NetworkRail

THE PWI
EMPOWERING RAILWAY ENGINEERING

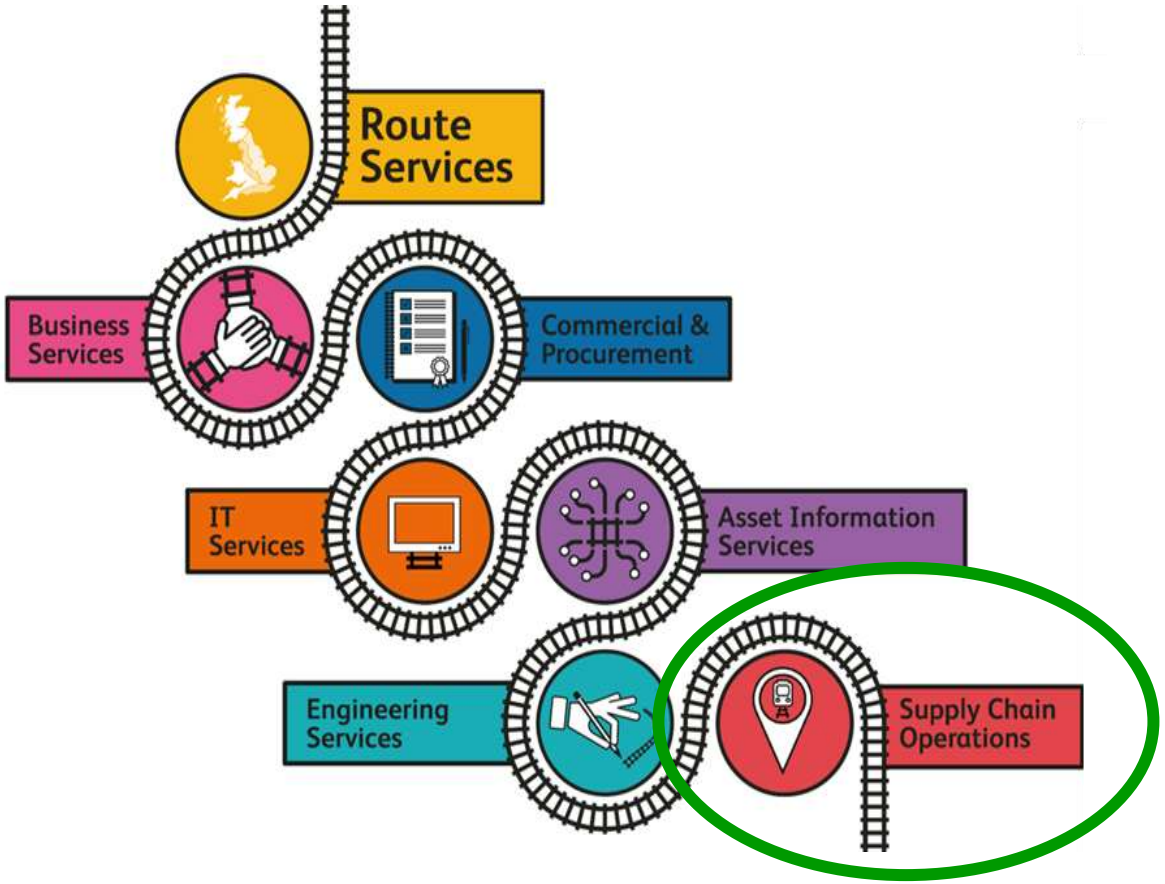
PWI: Working Together To Make Track Renewals Affordable

Ballast Cleaning on HS1

Kirsty Duggan & Peter Flynn

Simpler.
Better.
Greener.

Where Are High Output Now…?



Supply Chain Operations

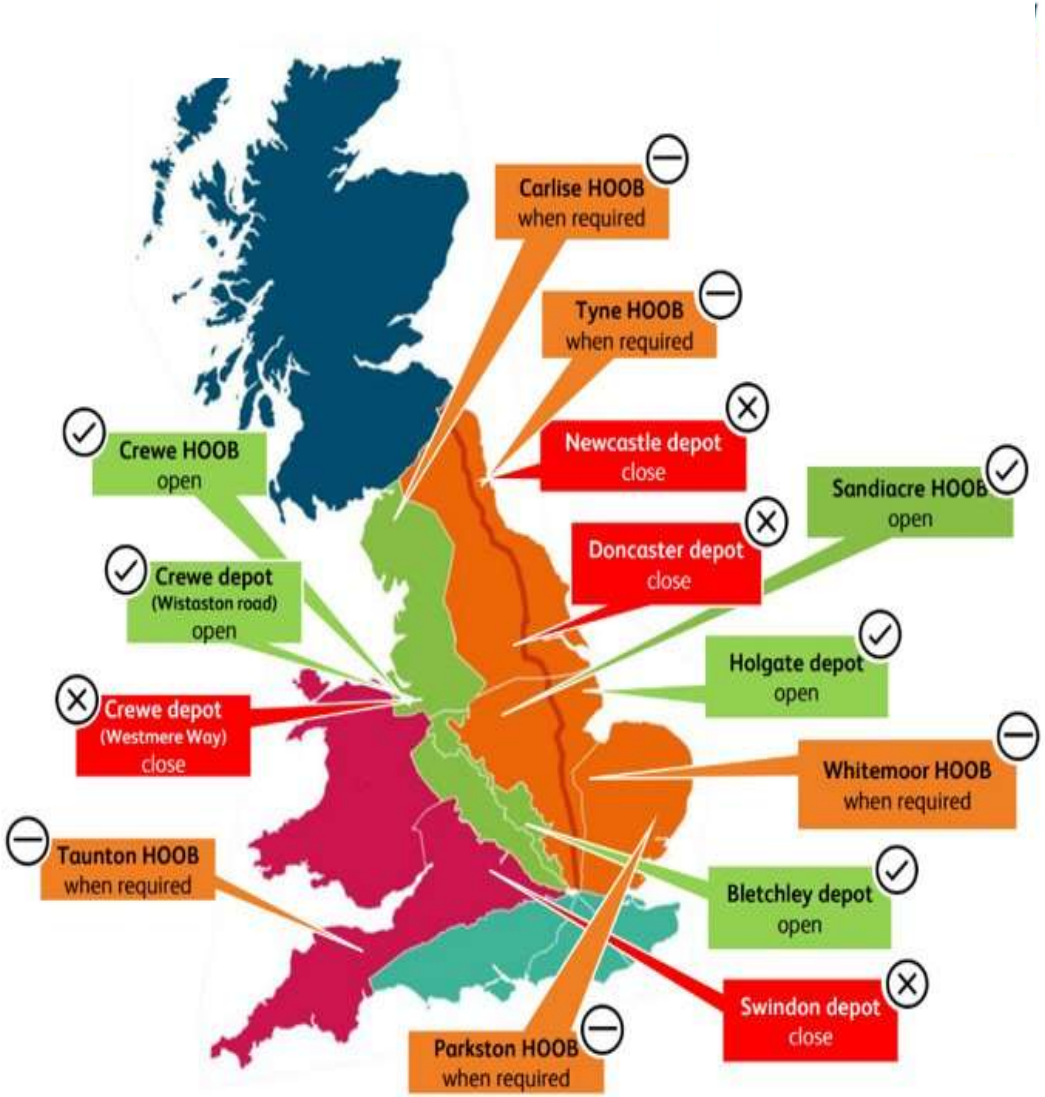
Construction Services

- **High Output Ballast Cleaning**
- **NR Air Ops**
- **OLE Renewals (OLET)**

The Journey So Far…

Current service level	Future service level
x 3 Ballast cleaning system (BCS)	x 1 Ballast cleaning system (BCS)
x 2 Track relaying system (TRS)	
x 14 Directly Operated Fleet (DOF)*	

*Directly Operated Fleet (DOF) is made up of 8 tampers and 6 ballast regulators



CP7 Ballast Cleaning in Numbers

During CP7 Construction Services have been remitted to plan and deliver Ballast Cleaning projects on North West & Central and Network Rail High Speed.

c.160km
of programmed Ballast Cleaning

£170m
Project AFC

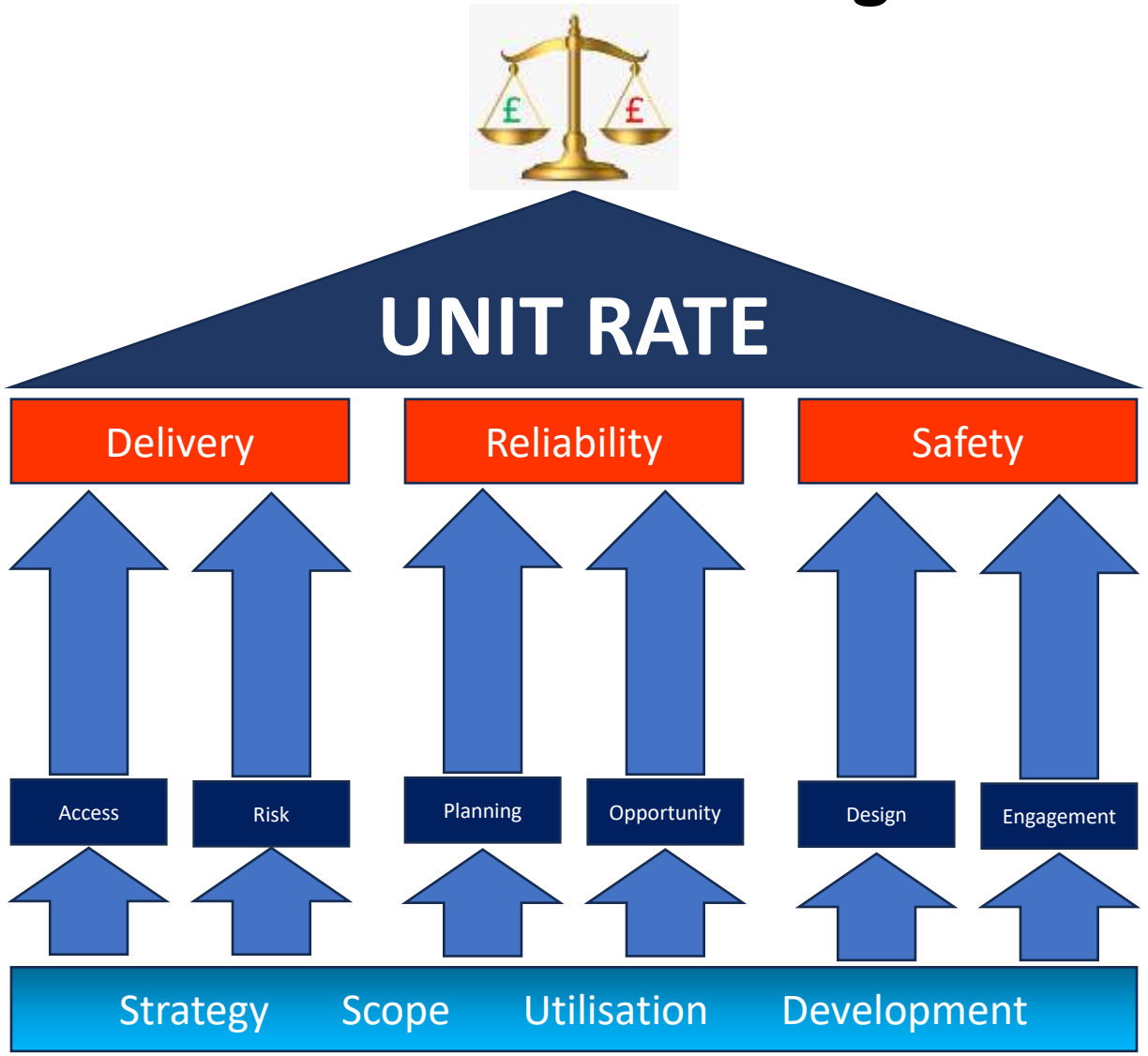
550+
Number of planned core deployments

4
Routes

NW&C	Year 2	Year 3	Year 4	Year 5
Volume	27km	25km	22km	25km
Total Cost	£25m	£24m	£18m	£25m
Duration	22weeks	20weeks	20weeks	20weeks
Forecast U/R	£1.01m	£1m	£1m	£1m

Network Rail	CP6	CP7					CP8
	Yr5	Yr1	Yr2	Yr3	Yr4	Yr5	Yr1
NRHS	CP3		CP4				
	Yr4	Yr5	Yr1	Yr2	Yr3	Yr4	Yr5
Construction Services Delivery Proposal							
Develop / prep							
Core Renewal					15/17 weeks	15/17 weeks	TBC
Follow Up							

Influences on Ballast Cleaning Unit Rate



Performance

Value for Money

Ballast Cleaning on High Speed 1

- **Strategic Prestige**: this contract positions NRIL as a trusted partner on nationally significant infrastructure.
- **Operational Excellence**: Demonstrates capability to deliver complex works in a high-speed, high-profile environment
- **Gateway to Future Opportunities**: Success on HS1 could open doors to future high-speed rail projects.
- **Innovation Platform**: Provides a high-profile platform to showcase operational excellence in ballast cleaning.
- **Strengthened Partnerships:** Builds deeper collaboration with key industry stakeholders.

Cost (Unit Rate influences)

What?

Ballast cleaning….what is it?

Mechanised process to remove “fines” from ballast, with the track still in place, by:

- Excavating ballast
- Passing it through vibrating screens
- Removing fines
- Returning larger pieces of ballast back into track
- Adding new ballast to make up for the removed material

Why?

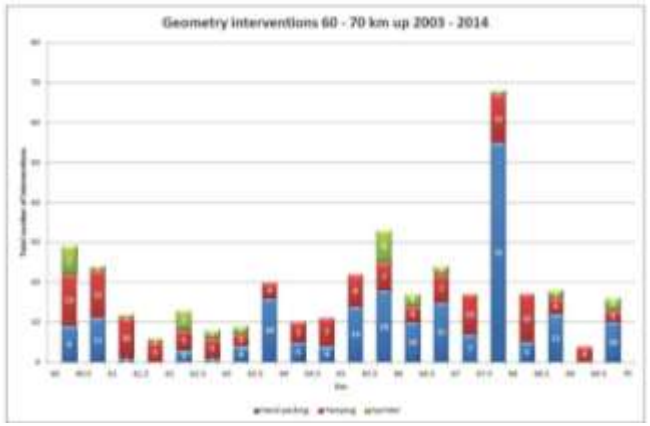
What is the problem and what are we doing?

The ballast quality within Section 1 (Ebbsfleet to Eurotunnel) of the HS1 route is not adequate to maintain the design track geometry and, as a result, NRHS have undertaken enhanced tamping and grinding campaigns to maintain operational performance.

These interventions, albeit effective in the short term, are not sustainable in the long term. In simple terms, each intervention causes further wear, reducing the service life of the asset. Some sites have been tamped over 20 times and hand packed over 50 times. Below is an example of a geometry fault on Section 1:

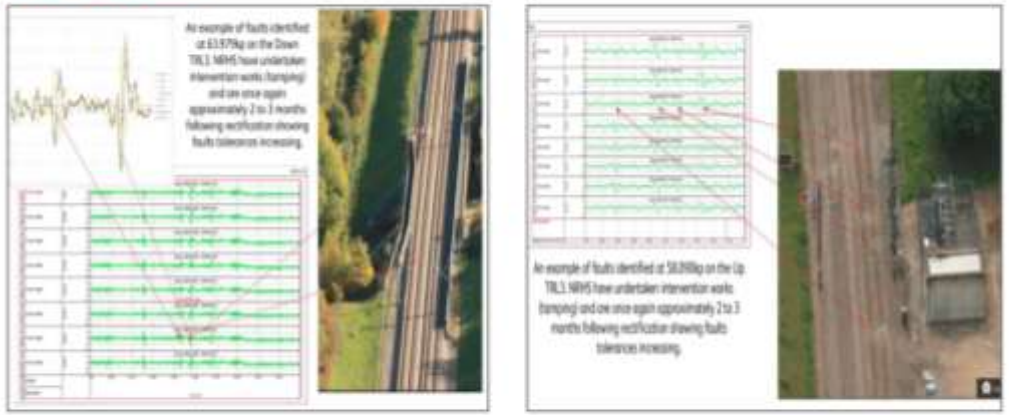
An example of faults identified at 52.770kp on the Down TRL3. NRHS have undertaken intervention works (tamping) and are once again approximately 2 to 3 months following rectification showing faults tolerances increasing.

Our Vision – "To deliver the best High Speed rail customer experience"



So what's next?

Further fault data:



So what's next?

We have now reached a critical point where the tamping interventions cannot effectively remove geometry faults. Refurbishment (renewal) of the ballast is needed to sustain the track geometry for high speed running

Our Vision – "To deliver the best High Speed rail customer experience"

*Acknowledgement - Report extracts courtesy of NRHS

Where?

Workbank Overview

- **Phase 1 - 4 sites scoped with Senior Asset Engineer:**

➢	**Up Line: 57.700km to 65.406km**	**(AIVR Mileage: 35m 1502y to 40m 1129y; 8427yds)**
➢	**Up Line: 67.066km to 75.392km**	**(AIVR Mileage: 41m 1184y to 46m 1490y; 9106yds)**
➢	**Down Line: 57.700km to 65.406km**	**(AIVR Mileage: 35m 1502y to 40m 1129y; 8427yds)**
➢	**Down Line: 67.066km to 75.392km**	**(AIVR Mileage: 41m 1184y to 46m 1490y; 9106yds)**
➢	**Total Phase 1 workbank:**	**32.064km (35,066yds)**

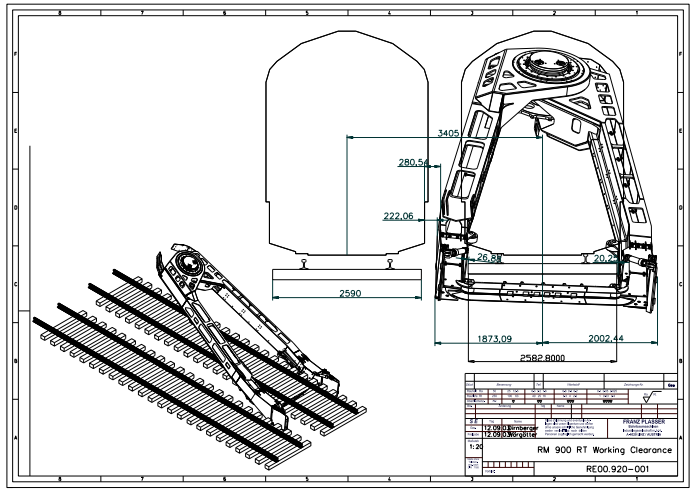
*Acknowledgement - Report extracts courtesy of NRHS

When?

Network Rail	CP6	CP7					CP8
	Yr5	Yr1	Yr2	Yr3	Yr4	Yr5	Yr1
NRHS	CP3		CP4				
	Yr4	Yr5	Yr1	Yr2	Yr3	Yr4	Yr5
Construction Services Delivery Proposal							
Develop / prep							
Core Renewal					15/17 weeks	15/17 weeks	TBC
Follow Up							

Tunnels (no, not the big one at the end!)

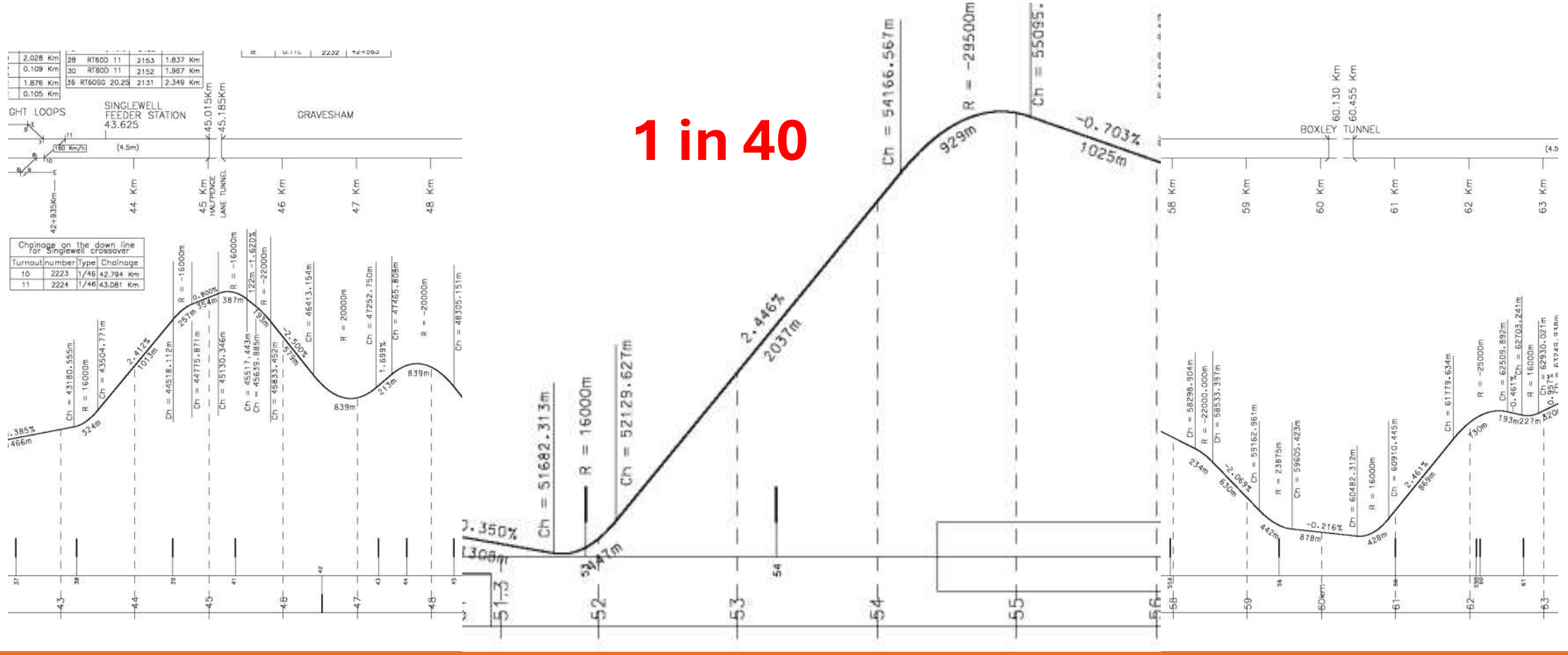
ELR	Track ID	Miles	Yards	KM	ROW Code	Site Length KM	KM Board	Feature	Suitable for BCS	Structures / Risks	Trial Holes Requir	Geometry
TRL3	2100	46	374	74.372	20			Start of Tunnel (227yds)	Risk (Tunnel)	Tunnel	Yes	Left Hand Curve
TRL3	2100	46	147	74.164	20			End of Tunnel (227yds)	Risk (Tunnel)	Tunnel	Yes	Left Hand Curve
TRL3	2100	42	460	68.013	20			Start of Tunnel (446yds)	Risk (Tunnel)	Tunnel	Yes	Point of Reverse
TRL3	2100	42	14	67.605	20			End of Tunnel (446yds)	Risk (Tunnel)	Tunnel	Yes	Right Hand Curve
TRL3	2100	37	1043	60.499	20			Start of Tunnel (439yds)	Risk (Tunnel)	Tunnel		Right Hand Curve
TRL3	2100	37	604	60.098	20			End of Tunnel (439yds)	Risk (Tunnel)	Tunnel		Right Hand Curve
TRL3	2100	35	1502	57.700	20	7.706		Start of North Downs Tunnel 3.3km (Derailment containment in sixfoot)	No (Derailment Containment in Sixfoot)	Tunnel		Right Hand Curve
TRL3	2100	35	773	57.034			57	57KM Board	No (Derailment Containment in Sixfoot)	Tunnel		Right Hand Curve
TRL3	2100	34	1454	56.047			56	56KM Board	No (Derailment Containment in Sixfoot)	Tunnel		Right Hand Curve
TRL3	2100	34	850	55.495					No (Derailment Containment in Sixfoot)	Tunnel		Point of Reverse
TRL3	2100	34	360	55.047			55	55KM Board	No (Derailment Containment in Sixfoot)	Tunnel		Left Hand Curve
TRL3	2100	33	1428	54.414	20			End of North Downs Tunnel 3.3km (Derailment containment in sixfoot)	No (Derailment Containment in Sixfoot)	Tunnel		Left Hand Curve



Other Tunnels (and ‘long’ bridges

Gradients

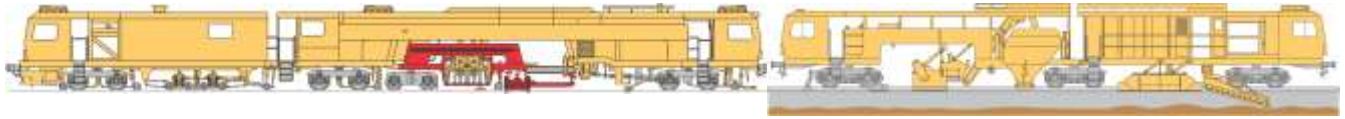
1 in 40

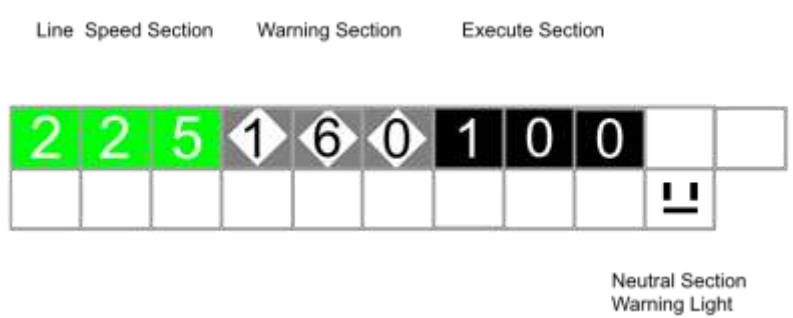


Shorter Train Consists

- Current max operating limits on NRIL – 3500t and 820m
- Current trailing weight limitations on HS1 - 1100t
- Recent haulage trials up to 1800t
- 2100t would equate to 11 loaded and 11 MT MFS

Haulage & Logistics





Ballast Supply & Specification

A9. Resistance to wear (micro-Deval coefficient)

The micro-Deval coefficient for railway ballast (micro-Deval coefficient) shall be ≤7.

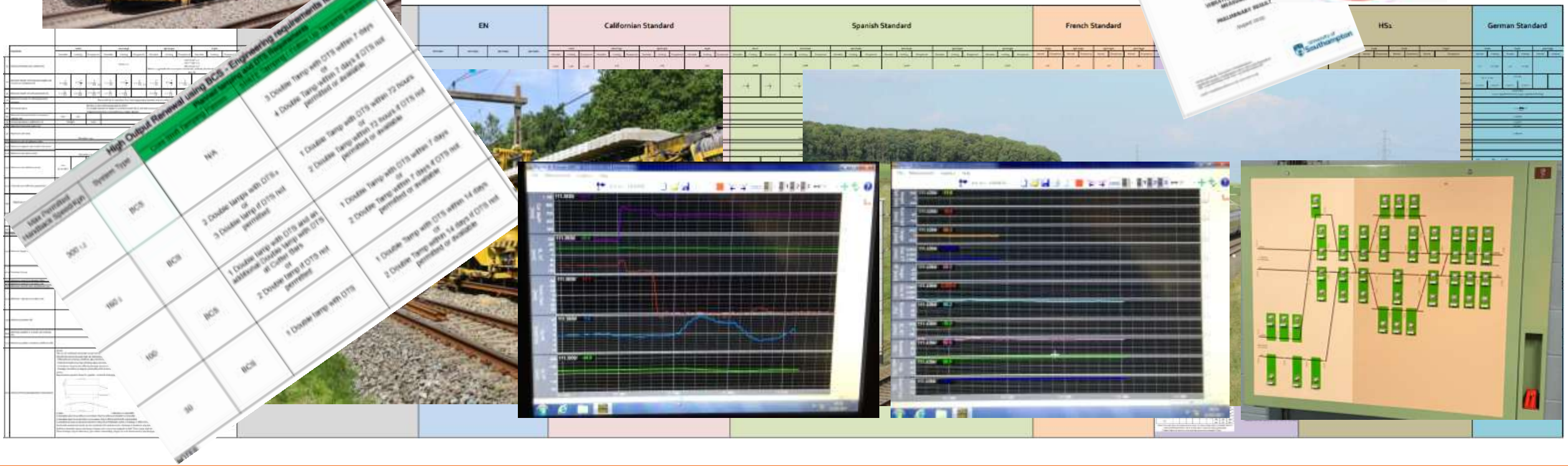
The micro-Deval coefficient for virgin ballast used for HS1 infrastructure shall be ≤5.

***Note 1**: As specified in BS EN 1097-1 using the conditions in Annex E of BS EN 13450 and to be as per Table 9, category M_{DE} RB 7 or M_{DE} RB 5– Categories for maximum values of resistance to wear of BS EN 13450.*

VS

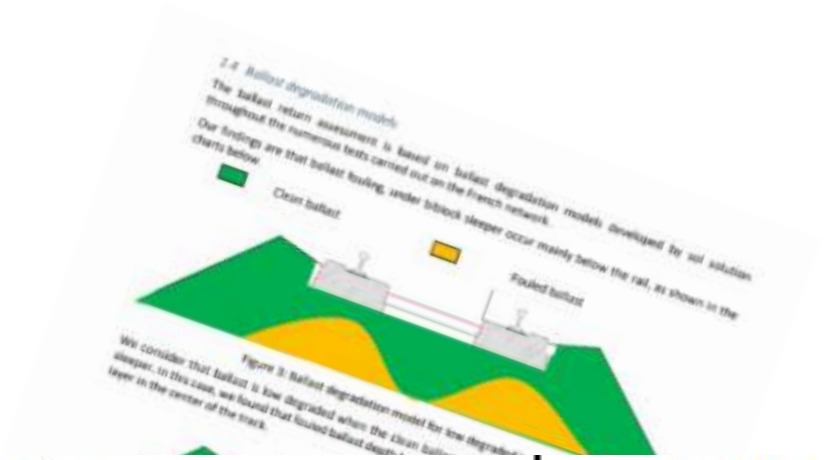
Higher ‘opening’ speeds

- Reviewing HS1 and other high speed geometry standards
- Visiting our European Colleagues
- Multiple passes DTS and Tamping



Ballast Returns

Section		GSD	Undercutter	
KP start	KP end	% passing 30mmm	Width (m)	Ballast retun rate
60,000	60,500	70%	3,75	68,2%
60,500	61,000	70%	3,75	67,3%
61,000	61,500	70%	3,75	67,1%
61,500	62,000	70%	3,75	70,0%
62,000	62,500	70%	3,75	70,0%
62,500	63,000	70%	3,75	64,8%
63,000	63,500	67%	3,75	62,0%
63,500	64,000	68%		
64,000	64,500	73%		
64,500	65,000	71%		
65,000	65,500	68%		
65,500	66,000	66%		
66,000	66,500	72%		
66,500	67,000	72%		
67,000	67,500	71%		
67,500	68,000	71%		
68,000	68,500	74%	3,75	72,9%
68,500	69,000	71%	3,75	69,3%
69,000	69,500	67%	3,75	64,5%
69,500	70,000	62%	3,75	57,9%
70,000	70,500	61%	3,75	55,9%
70,500	71,000	60%	3,75	57,7%
71,000	71,500	55%	3,75	53,2%
71,500	72,000	53%	3,75	53,3%
72,000	72,500	61%	3,75	60,9%
72,500	73,000	66%	3,75	62,4%
73,000	73,500	65%	3,75	61,9%
73,500	74,000	65%	3,75	62,8%
74,000	74,500	68%	3,75	67,7%

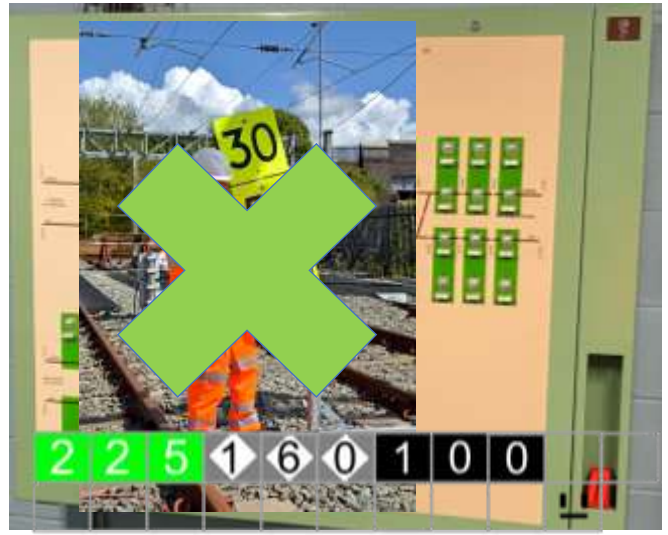


Mean value	65,1%

The area between KP 69+500 to KP 71+500 shows the less favorable values (<60%).

*BRF and report extract courtesy of NRH and Sol Solutions

No ‘clutter’



No Geotextile!!

REPETITION…

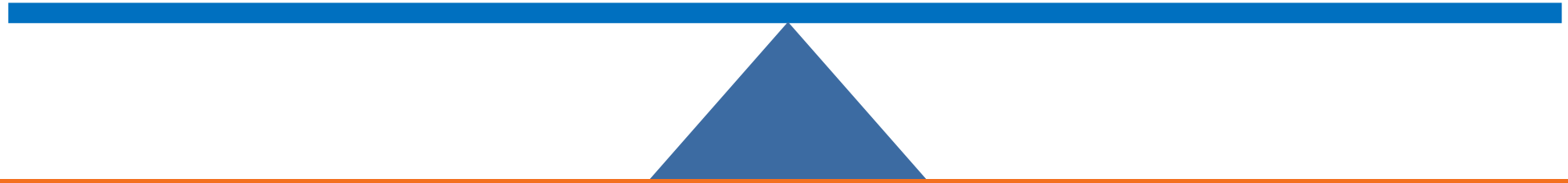
…….REPETITION….

…….REPETITION

REPETITION

Better for Unit Rate?

Worse for Unit Rate?

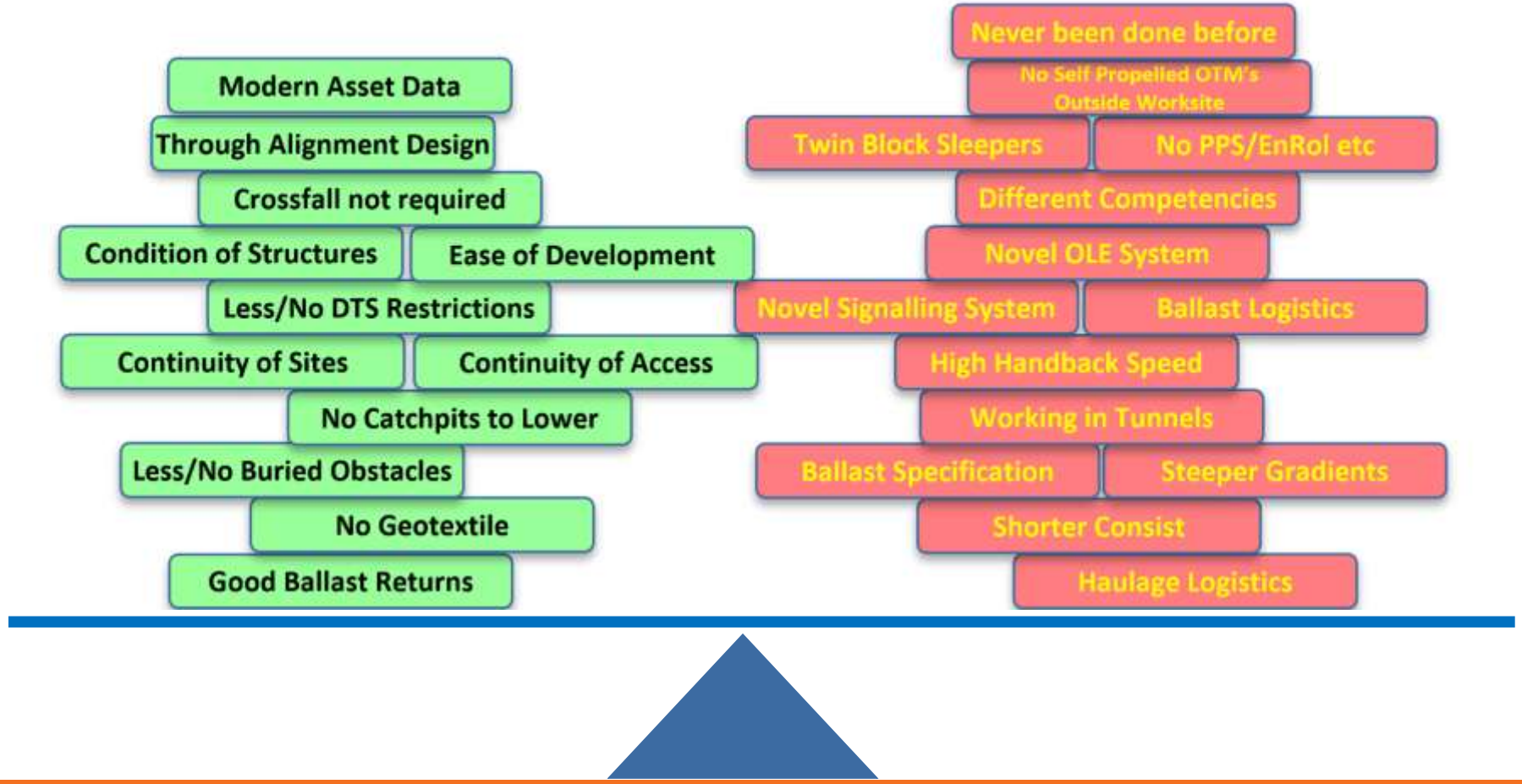


Better for Unit Rate?

- Modern Asset Data
- Through Alignment Design
- Crossfall not required
- Condition of Structures
- Ease of Development
- Less/No DTS Restrictions
- Continuity of Sites
- Continuity of Access
- No Catchpits to Lower
- Less/No Buried Obstacles
- No Geotextile
- Good Ballast Returns

Worse for Unit Rate?

- Never been done before
- No Self Propelled OTM's Outside Worksite
- Twin Block Sleepers
- No PPS/EnRoI etc
- Different Competencies
- Novel OLE System
- Novel Signalling System
- Ballast Logistics
- High Handback Speed
- Working in Tunnels
- Ballast Specification
- Steeper Gradients
- Shorter Consist
- Haulage Logistics



Potential Outputs

- 11 loaded MFS = Circa 400 tonnes new ballast
- 3.8 tonnes per linear m processed at 65% return
- 350mm deep with 0mm crossfall increases output by 5-10%.

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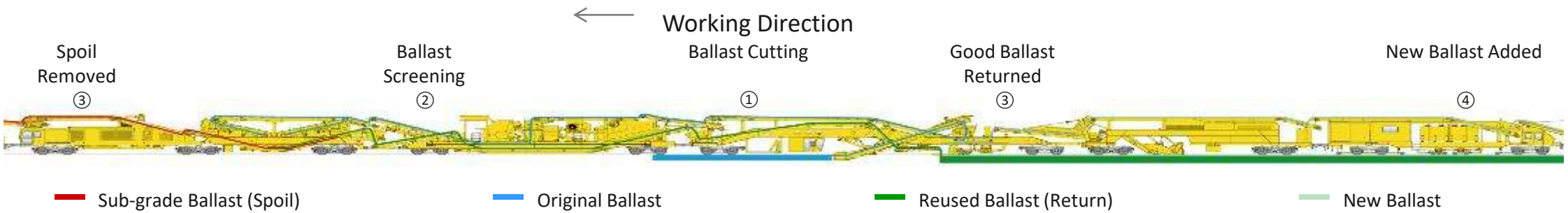
- ~300m linear metres of ballast cleaning per shift

What Next…?

What does CP8 Look Like for Ballast Cleaning



Ballast Cleaning System (BCS)

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