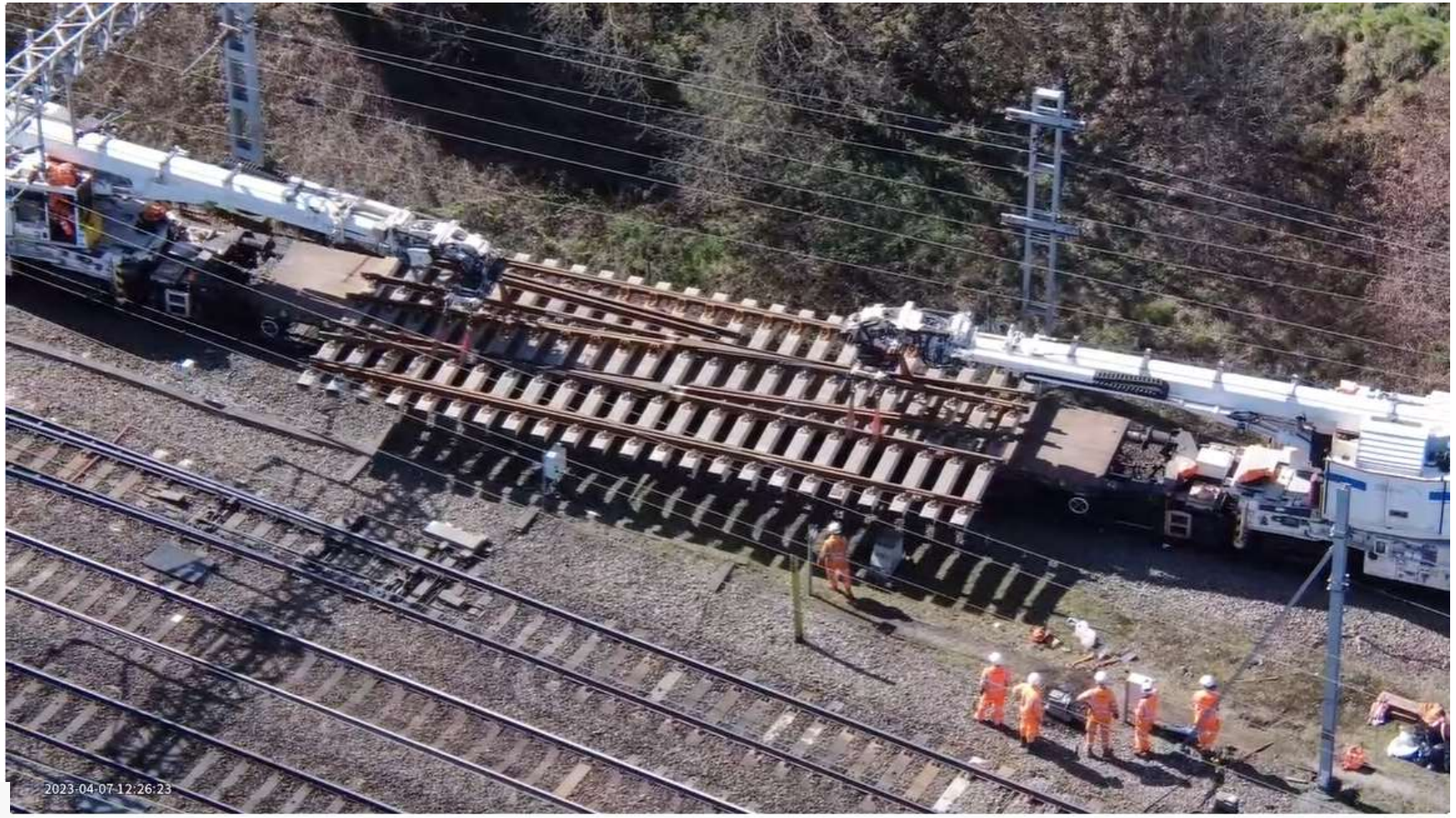
Crewe Basford Hall & Independent Lines (BHIL) Re-signalling Project



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Network Rail

Central Rail Systems Alliance
Improving Passenger Journeys

ATKINS
Member of the SNC-Lavalin Group

A Presentation given to the PWI Cheshire & North Wales Section on 5th December 2024
By Les Fox & Jon Hayes

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Crewe BHIL Re-signalling Project

Agenda:

Introduction – Les Fox

Part 1: Project Overview and Context – Jon Hayes

Part 2: Signalling – Jon Hayes

Part 3: Permanent Way – Les Fox

Part 4: Drainage – Jon Hayes

- Target duration 45-60 Mins plus additional questions (15mins max)

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Crewe BHIL Re-signalling Project

Part 1: Project Overview and Context

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Crewe BHIL Re-signalling Project

Crewe – a brief history

- Grand Junction Railway
- Station - 1837
- Locomotive works - 1842
- 1846 – LNWR formed
- Additional lines – major junction
- Independent lines – freight avoiding (constructed 1896 to 1901)

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Crewe BHIL Re-signalling Project

Historical Photo – Basford Hall

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Crewe BHIL Re-signalling Project

Basford Hall – Routeview Sept 2020

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Crewe BHIL Re-signalling Project

What is Crewe BHIL Re-Signalling?

Crewe South (Basford Hall) & Independent Lines Re-Signalling & Re-Control

- Renewal of life expired signalling equipment
- Closure of 3No. Signalboxes (Basford Hall Jn, SS North and Salop Goods Junction)
- Full Re-signalling and Re-control (Manchester ROC / Crewe SCC) – provided by Siemens

- **CRSA scope:**
  - Track
  - OLE & Traction Bonding
  - Drainage
  - Civils
  - Temporary Works
  - Earthing and Bonding / Environmental / Toposurvey
  - Subcontract designers – auger boring, de-watering, scaffolding, Cured In Place lining

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Crewe BHIL Re-signalling Project

Part 2: Signalling

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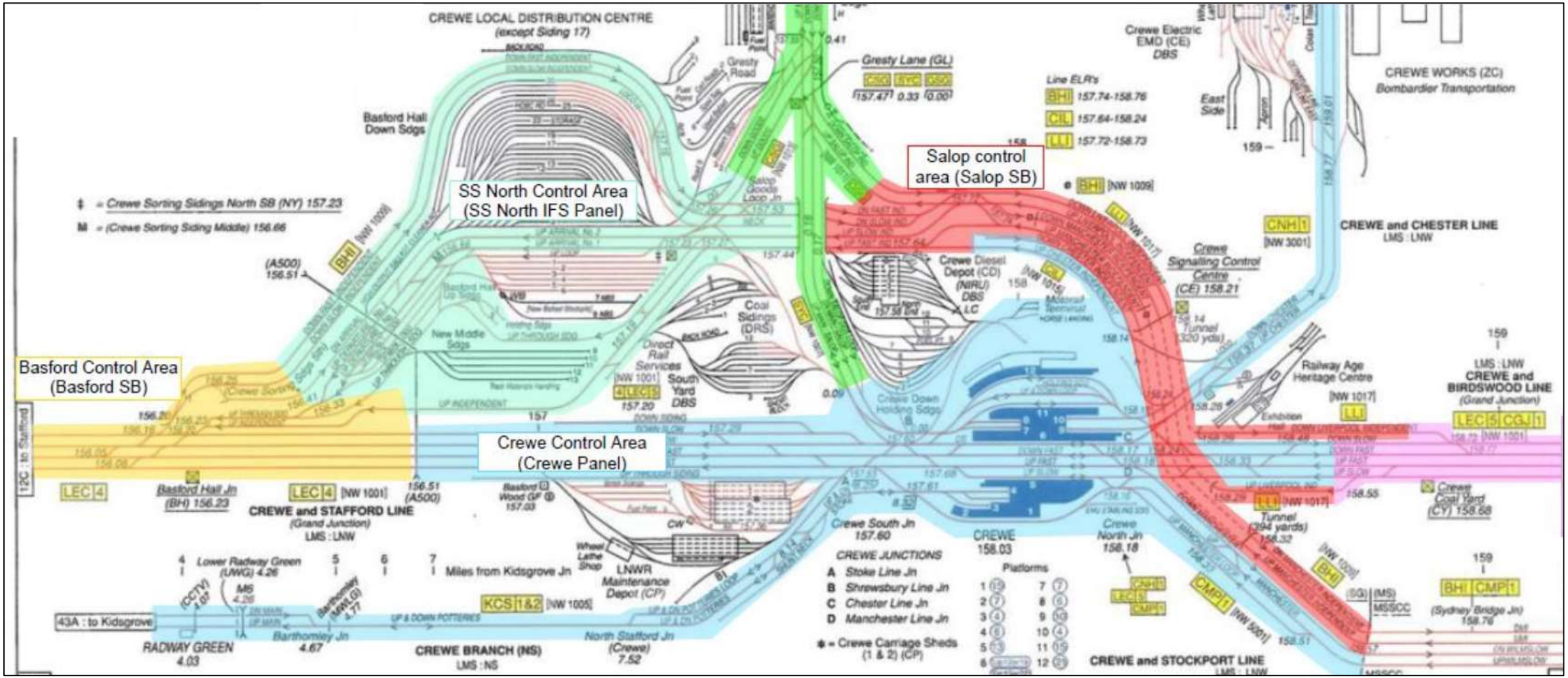
What is Crewe BHIL Re-Signalling?



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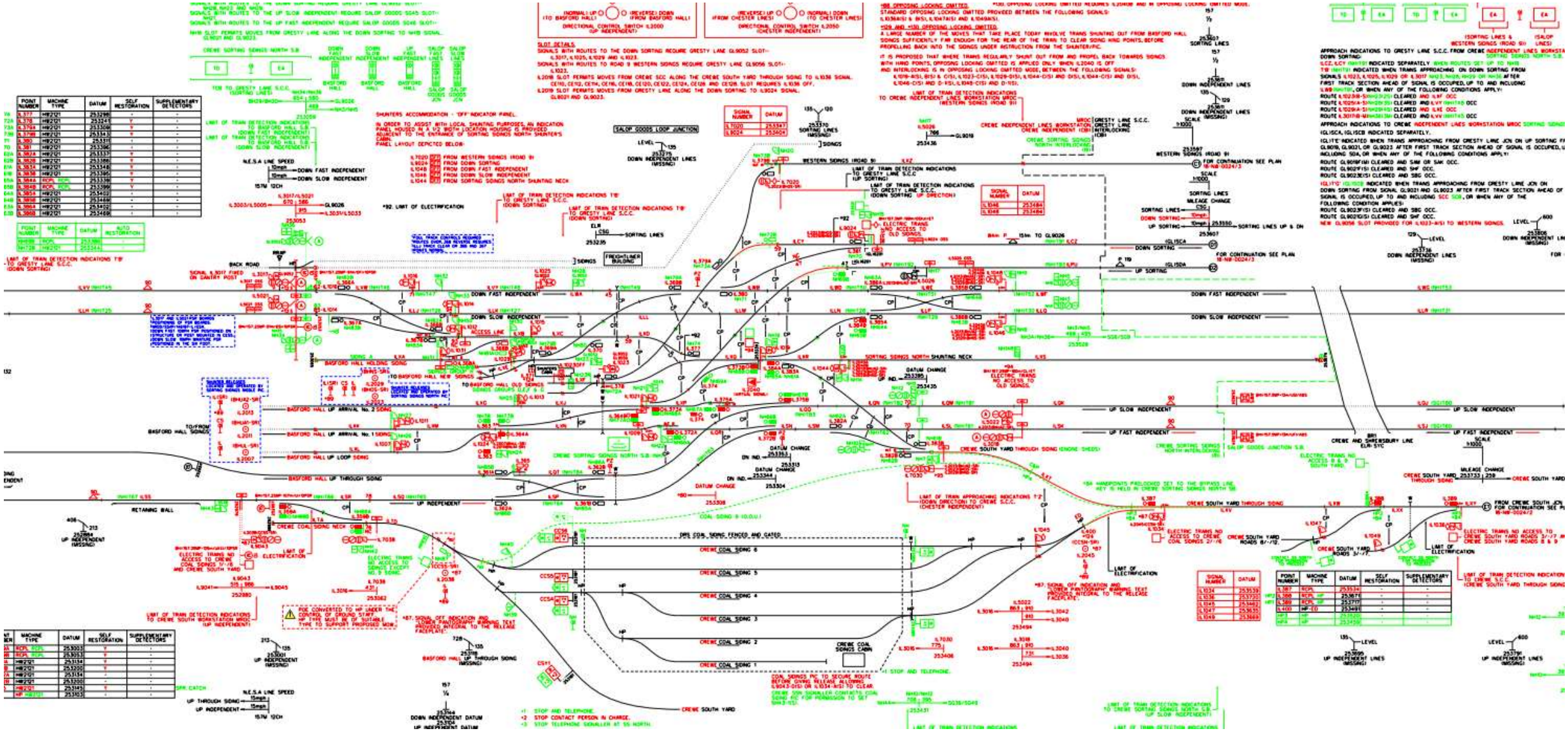
Crewe BHIL Re-signalling Project

Signalling Scheme Plan



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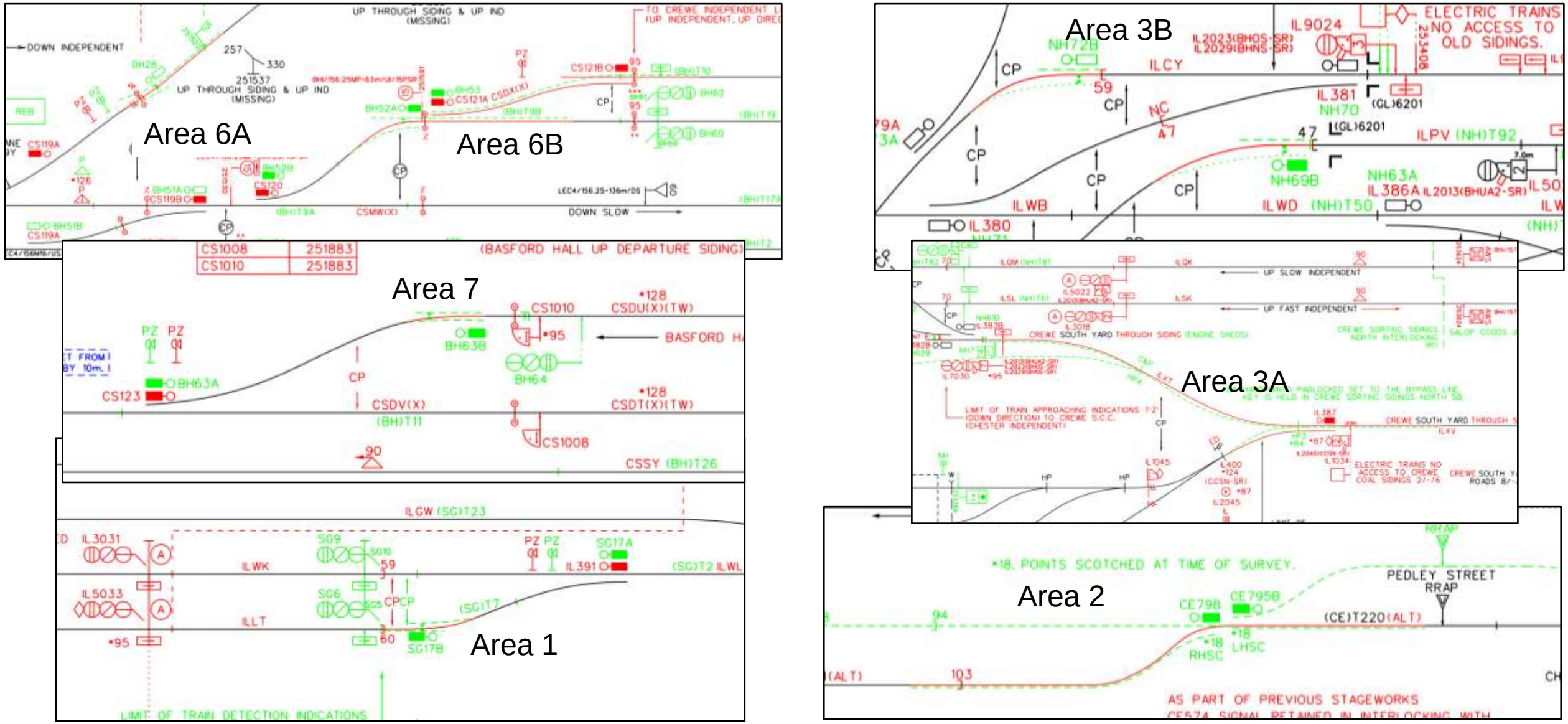
Crewe BHIL Re-signalling Project

Signalling Scheme Plan – Track Interventions



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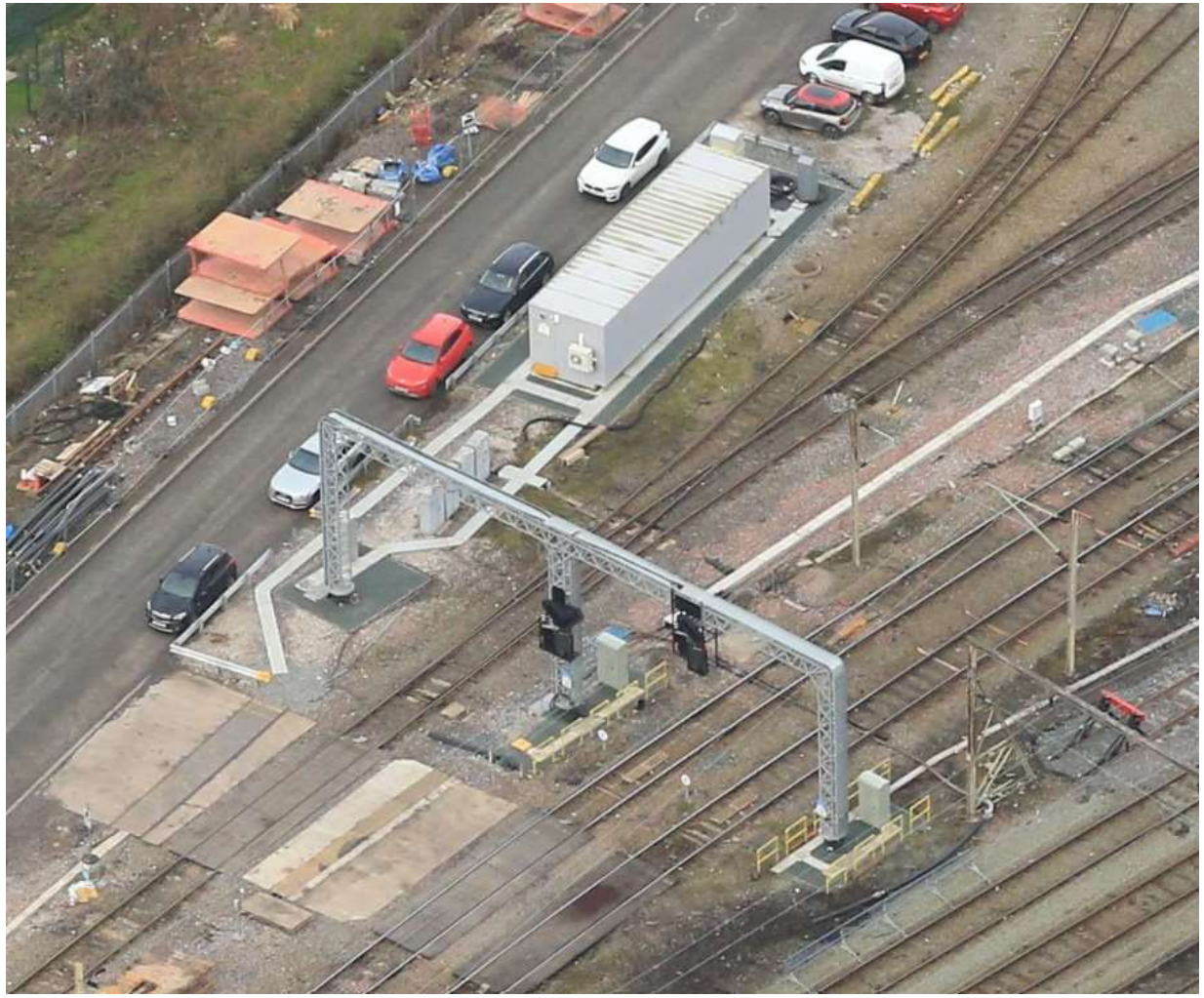
New Signalling Assets



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New Signalling Assets

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Part 3: Permanent Way

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Crewe BHIL Re-signalling Project

Basford Hall Jn – Renewal of 22A/B Pts and 48/49 Pts

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Crewe BHIL Re-signalling Project

Basford Hall Jn – Renewal of 22A/B Pts and 48/49 Pts

BH 48 Pts – Typical cracking in bearers

BH48/49 Pts – Typical cracking in bearers

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Crewe BHIL Re-signalling Project

Basford Hall Jn – Renewal of 22A/B Pts and 48/49 Pts

BH49 Pts – Emergency Gauge Tie Bars fitted on Up Fast Line in crossing area

BH22A/B Pts – Typical cracks in bearers around housings

Drone footage of railway track renewals in Crewe at Easter 2023 as West Coast mainline work completed - video Dailymotion

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Crewe BHIL Re-signalling Project

Recovery of Coal Siding No. 9 & Conversion of HP1/HP2 Tandem to 398 Pts

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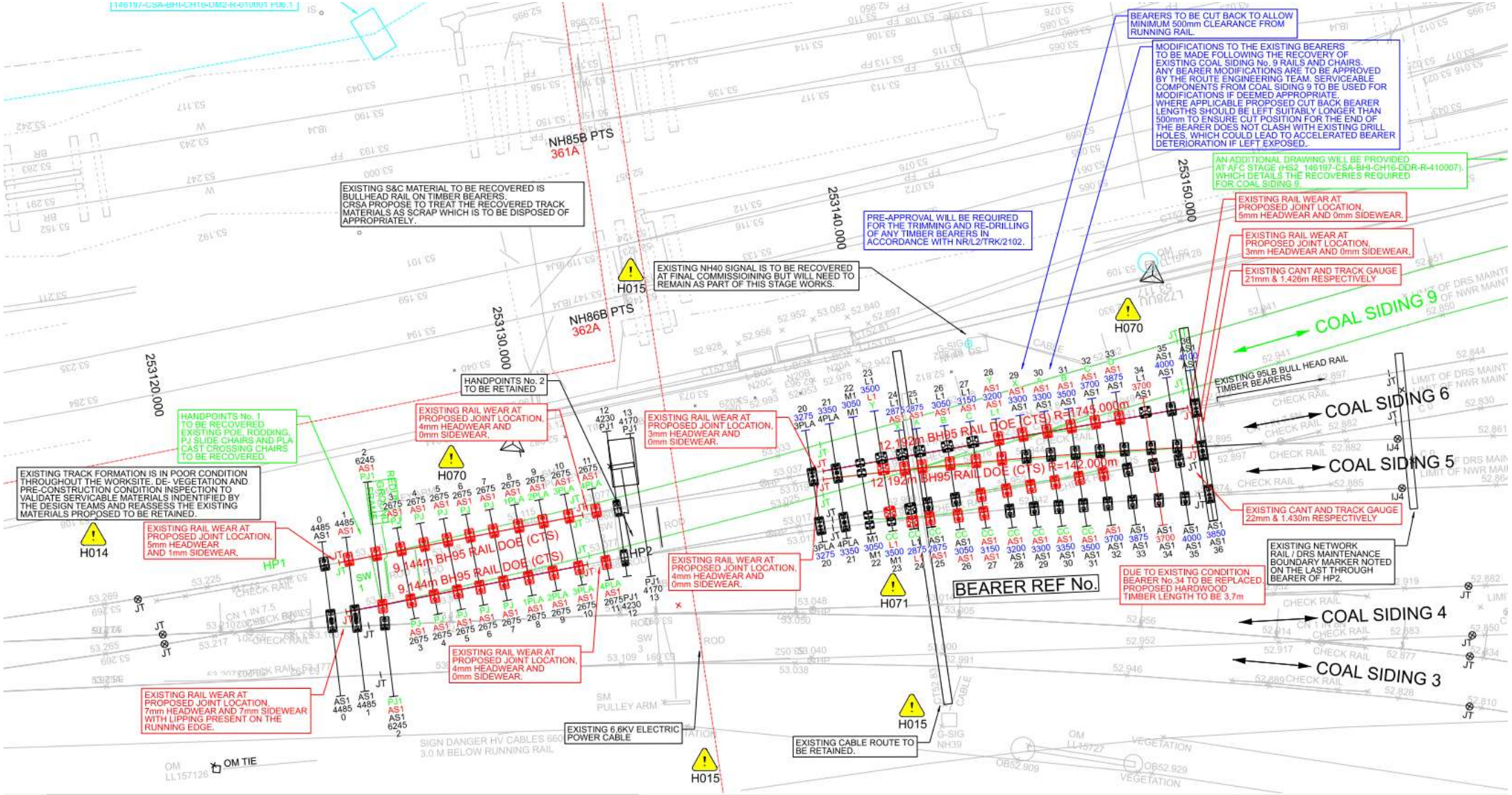
Crewe BHIL Re-signalling Project

Recovery of Coal Siding No. 9 & Conversion of HP1/HP2 Tandem to 398 Pts



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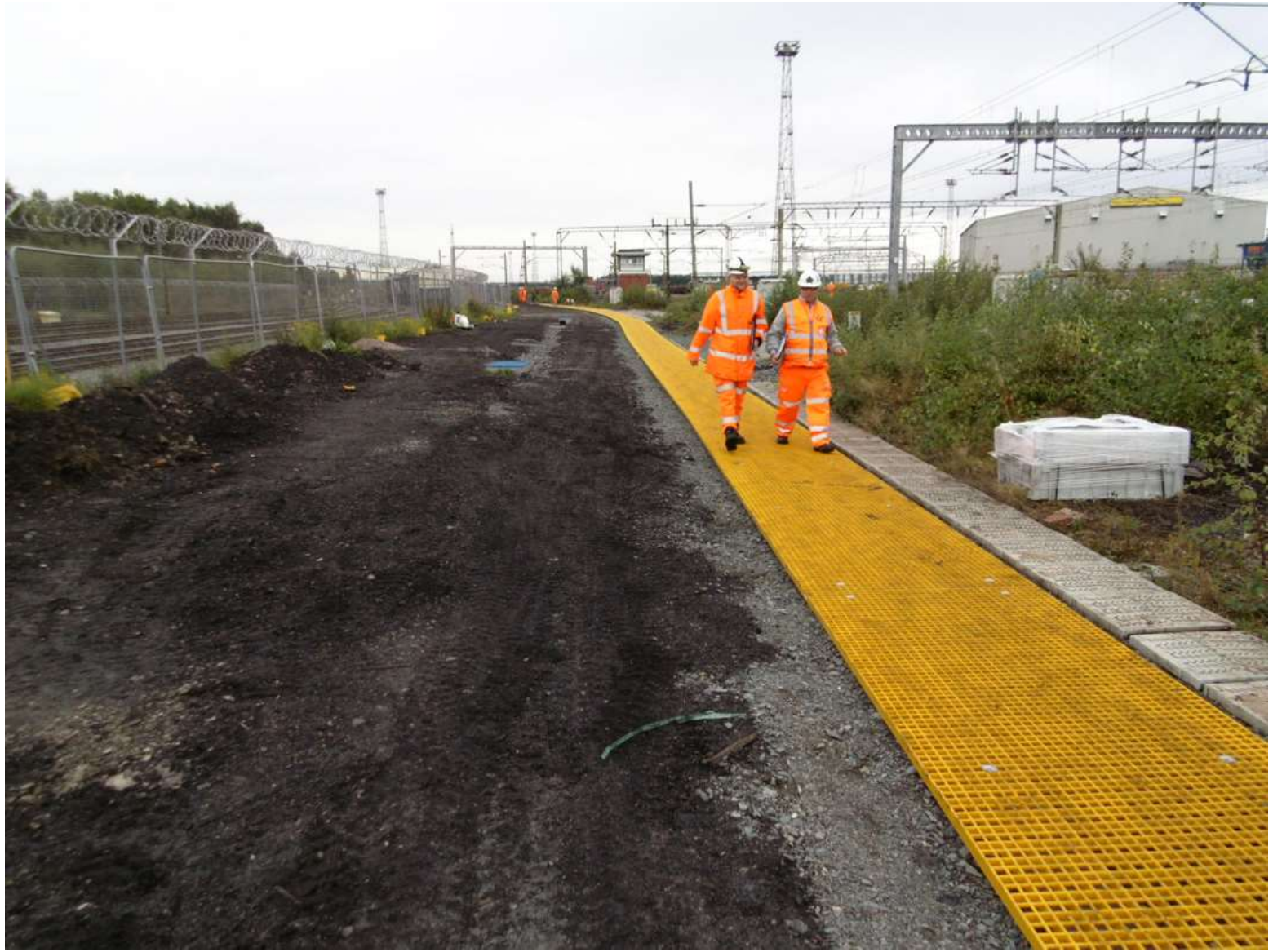
Crewe BHIL Re-signalling Project

Recovery of Coal Siding No. 9 & Conversion of HP1/HP2 Tandem to 398 Pts



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Crewe BHIL Re-signalling Project

'Area 3' South Yard Through Siding Renewal

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Crewe BHIL Re-signalling Project

‘Area 3’ South Yard Through Siding Renewal

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Crewe BHIL Re-signalling Project

‘Area 3’ South Yard Through Siding Renewal

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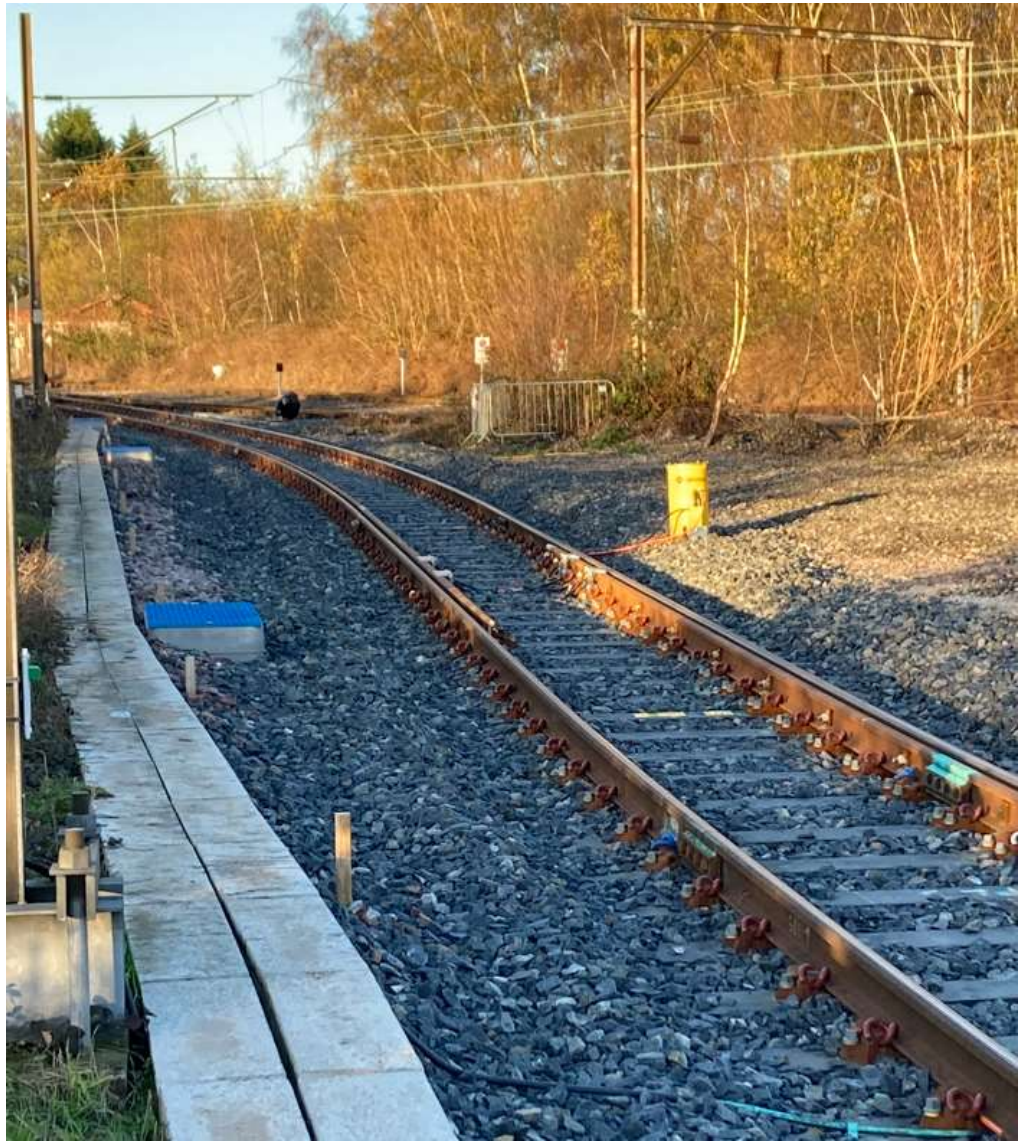
Crewe BHIL Re-signalling Project

‘Area 3’ South Yard Through Siding Renewal



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Crewe BHIL Re-signalling Project

‘Area 3’ South Yard Through Siding Renewal

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‘Area 3’ South Yard Through Siding Renewal

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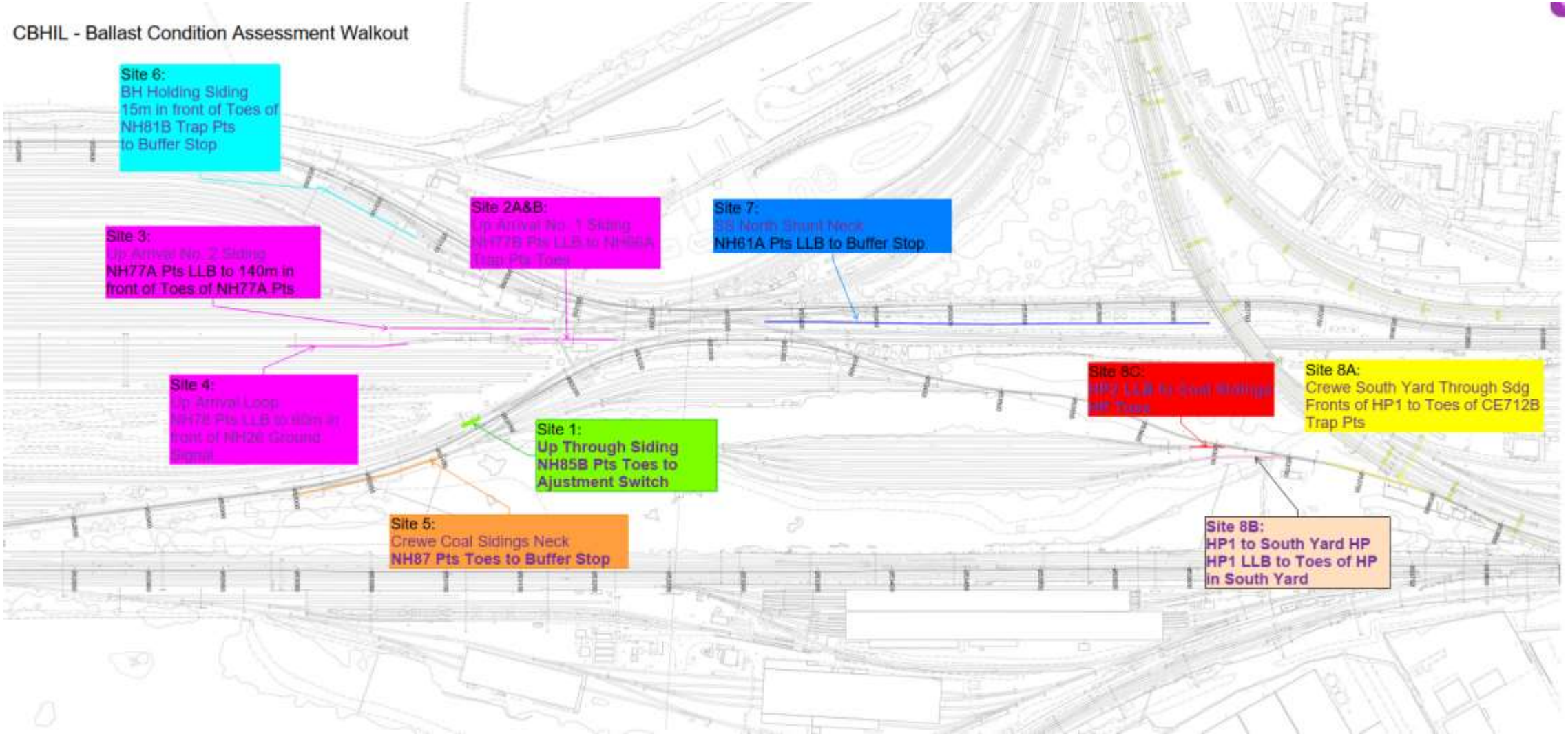
Crewe BHIL Re-signalling Project

Track Interventions for New Track Circuit Fitments: 900m of track reballasting and 250m of full track relaying



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Crewe BHIL Re-signalling Project

Reballasting With the Rail Vac

Nozzle

- Break through tough materials with 5,000 lbs (2,268 kg) of force
- Excavate materials up to 15 ft (4.6m) from track centers
- Excavate materials up to 50 yd^3/hr (38 m^3/hr)

Belt Conveyors

- On board storage up to 20 yd^3 (16m^3) of material
- Discharge excavated material up to 30 ft (9.1m) from track center or into an auxiliary car

BHIL Typical Production Rate – 100m per weekend

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Reballasting Sites – Up Arrival No. 2 Siding

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Reballasting Sites – Up Arrival No. 2 Siding

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Crewe BHIL Re-signalling Project

Reballasting Sites – Up Arrival Loop

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Reballasting Sites – SS North Shunt Neck

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Crewe BHIL Re-signalling Project

Reballasting Sites – Coal Sidings 400 Pts

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Reballasting Sites – South Yard Sidings

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Reballasting Sites – South Yard Sidings

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Reballasting Sites – South Yard Through Siding

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Reballasting Sites – Coal Sidings Neck

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Reballasting Sites – Coal Sidings Neck

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Crewe BHIL Re-signalling Project

Reballasting Sites – Holding Siding

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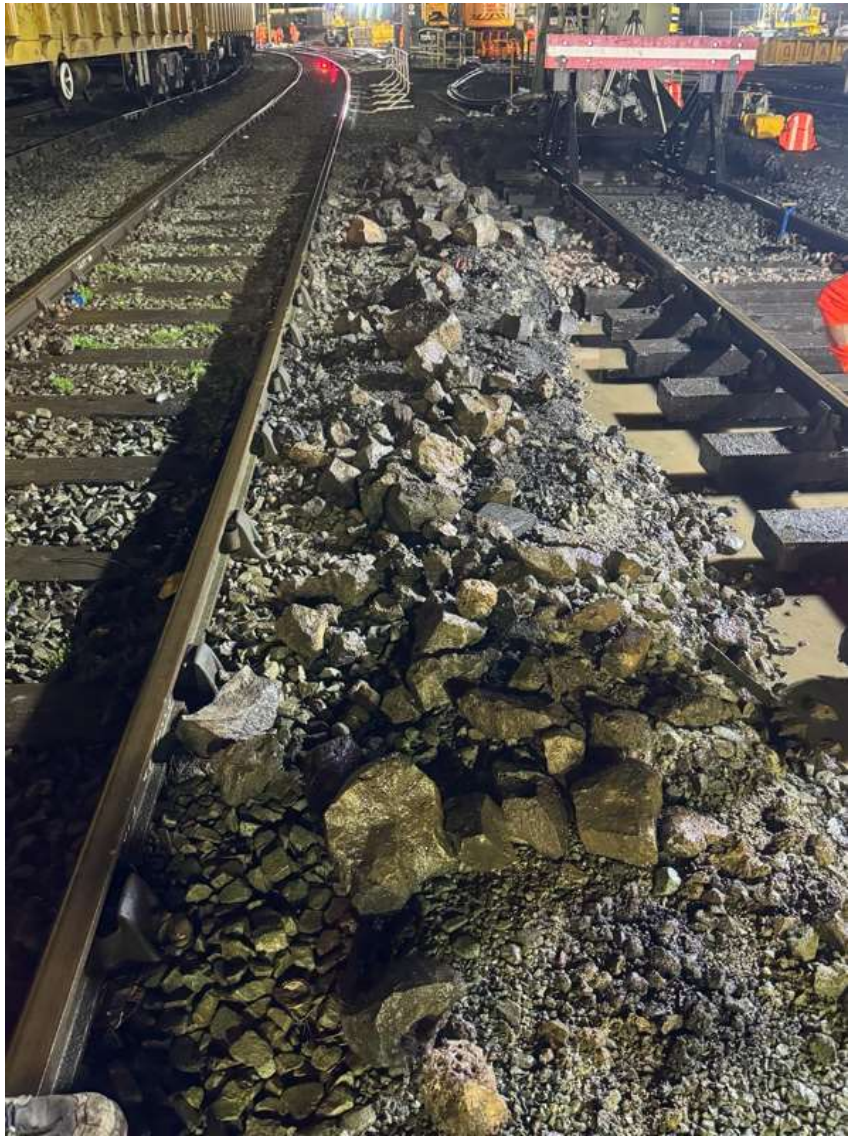
Crewe BHIL Re-signalling Project

Reballasting Sites – Holding Siding



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Buffer Stop Refurbishments – SS North Shunt Neck

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Buffer Stop Refurbishments – Coal Sidings Neck

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Crewe BHIL Re-signalling Project

Buffer Stop Refurbishments – Holding Siding

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Crewe BHIL Re-signalling Project

Existing Recoveries - Insulated Rail Joints (IRJ): Signalling Bonding Plan Example – SS North

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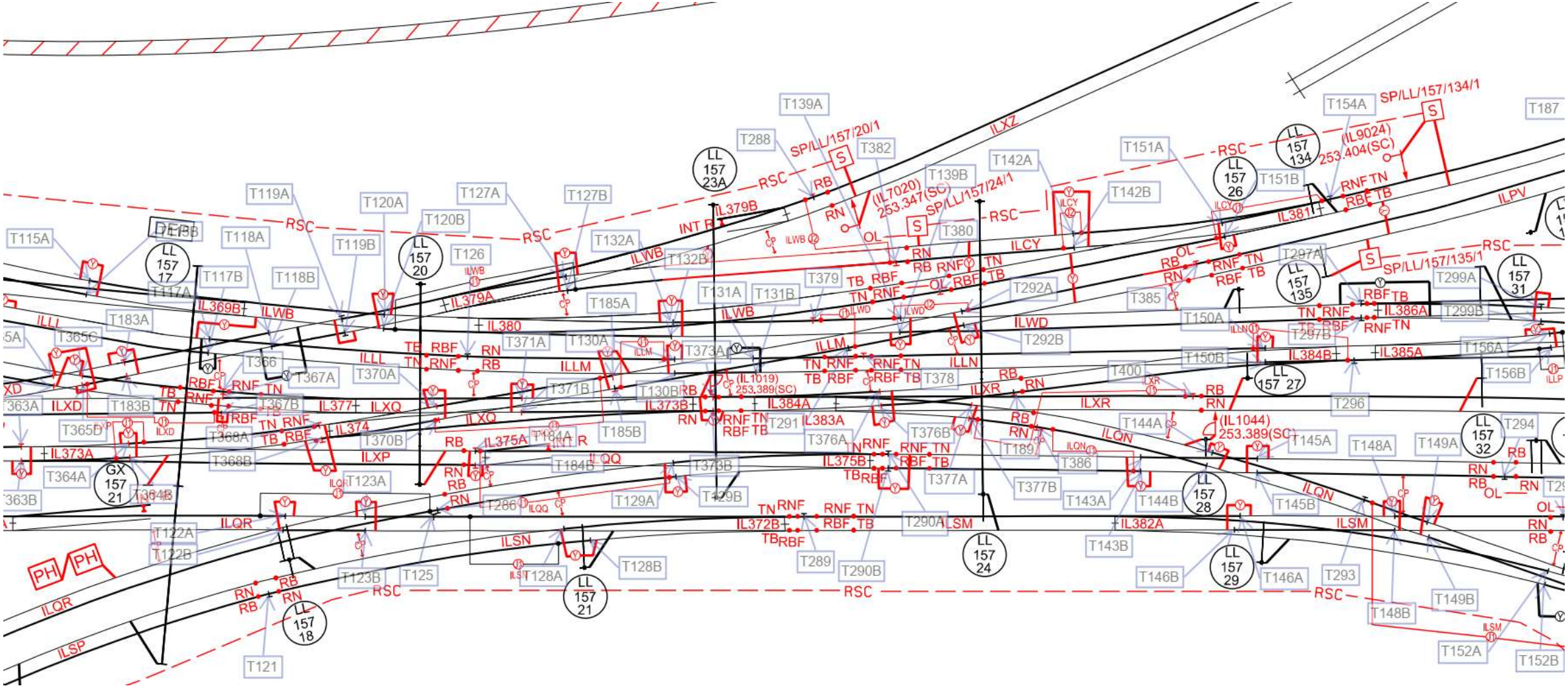
Crewe BHIL Re-signalling Project

Proposed Insulated Rail Joints (IRJ): Signalling Bonding Plan Example – SS North



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Crewe BHIL Re-signalling Project

Insulated Rail Joints (IRJ)

- LEC4 West Coast Main Lines and Basford Hall
- Existing IRJs Retained = 177
- Existing IRJs Refurbished = 37
- New Site Fitted IRJs = 207
- New Shop Glued IRJs = 22
- IRJ Recoveries = 136
- **Total IRJs = 578**
- 14 Weekend Inspection shifts Winter 2023/2024

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Crewe BHIL Re-signalling Project

Track Circuit Chair Protectors ('Murphys Slippers')

NetworkRail

Certificate of Authorisation of Variation

Standard Details

Title: Train Detection Handbook

Ref: NR/L2/SIG/11752

Issue No.3

Date of Issue:

Clause No(s): Part F, Section 2.1 - Insulated Rail Joints

Module Details:

Line Reference: BHI BASFORD HALL JN - SYDNEY BR JN (INDEPENDENT LINES)

Copy the text from the Standard where the variation is sought: The following shall be considered relative to IRJ provision in S&C as
constrained by permanent way engineering considerations:

· There shall be a minimum distance of 200mm between chair or rail fastenings of opposite polarity/phase to reduce the probability of failures due to metallic litter, etc.

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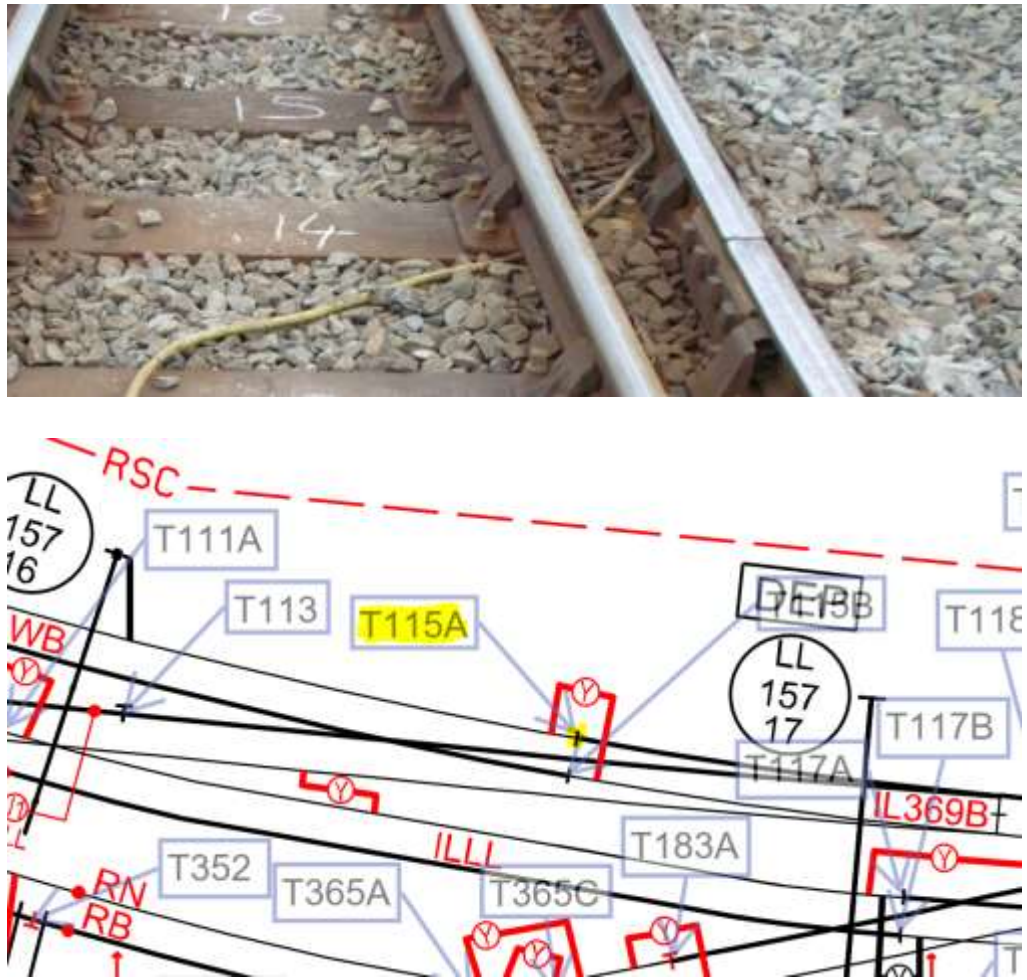
Track Circuit Chair Protectors ('Murphys Slippers')

Photo: IRJ T115A location



Extract from Signalling Bonding Plan

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Crewe BHIL Re-signalling Project

Track Circuit Chair Protectors (‘Murphys Slippers’)

- **Purpose:** Prevents adjacent track circuits shorting and Reduces the likelihood of SPADS.
- **How?** Provides insulation between adjacent rails of different polarity where debris between chairs/baseplates could lead to a short circuit.
- **Installations:** Sites already previously installed: Selhurst and Allerton, amongst others.
  Slippers only available to fit BRV Baseplates.

CHAIR PROTECTOR TRACK CIRCUIT

Pack Size:	1
Catalogue Number:	0057/027000
Lead Time(Working Days):	16
Stocked Status:	Non Stocked
Product Status:	Controlled
Part Number:	.
Drawing Number :	TSP 004
Certificate Number:	PA05/04509
Acceptance Comments:	N/A

For further information on supply chain pro
Support Hub.

NetworkRail

Murphy slippers fitted Allerton 187 m 1500 up fast

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Crewe BHIL Re-signalling Project

Track Circuit Chair Protectors (‘Murphys Slippers’)

NetworkRail

Certificate of Acceptance PA05/04509

Manufacturer:
PW Services (Southern) Limited

Issue : 3
Valid From : 16/05/2024

Product Configuration

Product Range

Part No.	Description	Catalogue No.
Drawing no.TSP004	Track Circuit Chair Protector	057/027000
Drawing no.TSP004	Track Circuit Chair Protector (Flame Retardant Version)	057/027001
Drawing L1/M1	Track Circuit Chair Protector (for L1/M1 Chair variations)	0057/027002

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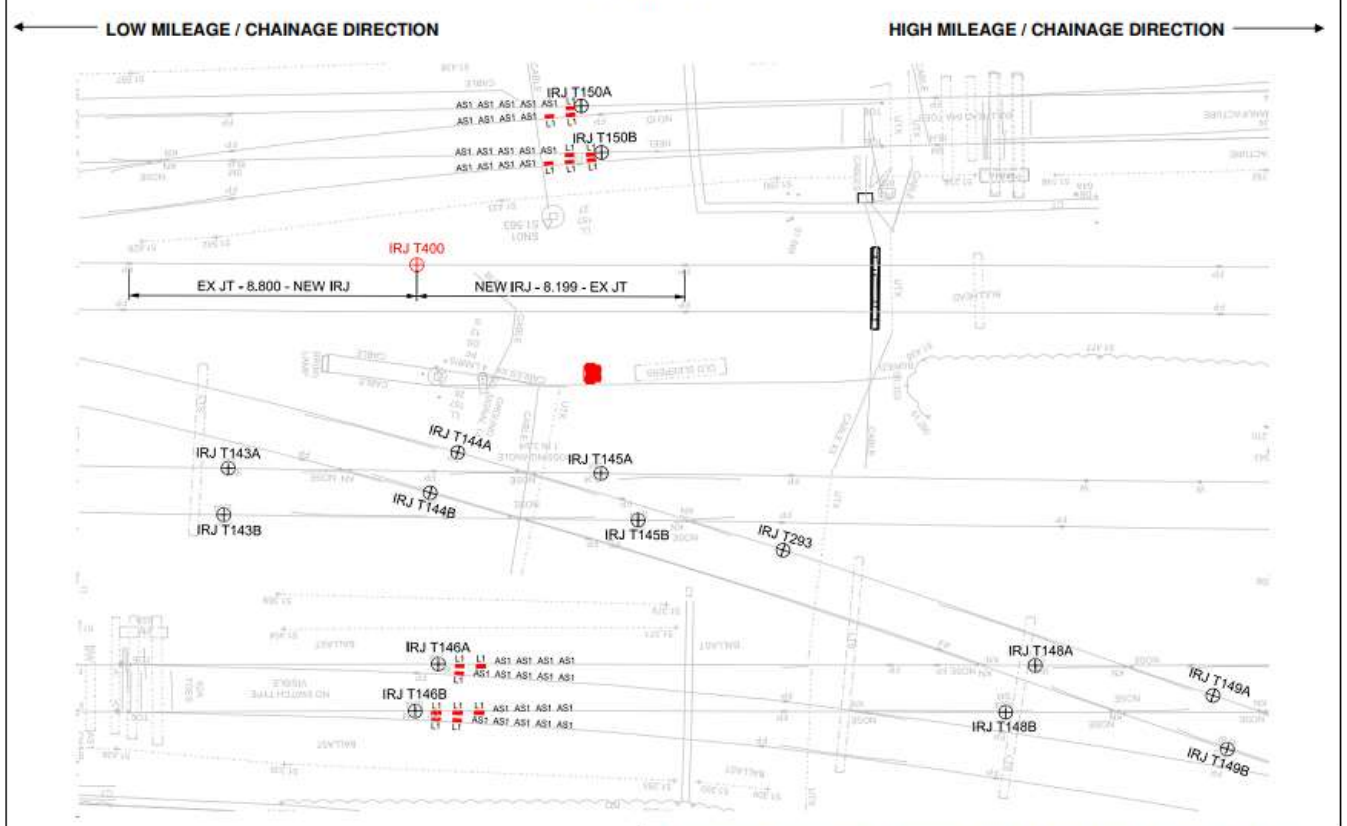
Crewe BHIL Re-signalling Project

IRJ Siting Sketches – 184 No. Issued

Key:

- 4 Hole Side Fitted IRJ - Existing Retained
- 4 Hole Side Fitted IRJ - Existing Refurbished
- 4 Hole Side Fitted IRJ - Existing to be Recovered
- 4 Hole Side Fitted IRJ - Proposed New
- 4 Hole Shop Glued IRJ - Existing Retained
- 4 Hole Shop Glued IRJ - Existing to be Recovered
- 4 Hole Shop Glued IRJ - Existing to be Permanently Bonded Out
- 4 Hole Shop Glued IRJ - Proposed New
- 6 Hole Close Tolerance IRJ - Existing Refurbished
- 6 Hole Close Tolerance IRJ - Existing Retained
- 6 Hole Close Tolerance IRJ - Existing to be Recovered
- 6 Hole Close Tolerance IRJ - Existing to be Permanently Bonded Out
- 6 Hole Close Tolerance IRJ - Proposed New
- 6 Hole Shop Glued IRJ - Existing Retained
- 6 Hole Shop Glued IRJ - Existing to be Recovered
- 6 Hole Shop Glued IRJ - Existing to be Permanently Bonded Out
- 6 Hole Shop Glued IRJ - Proposed New
- W — Proposed New Weld
- W — Recover Existing Weld
- W — Existing Weld Retained
- JT — Proposed New 4 Hole Plated Joint
- JT — Recover Existing Plated Joint
- JT — Existing Plated Joint Retained
- Proposed New Rail
- Recover Existing Rail
- Retain Existing Rail
- L1 — Proposed New Chair/Baseplate (Type Specified)
- PANV — Existing Chair/Baseplate (Type Specified) Retained
- AS1 — Existing Chair/Baseplate Recovered (Type Specified)
- Proposed Change in Rail Section
- Retained Existing Change in Rail Section
- Recovered Change in Rail Section
- Proposed Track Circuit Chair protector (Install on Side of Rail Indicated)
- Existing Axle Counter
- Proposed Axle Counter

IRJ Design Model Extract



Projectwise Model Ref: HS2_146197-CSA-000-CH16-DM3-R-110001 (Rev P15)

This Sketch Diagram Covers IRJ Location/s:

T143A/T143B/T144A/T144B/T145A/T145B/T146A/T146B T293/T148A/T148B/T149A/T149B/T400/T150A/T150B

LOW MILEAGE / CHAINAGE DIRECTION — HIGH MILEAGE / CHAINAGE DIRECTION

Note: All dimensions are shown in Metres (m)

Central Rail Systems Alliance
Improving Passenger Journeys

AtkinsRéalis

	Name	Date	Signature
Produced	A. Simpson	15/05/24	Asimpson
Checked	C. Edwards	15/05/24	
Authorised	L. Fox	15/05/24	

IRJ Schedule Ref:	176796-CSA-XX-BHI-SCH-ETR-000002	Version:	P13

Crewe Basford Hall and Independent Lines (BHIL) Re-signalling Project

IRJ Siting Sketch

IRJ Siting Sketch Ref: **BHI 157M080-2**

Sheet 1 of 1 | Date: 15/05/24 | Version: C02

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Challenging IRJ Locations – IRJ T185B

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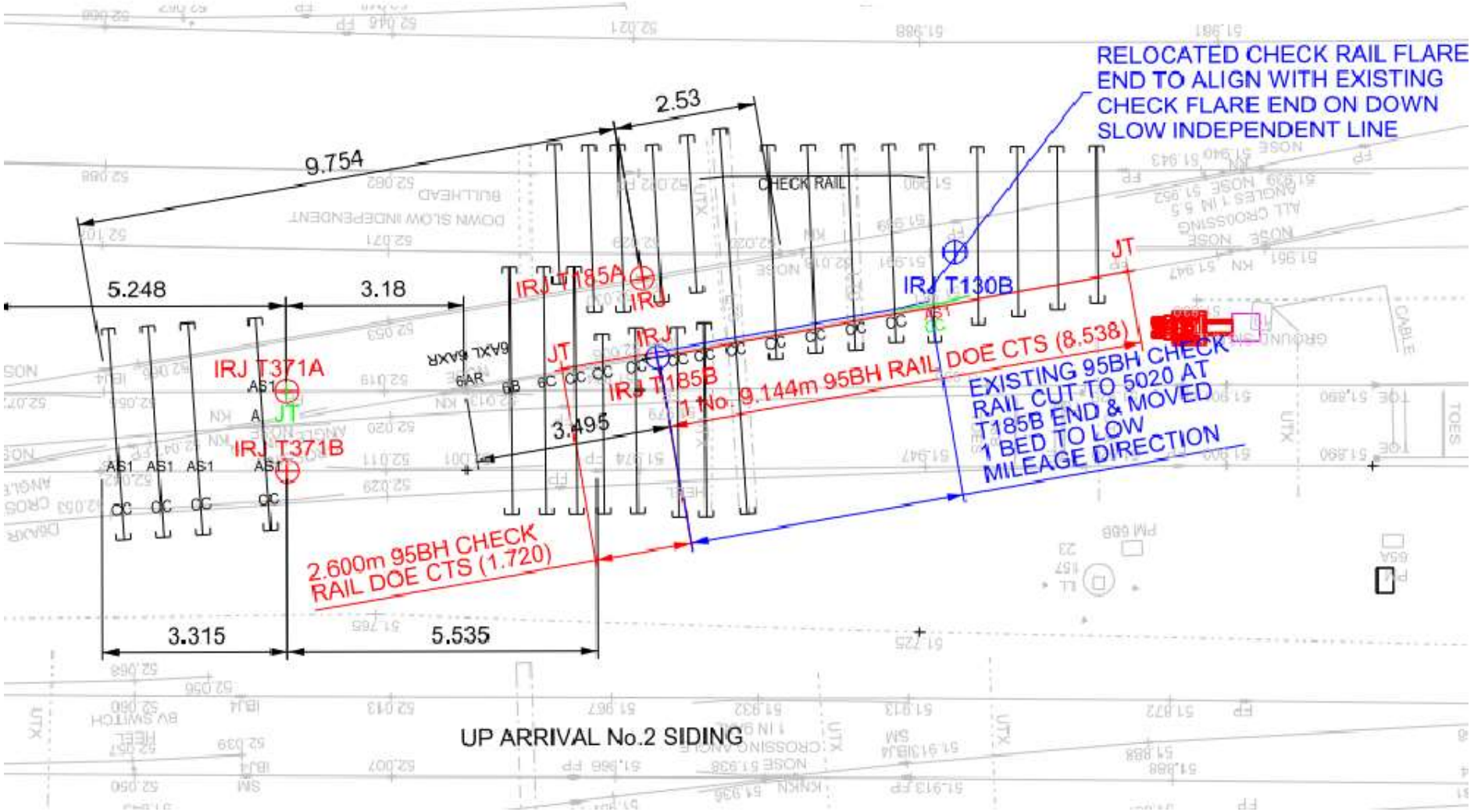
Challenging IRJ Locations – IRJ T185B



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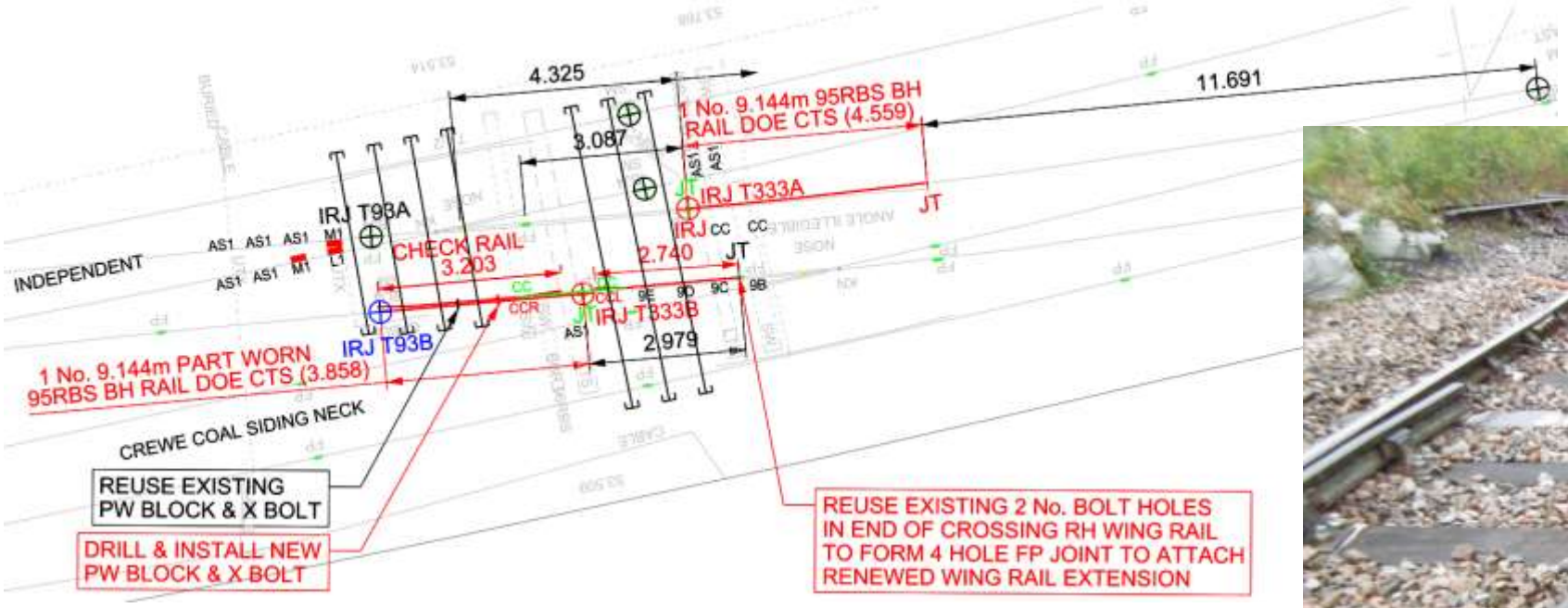
Challenging IRJ Locations – IRJ T333B



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Challenging IRJ Locations – IRJ T368A & B

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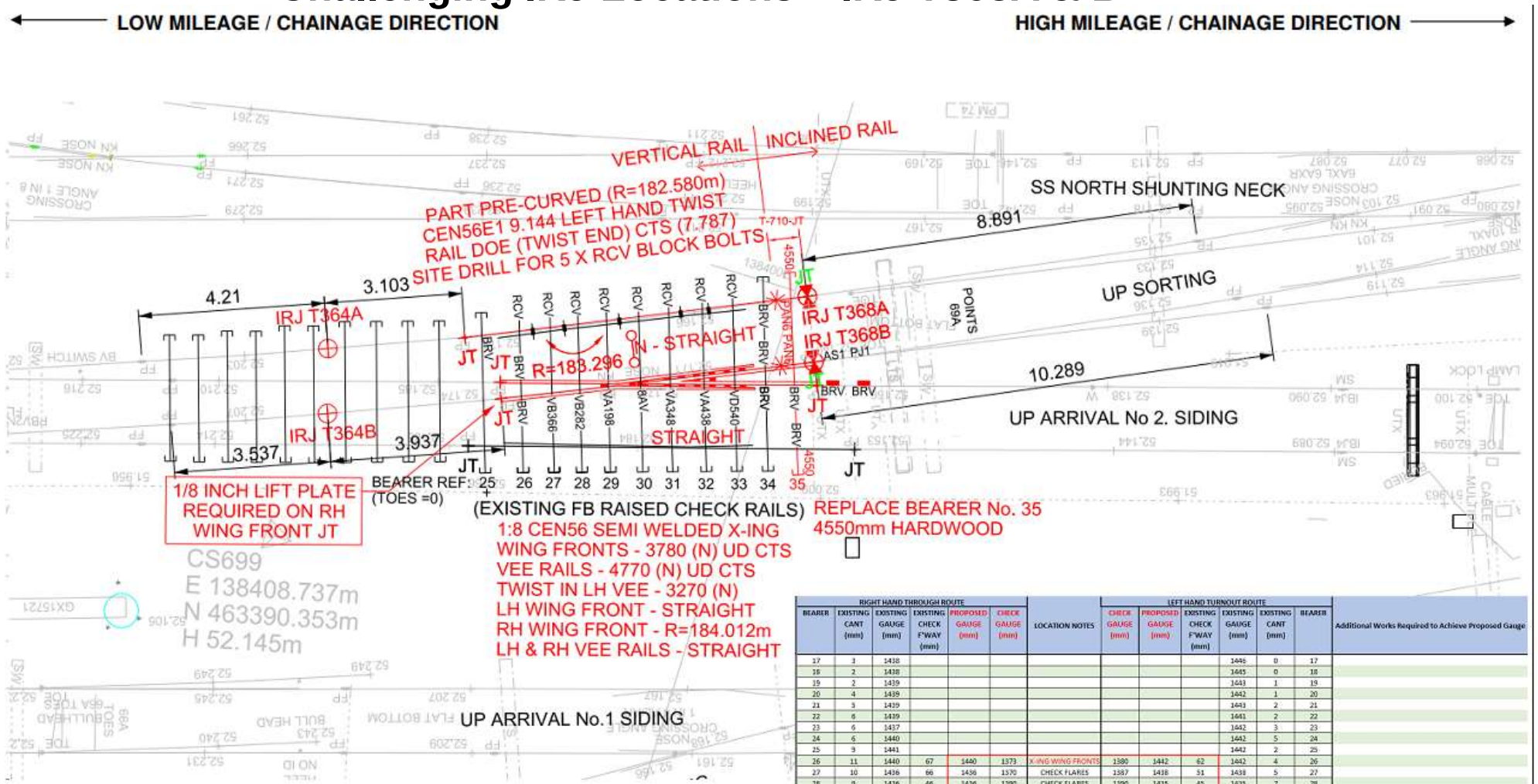
Challenging IRJ Locations – IRJ T368A & B



RIGHT HAND THROUGH ROUTE							LOCATION NOTES	LEFT HAND TURNOUT ROUTE						Additional Works Required to Achieve Proposed Gauge
BEARER	EXISTING CANT (mm)	EXISTING GAUGE (mm)	EXISTING CHECK F'WAY (mm)	PROPOSED GAUGE (mm)	CHECK GAUGE (mm)		CHECK GAUGE (mm)	PROPOSED GAUGE (mm)	EXISTING CHECK F'WAY (mm)	EXISTING GAUGE (mm)	EXISTING CANT (mm)	BEARER	
17	1	1438									1446	0	17	
18	2	1438									1445	0	18	
19	2	1439									1443	1	19	
20	4	1439									1442	1	20	
21	3	1439									1443	2	21	
22	6	1439									1441	2	22	
23	6	1437									1442	3	23	
24	6	1440									1442	5	24	
25	9	1441									1442	2	25	
26	11	1440	67	1440	1373		X-ING WING FRONTS	1390	1442	62	1442	4	26	
27	10	1436	66	1436	1370		CHECK FLARES	1387	1438	51	1438	5	27	
28	9	1436	46	1436	1390		CHECK FLARES	1390	1435	45	1435	7	28	
29	7	1434	41	1434	1393			1393	1435	42	1435	10	29	
30	15	1427	42	1432	1390		CROSSING NOSE	1392	1434	42	1435	8	30	Adjust Running rail RCV baseplates positions as required
31	10	1430	42	1430	1388			1388	1435	47	1435	10	31	
32	8	1430	54	1430	1376		CHECK FLARES	1386	1438	52	1438	9	32	
33	5	1434	70	1434	1364		CHECK FLARES	1378	1441	63	1441	7	33	
34	3	1436		1436					1443		1443	4	34	
35	2	1437		1437			RENEW BEARER		1442		1438	2	35	Proposed New Bearer
36	-4	1437					69A STOCK FRONTS				1441	0	36	
37	-6	1435					69A TOES				1435	-4	37	

EXISTING AND PROPOSED REGAUGING FOR NH 69A PTS CROSSING REPLACEMENT WORKS

Notes:
1. Check Gauge at Crossing Nose is Critical (Tolerance is 1388mm to 1392mm).
2. Maximum Variation in Gauge over 3m (4 beds) to be 8mm.

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Crewe BHIL Re-signalling Project

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Crewe BHIL Re-signalling Project

S&C Refurbishments for POE Conversions

25 S&C Units – Retain existing HW2121

9 S&C Units - Install new HW2121 Point Machines

31 S&C Units – Install new MK2 RPCL with RCM

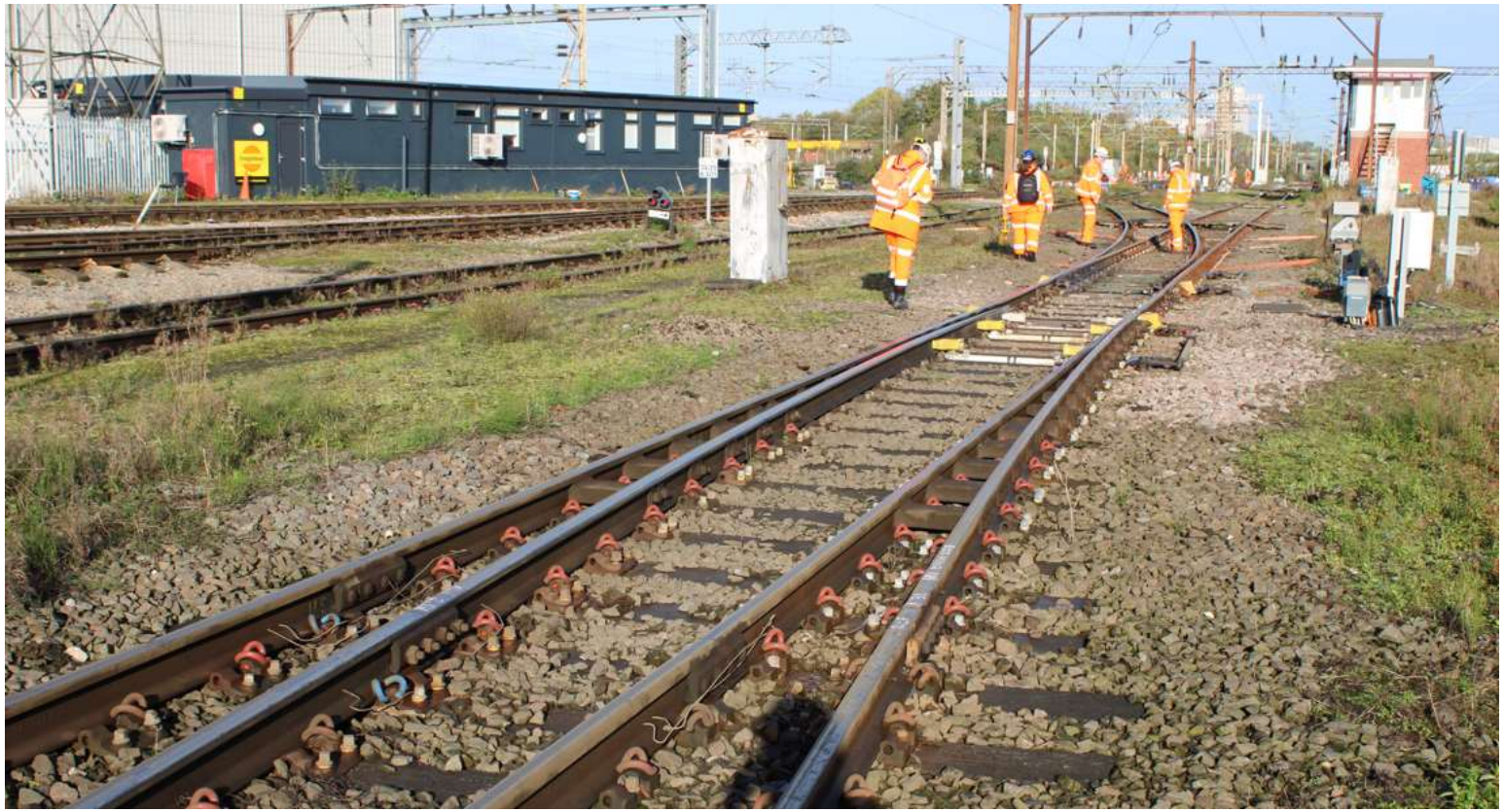
4 S&C Units – Install new IBCL with Hy-drive SO and RCM

1 S&C Unit – Convert from HW2121 to Hand Points

2 S&C Units – Fit electric detection to existing hand points

2020: Total No. of Initial Scoping Inspections = 90 S&C Units

2022 & 2024: Total No. of POE Conversion Refurbs (TEF3255) = 47 S&C Units



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Crewe BHIL Re-signalling Project

S&C Refurbishments for POE Conversions

NH66B Pts – Existing Layout Pre-Conversion

NH66B Pts – Completed POE Conversion

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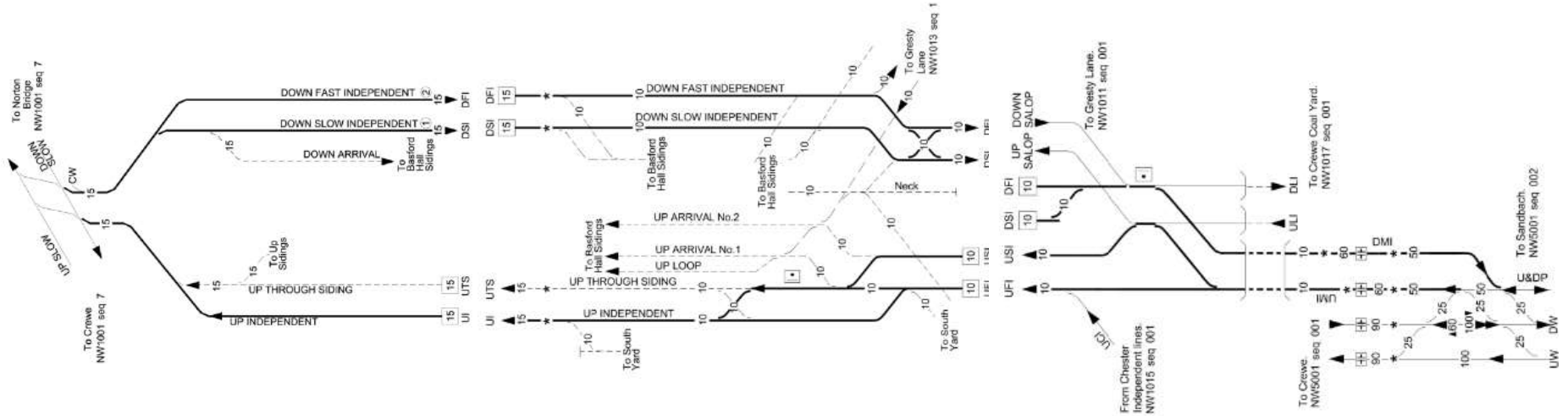
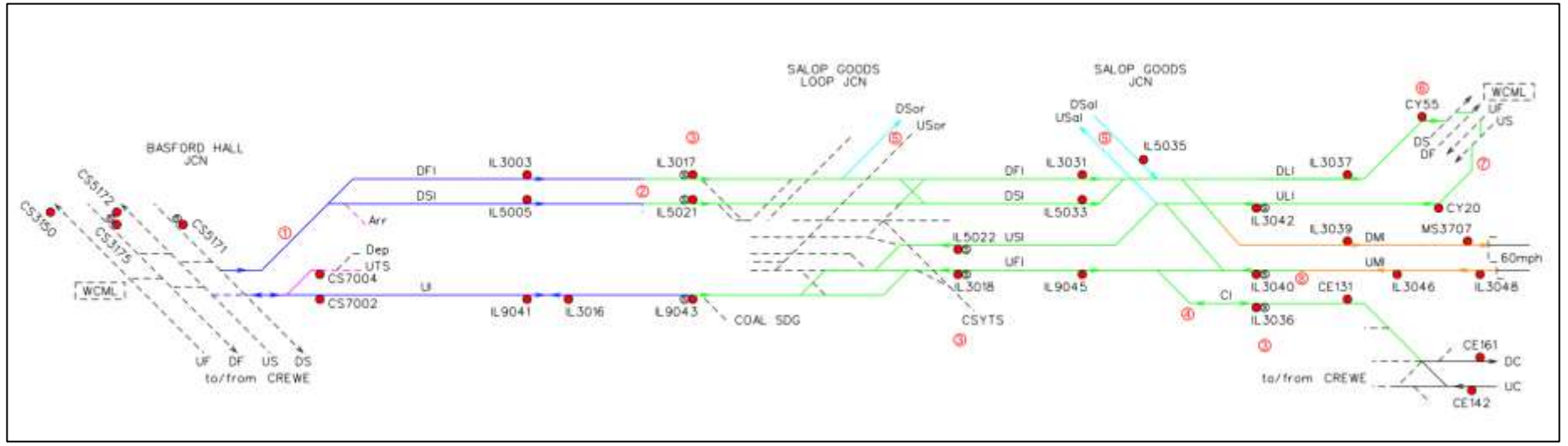
Crewe BHIL – Diversionary / Resilience

Existing Linespeeds – Sectional Appendix



Proposed Linespeed Increase (LSI)



10mph
15mph
20mph
25mph
30mph

Ⓢ - Main signal with PL aspect. Review release controls if speed raised above 15mph

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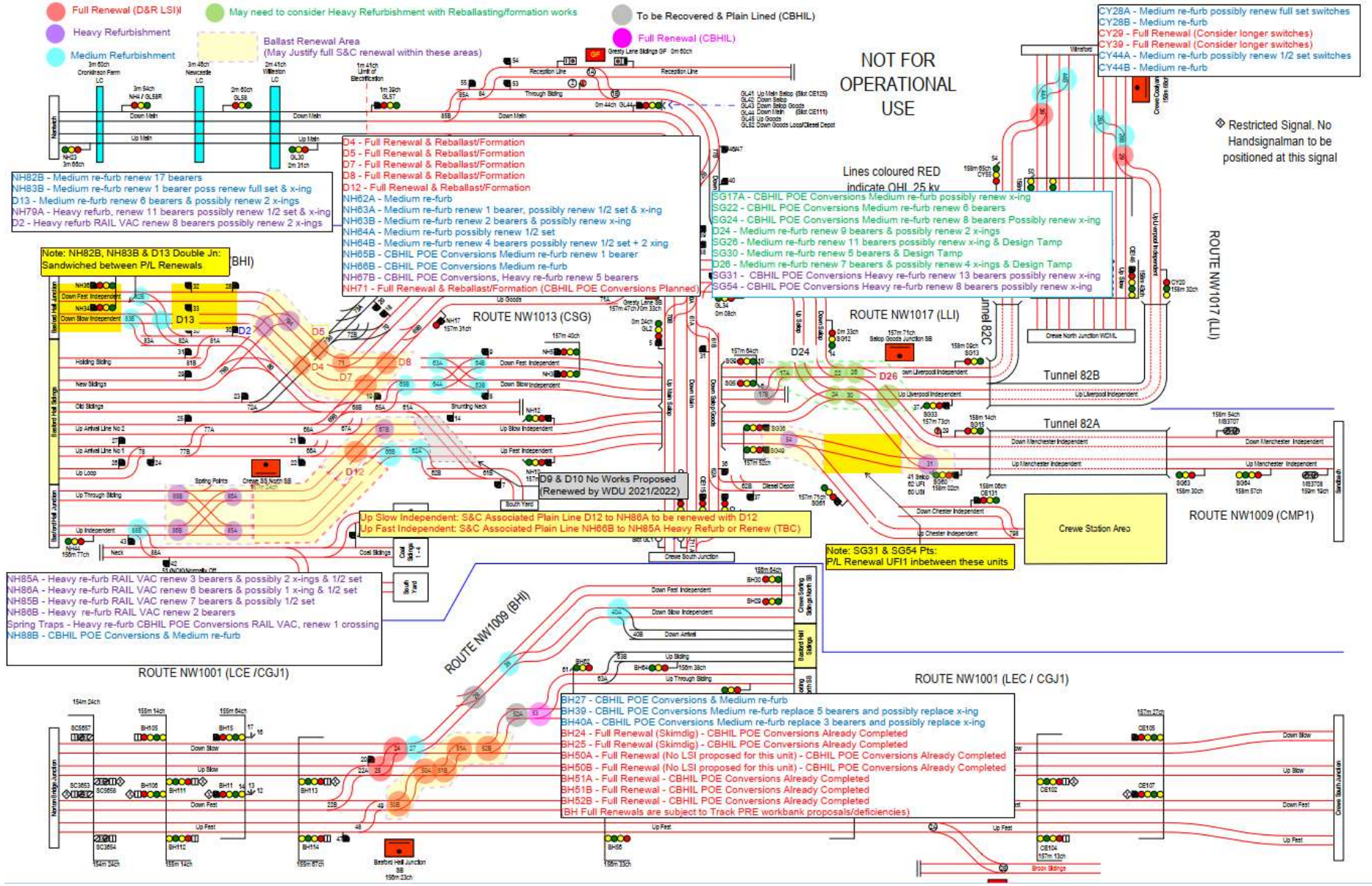
Crewe BHIL – Diversionary / Resilience

S&C: Proposed Scope of Works for Resilience



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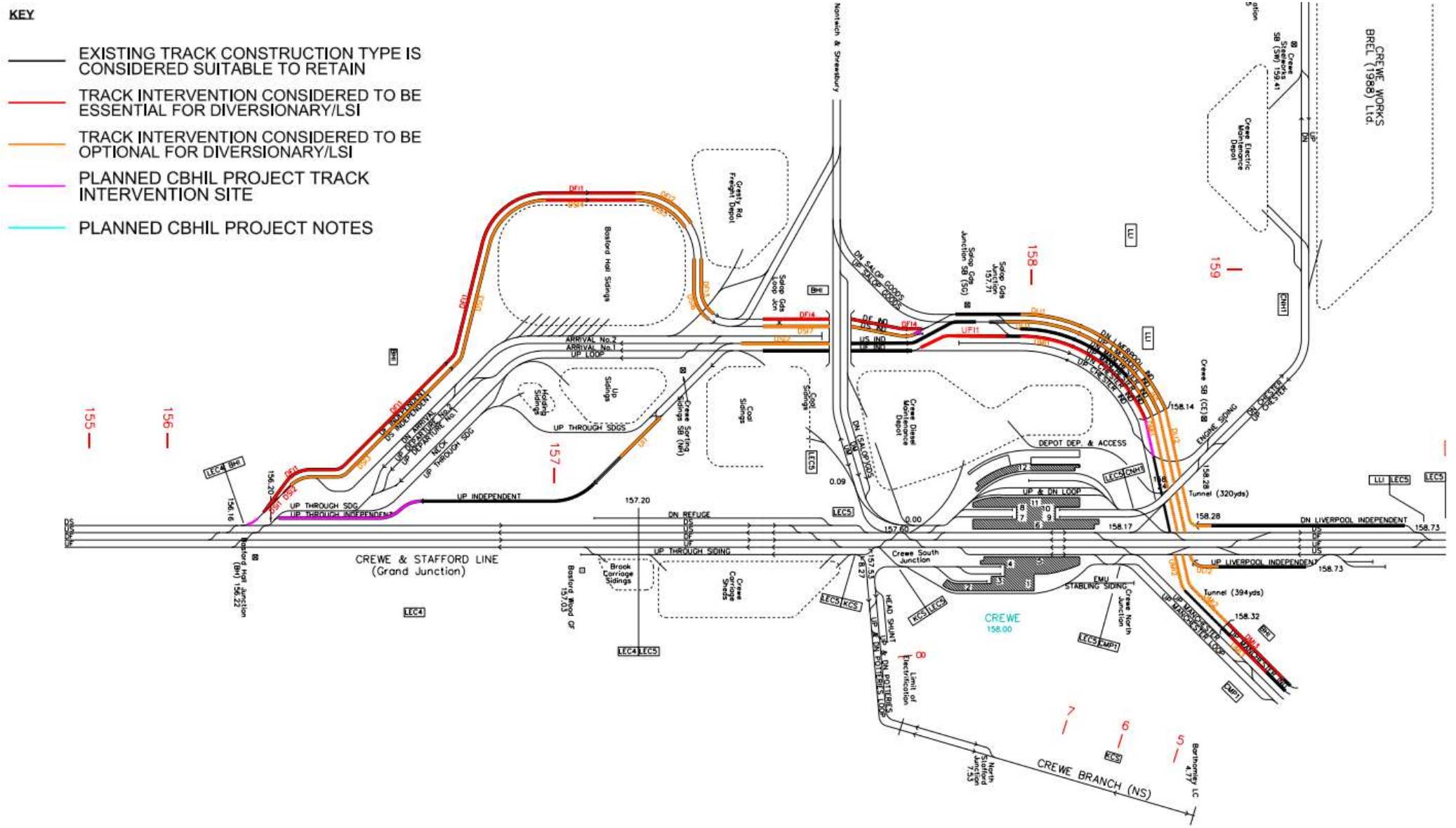
Crewe BHIL – Diversionary / Resilience

Plain Line: Proposed Scope of Works for Resilience



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Crewe BHIL – Diversionary / Resilience

Plain Line: Proposed Scope of Works for Resilience

Site Ref	Classification (Note 4)	Line Name	ELR	TID	Track Category	Project Chainage (r		Miles	Chain	Miles	Chain	Existing Construction			ROW Code (Note 7)	Renewal Description	Suggested Construction (Note 1)			Trackbed GI Design Required?	Ballast Excavation & Disposal ?	Total Renewal Length (m)	Total Renewal Length (yds)
						Start	End	Start		End		Rails	Sleepers	Fastenings			Rails	Sleepers	Fastenings				
DSI1	Essential	Dn Slow Independent	BHI	2200	2	251585	251639	156	23	156	25	Jointed FB	Timber	Pan 8	11 or 16	TRAX or Skimdig	CEN56 Jointed	New G44 Concrete	Fastclips	Yes	Yes	54	59
DSI2	Essential	Dn Slow Independent	BHI	2200	2	251675	251769	156	27	156	32	Jointed FB	Timber	Pan 8	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	94	103
DSI3	Optional	Dn Slow Independent	BHI	2200	2	251769	252739	156	32	156	0	Jointed BH	Timber	BH Keys	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	970	1060
DFI1	Essential	Dn Fast Independent	BHI	2100	2	251602	252980	156	24	157	12	Jointed FB	Timber	Pan 8	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	1378	1506
DSI4	Essential	Dn Slow Independent	BHI	2200	2	252739	252989	156	30	157	12	Jointed FB	Timber	Pan 8	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	250	273
UI1	Optional	Up Independent	BHI	1100	3	253030	253140	157	15	157	20	Jointed BH	Timber	BH Keys	11 or 16	TRAX or Skimdig	CEN56 Jointed	Serviceable Concrete	Pan to suit	Yes	Yes	110	120
DSI5	Optional	Dn Slow Independent	BHI	2200	2	252989	253075	157	12	157	17	Jointed FB	Timber	Pan 6	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	86	94
DFI2	Optional	Dn Fast Independent	BHI	2100	2	252980	253075	157	12	157	17	Jointed FB	Timber	Pan 6	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	95	104
DFI3	Optional	Dn Fast Independent	BHI	2100	2	253115	253252	157	19	157	26	Jointed FB	Timber	Pan 11	11 or 16	TRAX or Skimdig	CEN56 Jointed	New G44 Concrete	Fastclips	Yes	Yes	137	150
DSI6	Optional	Dn Slow Independent	BHI	2200	2	253135	253230	157	20	157	24	Jointed FB	Timber	Pan 6	11 or 16	TRAX or Skimdig	CEN56 Jointed	New G44 Concrete	Fastclips	Yes	Yes	95	104
DFI4	Essential	Dn Fast Independent	BHI	2100	2	253470	254047	157	36	157	65	Jointed FB	Conc F40/F27	Pandrol	20-2	Convert to CWR	FB CWR	Retain Existing	Pandrol	Yes	TBC by TBI	577	631
DSI7	Optional	Dn Slow Independent	BHI	2200	2	253470	254045	157	36	157	65	Jointed FB	Conc F40/F27	Pandrol	20-2	Convert to CWR	FB CWR	Retain Existing	Pandrol	Yes	TBC by TBI	575	628
UFI1	TQN ETR 000003	Up Fast Independent	BHI	1100	3	254125	254320	157	1517	157	1730	FB CWR	Steel	Pandrol	14	TRAX/Formation	CEN56 Jointed	New G44 Concrete	Fastclips	Yes	Yes	195	213
USI1	Optional	Up Slow Independent	BHI	1200	2	253400	253630	157	33	157	44	Jointed FB	Timber	Pan 11	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	230	251
UMI1	Essential	Up Manchester Independer	BHI	1100	3	254360	254665	158	1	158	16	FB CWR	Conc F19/F27	SHC/Pan	11 or 16	TRAX or Skimdig	CEN56 CWR	Serviceable Concrete	Pan to suit	Yes	Yes	305	333
DMI1	Optional	Dn Manchester Independer	BHI	2100	2	254485	254694	158	7	158	17	FB CWR	Timber	Pandrol	11 or 16	TRAX or Skimdig	CEN56 CWR	New G44 Concrete	Fastclips	Yes	Yes	209	228
DMI2	Optional	Dn Manchester Independer	BHI	2100	2	254694	255106	158	17	158	38	Jointed BH	Timber	BH Keys	11 or 16	TRAX or Skimdig	CEN56 CWR	Shallow Depth Conc	Fastclips	Yes	Yes	412	450
DMI3	Essential	Dn Manchester Independer	BHI	2101	2	255106	255750	158	38	158	70	FB CWR	Conc + Timbers	Pandrol	01/02, 30	TQ/Design Tamp	Rerail as Reqd	Replace spot timbers	Pandrol	Yes	TBC by TBI	644	704
UMI2	Optional	Up Manchester Independer	BHI	1100	3	254850	254980	158	25	158	31	FB CWR	Conc + Timbers	Pandrol	14	TRAX/Formation	Rerail as Reqd	Replace spot timbers	Pandrol	Yes	Yes	130	142
UMI3	Essential	Up Manchester Independer	BHI	1100	3	255350	255550	158	50	158	60	FB CWR	Conc G44	Fastclips	00a or 00b	TQ/Design Tamp	Retain Existing	Retain Existing	Retain Existing	Yes	TBC by TBI	200	219
DLI1	Optional	Down Liverpool Independe	LLI	2100	3	254290	254700	157	77	158	18	Jointed FB	Conc F40	Pandrol	20-2	Rerail & Design Tamp	CEN56 CWR	Retain Existing	Pandrol	Yes	TBC by TBI	410	448
DLI2	Optional	Down Liverpool Independe	LLI	2100	3	254700	255000	158	18	158	32	FB CWR	Timber	Pan 11	14 or 16	TRAX or Skimdig	CEN56 CWR	Shallow Depth Conc	Fastclips	Yes	Yes	300	328
ULI1	Optional	Up Liverpool Independent	LLI	1100	3	254340	254675	158	0	158	16	FB CWR	Conc F40	Pandrol	01/02, 00b	Rerail & Design Tamp	CEN56 CWR	Retain Existing	Retain Existing	Yes	TBC by TBI	335	366
ULI2	Optional	Up Liverpool Independent	LLI	1100	3	254675	255020	158	16	158	33	FB CWR	Timber	Pan 11	11	TRAX or Skimdig	CEN56 CWR	Shallow Depth Conc	Fastclips	Yes	Yes	345	377

Totals:

- TRAX/Skimdig 5900 yds (3m 620yds)
- CWR Conversion 1260 yds
- Rerail 814 yds
- TQ/Design Tamping 1737yds

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Part 4: Drainage

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Why was a drainage scheme required?

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Why was a drainage scheme required?

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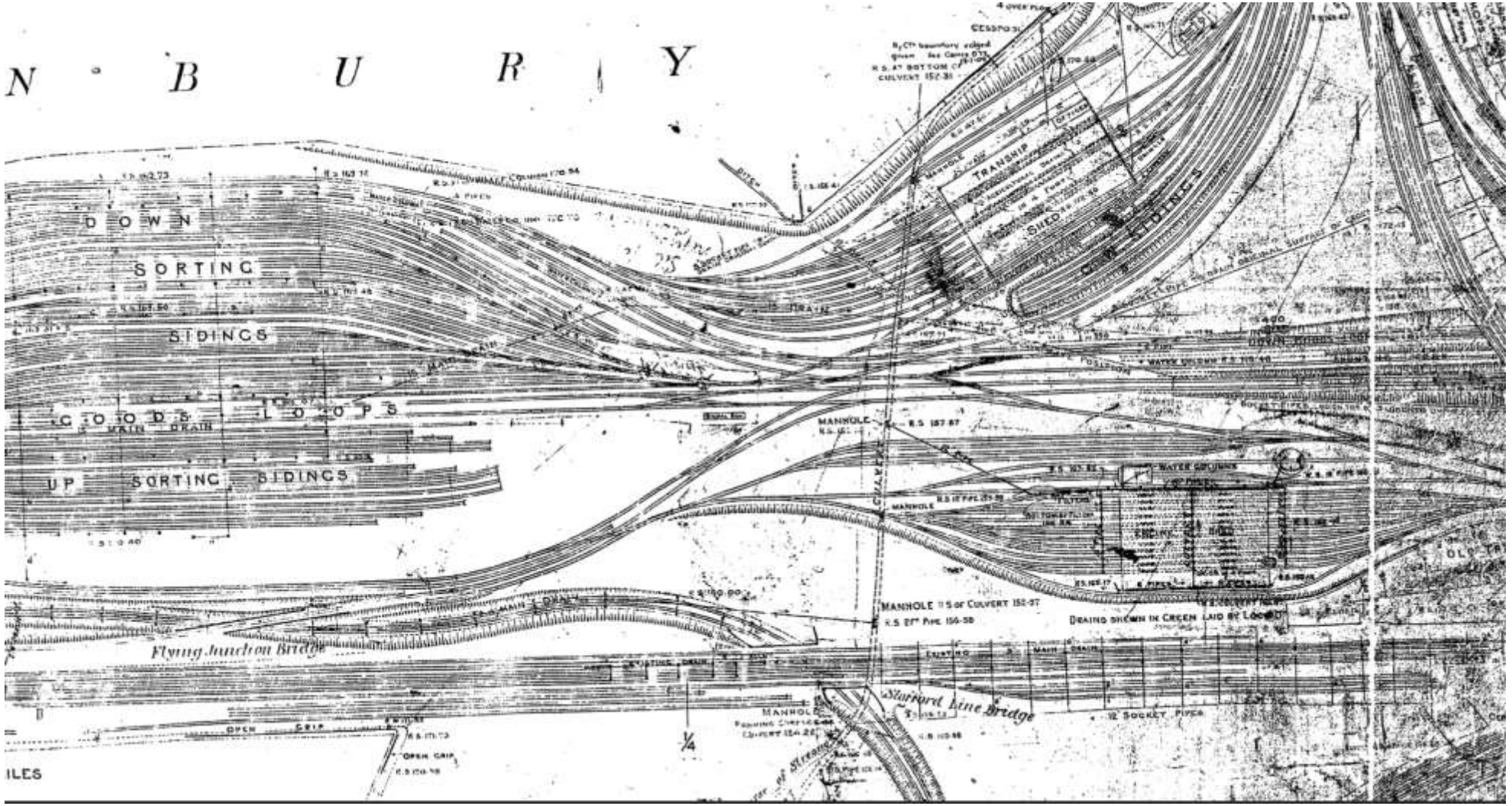
Existing drainage system – record drawings



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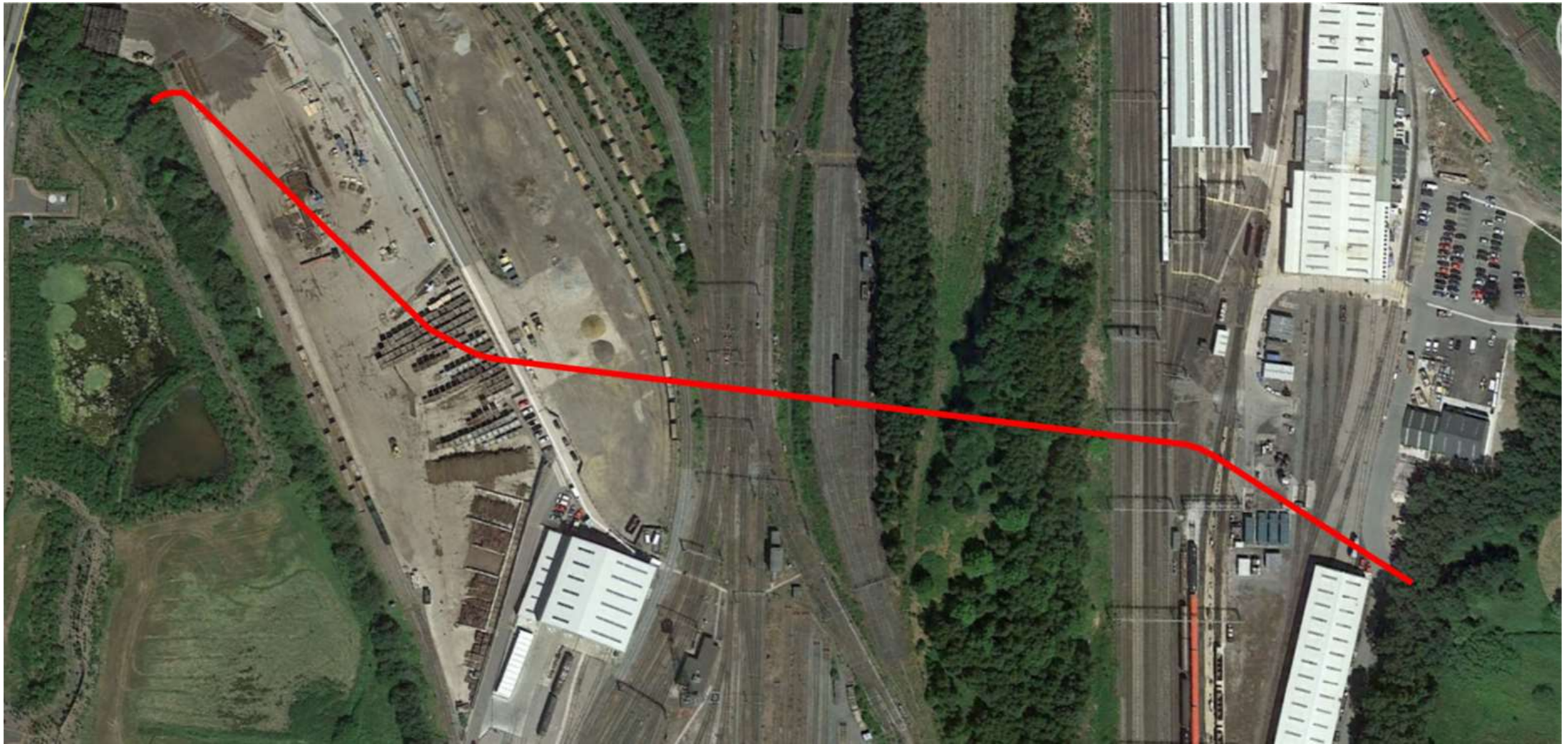
Gresty Brook Culvert



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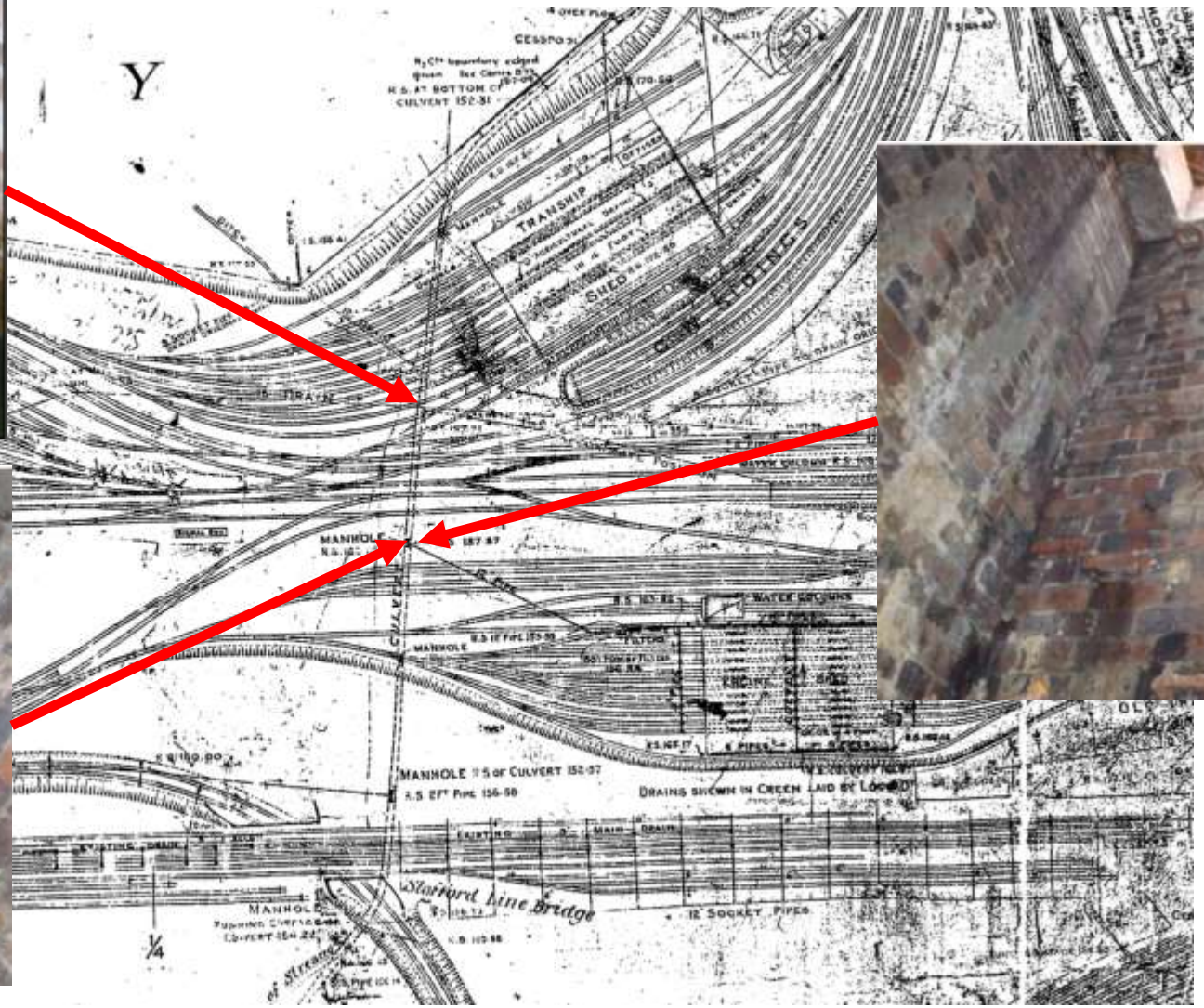
Gresty Brook Culvert



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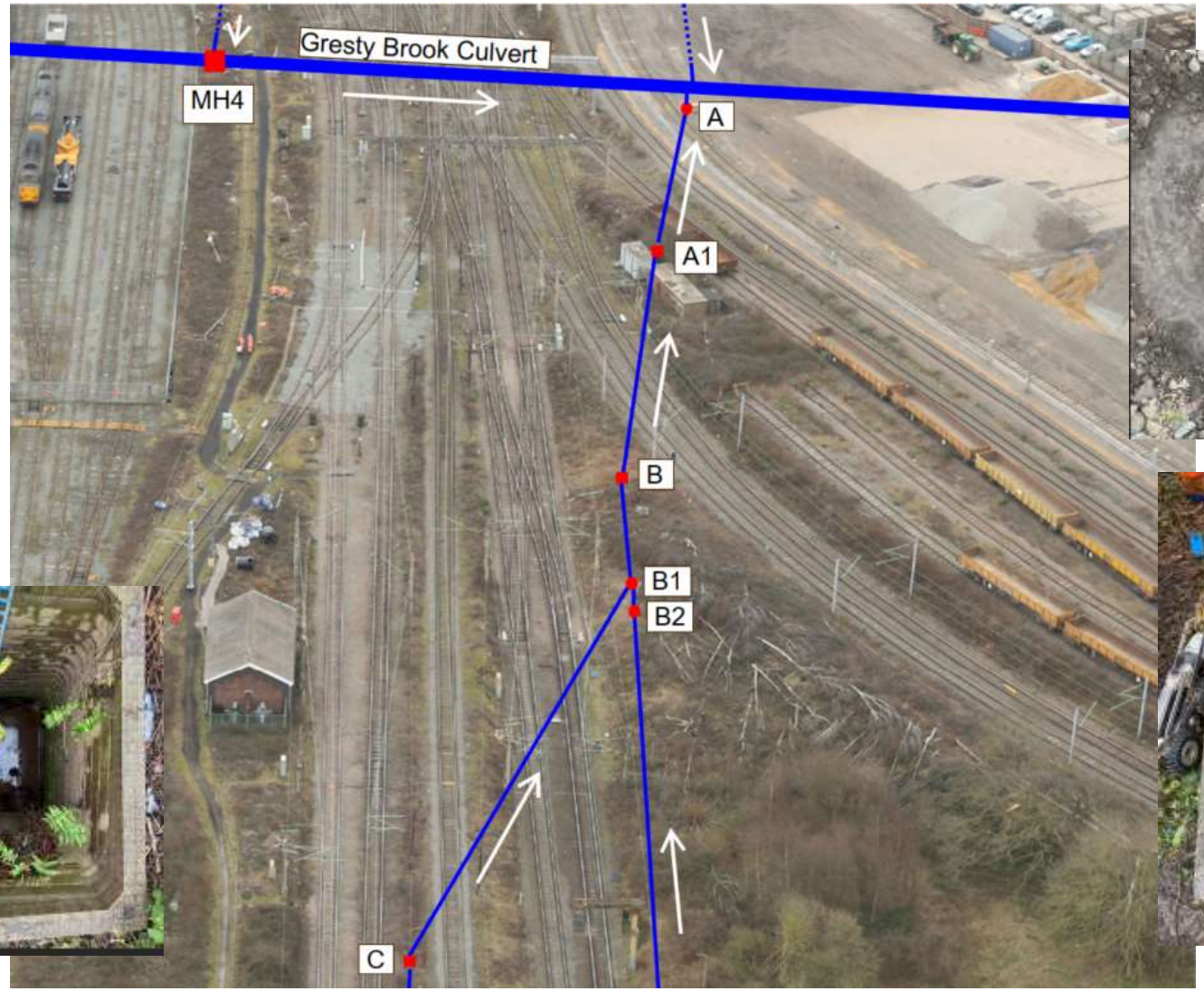
Surveys – establish connectivity & condition



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Surveys – outfall blockages

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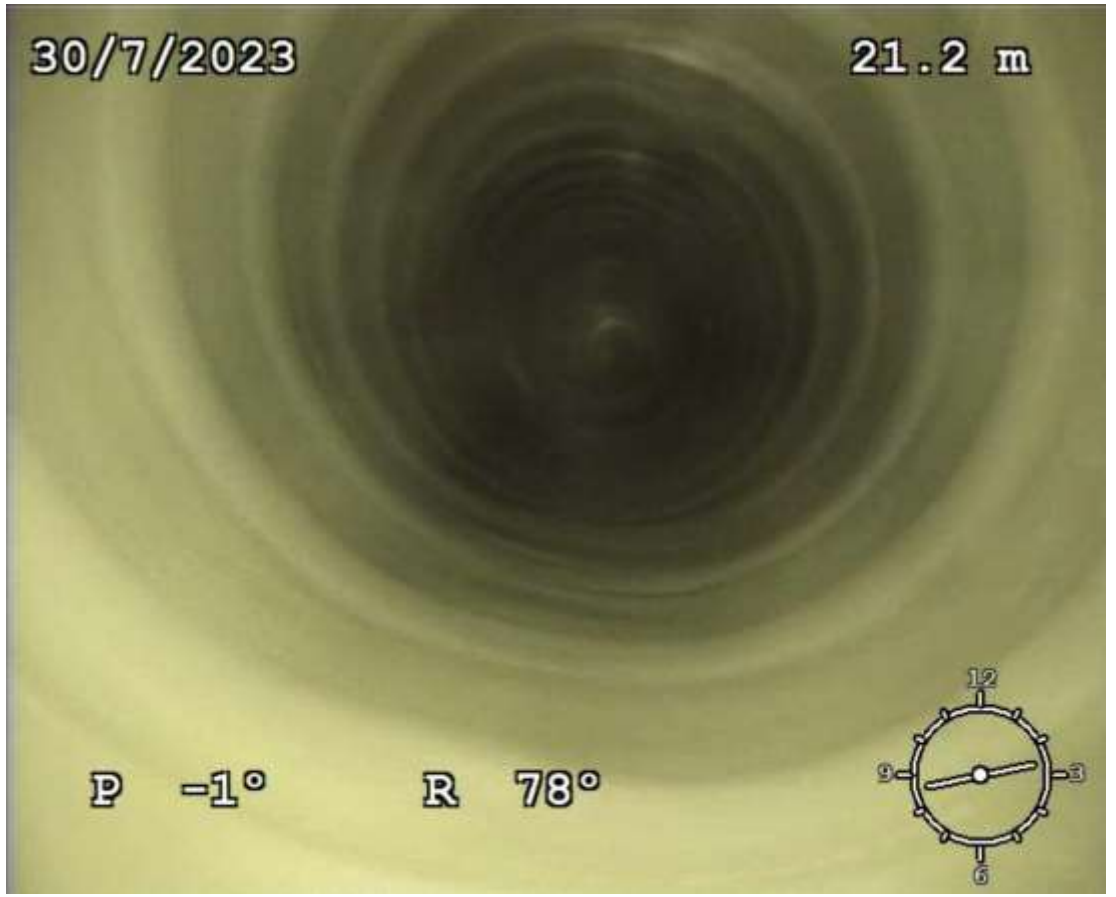
Collapse and refurbishment



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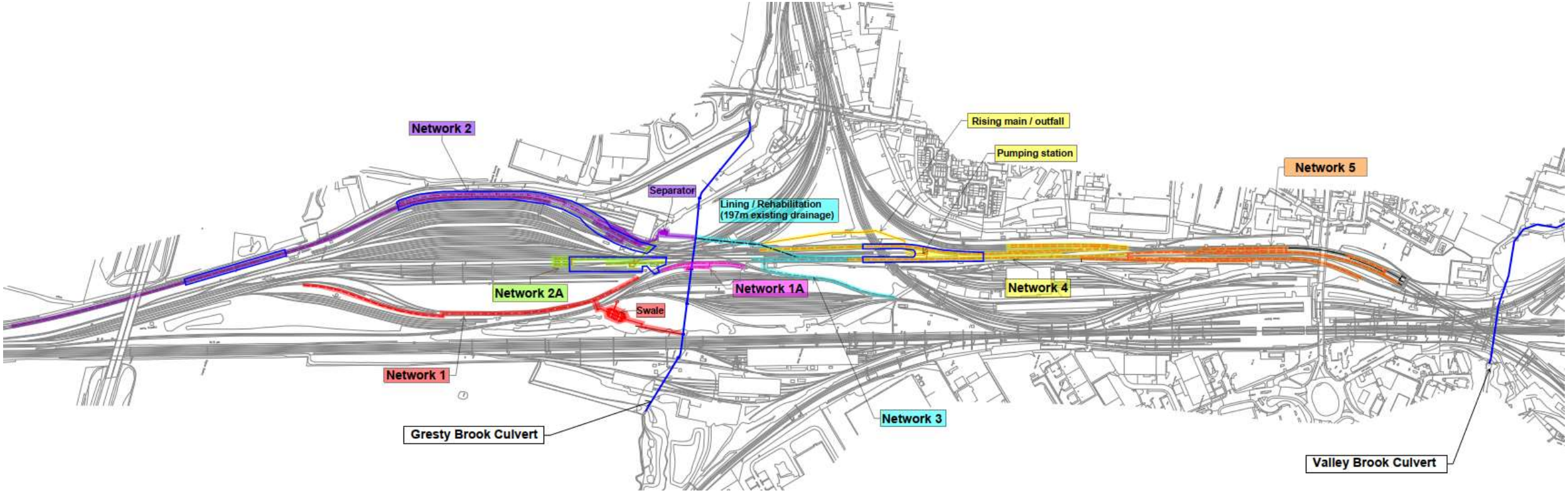
Proposed Drainage Scheme



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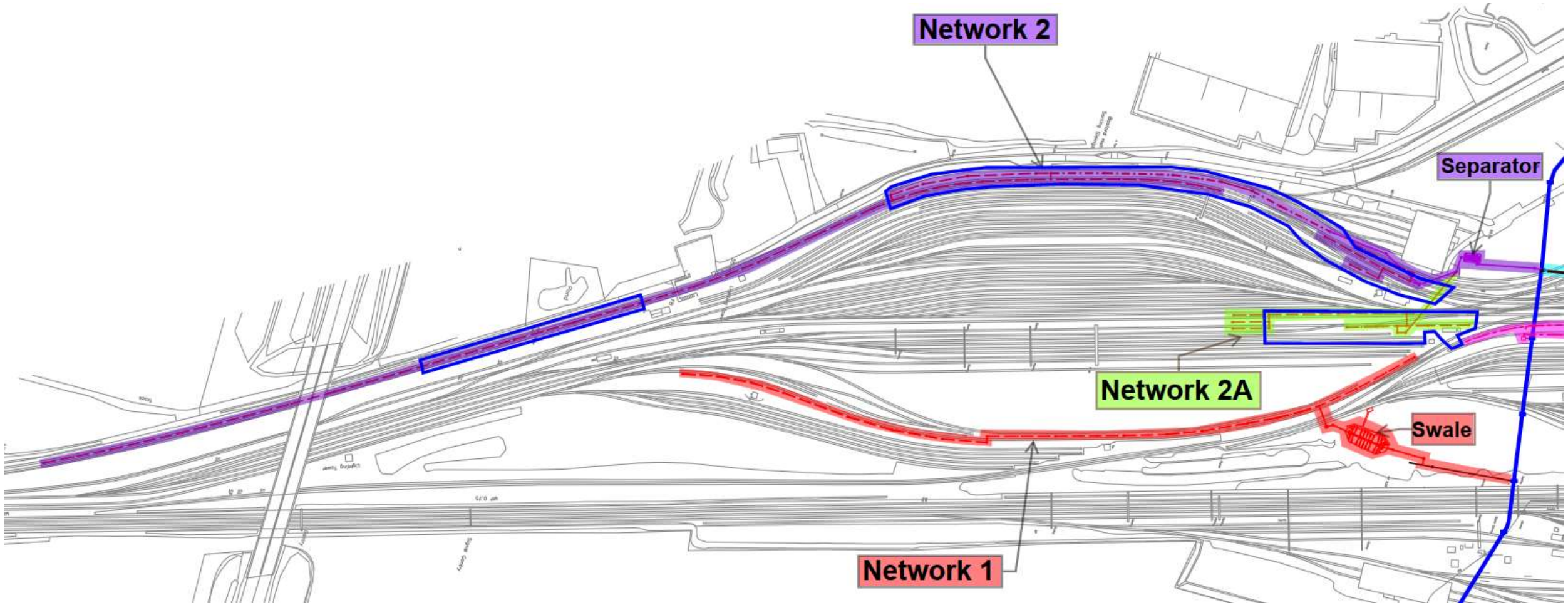
Drainage Network 2



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Drainage Network 2 – Deep Drainage problem

- 1.26km (end to end) collector network leads to depth exceeding 3m on approach to outfall
- Oil Separator required and re-use of existing outfall to Gresty Brook culvert – fixed end point
- Drainage > 2m requires separate filter pipes above deeper carrier pipes.
- Preferred drainage team installation method of trench cut and cover with trench support temporary works was deemed extremely difficult / impossible in a constrained six foot or cess at 2m + depth due to:
  - ground conditions
  - water ingress
  - Pipe size
  - Working space
- Six foot install would require track off – additional design / scope creep and massive cost and access requirement.
- Numerous constraints due track and OLE layout and other infrastructure

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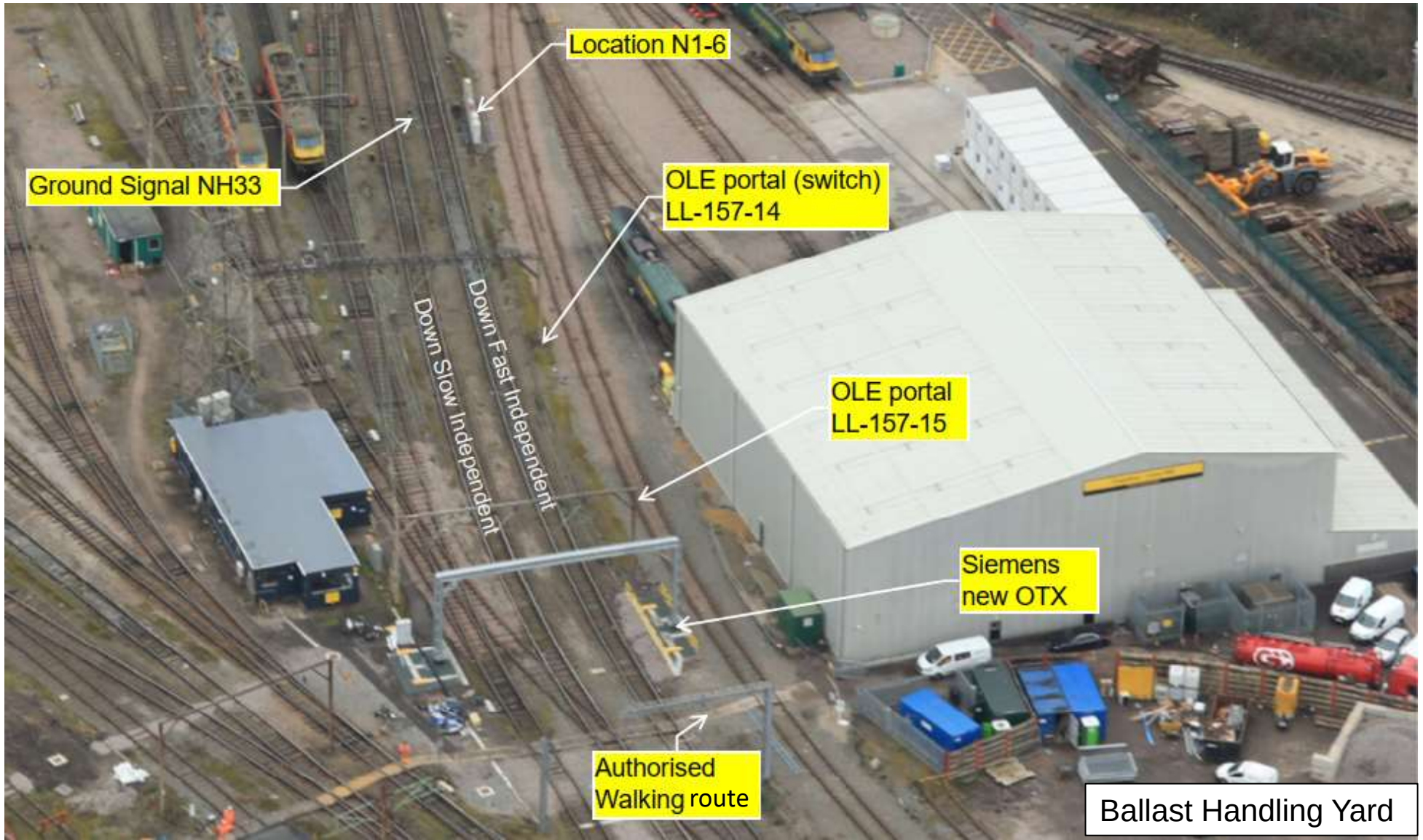
Drainage Network 2 – Constrained site



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Drainage Network 2 – Auger Boring solution

- Open trench installation not feasible.
- Following lengthy optioneering and cost comparison exercises, the chosen solution was Guided Auger Boring.
- Benefits:
  - Trenchless installation avoids complex temporary works including track on/off
  - Pipe routes can cross track at angles that are not achievable with open cut and avoid any constraining obstacles (subject to derogation).
  - Pipe can be carrier only with a separate shallow filter network that is easier to construct.
  - Laser guided therefore level accuracy of pipe install (essential for gravity drainage) is assured.
  - The above also enabled Network 2A to outfall via Network 2 separator.
- Installation method requires large drive and reception pits which were installed using precast concrete caissons (also minimises additional temporary works
- Settlement of tracks is a key consideration

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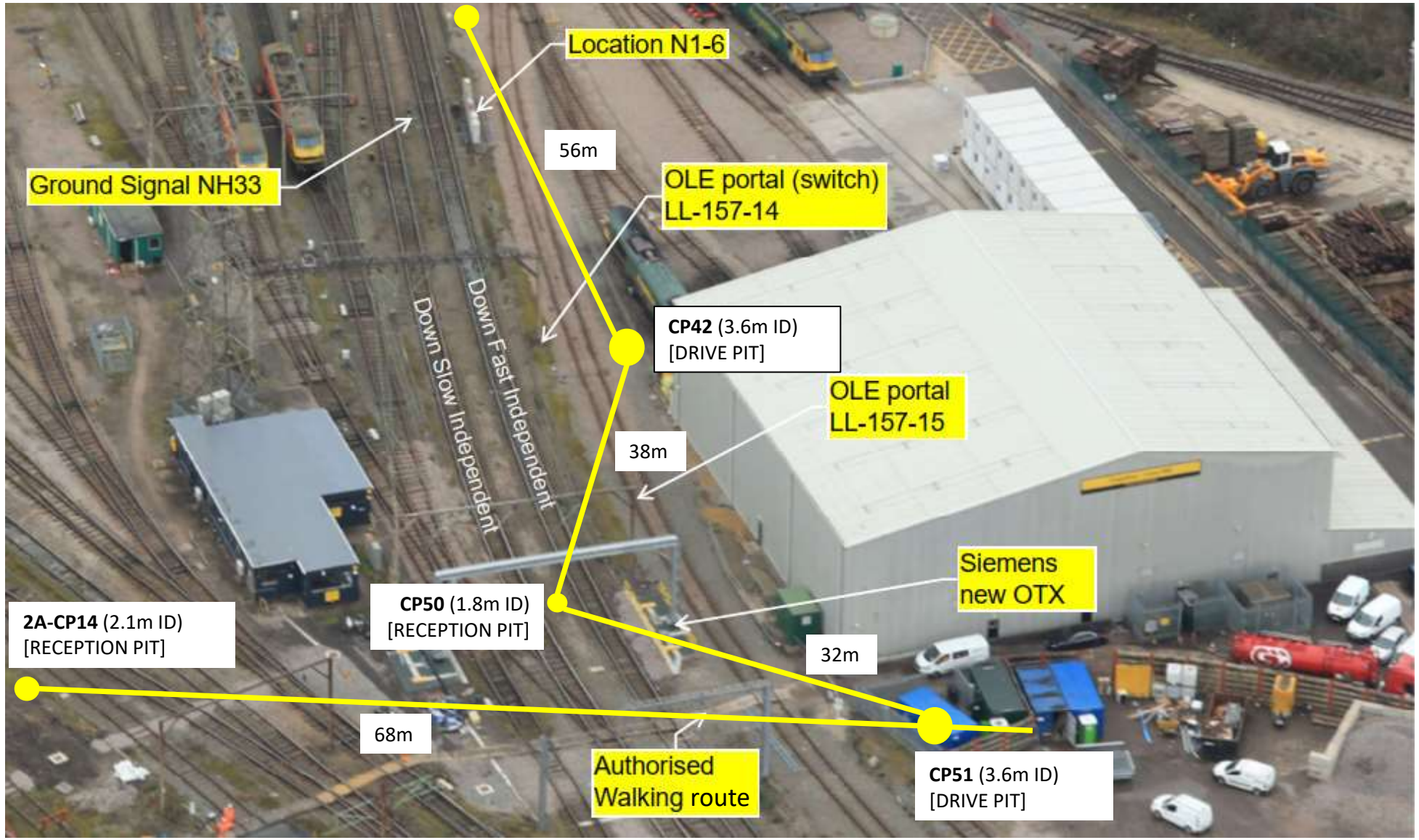
Drainage Network 2 – Auger Boring solution



Construction timeline

- Wk 34 (Nov 23) — Chamber:CP41
- Wk 6 (May 24) — Chambers: CP42, 50, 51 & 2A-14
- Wk 9 (May 24) — Pipe runs: 41 to 42, 50 to 51
- Wk 16 (July 24) — Pipe run: 2A-14 to 51
- Wk 22 (August 24) — Pipe run: 42 to 50

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Drainage Network 2 – Auger Boring solution

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Drainage Network 2 – Oil Separator

- Drainage design – for Network 2 & 2A - SPEL Puraceptor – P300 1C/SC – Full Retention Separator (12.4m long x 3.65m diameter).
- Large scale sheet piled coffer dam temporary works 17m long x 6m wide x 7m deep.
- Ground water at approx. 4m depth – active de-watering system using extraction and re-charge wells.
- Separator tank cannot support traffic loading directly.
- Used Ballast Handling yard location - separator location pre-agreed and cover slab designed for specific heavy plant e.g CAT 972 loading shovel - 30 Tonnes operating + 12 Tonnes tipping (rubber tyred).
- Cover slab to be flush and extremely robust to ensure loading shovels will not damage.
- Reinforced concrete cover slab spans over interceptor (between permanent sheet piles).
- Tank needs to be vented and monitoring equipment solar powered from adjacent NR maintenance compound.

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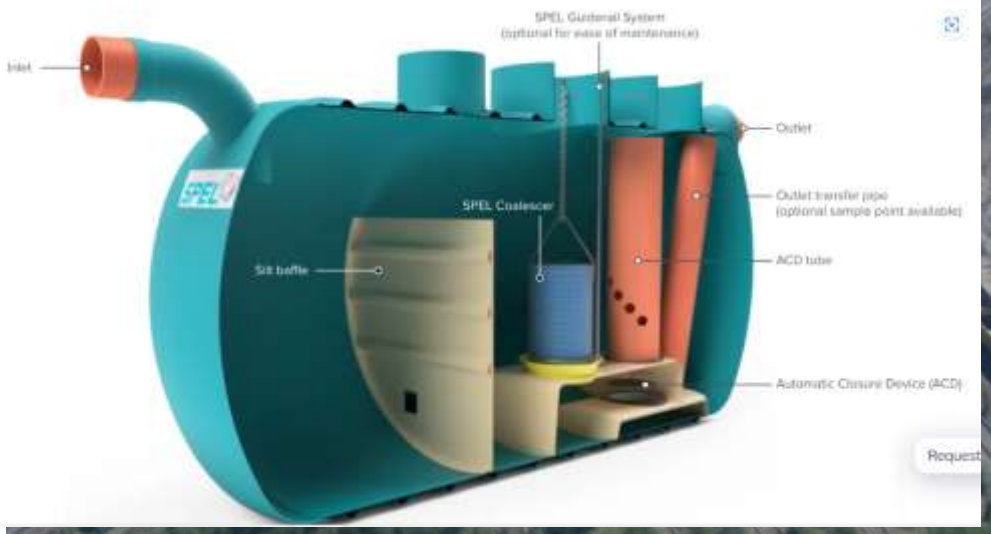
Drainage Network 2 – Oil Separator



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Thank you

Any questions?