System Approach to Electrical Clearances at Overline Structures

Route to Acceptance

Trans-Pennine Route Upgrade
Bolton to Wigan Electrification

Tom Kemp Principal Programme Engineer (E&P)

Andy Jarman Principal Programme Engineer (B&C)

David Woods Principal Programme Engineer (Track)

System Approach to Electrical Clearances at Overline Structures

Process for gaining RAM (E&P/ Structure/Track) endorsement on the OLE solutions at structures.

This has been development following review with the Directors of Engineering and Asset Management - 27th January 2020

Presentation:

- **Background to a System Approach to Electrical Clearances**
- **Introduction to multi-disciplinary “One pager”**
- **Early Application of Approach**
  - **Trans Pennine Route Upgrade**
  - **Bolton to Wigan Electrification**

EXCLUSIVE: Haines: electrification must start soon and progressively

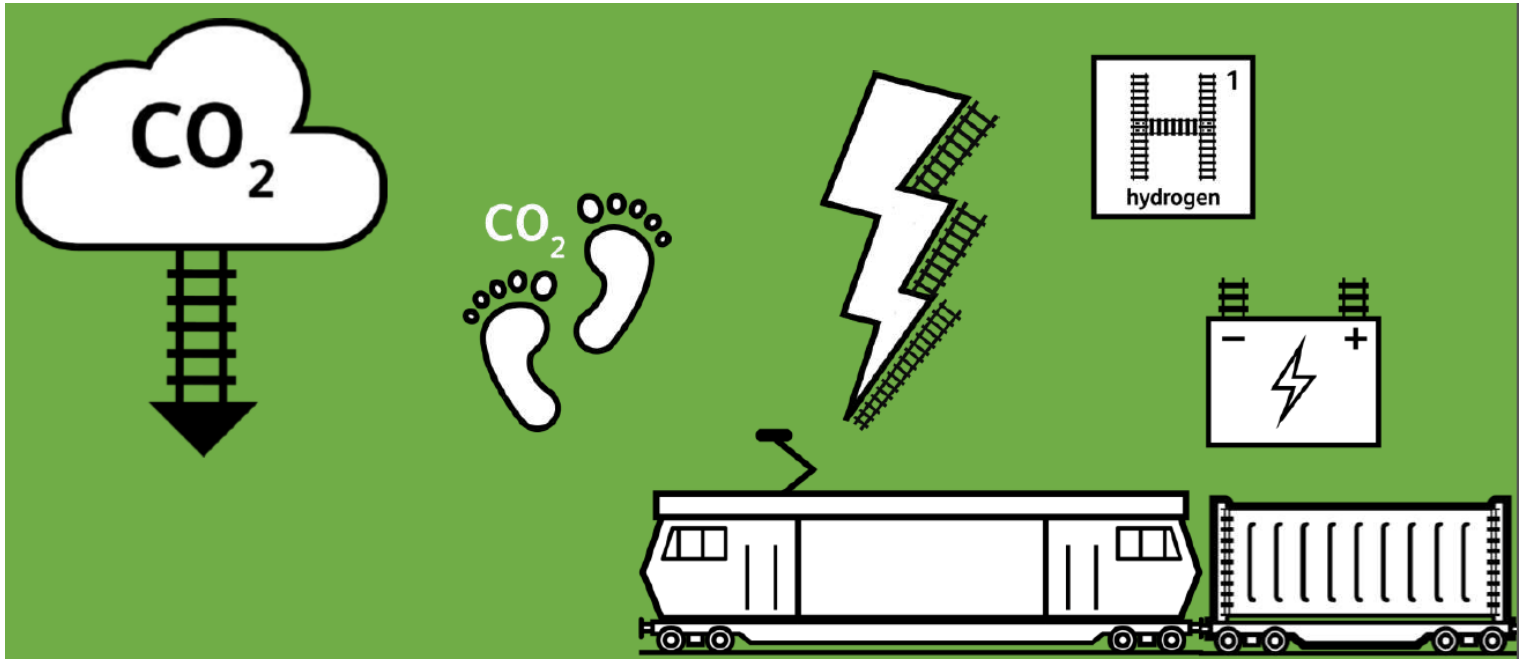
"My big pitch to Government on decarbonisation has been 'start soon and start progressively'," Network Rail Chief Executive Andrew Haines has told *RAIL* in an exclusive interview.

"Don't pretend you're going to unlock half a dozen schemes simultaneously because you'll probably flood the supply chain, we won't have the capacity, and we'll end up dropping a few balls and knock the cause back. But start to lay out the pipeline and basically demand that we demonstrate value for money."

Haines conceded that the industry will need to find more cost-effective ways of electrifying the network, but he is confident that with recent breakthroughs in methods for the likes of bridge clearances, NR could deliver electrification costs which are "much more credible and palatable than they were".

TRACTION DECARBONISATION NETWORK STRATEGY

INTERIM PROGRAMME BUSINESS CASE – Executive Summary



TDNS = Cross industry working group led by NR System operator in response to DfT decarbonising transport

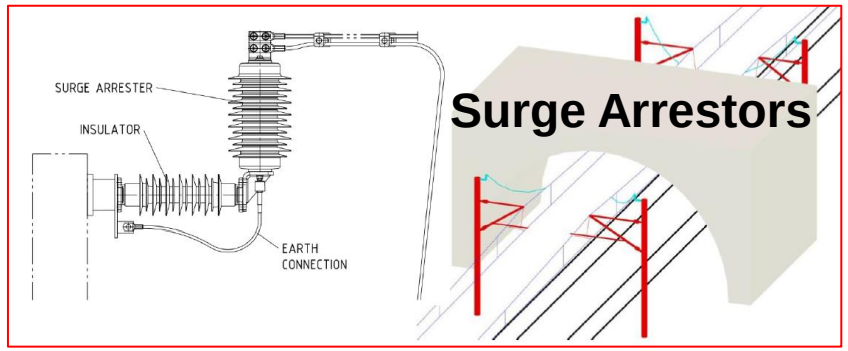
- Concludes out of the 15,400 STK remaining unelectrified network, **<u>11,700 STK must be electrified,</u>** with battery or hydrogen solutions the remainder.

Full maps and commentary are provided as part of the TDNS National Recommendations document, but a national map of the technology deployment is provided below.

Voltage Controlled Clearances (VCC) Recap:

- Voltage Controlled Clearances developed and introduced at **Cardiff Intersection Bridge**. £40m intervention saved
- VCC provide a way to satisfy electrical performance requirements without the need for expensive interventions
- VCC a key tool in making electrification affordable, and meeting decarbonisation legislation

VCC Mitigations:



Bridge Arms

GLS Polyurea Paint

	25 kV ac EN 50119 EN 15273:1	200 kV ac EN 50124 Without Mitigation	200 kV ac EN 50124 With Mitigation
1 - Flashover from Underbridge Arm to Bridge	270 mm	200 kV (370 mm)	20 mm
2 - Flashover from Contact Wire to Bridge	270 mm	200 kV (370 mm)	70 mm
3 - Flashover from OLE to Train Roof	**270 mm –** 150 mm	200 kV (370 mm)	**70 mm**
4 - Flashover from Uplifted Underbridge Arm to Bridge	150 mm	200 kV (370 mm)	20 mm +1.5 *S0*
5 - Flashover from Uplifted Contact Wire to Bridge	150 mm	200 kV (370 mm)	70 mm
6 - Flashover from Pan. to Pantograph Well	170 mm	200 kV (370 mm)	80 mm
7 - Flashover from Pantograph to Bridge	170 mm	200 kV (370 mm)	80 mm
8 – Flashover from Panto-graph to Handheld Object	-	200 kV (600 mm)	112 mm

DEAM Workshop 27th January 2020

- *Organised by the NP HoE and the Directors of Engineering and Asset Management (DEAM) for both Eastern and NW&C Regions. Attended by all Track, Structures and E&P RAM's from both regions, plus Lead Discipline Engineers, PDEM's, Sponsors*

- *The Following principles were agreed:*

1) Where an electrical clearance to overline structure "clash" is identified, if Managed Track Position and/or Voltage Controlled Clearances can solve the "clash", this shall be assumed to be an acceptable baseline position – pending the following points

2) The *maximum reasonably practicable* value of electrical clearance shall always be provided.

3) The project shall demonstrate that alternative solutions to achieve compliance (e.g. interventions) are not reasonably practicable.

4) The project shall undertake a CSM-RA at each structure

5) A multi-disciplinary "one pager" for each structure was requested to summarise all the pertinent design information, and form the basis for the RAM review workshops

Review all options through "one pager"

Overbridge Electrical Clearance Clash

Civil Intervention?

- Level of intervention required
- Access/Construction Costs
- Ownership
- Utility Diversions?
- Age / condition
- Reasonable opportunity?
- Social Economic Impact
- Carbon Impact ?
- Whole life cost ?
- Putting passengers first?

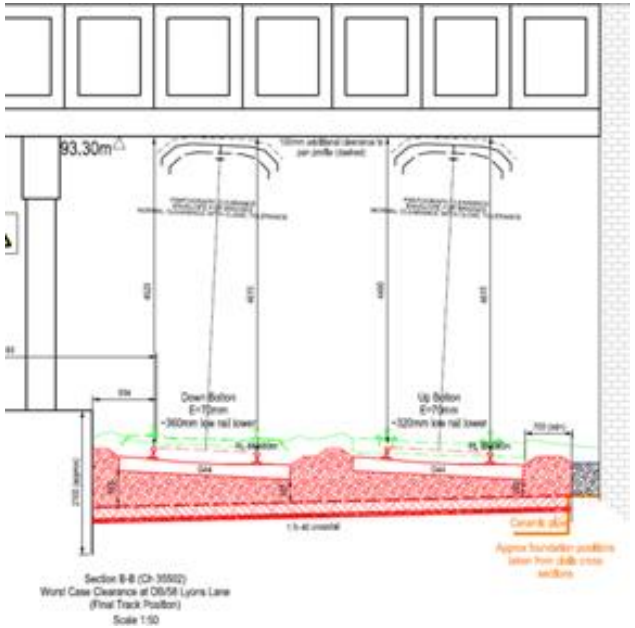
Voltage Controlled Clearances

- Reduce clearance to structure
- Reduce clearance to train
- VCC mitigations
  - Surge arrestors
  - CW Cover
  - GLS Paint
  - Bridge arm
- Carbon impact - low
- Whole life cost - low

Track Intervention?

- Level of intervention required?
  - full dig / ballast pads / MTP
- Reasonable opportunity test?
- Access / Construction Costs?
- Risk to running line?
- Risk to structure?
- Carbon Impact?
- Impact on drainage?
- Whole life cost
- Putting Passengers First?

Overview – Track Perspective



Managed track position and Track up lift allowance

The Route Asset Manager [Track] (RAM [T]) shall specify areas requiring managed track position.

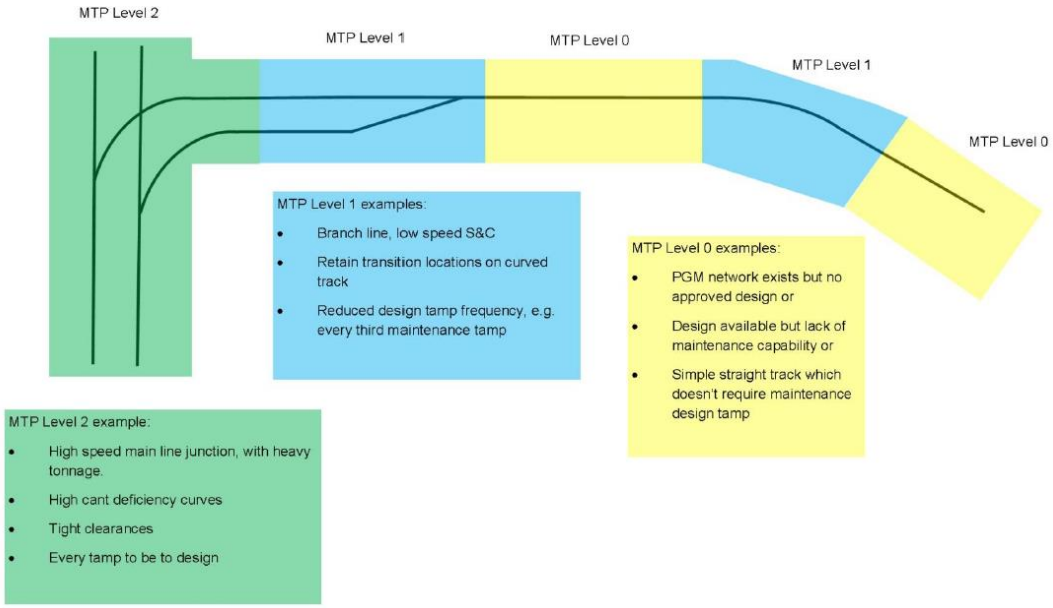


Table 5 – Track position on routes with overhead line electrification

Parameter	Maintenance tolerance
Vertical position of track where the tolerance is Full or Close.	Full tolerance +25/–25mm Close tolerance +15/–15mm
Horizontal position of track where the tolerance is Full or Close.	Full tolerance +25/–25mm Close tolerance +15/–15mm
Cross-level of track where the tolerance is Full or Close.	Full tolerance +20/–20mm Close tolerance +15/–15mm Within the height tolerance

Benefits to track uplift tolerances

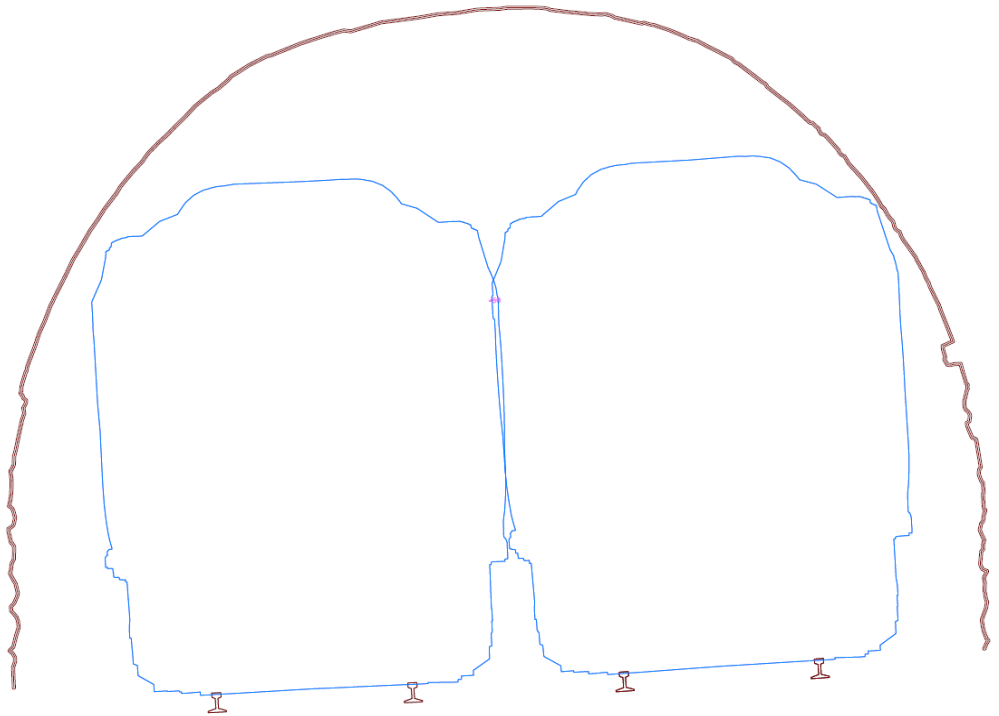
Initail request for 100mm track maintenance uplift allowance.

Q/ What uplift tolerance would be accepted with Managed Track Position in place?

Current allowance in track maintenance standards .. 25mm.

Clearances

- Passing clearance challenges for existing route cleared gauges.
- Achieving OLE requirements may not rectify clearance challenges or provide W12 freight



Overview – Structures Perspective

Masonry repairs to linings

- Structure condition
- Sweeps / tees

Water management in tunnels

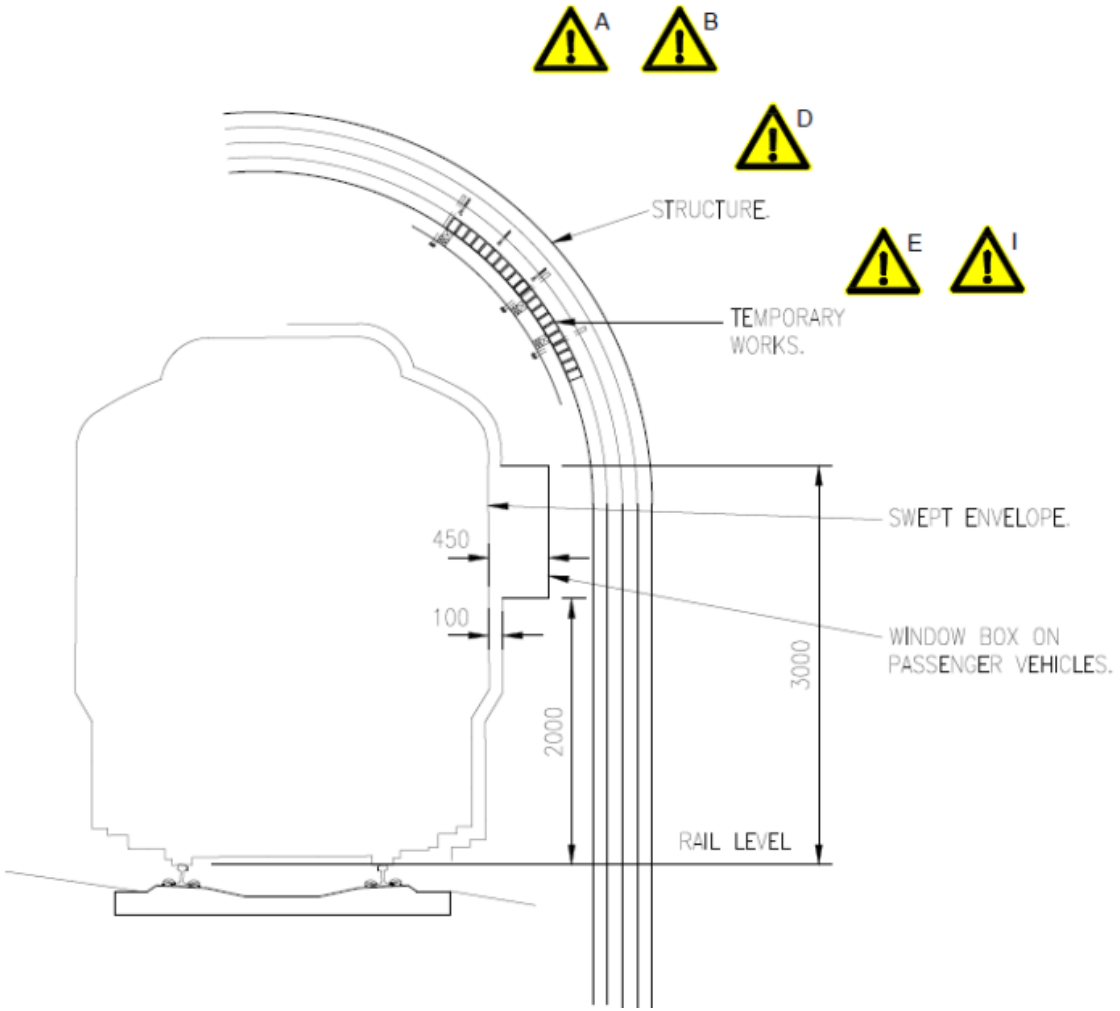
- Flashovers / Icicle risk in winter

GLS Paint

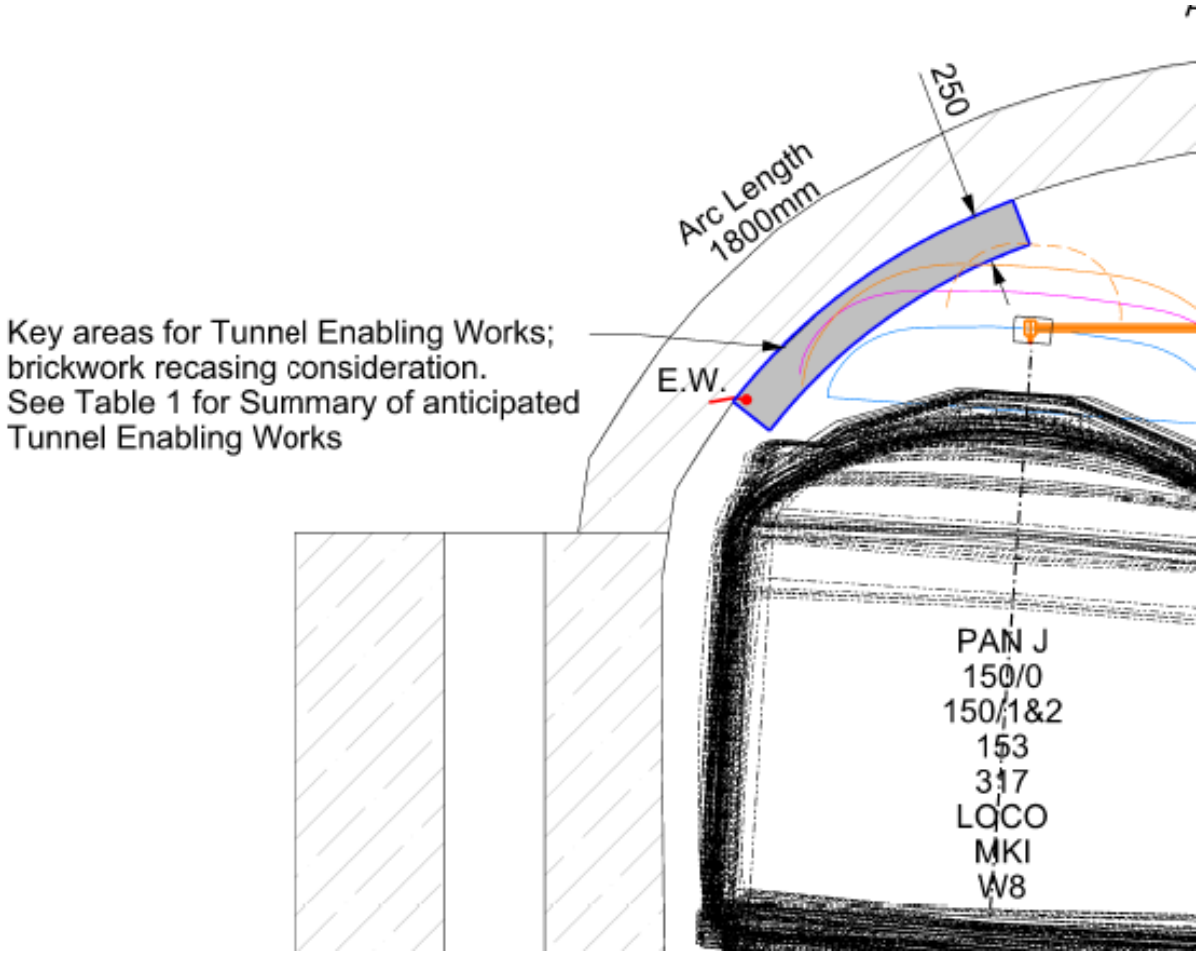
- Inspection and maintenance regime

Overline Structures– Maintenance Considerations (1)

- Condition of lining / arch barrels
- Gauge clearance to sweeps and lags

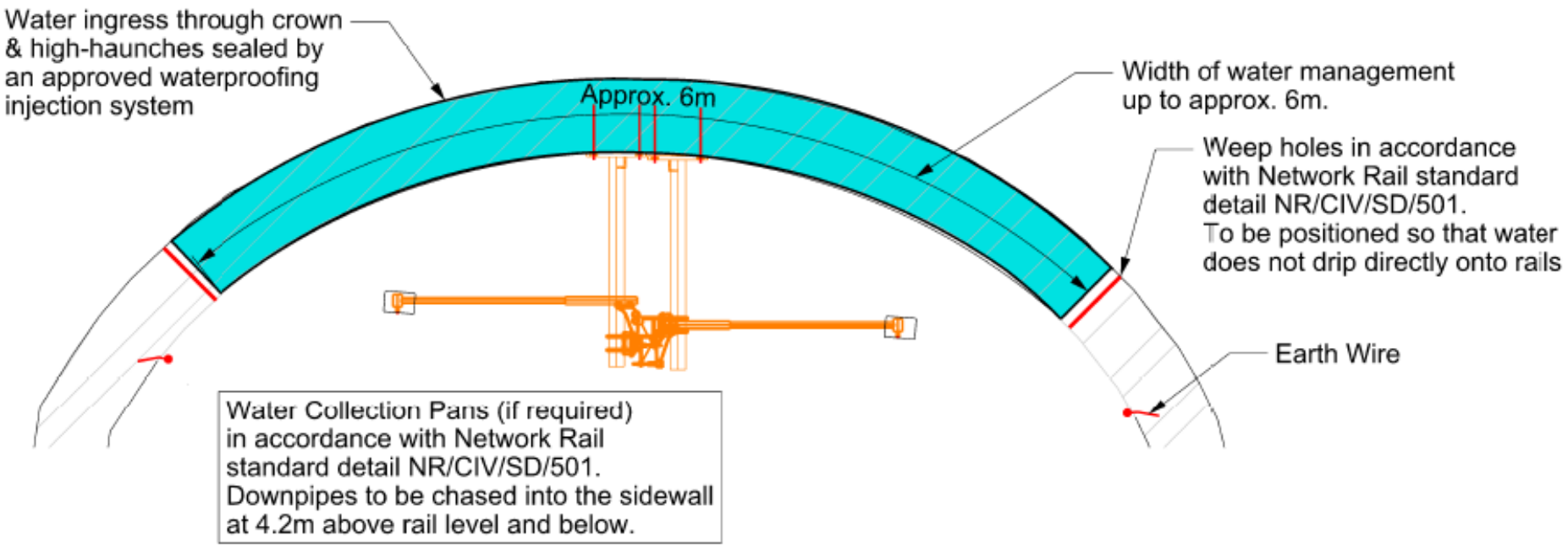


Overline Structures– Maintenance Considerations (2)



Overline Structures – Water Management (1)

Overline Structures – Water Management (2)



Typical Crown Water Management Detail

Scale 1:50

Structures Interfaces – GLS Paint

SRAC 07	***The protective coating of the bridge shall be subjected to a regular inspection and test regime with repairs and cleaning as necessary.***

Outline of Multi D "One pager"

Northern Programmes - Overline Structure Electrical Clearances - Option Selection

PART A - GENERAL INFORMATION

Track CRE		Main Photograph	Links
Civil/Structural CRE			
OLE CRE			
PV Reference number:			
Version			
Description			
Railway ID			
Route			
ELR			
Mileage to			
Mileage from			

General Comments on Structure / Locati

e.g. type of bridge, road/rail/water, countryside, proximity to populated areas, services, schools

High Level Options Considered. Include D

1

2

3

PART B - STRUCTURE INFORMATION

Basic Asset Information:

Asset Group	Tunnels	Asset Type	Tunnel Bore	Operational Status	Functionary	Owning Party	Network Rail CE Struct	Listed	No
Primary Material	RBE - Brick						

Examination and Assessment Status:

Detailed Exam Frequency	1 year
BCMI/TCMI Score	97
Last Assessment	2008

Other Features:

Parapet Type	Masonry - Ashton En
Impact - Bridge Strike Rating	N/A
Other Relevant Information:	Tunnel has no shafts

PART C - TRACK INFORMATION

General Comments	Lateral resistance plates fitted throughout
Track geometry Summarising the trends of the 1/8ths immediately each side of the structure and through where possible:	TQ 'good' through tunnel and either side for both lines.
Track components (e.g. sleeper type, fastening, rail type, rail age)	G44 concrete sleepers, fast clips, UIC60 rail, 2017 rail.
Is the structure letting in water (i.e. localised head loss sit (this may be included in the Opex commentary)	Not as far as we know.
Is the area subject to linespeed increase?	
Minimum freight vehicle clearance	
Freight gauge	
Minimum passenger vehicle clearance	

PART D - OLE PROPOSAL

complete white cells only

Survey
Type of survey:
Accuracy:
Date of survey:
Link to report/file:

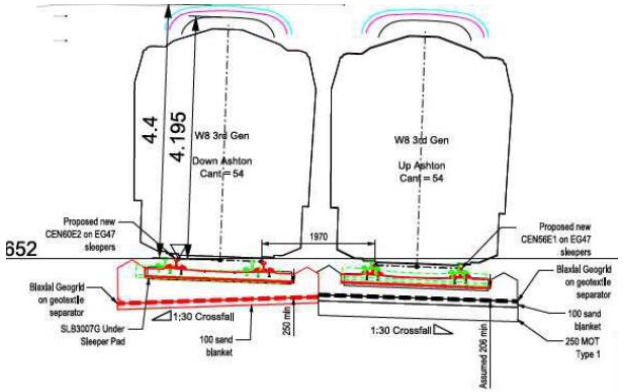
Preliminary Design Details
Is the structure proposed to be fitted or free running?

System depth:

Design encumbrance through structure:

Are surge arresters proposed? (Yes/No)

Is secondary insulation proposed? Type / Depth

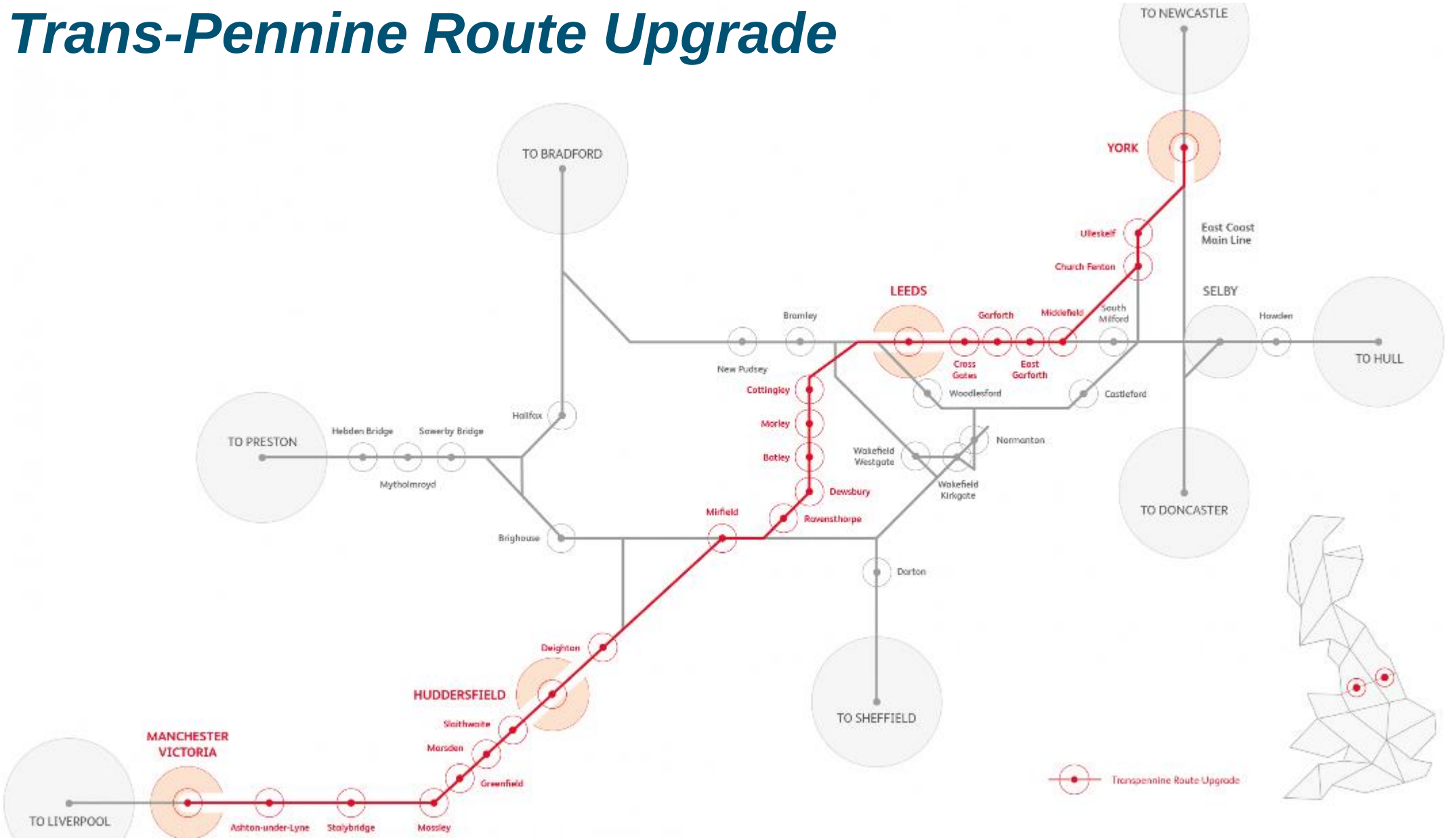


PART E - ACCEPTANCE & COMMENTS

Chosen Option / Notes	*Risks and Mitigations - Future Operation and Maintenance*	*Freight Allowance / Notes*

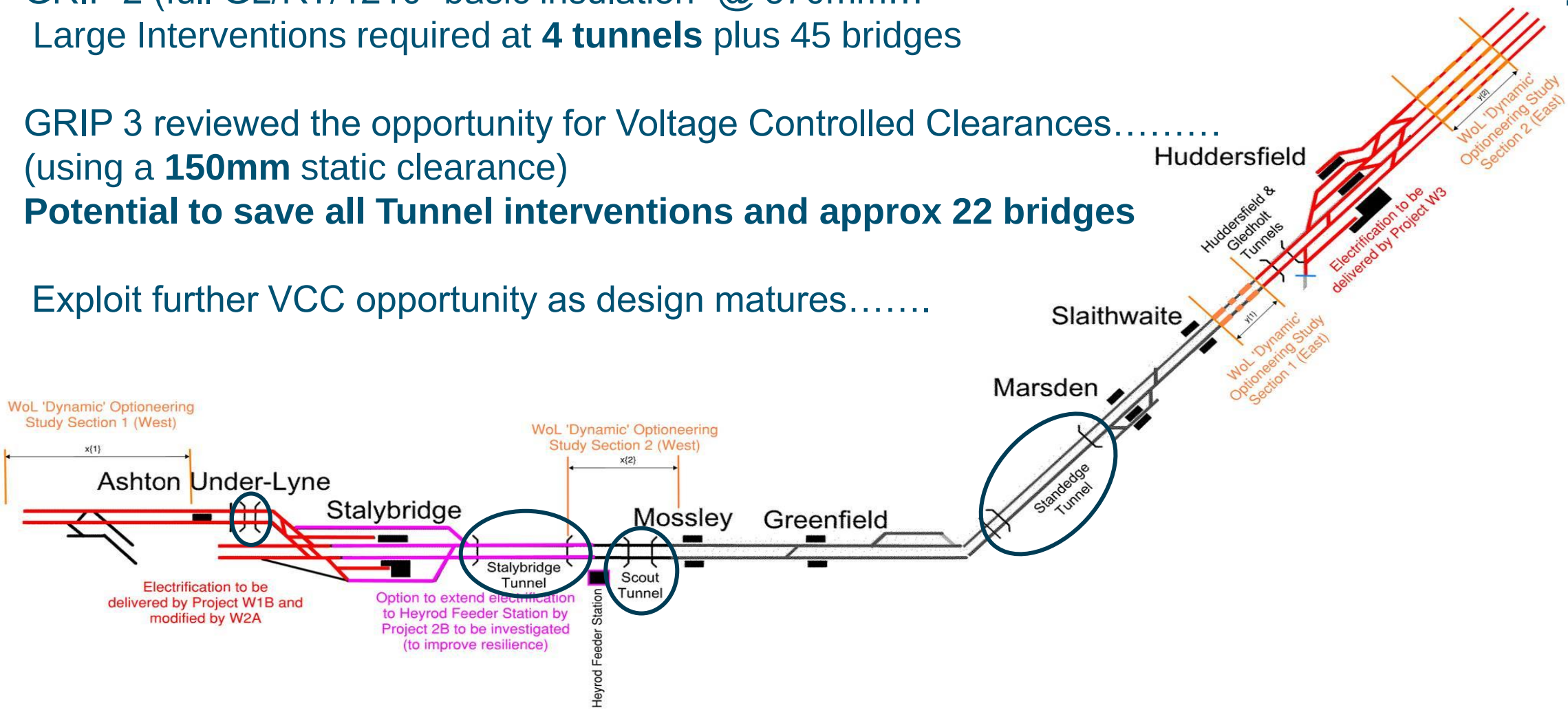
Acceptance	*Acceptance*	*Acceptance*
RAM Structures (Name)	*RAM Track (Name)*	*RAM E&P (Name)*
Conditions/Comments	*Conditions/Comments*	*Conditions/Comments*
Signature *Date*	*Signature* *Date*	*Signature* *Date*

Trans-Pennine Route Upgrade

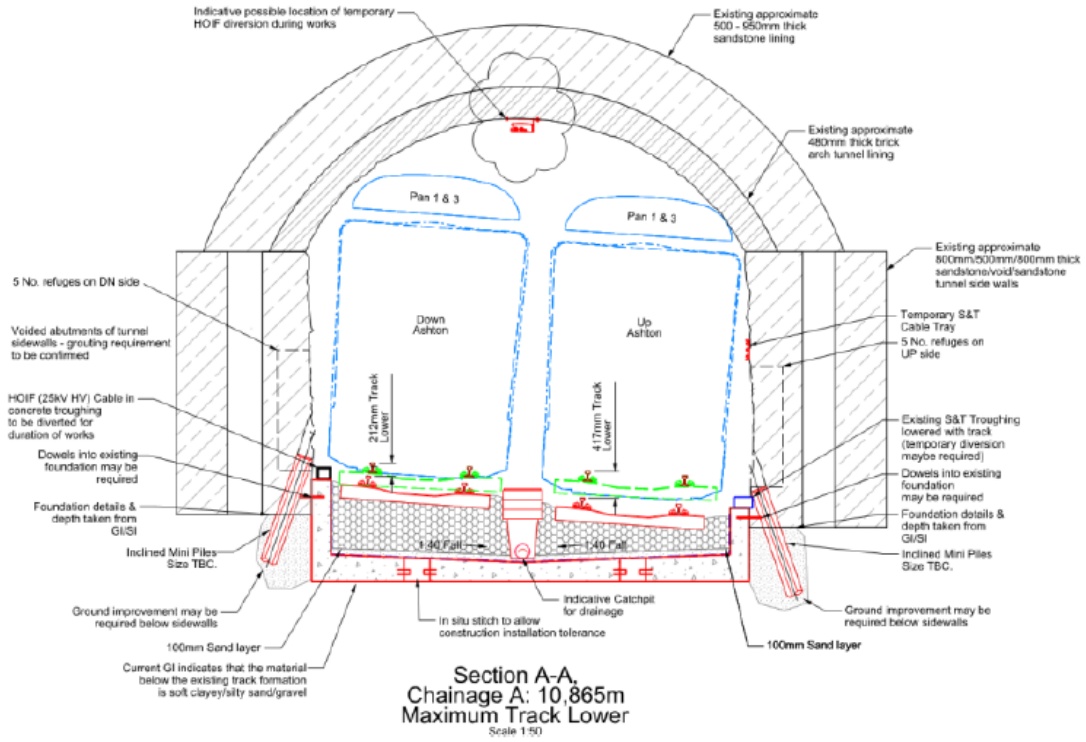


Transpennine Route West Example:

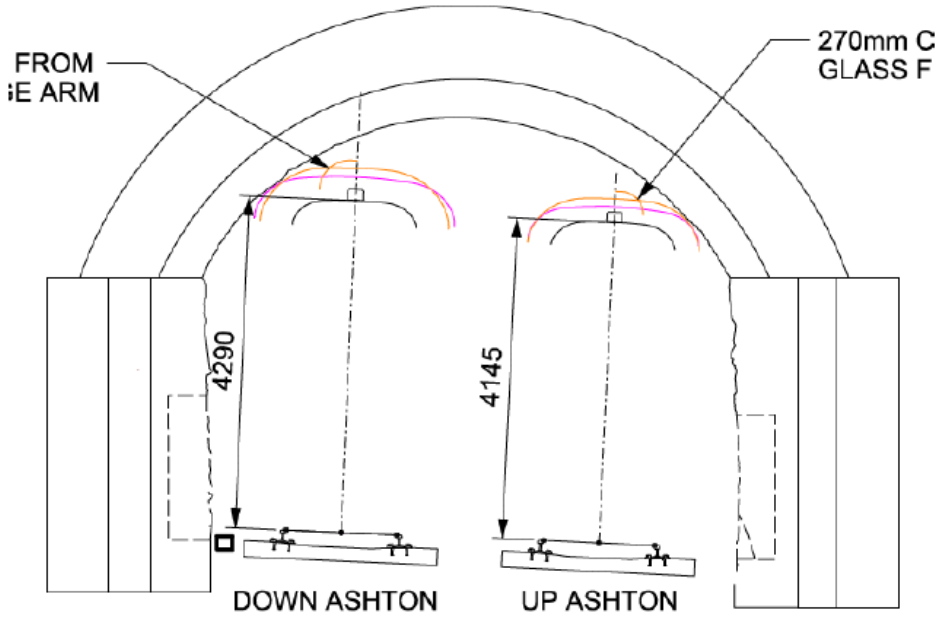
- Complex route: **6 tunnels** + 77 bridges
- GRIP 2 (full GL/RT/1210 “basic insulation” @ 370mm…
  Large Interventions required at **4 tunnels** plus 45 bridges
- GRIP 3 reviewed the opportunity for Voltage Controlled Clearances……
  (using a **150mm** static clearance)
- **Potential to save all Tunnel interventions and approx 22 bridges**
- Exploit further VCC opportunity as design matures…….



Voltage Controlled Clearances - Katherine Street Tunnel



TRU December 2017 Submission



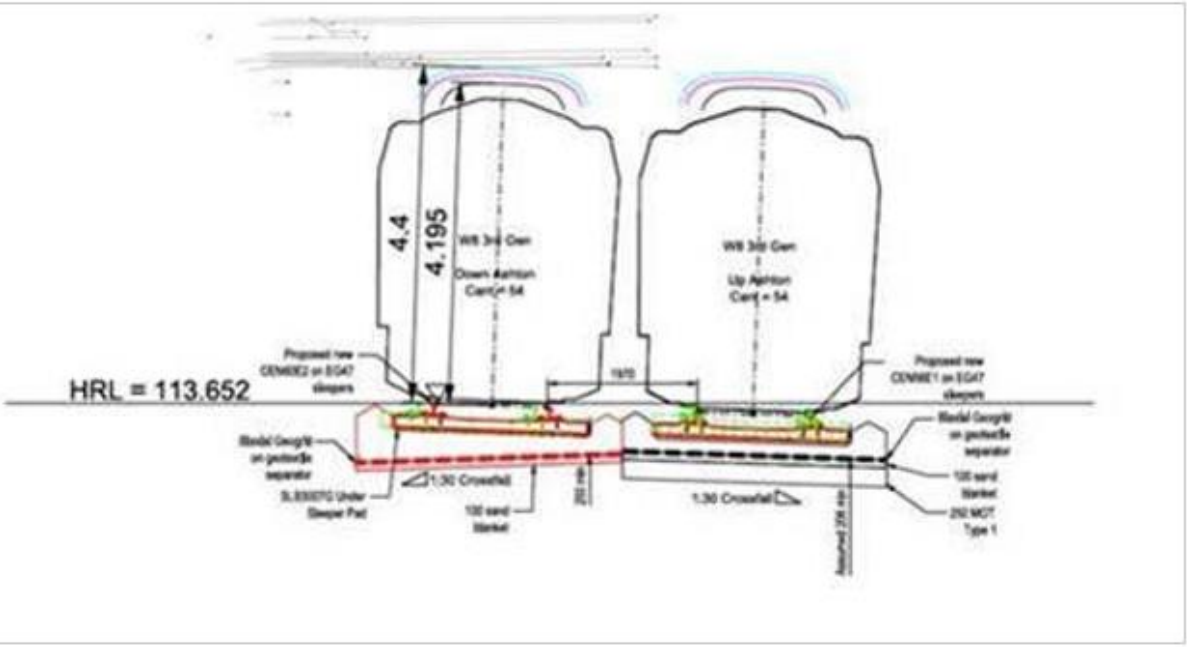
Voltage Controlled Clearances

No invert works required

Application of System Approach

Trans-Pennine Route Upgrade

MVL1/32 Stamford Street – compromise solution – retaining current structure



Achieved by challenging the project:

- Structure – removal of concrete flange covers – safety concern – gained 63mm headroom
- Structure / OLE – bridge arms positioned within jack arches
- Track – Components – Ballast depth – TMLA - subject to whole life cost assessment

Whole Life Cycle Assessment

Options	Description	Stamford Street
Option 1	25mm TMLA limit	£3.2m
Option 2	50mm TMLA limit	£2.1m
Option 3	100mm TMLA limit, bridge reconstructed.	£4.2m

MVL1 Stamford Street whole life costs - tamping and ballast cleaning details

			Years following renewal date																																	
Option No.	Bridge re-con?	Track Maintenance Lift Allowance (mm)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Total number of tamps	Total numbe of balla cleans
1	No	25			T		BC			T		BC			T		BC			T		BC			T		BC			T		R	6	5
2	No	50			T		T		BC			T		T		BC			T		T		BC			T		T		BC		R	8	4
3	Yes	100			T		T		T		T		BC			T		T		T		T		BC			T		T		T	R	11	2

Agreed RAM track guidance for Track Maintenance Lift Allowance (TMLA) for Voltage Control Clearances

- 50mm TMLA - starting point for Track when Voltage Control Clearances are being proposed
- Managed Track Position (MTP) to be implemented *

- 25mm TMLA - this is the last resort on ballasted track
- Consideration of fixity required

- 15mm TMLA - not acceptable on ballasted track
- High fixity of the track needs to be implemented via non ballasted track solutions

Bolton to Wigan Electrification

Early Grip 1 to 2 assessment by project team using one pagers

13No. Overbridges assessed

Potential Savings due to System Approach

Additional funding from RAMs due to early engagement – demonstrated works not needed for OLE – enable correct funding

Proposals to be worked be developed with design support

System Approach to Electrical Clearances at Overline Structures

Summary

- Cost Effective Way of Electrifying the Network
- Early Engagement GRIP Stages
- Multi-disciplinary - System Approach
- Stakeholder Engagement