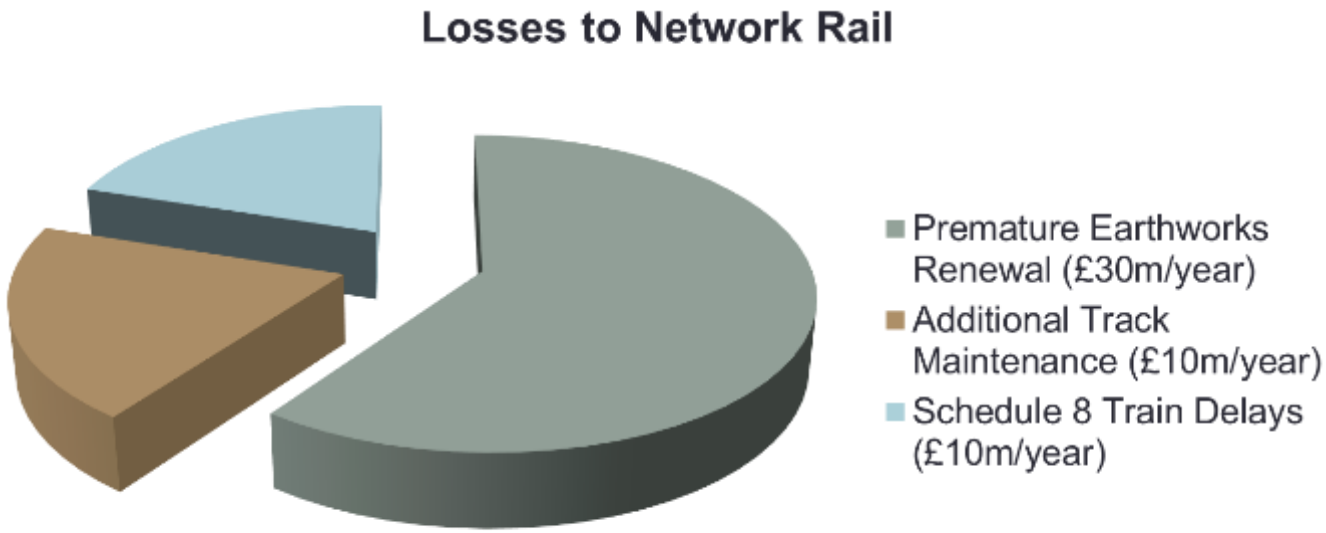
Drainage resilience

Application of technology to mitigate risk

Poor and ineffective drainage was identified as a key contributory factor in major incidents at:

- Gillingham in 2009
- Marks Tey in 2008
- Kemble in 2007
- Clarborough in 2012
- Baildon in 2012, 2016 and 2017
- Carmont in 2020

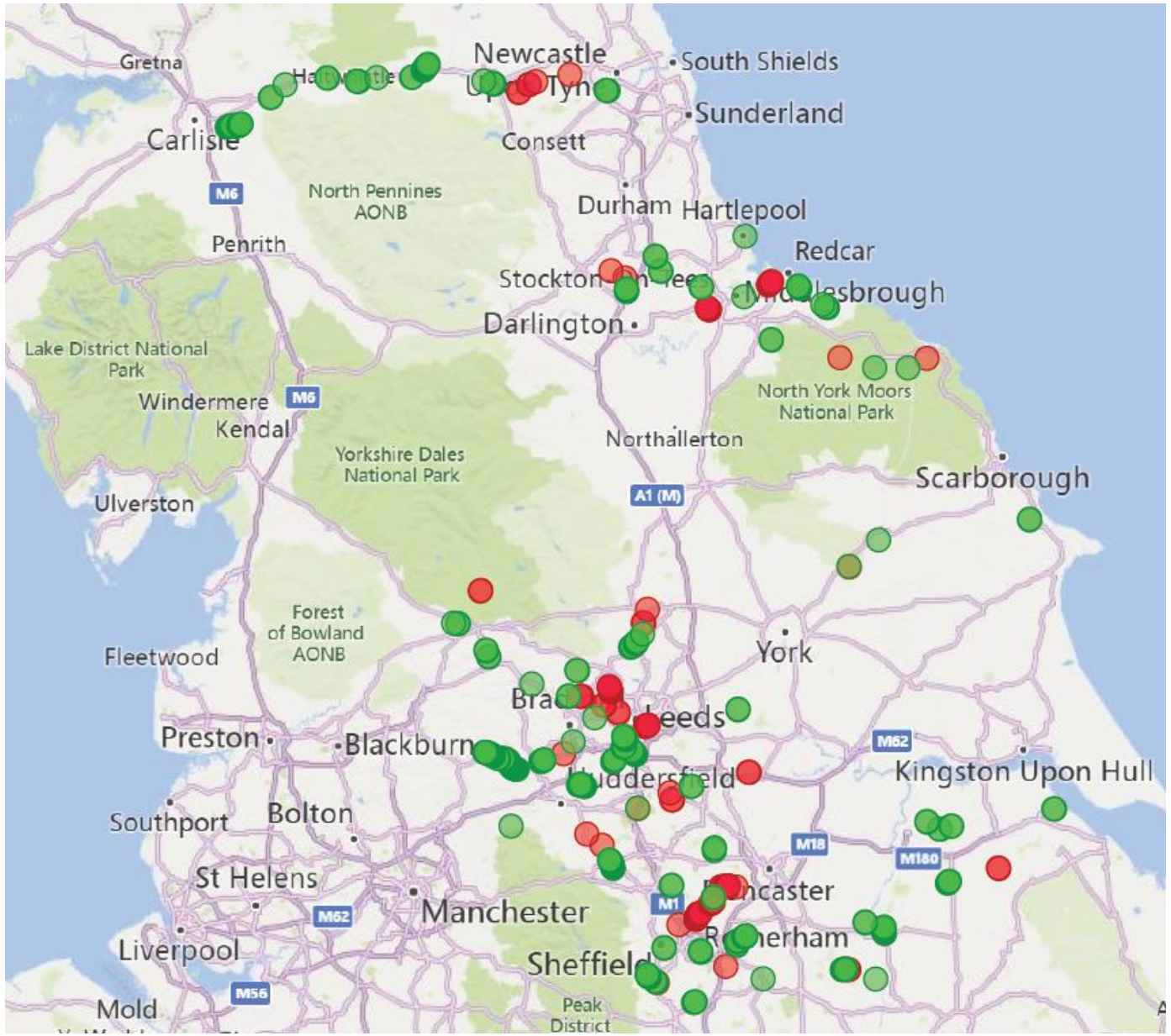


SITES WITH POOR DRAINAGE HAVE:

1.8 times more track faults
6 times more wet beds per mile
50% more twist faults

SITES WITH POOR DRAINAGE NEED:

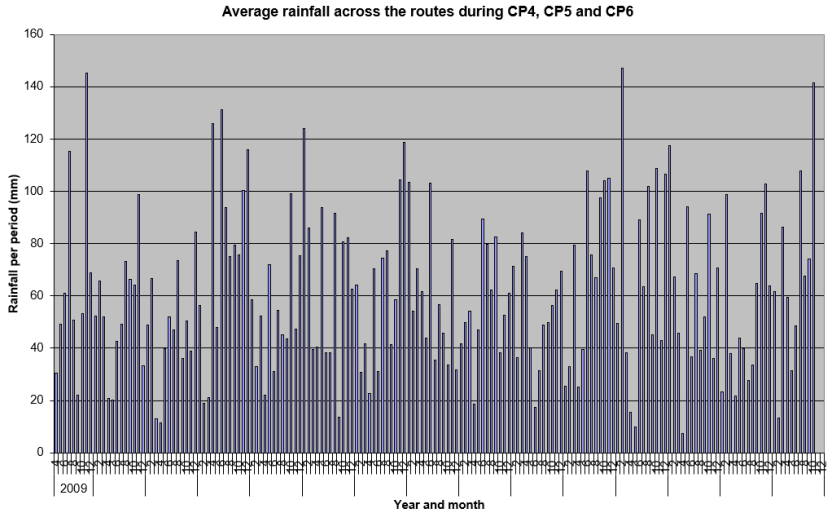
Three times more tamping or stoneblowing
Twice as much manual lifting and packing
Four times more money spending on it



Impact of STORM BABET
27th October 2023

Green: sites of historic flooding unaffected by Storm Babet

Red: sites of flooding during storm Babet



Named storms

Weather Event	Date	East Coast	East Midlands	North and East	Grand Total
		Minutes	Minutes	Minutes	Minutes
Babet	2023/24 P08	9336	9857	6236	25429
Christophe	2020/21_P11	569	1160	5834	7563
Angus	2016/17_P09	3079	2080	1853	7012
Darcy	2020/21_P11	1280	48	4668	5996
Bella	2020/21_P10	4839	444	660	5943
Dennis	2019/20_P12	1237	1043	2340	4620
Lorenzo	2019/20_P07	0	1754	2685	4439
Franklin	2021/22 P12	0	0	4192	4192
Elsa	2019/20_P10	0	1551	2011	3562
Desmond	2015/16_P09	22	0	3291	3313
Ciara	2019/20_P12	0	528	2486	3014
Alex	2020/21_P07	1009	1761	0	2770
Abigail	2015/16_P08	0	0	2630	2630
Eva	2015/16_P10	8	0	1613	1621
Miguel	2019/20_P03	521	818	40	1379
Helene	2018/19_P07	0	0	1353	1353
Jake	2015/16_P12	36	297	862	1195
Katie	2015/16_P13	0	914	64	978
Gareth	2018/19_P13	0	48	586	634

How do we reduce flood risk on the railway?

Inspection, maintenance and rapid response

- Risk-based inspection and maintenance
- Proactive maintenance
- Jetting and CCTV
- Incident management and risk mitigation

Physical work: refurbishment, renewal and new build

- Feasibility, design and implementation

Remote condition monitoring

- CCTV and telemetry (in-house and 3rd party)

Evaluation, analysis and modelling

- Catchment studies, upsizing of components and future-proofing at a system level

Drainage Management Plans

- Joint Maintenance/Asset management risk assessment and delivery plans

Drainage Inventory Completion

- Identification of missing assets and upload to Ellipse and accessible mapping platform

Standard Operating Procedures

- Site-specific processes to anticipate and mitigate risk of flooding.

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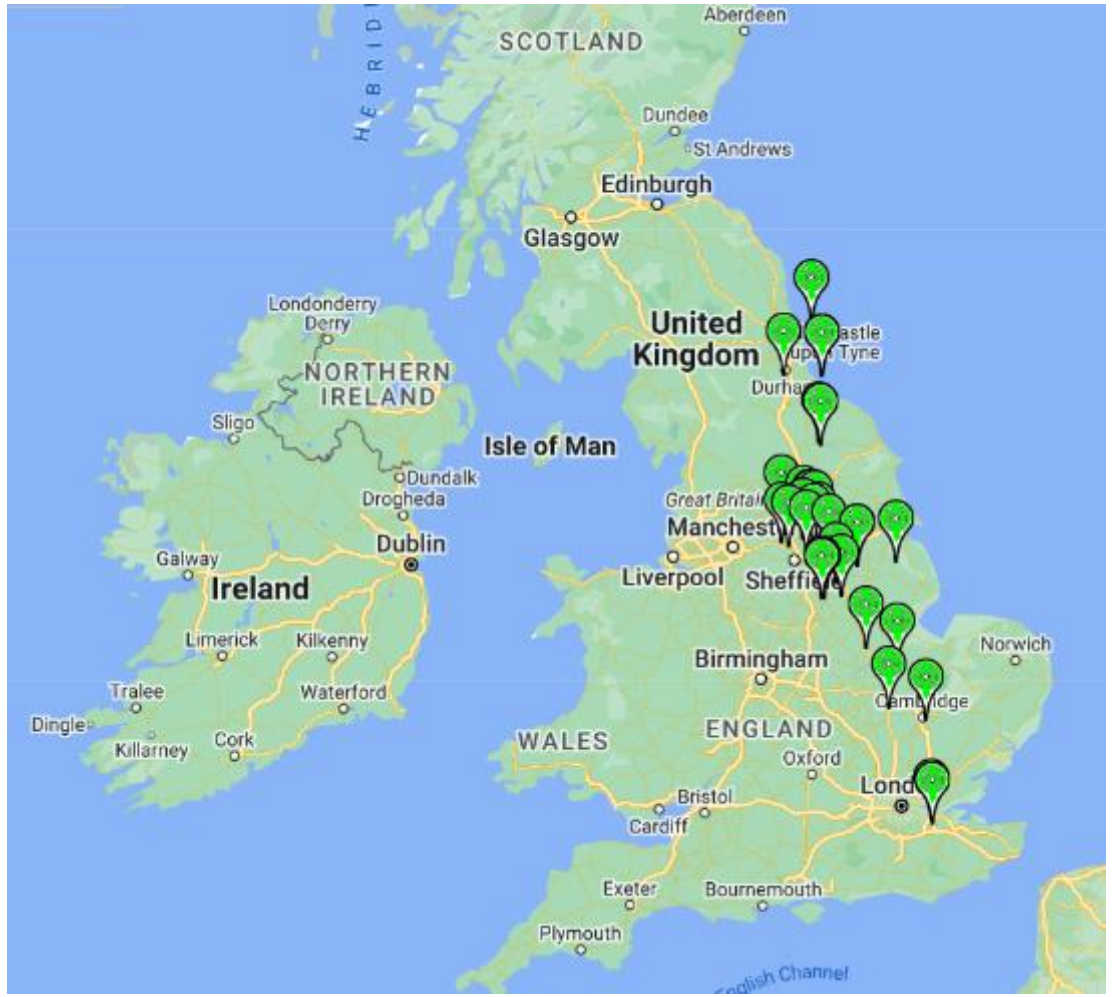
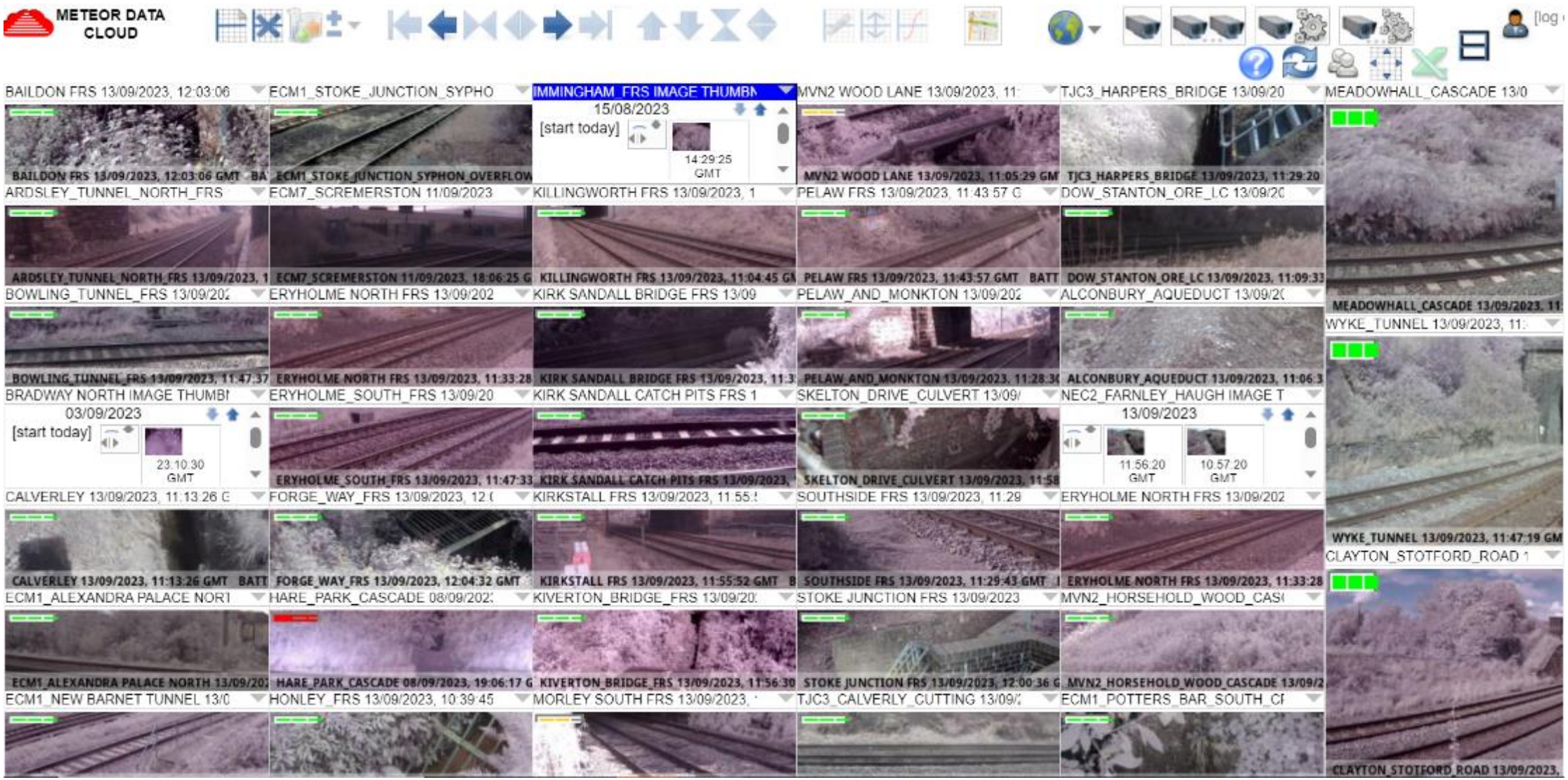


Distribution of fixed CCTV cameras

Distribution of remote condition monitoring

Monitoring of flood risk sites by fixed CCTV

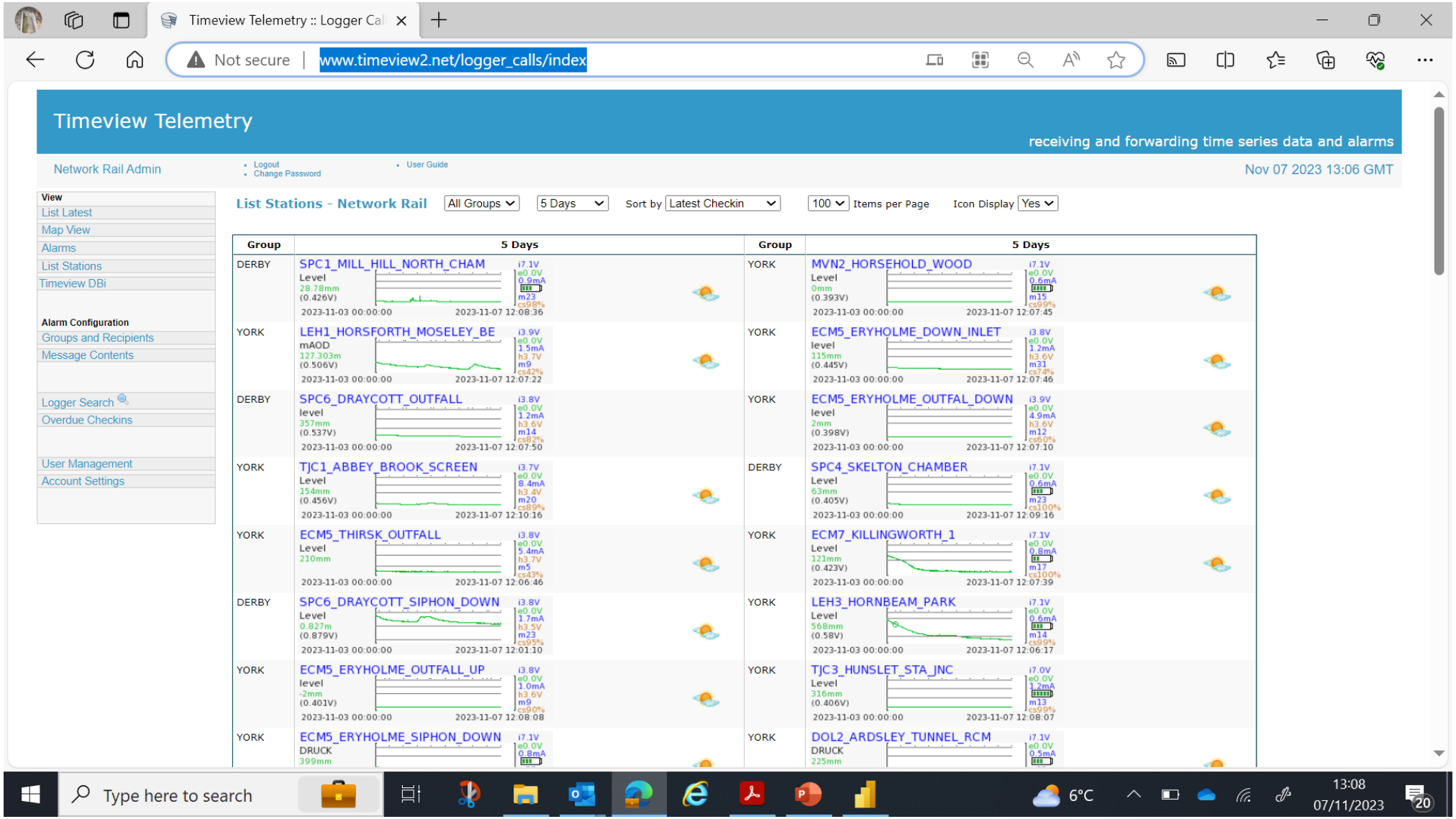


Monitoring of flood risk sites by fixed CCTV

Wood Lane
ELR:MVN2

Harpers Bridge
ELR:TJC3

Monitoring of flood risk sites by telemetry



Management of flood risk through use of Flood Guidance Statements

Flood Guidance Statement

10:30hrs Monday 06 November 2023

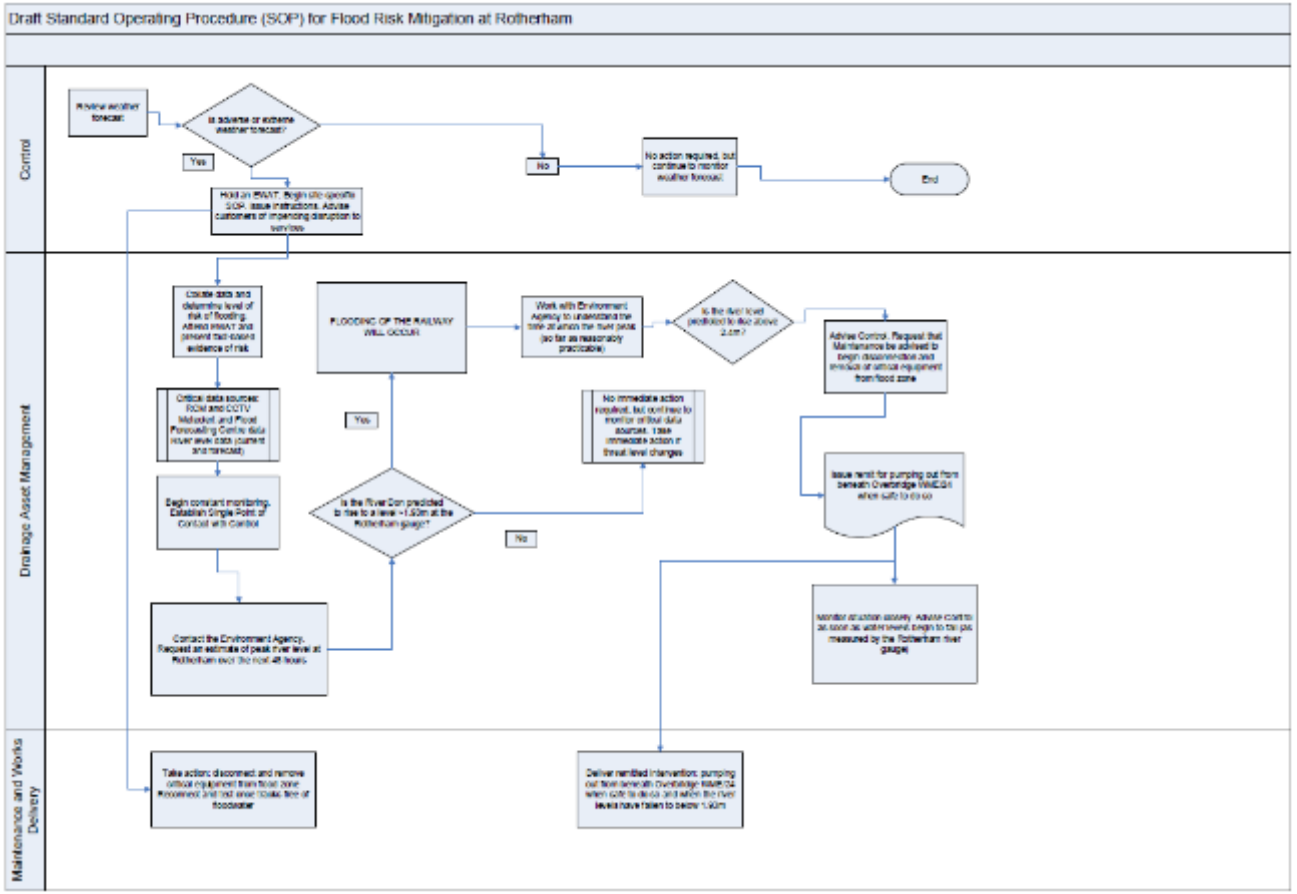
FLOOD FORECASTING CENTRE

A working partnership between Environment Agency | Met Office

Monday	Tuesday	Wednesday	Thursday	Friday
6 Nov 2023 10:30-23:59	7 Nov 2023	8 Nov 2023	9 Nov 2023	10 Nov 2023
Trend since last FGS				
Increased ↑	Steady →	Increased ↑	Steady →	Steady →

Minor surface water flooding impacts are possible today (Monday) in the North West of England. Ongoing minor river flooding impacts in the South East of England and parts of Norfolk today. The overall flood risk is LOW.

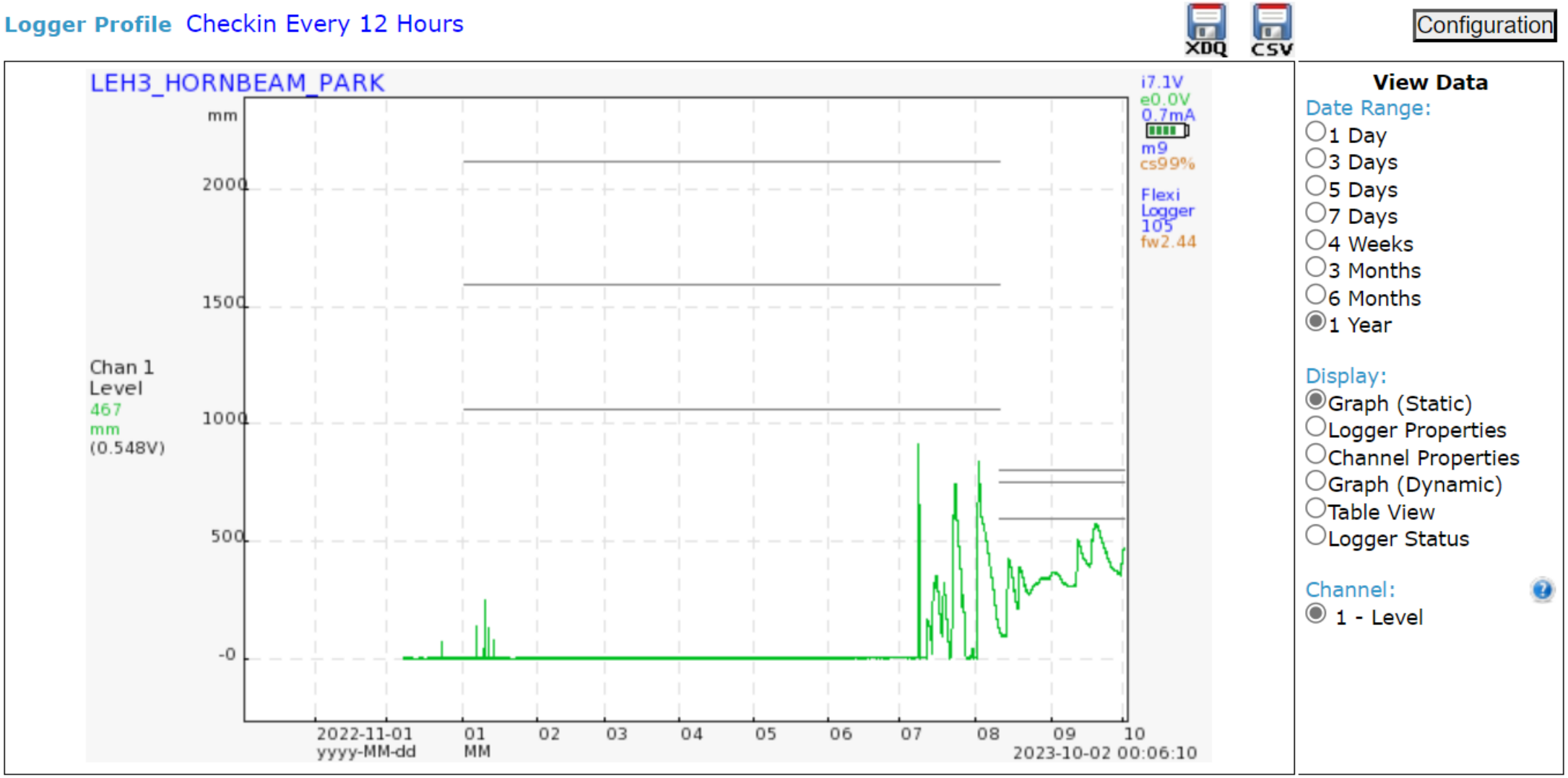
Management of flood risk through use of Standard Operating Procedures



Flowchart No.	Activity	Responsibility
1	TRIGGER STAGE: review available data • Meteolert warnings • Flood Forecasting Centre forecasts • MetDesk forecasts • Precipitation Analysis Tool daily forecasts • Met Office weather warnings • River level gauge data • Antecedent rainfall levels • Environment Agency river level forecasts • EWAT forecasts • CCTV and Remote Condition Monitoring • Evidence from recent site visits • Current confidence in the resilience/condition of the drainage system and drainage assets	Drainage Asset Management
2	Determine level of flood risk based on available fact-based evidence • Red: will flood • Amber: may flood: continuous monitoring required • Green: will not flood	Drainage Asset Management
3	Communicate outputs from asset management risk review to Control (Senior Network Delivery Manager) either during an EWAT or by telephone	Drainage Asset Management
4	Assess fact-based evidence available and (in conjunction with asset management, maintenance and operations colleagues) determine a course of action to mitigate risk	Control
5	Mobilise S&T to disconnect and remove critical equipment (a minimum of 6 hour's notice is required). Give advance warning to customers that flooding is imminent and that the route will be closed for a period.	Control

CASE STUDIES

Telemetry application CASE STUDY
Hornbeam Park (LEH3)



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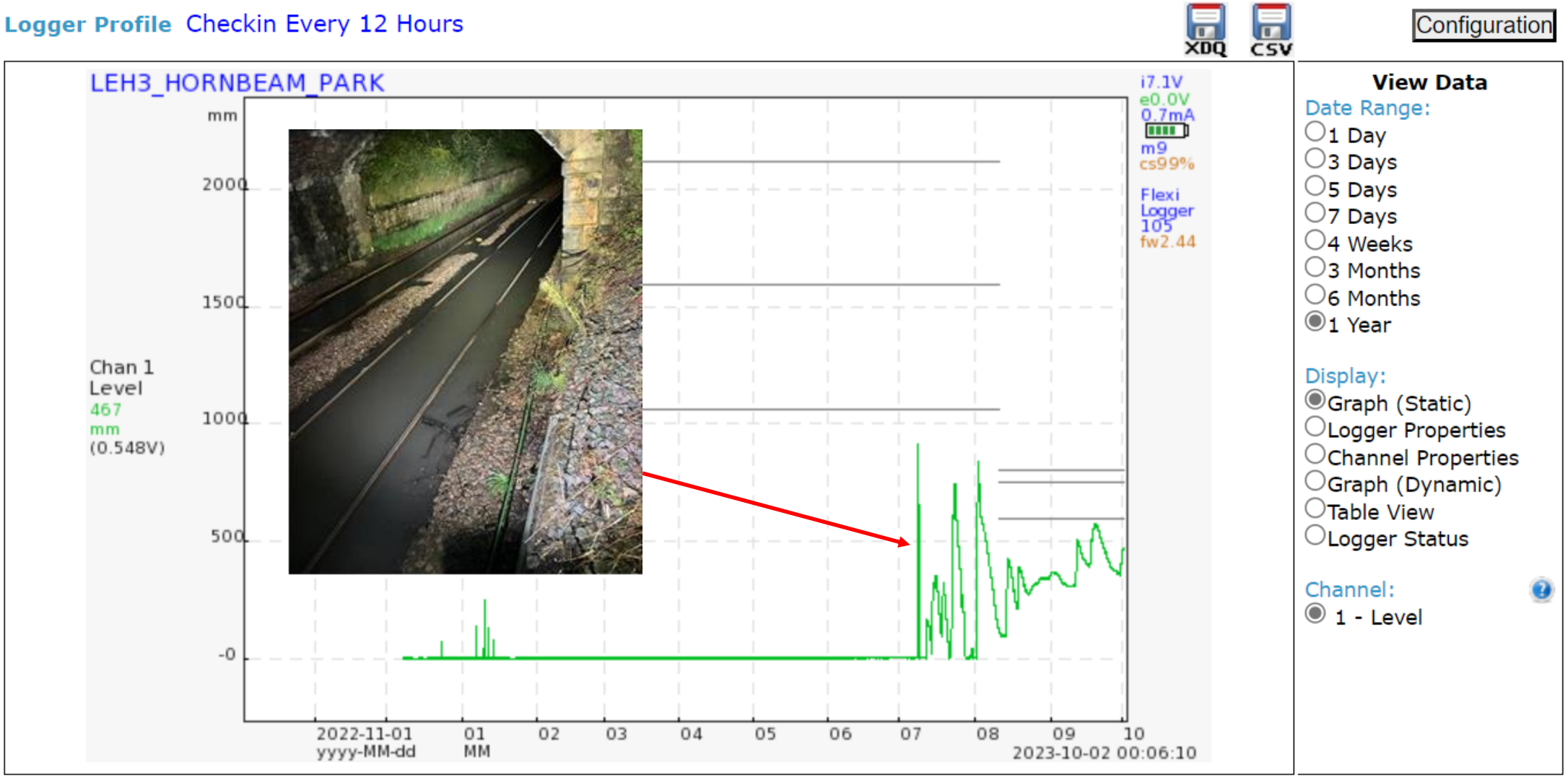
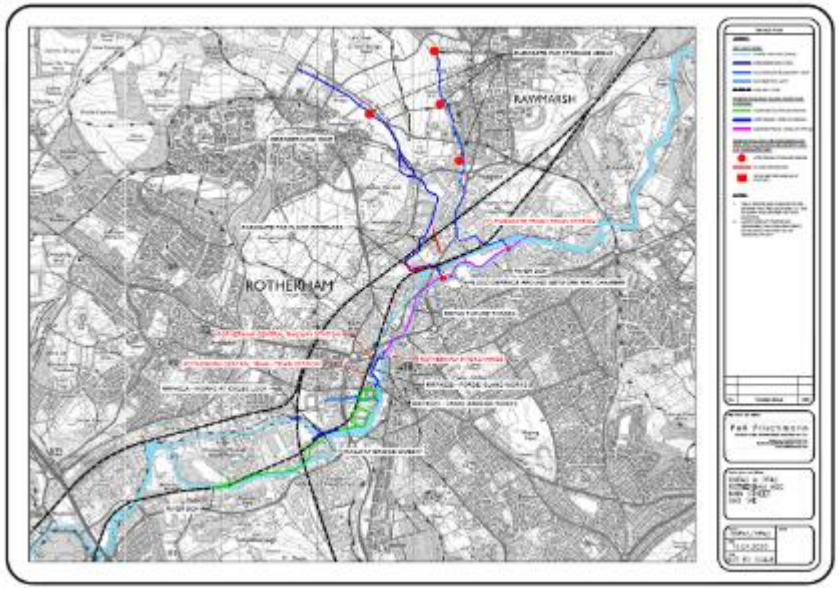
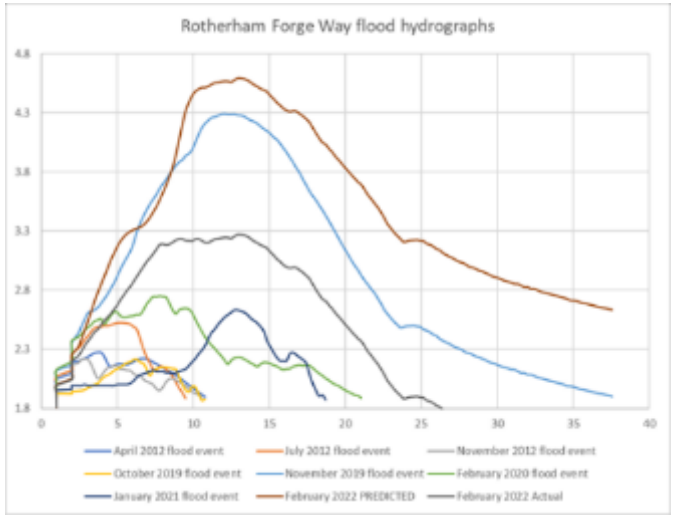
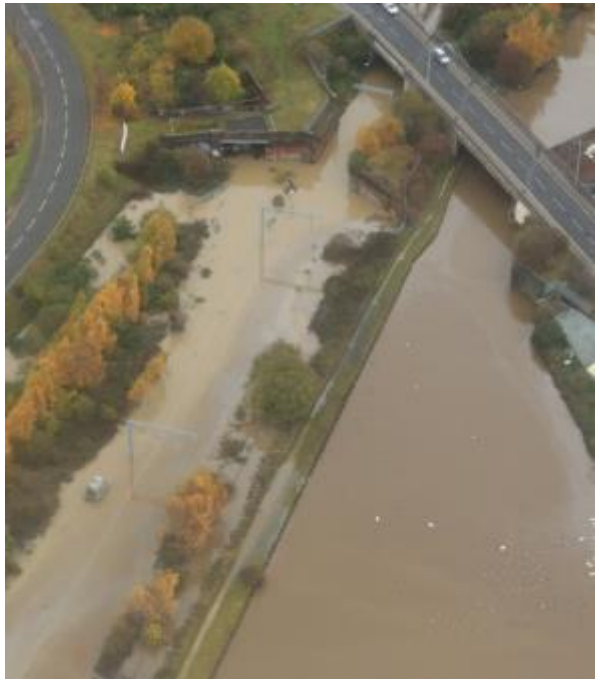
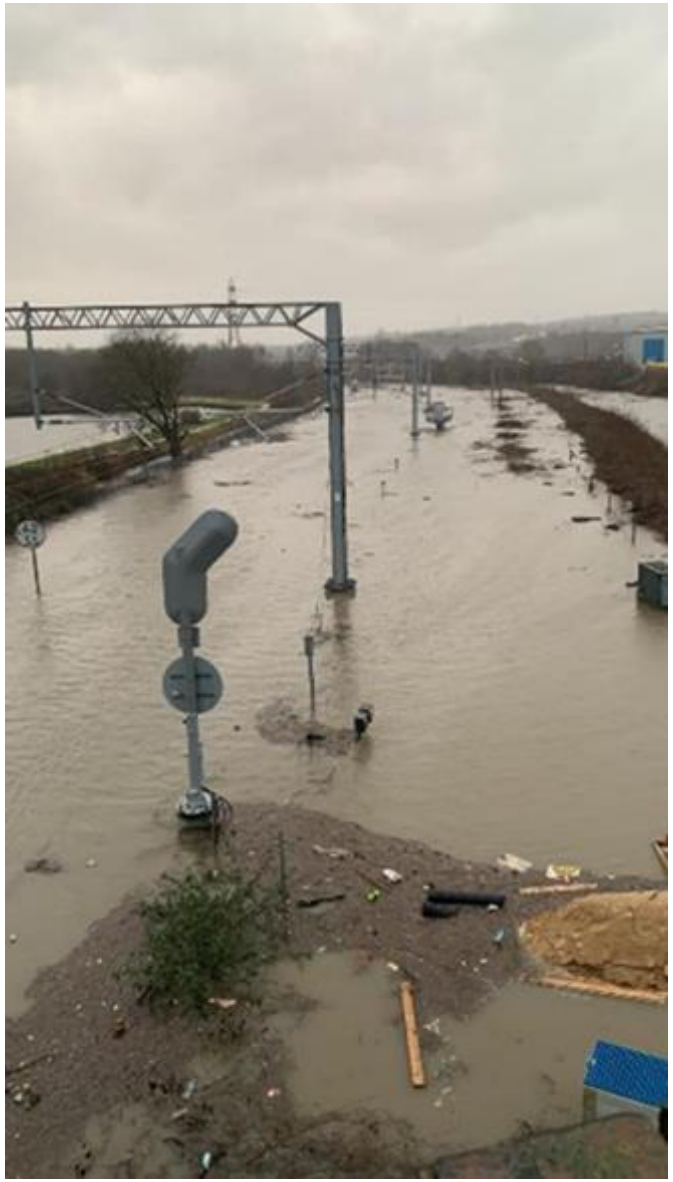










ROTHERHAM FLOOD RISK SITE

- High flood risk: 30% annual Exceedance Probability
- Root cause: high levels of River Don and Greasborough Dyke
- Cannot be solved in isolation: complex and extensive catchments
- Network Rail is working closely with Rotherham MBC to deliver a joint FAS
- Combination of hard solutions and natural flood management planned to deliver a level of protection to 1 in 100

River Don level at Rotherham Forge Island

Map Upstream Downstream Nearby levels

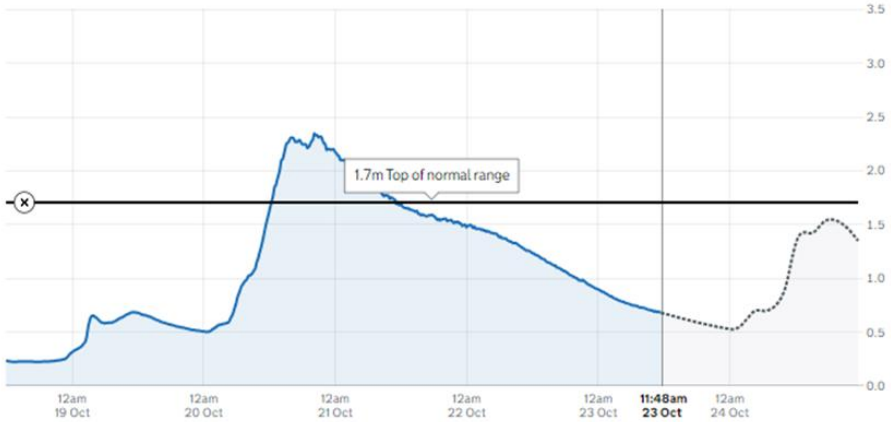
Latest at 11:30am on 23 October

Height	Trend	State
0.68m	Steady	Normal

Normal range 0.23m to 1.70m

Height in metres over the last 5 days and up to 36 hour forecast

This station includes an automated model which you should consider alongside other factors. The highest level in the model is 1.54m at 24 October at 6:15pm.



Download data CSV (16KB)

How levels here could affect nearby areas

3.32m	Water reaches the highest level recorded at this measuring station (recorded on 8 November 2019)	Show on chart
2.20m	Property flooding is possible above this level. One or more flood warnings may be issued	Show on chart
1.70m	This is the top of the normal range	Show on chart
0.68m	**Latest level**	

Rotherham Forge Way Downside