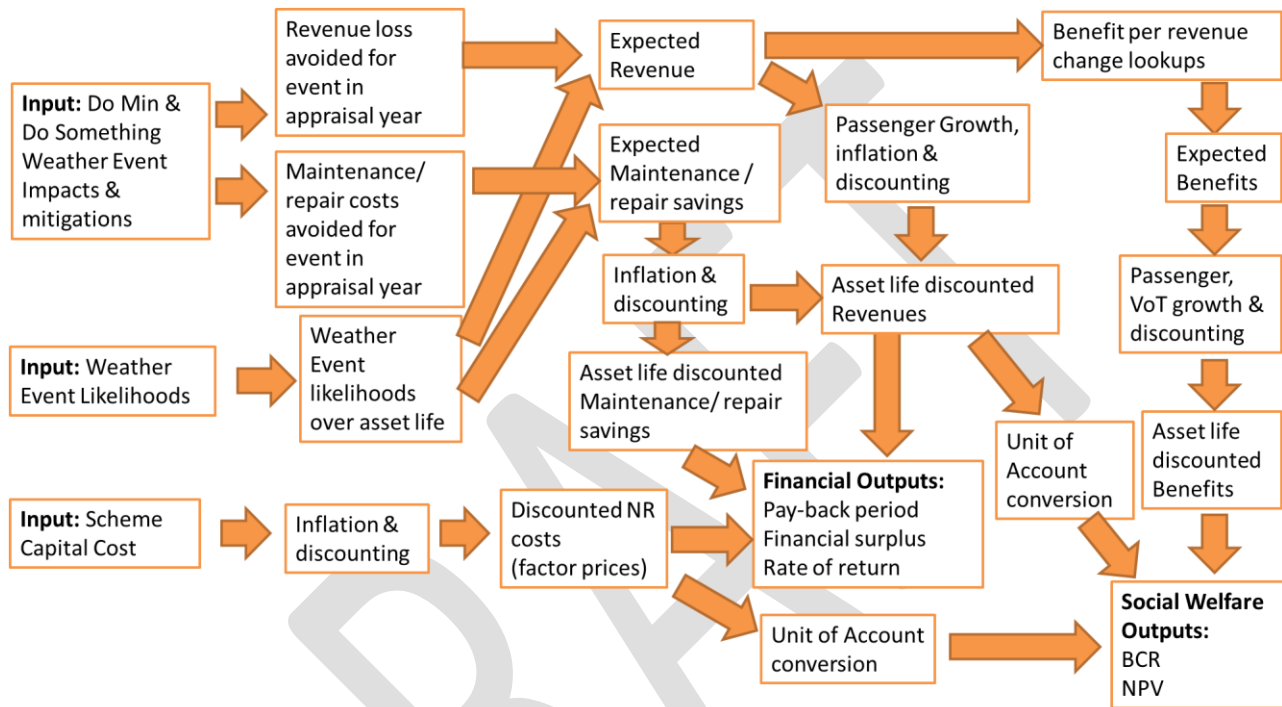
D.01.01   Calculation of Benefits

The model uses Network Rail's benefit per revenue change lookup to calculate Transport User Benefits of the disruption reduction in the Do Something for the train service groups impacted by the resilience scheme.

D.01.02   Time Series

The model assesses benefits, costs and revenues across the resilience scheme's asset life. The model grows the different variables to future years using the following rates, which are consistent with DfT's WebTAG and HMT Green Book guidance:

- **Expected Benefits** are grown with:
    - The demand growth rate calculated in like with PDFH 5.1 for the rail sector selected by the user
    - Long run GDP/capita growth - this represents the growth in the value of travel time across the appraisal period
- **Revenue loss avoided** are grown with:
    - The demand growth rate selected in the other inputs section

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- o RPI for the current parliament and RPI +1% thereafter, to represent fare inflation
- **Resilience scheme Capital Costs and repair & maintenance costs** are inflated in accordance with WebTAG
- **Discounting and inflation basing**
  - o Future year benefits, revenues and costs are discounted into present values at 3.5% (falling to 3.0% after 30 years) in line with the Green Book. The discount base is 2010. This discount rate is used for both financial and social welfare assessments.
  - o Outputs are shown in 2010 prices, rebased using the GDP deflator

D.01.03 Unit of Account

Social Welfare assessments are made in market prices. Revenues and costs are converted to market prices using the DfT rate (19%) for welfare assessments.

The Pay-back period, financial surpluses and Network Rail's rate of return are assessed using factor prices. Revenues and costs are not converted to market prices.

D.01.04 Expected values & risk neutrality (for the Event Based Input)

The model assesses benefits, costs and revenues from the resilience scheme on an expected value basis. The expected value approach means that for the purpose of appraisal, ex ante we assume that a 1/10 year event which costs £100 every occurrence would have an expected cost of £10 every year.

We also assume that the decision maker is risk neutral, with no additional loss being added to Weather Events with very high costs. This means that a decision maker values the complete mitigation of a 1/10 year event with £100 cost the same as a 1/100 year event with £1,000 cost.

Weather Event likelihood changes are linearly interpolated between the appraisal and future years.