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OFFICE OF RAIL REGULATION

31 March 2015

Ms Carolyn Griffiths
Chief Inspector of Rail Accidents
Cullen House
Berkshire Copse Rd
Aldershot
Hampshire GU11 2HP

Dear Carolyn,

RAIB Report: Landslips affecting Network Rail infrastructure

I write to report[1] on the consideration given and action taken in respect of the recommendations addressed to ORR in the above report, published on 2 April 2014.

The annex to this letter provides details of the consideration given/action taken in respect of each recommendation.

We expect to update you on progress with regard to recommendations 4 and 5 by 28 August 2015.

Where recommendations are being reported as 'Implementation on-going' ORR will continue to monitor progress and will advise RAIB when actions being taken to address this recommendation have been completed.

We will publish this response on the ORR website on 17 April 2015.

Yours sincerely,

Russell J Keir

[1] In accordance with Regulation 12(2)(b) of the Railways (Accident Investigation and Reporting) Regulations 2005

Initial consideration by ORR

1. All 5 recommendations were addressed to ORR when the report was published on 2 April 2014.

2. After considering the recommendations ORR passed the 5 recommendations to Network Rail asking it to consider and where appropriate act upon them and advise ORR of its conclusions. The consideration given to each recommendation is included below.

The report and recommendations was also brought to the attention of London Underground Ltd, Nexus, UK Tram and the Institution of Civil Engineers.

Recommendation 1

The intent of this recommendation is that Network Rail revises its processes for managing earthwork and drainage risk associated with neighbouring land so that the processes are accurately documented, proportionate, reflect practical limitations and take account of benefits offered by new technology such as aerial sensing and the use of computers to process large amounts of data.

Network Rail should review and improve its processes for managing earthworks related risk arising from neighbouring land, including associated drainage issues. This should provide a documented process which takes account of the extent to which it is practical and proportionate for Network Rail to review and/or rely on land management activities undertaken by neighbours.

The new process should, where reasonably practicable:

- obtain relevant information from other sources where it cannot be collected by earthwork examiners (e.g. where examiners are unable to view areas due to access constraints, fences, etc.);
- take advantage of opportunities offered by current technology to assess areas at risk from ground movement and areas where ground movements are occurring;
- provide a robust process for identifying, and responding appropriately, to activities on neighbouring land which have the potential to significantly increase risk to the railway between routine earthwork examinations; and
- take advantage of opportunities offered by real-time rainfall monitoring to issue alerts identifying heavy rainfall when this has not been forecast.

Steps taken or being taken to address the recommendation

3. On 20 June 2014, Network Rail provided the following information:

Network Rail's initial review has found that the formal controls for managing risks arising from neighbouring land are limited unless that risk is from built infrastructure (i.e. controls for natural hazard-posed risks are not currently considered adequate).

A discovery phase will facilitate a formal gap analysis, which will feed into a multifunctional workshop involving Legal Services, Liabilities, Outside Parties and

the Geotechnical Community to discuss this issue and agree a clear and consistent way forward.

The intended outcome is a set of appropriate and proportionate controls built into a documented process, which is deliverable and can be evidenced, to enhance management of risk imported from third party land.

Timescale: 30 April 2015

4. On 5 August 2014, ORR wrote to Network Rail asking it for details of its plan, including interim milestones. ORR also requested specific information on how it is to address each bullet point. On 26 August 2014, Network Rail provided the following information:

Recommendation 1 (bullet 1) – Network Rail is carrying out a national study to understand the quantum of locations where third party land could potentially pose a hazard to the safe operation of the railway. Once defined, each location will be reviewed for the adequateness of control measures currently employed.

Recommendation 1 (bullet 2) – In parallel the Remote Condition Monitoring (RCM) development work into the potential uses of technology in the earthworks discipline is underway, much of which would be transferable to Outside Party Slopes.

Recommendation 1 (bullet 3) – Network Rail will undertake a review of the current Asset Protection process and arrangements and consider appropriate enhancements.

Recommendation 1 (bullet 4) – Real-time weather intelligence is covered by the response to Recommendation 3, which is being led by Network Rail's National Operations Centre (NOC), as well as Recommendation 5.

ORR decision

ORR, in reviewing the information provided by Network Rail, has concluded that in accordance with the Railway (Accident Investigation and Reporting) Regulations 2005. It has:

- taken the recommendation into consideration; and
- is taking action to implement it by 30 April 2015.

Status: Implementation on-going. *Network Rail has yet to complete its review of its processes for managing third party risks associated with earthworks. ORR will advise RAIB when all actions to address this recommendation have been completed.*

Recommendation 2

The intent of this recommendation is to ensure that Network Rail takes account of all safety related information contained in reports for slopes that have been categorised as marginal or serviceable by the SSHI and RSHI algorithms (i.e. reports which, at present, are not necessarily reviewed by Network Rail's geotechnical staff).

Network Rail should review and improve its processes so that due consideration is given to all safety related information provided by earthwork examiners and earthwork engineers, including safety related information associated with slopes categorised as marginal or serviceable by the SSHI and RSHI algorithms.

Steps taken or being taken to address the recommendation

5. On 20 June 2014, Network Rail provided the following information:

During individual approval of examination reports the Earthwork Examining Engineer (EEE) is expected to pick up examiner comments including recommendations for repair / maintenance and communicate these to Network Rail. This has been reinforced by adding drop-downs for recommended standard maintenance items to electronic handheld examination units.

Redrafting of Company Standards will specify the response actions required by Route teams for slopes rated as Serviceable or Marginal by the current Soil Slope Hazard Index (SSHI) and Rock Slope Hazard Index (RSHI) algorithms or A, B or C under the new Soil Embankment Hazard Index (SEHI), Soil Cutting Hazard Index (SCHI) and modified RSHI algorithms to be implemented from October 2014. It is anticipated that examiner recommended interventions will be used to populate a work-bank in future via Civils Strategic Asset Management System (CSAMS).

Planned completion date (Standards reissue): 31 August 2014
Planned completion date (CSAMS operational): 31 August 2015
Timescale: 31 August 2015

6. ORR confirmed that the following Network Rail company standards are now in place:

- NR/L2/CIV/086 Management of Earth Works
- NR/L3/CIV/065 Examination of Earth Works

7. The planned completion date (CSAMS operational) has been extended until 24 July 2016.

ORR decision

ORR, in reviewing the information provided by Network Rail, has concluded that in accordance with the Railway (Accident Investigation and Reporting) Regulations 2005. It has:

- taken the recommendation into consideration; and
- is taking action to implement it by 24 July 2016.

Status: Implementation on-going: *ORR will advise RAIB when actions to address this recommendation have been completed.*

Recommendation 3

The intent of this recommendation is to increase the likelihood that appropriate Network Rail staff are aware of landslip risk due to adverse rainfall conditions which have not been forecast or detected by Network Rail's formal rainfall monitoring processes.

Network Rail should implement a process for real-time collection (and appropriate use of) intelligence about very unusual rainfall or flooding conditions. Development of this process should take into account the differing risk levels on different parts of the infrastructure and should consider using the following information sources:

- emergency service control centres;
- other organisations involved in the provision and management of rail and non-rail transport;
- reports (encouraged by appropriate railway industry publicity) from on-duty and off-duty railway industry staff including those employed by train operating and maintenance companies; and
- rain gauge and other types of weather sensor capable of providing data in real time.

Steps taken or being taken to address the recommendation

8. On 20 June 2014, Network Rail provided the following information:

The agreed action will be completed by the following steps:

1. Review the current projects that form the Weather Resilience and Climate Change (WRCC) programme and National Weather Event Response (NWER) sub – programme and confirm that by satisfactory completion they will satisfy or offer a suitable alternative to the recommendations of this report. This will specifically review:

- *The quality of the available data and reporting available through emergency services control centres, other transport companies (rail and non-rail) and whether this offers a feasible solution.*
- *The current arrangements by which on or off duty (whether that be Network Rail, contractor or TOC/FOC) are encouraged to report issues they perceive to be a risk.*
- *What technology is available to provide accurate actual rain fall amounts in real time and predictive alerts of adverse and extreme rainfall amounts.*

Planned completion date: 9 December 2014

2. Satisfactorily complete required WRCC and NWER programmes and any associated and agreed additions found from the initial review and part 1 of the actions.

Planned completion date: 1 April 2015

The Weather Resilience and Climate Change (WRCC) programme was set up with a vision to make the operation of the rail network safer and more resilient to the effects of adverse and extreme weather through the seasons.

The National Weather Event Response (NWER) sub-programme aims to establish weather definitions; clear process and well defined responsibilities for commanding responses to; implement a weather management and information support system and implement a cost effective cross-route strategic resource management strategy that supports Routes in the advent of concurrent adverse or extreme weather occurrences.

Timescale: 1 April 2015

9. On 5 August 2014, ORR wrote to Network Rail asking it for the outcomes of its review. On 23 January 2015, Network Rail provided the following information:

Part 1: *Investigate the quality of the available data and reporting available through emergency services control centres, other transport companies (rail and non-rail) and whether this offers a feasible solution.*

Findings:

As part of the Weather Information Requirements and Flows project, which forms part of the National Weather Event Response Programme, a sub-programme of the Weather Resilience and Climate Change Programme, Network Rail has been in contact with emergency service representatives, who act as lead contacts for numerous Local Resilience Forums (LRF). In a telephone call to each, the following question matrix was reviewed:

	Current	*Ideal*
Requirements	*What information do you currently get regarding adverse and extreme weather…?* *…from Network Rail?* *…from other parties?* *Is it sufficient?* *Are you involved in the EWAT?*	*What information should you get regarding adverse and extreme weather…?* *…from Network Rail?* *…from other parties?* *Should you be involved in the EWAT? (What can you add to or gain from involvement?)* *What information do you receive that could benefit Network Rail and other sector parties?*
Flows	*How is this information received?* *From whom does this information come?* *Who receives this information?* *What action does this information prompt?* *Do EWAT actions and outcomes get shared with your organisation?*	*Is the information received in the right fashion?* *Does it come from and go to the right people?* *Are the actions that it prompts correct?* *How do you share your weather information and the actions that it prompts?* *How are the lessons learnt from weather events communicated to others?* *How could the end-to-end process be improved to make it more efficient, enhance safety and reduce delay?*

The general consensus in this response is that they get the following information, via email:

- *Met Office forecasts, which includes their National Severe Weather Warning, Hazard Manager services*
- *Met Office Public Weather Service Advisor advice on forecasted weather*
- *Environment Agency Floodline Warnings Direct service*

- *Flood Forecasting Centre Daily Flood Guidance Statement*

Hazard Manager, EA Floodline Warnings Direct and the FFC Daily Flood Guidance Statement are free services to Category 2 responders, and staff within Network Rail, including Route Controls and Seasons Delivery Specialists are already subscribed to these services in addition to Network Rail's procured Meteogroup forecasts and Hydrocast system.

Some Routes have chosen to procure the Met Office's National Severe Weather Warning system for rainfall. However, there has been criticism surrounding the accuracy and timeliness of this service from both Network Rail and LRFs, which negates its use somewhat and some of Network Rail's routes that have procured it choose not use it alone, but rather in conjunction with Hydrocast.

Outside of the rail industry, Heathrow Airport makes use of an imbedded Met Office forecaster. Network Rail has previously undertaken a one month trial of having an embedded forecaster in its National Operations Centre, however the trial wasn't well structured and the weather relatively benign which has prevented Network Rail from fairly evaluating the usefulness of such a service.

The Highways Agency Weather Information System (HAWIS) uses Met Office forecasts, but it too makes use of an embedded forecaster in their National Control Centre. It use this forecast information in conjunction with their weather stations, which are installed and managed by Vaisala. This information is not freely available to Network Rail. However, some Routes have procured the data from these weather stations. At a local level, contractors who undertake road treatment must make their own local commercial agreements, and Met Office, MeteoGroup and MetDesk have contracts in various areas across the country, although this information is more relevant to forecasted conditions of ice and snow.

Actions: Ensure all Seasons Delivery Specialists, Route Controls and the National Operations Centre are subscribed to Hazard Manager, EA Floodline Warnings Direct and the FFC Daily Flood Guidance Statement – By 31 January 2015.

***Part 2:** Investigate the current arrangements by which on or off duty (whether that be Network Rail, contractor or TOC/FOC) are encouraged to report issues they perceive to be a risk.*

Findings:

Signallers, front-line operations staff, delivery unit staff and TOC/FOC drivers receive briefings at various times throughout the year and part of this informs of possible weather issues. However, the majority of these staff won't have the necessary knowledge to judge whether an embankment is at risk of slipping, but will obviously be capable of reporting when an event has occurred.

To contact the wider community, when periods of high rainfall are expected and soil moisture deficit warrants it, Network Rail can use its internal media of the possible risk of landslips on and around our infrastructure and use the expertise of Network Rail's Professional Head of Buildings and Civils to provide information on what staff should be aware of prior to a landslip occurring.

There is no process by which Network Rail can mandate staff that are off-duty to report issues of any type; however, Network Rail has evidence of staff previously reporting incidents while off-duty such as the landslip at Penrith in 2012.

Actions: Look into establishing a 'Weather Page' on our intranet system to highlight particular seasonal and extreme weather risks. By: 31 March 2015.

***Part 3:** Investigate what technology is available to provide accurate actual rain fall amounts in real time and predictive alerts of adverse and extreme rainfall amounts.*

Findings:

As part of Network Rail's national forecasting contract with Meteogroup, Network Rail has access to data from a number of weather stations across the country, which captures rainfall levels using tipping buckets; however, many of these stations are not situated particularly close to the railway. Equally, public access is available to numerous weather stations of varying quality through Met Office's Weather Observation Window, although the interface for the service is not particularly user-friendly to capture anything other than information for the previous hour. As stated, some routes have commercial agreements for data from Vaisala, although these weather stations are situated on the road network and may not be particularly close to the railway.

While LRFs use the National Severe Weather Warning service to inform of events of extreme rain, this information does not nominally include rainfall amounts, as weather warnings are judged on the likelihood of occurrence and the impact of the event. The information from EA and FFC is specific to flooding, which takes into account rainfall and soil moisture deficit, however, this information is not specifically gauged towards the railway so, while it may give Network Rail an indication that flooding is possible in a geographical region, it will not provide any insight into the stability of Network Rail's line side.

Network Rail has a contract for Meteogroup's Hydrocast service which shows expected rainfall levels at locations which Network Rail has declared as high risk over each of the next three hours, the next seven hours and the 12 hours after that, according to Met Office forecasting models, and expected rainfall totals over the next four days according to forecasting models provided by the European Centre for Medium-range Weather Forecasts (ECMWF). The service also shows live radar, going back for three hours and forecasting the track of a weather system over the next three hours; rain anomaly state, which estimates the saturation of ground at high risk locations given recent and long-term rainfall averages; and provides the ability to run off reports for single or multiple locations on various statistics for the catchment area or 1km pixel, including average rainfall, percentage difference from average and rain anomaly state.

Actions: No further actions identified

ORR decision

10. ORR, in reviewing the information provided by Network Rail, has concluded that in accordance with the Railway (Accident Investigation and Reporting) Regulations 2005. It has:

- taken the recommendation into consideration; and

- is taking action to implement it by 1 April 2015.

Status: Implementation on-going: *ORR will advise RAIB when actions to address this recommendation have been completed.*

Recommendation 4

The intent of this recommendation is for Network Rail to formalise the processes already being developed and introduced with the intent of improving management of earthworks during adverse weather, and for these processes to include timely updating of the 'at risk' register.

Network Rail should complete initial development of its modified adverse weather earthwork management system. It should then alter its standards and, if necessary, other formal documentation to reflect the modified system. The updated documentation should include a process for the rapid updating of the 'at risk' register when significant risks become apparent.

Steps taken or being taken to address the recommendation

11. On 20 June 2014, Network Rail provided the following information:

The developments around adverse weather management made in response to Improvement Notice I/ENF-NOT-57/JPMcG from ORR will be written into the NR/L2/CIV/086 Management of Earthworks Company Standard. This will mandate each Route to:

- *Risk assess and prioritise earthworks that require operational control measures during adverse rainfall when pre-set triggers are reached;*
- *Set suitable rainfall triggers;*
- *Assure itself that Network Operations (Control/Maintenance) have:*
  - *An appropriate documented baseline response plan agreed, signed-off and operational;*
  - *A weather warning system in place that initiates the baseline response plan when the pre-set triggers are reached;*
- *Revisit the risk assessment, trigger values, weather warning system and baseline response plan annually and update where appropriate.*

Timescale: 31 October 2014

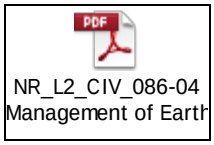
12. On 5 August 2014, ORR wrote to Network Rail asking it to explicitly explain how it addressed the last part of the recommendation. On 26 August 2014 Network Rail provided the following information:
Company Standard NR/L2/CIV/086 (Issue 4) is programmed for publication on 5 September 2014. The updated Standard mandates each Route to create and maintain an Adverse / Extreme Weather Plan (for Earthworks), and to review this on at least an annual basis. The fitness for purpose of the baseline plan is considered at the time of the EWAT. A review of the EWAT process is currently being undertaken as part of Network Rail's Weather Resilience & Climate Change Programme's (WRCC) National Weather Event Response (NWER) Sub-programme. This Sub-programme will also address Recommendations 1, 3 and 5.

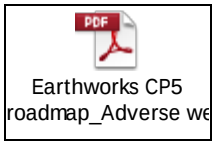
13. On 5 November 2014, Network Rail provided a copy of its ‘Closure Statement’:

The first generation Adverse/Extreme Weather Risk Assessment methodology plotted Track 5 Chains on an "Adverse/Extreme Weather Matrix”, which was reviewed in terms of its x-axis (likelihood of failure, based on SSHIIRSHI), y-axis (consequence of failure, biased towards local infrastructure features) ,and regions of risk (same for all asset types). At this time the "Policy Matrix" plotting Asset 5 Chains on axes of SSHI/RSHI versus modified-EPM (biased towards route train/timetabling features) was also under review. Reviews were carried out with "Panels of Experts" assembled from Routes as well as specialist consultants, and the Regulator was consulted throughout.

To address observed inadequacies, the result of the reviews was development and implementation of:

- new Hazard Indices (SEHI and SCHI) for soil slopes that are a five-times better predictor of failure than the SSHI algorithms they replace;
- the Common Consequence Tool (CCT) for Earthworks that Integrates both route train/timetabling features and local infrastructure features but is dominated by neither;
- a new combined Earthworks Safety Risk Matrix plotting Earthwork Assets (formerly known as Asset 5 Chains) on axes of HI vs. CCT replacing the Policy and Adverse/Extreme Weather Matrices;
- overlays for each asset type that guide where Renew/Refurb/Maintain Interventions reducing likelihood of failure (i.e. HI) may be carried out;
- overlays for each asset type that guide where mitigations including inclusion in Adverse/Extreme Weather Plans reducing consequence of failure (i.e. CCT) should be directed;
- Issue 4 of Company Standard NRIL2JCIV/086 Management of Earthworks on 5 September 2014 mandating the above;
- Issue 1of Guidance Note NRIGNICIVI207 Definition of Adverse/Extreme Rainfall Prioritisation Procedure; and
- Civils Adjustment Mechanism (CAM) work planning tools ("Powerpacks ") with the above built- in (i.e. including a national second generation Adverse/Extreme Weather Risk Assessment).





ORR decision

14. ORR is not satisfied that the last part of the recommendation has been adequately addressed; *The updated documentation should include a process for the rapid updating of the ‘at risk’ register when significant risks become apparent*. ORR continues to engage with Network Rail to resolve this concern.

***Status: In-progress**. ORR will update RAIB by 28 August 2015.*

Recommendation 5

The intent of this recommendation is for Network Rail to formalise the process for dealing with the rare circumstances when the mitigation normally provided in response to a red warning would be inadequate. This requires consideration of additional mitigation for locations on the 'at risk' register and consideration of mitigation for locations which are not normally considered to be at risk during extreme weather conditions.

Network Rail should formalise the process for implementing additional mitigation if very extreme rainfall conditions mean that the mitigation normally provided in response to a red warning is inadequate for earthworks on the 'at risk' register and/or there is a significant likelihood of landslips at locations not included on this register.

Steps taken or being taken to address the recommendation

15. On 20 June 2014, Network Rail provided the following information:

Network Rail will review this recommendation as part the Adverse Weather Topic Verification to be delivered by a combination of the Weather Resilience & Climate Change (WRCC) Programme's activities and Technical Services projects "T01190 CP5 Interim Geotechnical Business Plan Development - Civils Adjustment Mechanism March 2015" and "T00978 Corporate Engineering Verification Civils (Geotechnical)".

This recommendation has been interpreted to relate to real-time monitoring of rainfall to facilitate rapid responses to control the dynamic risk posed by short, high-intensity showers that the predictive models have "disguised". Even if a red or equivalent warning is in place in such circumstances the baseline mitigation may need to be supplemented by additional control measures. Network Rail's Extreme Weather Action Team (EWAT) will consider how the process for implementing additional mitigation can be formalised.

Timescale: 31 December 2014

16. On 5 August 2014, ORR wrote to Network Rail asking it to clarify the actions it is taking to formalise its processes. On 26 August 2014, Network Rail provided the following information:
It is Network Rail's intention to consider this scenario as part of the EWAT process review described above and the Adverse Weather Topic Verification. The EWAT process review is scheduled to be completed and an enhanced EWAT process implemented by 28 November 2014. As shown in the attached programme NWER is strengthening Network Rail's weather warning capability. In accordance the EWAT process will be further updated as the Future Weather Warning System is rolled-out.

ORR decision

17. Network Rail has yet to provide evidence of completion of its review or implementation of changes to its process for mitigation of very extreme rainfall conditions.

***Status: In-progress**. ORR will update RAIB by 28 August 2015 on the action being taken to address this recommendation.*