



A post incident inspection into the derailment of J608 at Wicklow -16th November 2009



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1. General overview of Incident

At approximately 0630 hrs on the 16th November 2009, a four car diesel unit operated by Iarnród Éireann struck a substantial landslide near to Wicklow station. The volume of earth and debris was sufficient for the leading vehicle to leave the rails and be deflected to the left of the running line.

2. Purpose of investigation

The RSC is, amongst other things, concerned with the prevention of accidents and incidents. The purpose of this post incident inspection is to identify any organisational issues, actions or foreseeable technical failures which may have contributed to the event in order to prevent a re-occurrence.

The RAIU investigate 'for cause' and the RSC shall respond to the findings of their investigation once complete, as appropriate.

3. Evidence

3.1. Evidence used in the Investigation

Evidence gathered at site

- Detail of the infrastructure components.
- Unit number
- Photographs taken of derailment site
- Photographs taken of the landslide
- Photographs from the field above the cutting
- Notes of conversation with the driver, ganger and acting PWI

Evidence supplied

- Statement from Acting PWI
- Preliminary report from M. Grace of UCD
- I-PWY-1107 Track and Structures Inspection Requirements
- I-PWY-1307 Standard for Track Patrolling
- I-STR-6510 Structural Inspections Issue 3
- I-STR-6530 Civil Engineering Structures Design Standard Issue 1
- I-STR-6519 Earthworks and Coastal & River Defences Inspection Guidance Issue 1
- Response to questions to the Iarnród Éireann, received via the safety department

Other information referred to

- Network Rail - Management of Structures NR/L1/CIV/032 Issue 2

- Network Rail – Managing the risk arising from mineral extraction and landfill operations NR/L3/CIV/037
- Met Éireann meteorological results for field saturation figures for the 16th November 2009
- Carl Bro – Final Feasibility report 2001 for Iarnród Éireann
- Construction of Highway Earthworks HA 70/94 vol 1

3.2. Sequence of events

- a) Approximately 1700hrs (Sunday 15th November) – The last train of the day passes the landslide site heading in the Up direction (North) to Dublin.
- b) 0620hrs (Monday 16th November) – J608 approaching Wicklow is requested by the regulator via the train radio to work to Arklow instead of Wicklow as diagrammed.
- c) As J608 approaches Wicklow station, the train is signalled into the loop with a single yellow aspect.
- d) Once part way down the platform, the two aspect colour light signal cleared to green.
- e) On receiving a green aspect, the driver re-applied power.
- f) Whilst accelerating, the driver sighted what appeared to be a tree across the line and placed the brake handle into Emergency
- g) The train collided with the landside and the leading vehicle derailed and was deflected to the left.
- h) Approx 0630hrs – The driver contacted the CTC signaller via train radio and makes an Emergency call.

Note this sequence of events was constructed from notes taken at the incident site whilst the driver of J608 was in attendance.

4. Details

4.1. General description of location

The location of the derailment was immediately south of Wicklow station between the 28 ¼ and 28 ½ mileposts.

The line at the site of the incident is a single track railway. The formation runs through a deep cutting set into the side of the valley, with the fall of the land being right down to left in the direction of travel of the train.

All the infrastructure at the site within the boundary fence is owned and maintained by Iarnród Éireann. The land boundary was not evident at the top of the cutting due to vegetation and may have previously been defined by a hedge.

4.2. Description of the service and vehicles

The train was not in passenger service and was running as Train ID J608. Due to a previous line closure between Gorey and Arklow, through services to Enniscorthy and Rosslare were not operating and the service was due to only operate as far Wicklow where it would form an early service to Dublin. During the journey, the driver was requested to work on to Arklow due to issues with bus access at intermediate stations by the Regulator at CTC.

The train was formed of a four car diesel multiple unit (DMU) of the 29000 class. The vehicles being numbered 29126, 29226, 29326 and 29426. The unit was built in 2005 by CAF of Spain. Each vehicle weighs approximately 45 tons, with each vehicle being powered. There was no evidence to suggest the design or upkeep of the vehicles contributed to the incident.

4.3. Description of the Infrastructure involved

4.3.1 Track

The track at the location was plain line with flat bottom continuously welded rail rail mounted on concrete sleepers with baseplates and Vossloh fixings. Conventional crushed stone ballast was noted which appeared to be free of contamination and present in the correct quantities. No defects were apparent with the track.

4.3.2 Earthworks

The line runs through a cutting into the hillside. Consequently, one side of the cutting is deeper than the other reflecting the original topography. The earthworks date from the original construction of the line in 1861.

The angle of slope of the cutting side was surveyed to be in the region of 50 to 55 degrees from horizontal on the lower section and a flatter slope at the top of the embankment (extracted from the M Grace Preliminary report to IÉ).

Vegetation appeared to be mixed, with long grass and ferns evident at lower levels and gorse and other large shrubs at the top of the cutting. Some small trees were evident in and amongst the

vegetation. The profile of the vegetation supports the statement that flailing has been used in the past to clear line side vegetation.

The Ganger and Acting Permanent Way Inspector were not aware of any previous history of landslips in the cutting.

5. Factors for consideration

5.1. Construction of the Earth works

The railway south of Wicklow to Rathdrum was opened in 1861. There is no evidence to suggest that there has been any substantial reconstruction of the earthworks since that date.

The cutting slope is at an angle of 50-55 degrees in the lower sections. This is somewhat steeper than the standard 2:1 ratio (or 30 degree slope) recommended for plain earth structures in current construction standards. Both the reports by the Civil Engineer engaged by Iarnród Éireann and the Carl Bro report refer to large numbers of earthworks of the network having been built with steep slope angles. The Carl Bro report commented “Over-steep slopes for the material used are common on most lines. This results in a marginal factor of safety and potential for instability”.

Drainage is incorporated into the ballast formation with a buried perforated pipe. This appeared to be functioning correctly with no ‘pooling’ or surface water evident at track level.

5.2. Vegetation

The cutting appeared to have unsubstantial vegetation consisting of brambles, bracken and long grass up to 3m above rail level. Above this height the vegetation appeared to be more substantial, consisting of gorse and trees. This profile appeared to be consistent with the use of a ‘flail’ unit – see the photograph in Appendix A.

The location of the railway boundary was not apparent at the top of the cutting, with only dense vegetation demarcating the edge of the field.

Vegetation is managed by local Permanent Way staff under the control of the Ganger. It is understood that the recent works to a new bridge near Wicklow station had reduced the number of available staff to undertake routine tasks as staff were needed to act as Track Safety Co-ordinators.

Vegetation was partially trimmed in March 2008 by flail mower according to a statement from the Acting PWI. This accounts for the lower density foliage to below cant rail height.

5.3. Inspection of Earthworks by Iarnród Éireann

Structures specific Inspection

Iarnród Éireann have a Civil Engineer's standard relating to the inspection of structures. This standard is 'I-STR-6510 – Structural Inspections'.

Within this standard structures are categorised according to the frequency at which they must be inspected. Cuttings over 3m are categorised as being category 'B' structures. The standard requires that category B structures will be inspected with a 'General Engineering Inspection' (GEI) at maximum intervals of between 1 year and 10 years.

The 'GEI' is defined below:

"This is a systematic visual inspection of a structure that is generally adequate to monitor and assess its condition. The inspection is usually undertaken from ground or water level with the assistance of binoculars or ladders where necessary so that all visible elements are examined."

The standard identifies that there may be further features of the structure that require 'additional examination measures'.

The current issue of this standard is issue 3, taking effect in Oct 2009. The first iteration of the standard produced in 2006 did not utilise the term 'General Engineering Inspection' but did still require assessment and inspection of Earthworks that were over 3m.

A further standard gives guidance on inspecting structures. This is 'I-STR 6519 Earthworks and Coastal River Defences: Inspection Guidance Notes Issue 1' and it gives illustrated and detailed guidance on inspecting earthwork cuttings.

Patrolling

The Permanent Way standard 'I-PWY-1307 Standard for Track Patrolling – Issue 1.1' also includes a requirement for individuals patrolling the line to examine cuttings and embankments. Patrollers are advised to look for:

- *Slipped material from cuttings or embankments, especially after flooding or heavy rainfall*
- *Excavations or undermining of earthworks in the vicinity of the track or adjoining assets*
- *Signs of movement or instability, especially after flooding or heavy rainfall: includes leaning fence posts, OHLE masts, signal posts, telegraph poles*

This guidance appears to be sufficient for those undertaking track patrolling duties.

The standard I-PWY-1307 details what should be recorded on the 'Patrol Length Features form'. This does not include specific embankments or earthwork features. The Patrol Length Features forms are understood to be undergoing updating with illustrations and more detail.

5.4. Inspection activity undertaken

The line is patrolled three times a week by a Wicklow based patrolman.

The cutting to the South of Wicklow was not on the list of structures to be inspected immediately before the incident. Iarnród Éireann have acknowledged validation of the list of structures to be inspected is still underway and that until this is complete, compliance with standard 'I-STR-6510 – Structural Inspections' will not be achieved.

5.5. General maintenance activity at the site

A statement from Iarnród Éireann staff identified the following maintenance activity at the site:

- Relaying work in June 2000, involving total track replacement
- Flailing of the undergrowth in March 2008
- Cable laying in connection with re-signalling in April 2008
- Tamping of the track in Feb 2009

All of these represent routine railway maintenance activities and all occurred some months before the landslide event.

5.6. Similar Incidents

RSC records show there have been a number of other earthwork failures in the last three years, which are listed below:

19 th November 2009	Milepost 19 Limerick – Ennis, Cutting side failure
14 th November 2009	Milepost 58 near Gorey – Embankment slip
4 th February 2009	Milepost 50 ¾ near Arklow – Embankment slip
22 nd January 2009	Cabra – Great Southern Branch – Cutting side failure
8 th December 2008	Navan branch – Cutting side failure
16 th August 2008	Portarlinton – Cutting side failure
1 st August 2007	Manulla – Embankment failure
25 th June 2007	Phoenix Park – Cutting failure (possible 3 rd party contributing factors)

Note: Events on the coastal section at Bray head are excluded.

5.7. Weather

Observation at the site indicated that soil in the field above the railway line appeared to be saturated, with standing water evident in the furrows and depressions in the field.

Met Éireann produce a Soil Moisture Deficit diagram daily. The diagram for the 16th November indicates that poorly drained soil was at saturation point on the 16th November 2009 confirming the observation made above.

Heavy rainfall had ceased at the site within one hour of the incident occurring. However, water was noted to be flowing from the site of the slip to the cess by the attending RSC inspector, indicating that the soil was saturated and there was some surface run-off on the hillside above. In the field above the cutting, surface water was noted.

5.8. Third party activity

An inspection of the site above the top of the cutting indicated that ‘surcharging’ or building up of the level of the land had taken place at the top of the cutting beyond the boundary fence, where the land is in use as a field.

A preliminary report by a civil engineer specialising in earthworks and geo-technical matters (engaged by Irish rail) has identified surcharging to a depth of 1m. This included deposition into and over a field drain running parallel to the railway at the top of the cutting. This activity exactly matches one of the Permanent Way Institute (PWI) defined causes of deep seated cutting slips*.

*G.H. Cope, 1993, British Railway Track- Design, Construction and Maintenance, PWI

5.9. Operational, Signalling and Rolling stock

There is no evidence to suggest that the operation of the train or signalling system contributed to the incident.

There is also no causal link between the rolling stock and the incident. However, it is worthy of comment that the derailed vehicle remained upright and both bogies stayed attached. The inter-vehicle coupling appeared to have resisted the twisting (overturning), vertical and buffing loads in the collision and derailment event.

6. Immediate cause and Underlying causes

It is conclusive that the immediate cause of the derailment of J608 was the result of colliding with a large volume of earth and debris.

A number of underlying causes of the derailment of J608 have been established, but the level of contribution of each cause is less conclusive.

It should be noted that an RAIU investigation is under way, which is specifically being undertaken to ascertain cause. Should this investigation identify further items or issues to pursue, then the RSC shall respond accordingly.

The underlying causes include:

- Heavy rainfall over a period of days saturating the area, making it more susceptible to movement.
- The deposition of soil along the boundary at the top of the cutting altered the drainage and increased the water table, causing water to exit the cutting side.
- Excess vegetation above cant rail height on the cutting sides made inspection for movement difficult to achieve.
- The structure was not inspected in line with the internal standard “I-STR-6510 – Structural Inspections”.

7. Conclusions

The focus of this report is to identify if the cutting collapse and subsequent derailment of J608 could have been reasonably prevented.

It can be concluded from the evidence gathered that the derailment was caused at least in part by factors outside of the railway management’s immediate influence. The recent ‘surcharging’ of soil on third party land was obscured from view and would not necessarily have been readily apparent to railway staff or management, especially from routine patrolling. Even if thorough inspection of the cutting was undertaken at an annual frequency, it is accepted by the RSC that this may not be detected. Consequently the impact on drainage under certain weather conditions was also not highly foreseeable.

However, the investigation has identified some opportunities for improvement. These primarily relate to the management of earthwork structures.

The cutting falls within the scope of infrastructure standard ‘I-STR-6510 – Structural Inspections’ (and accompanying guidance ‘I-STR 6519’), but was not included in the list of structures held by the current ADE. The RSC has been informed that this list is understood to have inaccuracies and is already in the process of being validated. Thus the cutting in question did not have a specific assessment undertaken or a corresponding record (as per the standard) prior to the landslide event.

Given that earthworks have been previously highlighted by independent reports (IRMS and Carl Bro) as being a particular risk issue for Iarnród Éireann, it is clear that full compliance with the internal standard on inspection of structures could deliver a clear safety benefit.

The infrastructure inspection standards also make very limited reference to vegetation and no explanation on how this can present a problem. The level of vegetation would have undoubtedly made it difficult to observe any change in the upper part of the structure at Wicklow. It is also

possible that the presence of trees in the upper cutting side could have contributed to de-stabilising the steep slope.

8. Recommendations

For Iarnród Éireann

1. To identify what the current status of the inspection of structures is, ascertain the extent of technical non-compliance with the relevant standard (I-STR-6510) and develop a plan with defined timescales to address any shortcomings.
2. To review the risk presented by vegetation on steep earthworks and particularly consider how this impacts upon their monitoring and inspection.

Appendices

Appendix A Photographs



Photograph of field showing 'surcharging' or deposited soil at cutting top.



Image illustrating the vegetation above the reach of the flail (blue) and in the reach of the flail (red).