



Railway Accident Investigation Unit

Ireland



INVESTIGATION REPORT

Difflin Light Rail Passenger Fall, Co. Donegal

17th December 2016
RAIU Report No: 2017 -001
Published: 7th November 2017

Report publication

This report is published by the Railway Accident Investigation Unit (RAIU). The copyright in the enclosed report remains with the RAIU by virtue of section 61(5) of the Railway Safety Act, 2005. No person may produce, reproduce or transmit in any form or by any means this report or any part thereof without the express permission of the RAIU. This report may be freely used for educational purposes. For further information, or to contact the RAIU, please see details below:

RAIU
2nd Floor, 2 Leeson Lane
Dublin 2
Ireland

email: info@raiu.ie
website: www.raiu.ie
telephone: + 353 1 604 1241
fax: + 353 1 604 1351

The original publication details are given below:

Title	Difflin Light Rail passenger fall, Co. Donegal
Document type	Investigation Report
Document number	2017 -001
Document issue date	08 th Nov 2017

Where the report has been altered following its original publication, details on the changes are given below:

Revision number	Revision date	Summary of changes

Reader guide

All dimensions and speeds in this report are given using the International System of Units (SI Units). Where the normal railway practice, in some railway organisations, is to use imperial dimensions; imperial dimensions are used and the SI Unit is also given.

All abbreviations and technical terms (which appear in italics the first time they appear in the report) are explained in the glossary.

Descriptions and figures may be simplified in order to illustrate concepts to non-technical readers.

Report preface

The RAIU is an independent investigation unit within the Department of Transport, Tourism and Sport (DTTAS) which conducts investigations into accidents and incidents on the national railway network, the Dublin Area Rapid Transit (DART) network, the LUAS, heritage and industrial railways in Ireland. Investigations are carried out in accordance with the Railway Safety Directive 2004/49/EC enshrined in the European Union (Railway Safety) (Reporting and Investigation of Serious Accidents, Accidents and Incidents) Regulations 2014.

The RAIU investigate all *serious accidents*. A serious accident means any train collision or derailment of trains, resulting in the death of at least one person or *serious injuries* to five or more persons or *extensive damage* to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety.

The RAIU may investigate and report on accidents and incidents which under slightly different conditions might have led to a serious accident.

The purpose of RAIU investigations is to make safety recommendations, based on the findings of investigations, in order to prevent accidents and incidents in the future and improve railway safety. It is not the purpose of an RAIU investigation to attribute blame or liability.

Report summary

On Saturday 17th December 2016, a 'Santa Express' train service was operating at Difflin Light¹ Railway (DRL), a 4.5 km narrow gauge railway based in Oakfield Park, Raphoe, Co. Donegal. The Santa Express excursion included a return train ride from Oakfield Park Station to visit Santa's Grotto.

At approximately 17:00, shortly after departing Santa's Grotto, a family of nine (including a six year old girl) boarded the Santa Express, for their return journey to Oakfield Park Station. The train travelled a short distance, before starting to travel around a right hand curve, when the six year girl fell from the train, became entangled with the side of the train and was dragged a short distance along the gravel before the train came to a stop. The child sustained injuries to her legs that required hospital treatment, a skin graft as an outpatient, and subsequent check-ups.

The immediate cause of the accident was that a small child fell out of an open carriage of a moving train as it was travelling around a curve. Contributory and underlying to this occurring were the fact that:

- There were insufficient physical or procedural safeguards to prevent small children, whose feet do not touch the ground in a seated position in a coach, from falling from an open carriage.

The root cause associated with this accident:

- The existing risk assessment, within the Safety Management System's (SMS) documentation, did not identify the risk posed by small children.

Additional observations, made by the RAIU during their investigation, include:

- DLR were not fully adhering to the requirements of their own Safety Management System, in that they failed to carry out the emergency plan as required after the occurrence of an accident, they did not report the accident to the RAIU or Commission for Railway Regulation (CRR); staff were not seasonally re-briefed; risk assessments were not reviewed periodically as called for by DLR SMS.
- There was no dedicated first aid location at DLR to treat injuries to staff or passengers

The RAIU have made the following four safety recommendations as a result of the investigation:

¹ Difflin Light Railways is also known as Difflin Lake Railways, as the Safety Management System refers to Light, this will be used for consistency.

As there were insufficient physical or procedural safeguards to prevent small children, whose feet do not touch the ground, from falling from an open carriage (CF-01, CF-02), the RAIU make the following safety recommendation:

DLR should review the physical and procedural safeguards for the operation of their trains, to prevent small children whose feet do not touch the ground in a seated position, from falling from open carriages.

The DLR SMS failed to fully identify all the risks associated with operation of their trains (RC-01); in addition, there were several other issues identified with the DLR SMS (AO-01); as a result the RAIU make the following safety recommendation:

DLR should review their risk assessment process to ensure that all reasonably foreseeable risks associated with the operation of trains are identified and suitable control measures identified.

DLR should review the DLR SMS, in its totality, and ensure that there are internal monitoring procedures that mandates the periodic checking of application of SMS processes and practises.

As there is no dedicated first aid location (AO-02), the RAIU make the following safety recommendation:

DLR should review their responsibilities under the Safety and Welfare at Work Regulations as to dedicated First Aid areas.

Contents

THE ACCIDENT	1
Summary of the accident.....	1
Parties and roles involved, directly and indirectly, in the accident	2
General description of the railway	3
Fatalities, injuries and material damage.....	5
External circumstances	6
RAIU INVESTIGATION.....	7
RAIU decision to investigate.....	7
Scope of investigation	7
Investigation and evidence	7
EVIDENCE.....	9
Infrastructure	9
Rolling Stock.....	11
DLR's Safety Management System	13
Regulatory oversight by the CRR.....	22
Events before, during and after the accident.....	24
ANALYSIS	29
Infrastructure	29
Rolling Stock.....	29
DLR's SMS	29
Regulatory oversight by the CRR.....	31
Actions of parties on the day of the accident.....	31
CONCLUSIONS	34
Immediate cause, contributory factors and underlying causes, root causes and additional observations	35
RELEVANT ACTIONS TAKEN OR IN PROGRESS	36
Actions taken by DLR.....	36
Actions taken by CRR	36
SAFETY RECOMMENDATIONS.....	37
General description	37
ADDITIONAL INFORMATION	38
List of abbreviations.....	38

Glossary of terms 38
References 40

The Accident

Summary of the accident

- 1 On Saturday 17th December 2016, a family of nine were attending a pre-booked Santa Train excursion operated by Diffilin Light Rail (DLR) in Oakfield Park, Raphoe, County Donegal, see Figure 1. The excursion was to include, travelling from Oakfield Park Station by train, to visit Santa's Grotto and then to return by train to Oakfield Park Station.

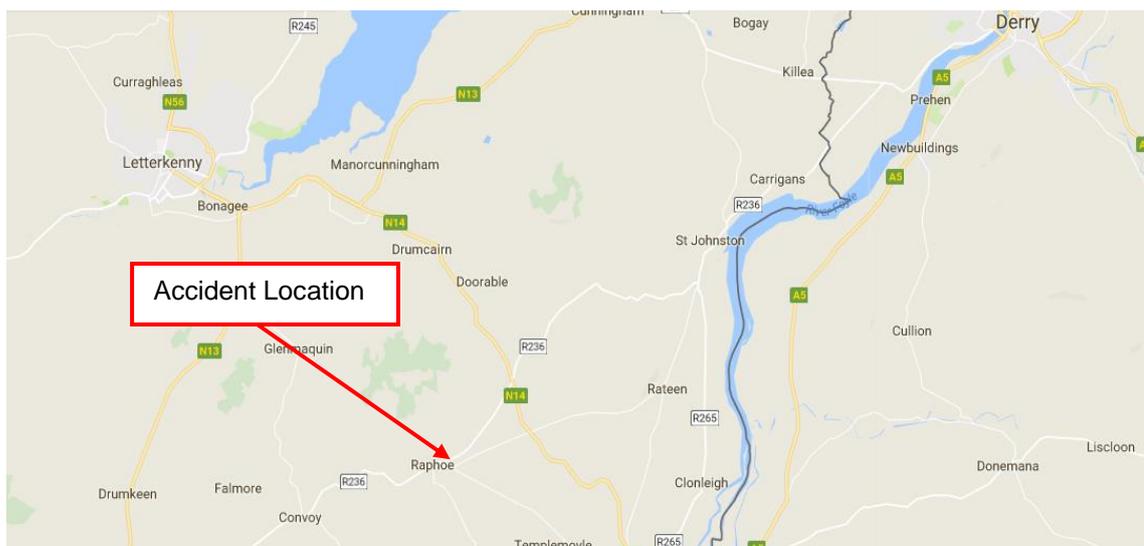


Figure 1 – Location of the accident

- 2 At approximately 16:15 hrs, the family boarded the train, as instructed, at Oakfield Park Station and travelled to Santa's Grotto, without incident.
- 3 At approximately 17:00 hrs, after visiting Santa's Grotto the family re-boarded an open carriage on the train for the return journey back to Oakfield Park Station.
- 4 Shortly after departure, at a distance of approximately 20 metres (m) from the departure point at Santa's Grotto, the train began to negotiate a right hand curve. A six year old girl, positioned to the left of the vehicle, fell out of the door gap, over a chain that was securing the doorway.
- 5 The girl was dragged by the underframe of the train for a distance of approximately 5m before the driver was able to stop the train when he was alerted by witnesses shouting to him.
- 6 The girl sustained a friction damage injury to her right calf /ankle and her left calf that required hospital treatment, a subsequent skin grafts and the child continues to receive on going medical treatment (as of the publication date of this report).

Parties and roles involved, directly and indirectly, in the accident

Parties involved in the accident

Difflin Light Railway

- 7 Difflin Light Railway (DLR) is a privately operated 15-inch (0.381 m) *narrow gauge railway* in the grounds of Oakfield Park, Raphoe, County Donegal. The 4.5 kilometre (km) line runs through a variety of landscaped gardens with features such as lakes, lawns, woodlands, meadows and streams. The main section of the railway was constructed and opened in 2004.
- 8 The railway is open to the general public on specified dates when the gardens are open, and is available to carry passengers on other special occasions by special arrangement. DLR operates seasonal services and in this instance it was operating a 'Santa Express', where customers travelled on the train around Oakfield Park garden grounds to Santa's Grotto.
- 9 DLR currently operate under a Safety Management Certificate issued by the Commission for Railway Regulation (CRR)² in April 2014 in conformity with Railway Safety Act 2005. They are one of five such railways operating in the Republic of Ireland currently licenced by the CRR.

Other parties not directly involved in the accident

- 10 The CRR is the national safety authority, whose statutory mandate is to ensure that each railway organisation has developed, implemented, and is complying with its Safety Management Systems (SMS) and that it conforms to the legislative requirements in accordance with the Railway Safety Act 2005 and the European Railway Safety Directive.
- 11 The CRR's mission is to advance the safety of railways in Ireland through diligent supervision and enforcement. The CRR is required to ensure that each railway organisation operating in Ireland understands and effectively manages the *risk* to safety associated with its activities.

² CRR changed from the Railway Safety Commission in 2016, but will be referred to as the CRR for the entirety of this report for ease of reading.

Roles involved in the accident

DLR Staff

12 The DLR staff directly involved in the accident were:

- Driver – Had been driving since 2015, and had been verbally briefed by the Estate Manager on working at night before the Santa Express commenced. The Driver was responsible for the safe operation of the train; and to initiate the emergency plan by contacting the Estate Manager;
- Estate Manager – Is “*Responsible for the Difflin Light Railway*” including its SMS, risk assessments, employee health and safety, training and competence of staff. The SMS states that the Estate manager is to co-ordinate the emergency plan in the event of an accident and notify the incident to the relevant external parties;
- First Aider – The nominated person who was responsible for administering first aid on the day of the accident, who was a member of the kitchen staff.

Members of the public

13 The injured party involved in the accident was Girl A, a six year old passenger travelling with her parents and extended family. She was right handed and had recently received a pair of new shoes for Christmas. Her key measurements are:

- Mass – 22.9 kg;
- Ankle to knee measurement – 0.31 m;
- Height – 1.26 m;
- Knee to waist measurement – 0.43 m.

General description of the railway

Infrastructure

14 DLR maintains approximately 4.5 km of 15-inch (0.381 m) narrow gauge single track. This track is set on a mixture of galvanised steel and treated soft wood sleepers. The railway comprises of a single track route, with a main return loop, together with an eastern loop, connected by triangular junctions to permit direct running between all route sections, including a continuous loop operation.

Operations

15 DLR is a privately operated railway that own two locomotives, which can pull a combination of carriages. The railway is operated by *line-of-sight* with a two-way estate radio system to report location of trains on the looped railway.

16 Communication between the Driver and other members of staff is by means of a two way hand held radio system.

Rolling stock

17 DLR operates two locomotives, one steam and one diesel powered. The locomotive involved in the accident was the diesel locomotive, the 'Earl of Oakfield', see Figure 2; which is a 1500 kilogram (kg) (1.5 tonne) diesel engine locomotive. The maximum allowable speed of the train is 16 kilometres per hour (km/h) (10 mph); with the speed being controlled by a throttle lever.



Figure 2 – Diesel Locomotive: “Earl of Oakfield”

18 The locomotive can pull a combination of carriages, consisting of various types of carriages: open carriages where chains secure the access and egress point of the train (Figure 3); enclosed carriages (Figure 4) which have doors that close to form a fully enclosed carriage; and, freight wagons.



Figure 3 – Open carriage with chains



Figure 4 – Enclosed carriage

- 19 The Santa Express operates in a regular formation of a locomotive hauling three carriages; with two open carriages immediately to the rear of the locomotive and the enclosed carriage trailing at the rear end.
- 20 Open carriages No. 6 and No. 7, involved in the accident, were built and supplied in 2002. Each carriage has a mass of approximately 700 kg (0.7 tonnes) and is of steel construction with timber slatted seating for twelve adults or eighteen children.
- 21 All items of rolling stock were manufactured and supplied by Alan Keef Limited, Herefordshire England; and are fitted with a single-pipe balanced pressure, fail-safe air brake system and Heywood type latch couplings.
- 22 The trains are not fitted with a tachograph or train data recording equipment.
- 23 All rolling stock involved on the day of the accident was approved by the CRR.

Signalling and Communications

- 24 DLR operates under the principles of line-of-sight with two way estate radios for the driver to communicate with other members of staff.
- 25 Track information to drivers is communicated by line side signage such as speed restrictions and associated whistles boards on curves.
- 26 *Points* are manually operated with cast-iron throw-over operating levers visually indicating the road set.

Fatalities, injuries and material damage

Fatalities and injuries

- 27 There were no fatalities as a result of this accident.
- 28 There was an injury to Girl A that required attendance at hospital, a skin graft and ongoing outpatient medical treatment (as of the date of this report).

Material damage

- 29 No material damage occurred to DLR rolling stock or infrastructure as a result of this accident.

External circumstances

- 30 Weather recorded at the nearest Met Éireann Station, Finner Camp, showed weather at 17:00 hrs on the 17th December was dry with an approximate temperature of 8° Celsius and was not a contributing factor.

RAIU Investigation

RAIU decision to investigate

- 31 In accordance with the Railway European Union (Railway Safety) (Reporting and Investigation of *Serious Accidents*, Accidents and Incidents) Regulations 2014, the RAIU investigates incidents and accidents on the national railway.
- 32 The Railway Safety Act 2005, defines a railway as a railway with a gauge of not less than 350 mm and which is used for the carrying of fare-paying passengers, or fee-paying members, or the conveyance of merchandise. As the gauge of this railway is 381 mm, it falls within the remit of investigation for the RAIU.
- 33 Also, given that under slightly different circumstances, this accident may have led to a serious accident with the potential for a fatality, as a result the RAIU have made the decision to conduct a full investigation.

Scope of investigation

- 34 The RAIU must establish the scope of the investigation to ensure that only pertinent information is recovered and reviewed. Therefore, for this investigation, the RAIU have defined the following scope:
- Establish the high level sequence of events for the accident;
 - Establish, where applicable, the immediate cause, contributory factors, underlying factors and root causes;
 - Examine the relevant elements of the SMS.

Investigation and evidence

- 35 During this investigation the RAIU collated and logged the following evidence:
- Witness testimonies from DLR staff, and family members present at the incident,
 - DLR SMS Relevant standards, procedures and other documentation,
 - DLR investigation report into accident,
 - DLR maintenance condition audit reports,
 - Risk assessments;
 - Training and competence records,
 - Site Safety Briefing Forms,
 - Photographs from the scene of the accident,
 - CRR audit reports and guidance documents.

- Interviews
- Cornering force measurements.

Evidence

Infrastructure

- 36 DLR consists of approximately 4.5 km of narrow gauge single track. The track comprises of rail either clipped and bolted to galvanised steel sleepers or clipped and coach-screwed to treated softwood sleepers. The track is set in crushed limestone ballast, either ballasted to railhead level for the sections of steel sleepers or to top of sleeper level on the timber sleeper sections. The turnouts are fabricated assemblies on steel sleepers with cast-iron throw-over operating levers.
- 37 The railway comprises of a single track route, with a main return loop, together with an eastern loop, connected by triangular junctions to permit direct running between all route sections, including a continuous loop operation. Santa's Grotto is located within a castle structure along the route of the railway. A map of the track network can be seen below in Figure 5.

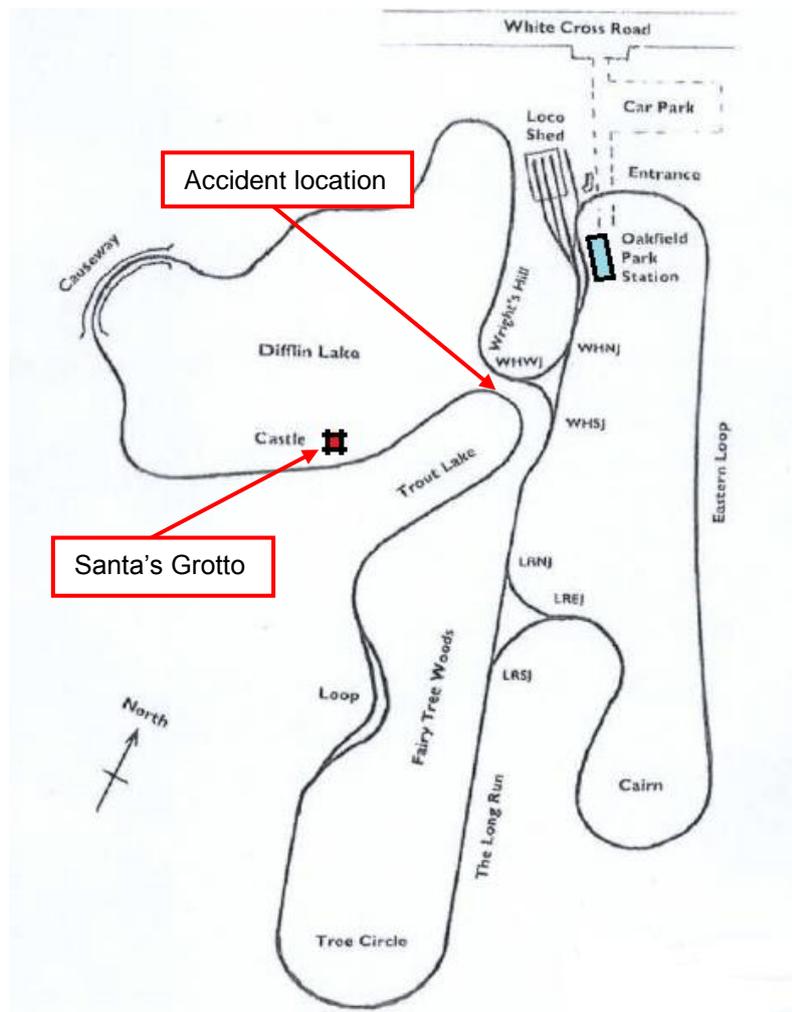


Figure 5 – Map of DLR network

38 The accident occurred whilst negotiating a right hand curve in an area known as 'Trout Lake'. The train in its stopped position, after the accident, can be seen below in Figure 6. (reconstruction)



Figure 6 - Overhead view of right hand hairpin curve around Trout Lake

39 Trout Lake Curve has a speed restriction of 5 mph (8km/h). The signage on the approach to the curve can be seen in Figure 7.



Figure 7 – Speed board on approach to Trout Lake Hairpin

- 40 Data was gathered to ascertain cornering forces experienced on the trout lake hairpin. Measurements recorded around this curve showed an average experienced acceleration of 0.206m/s^2 whilst the maximum instantaneous acceleration recorded was 1.2 m/s^2 .
- 41 The trains are not fitted with a tachograph or data recording device and it was not possible to establish what speed the train was travelling at the time of the incident
- 42 The lane from Santa's Grotto to the train was a gravel pathway. After visiting Santa's Grotto the family returned via this pathway to board the train at the designated drop-off/pick up point, see below Figure 8.



Figure 8 – Gravel pathway from designated drop-off/pick-up point to Santa's Grotto

Rolling Stock

- 43 The rolling stock is well presented and appears to be in good condition. There was no sign of visual corrosion and inter carriage couplers showed little sign of wear and were well lubricated. The open carriages have a 'C' channel structural steel making up the core of the carriage chassis, see Figure 9.
- 44 The rolling stock was in date for the manufacturers prescribed maintenance schedule's.

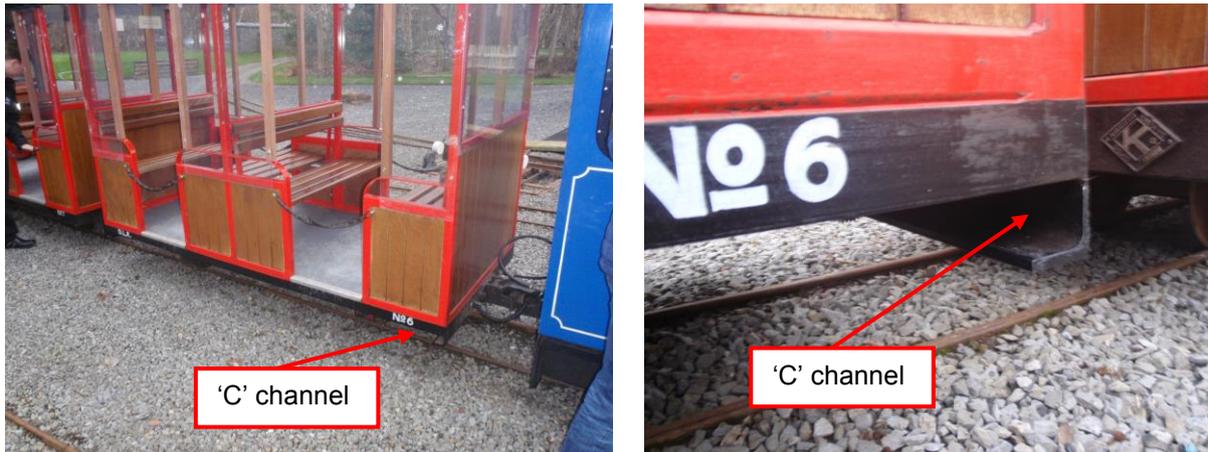


Figure 9 – Open Carriage with 'C' channel

- 45 On the open carriage the height of the seat from the floor level was 0.43 m, see Figure 10, and the height of the chain from the floor level is 0.42 m, meaning the middle portion of the chain is below the seat height, see Figure 10.
- 46 It should be noted that a chain was added to the carriage post manufacture, there was no record of this having been done or for what reason, but as previously mentioned the carriage was approved by the CRR.

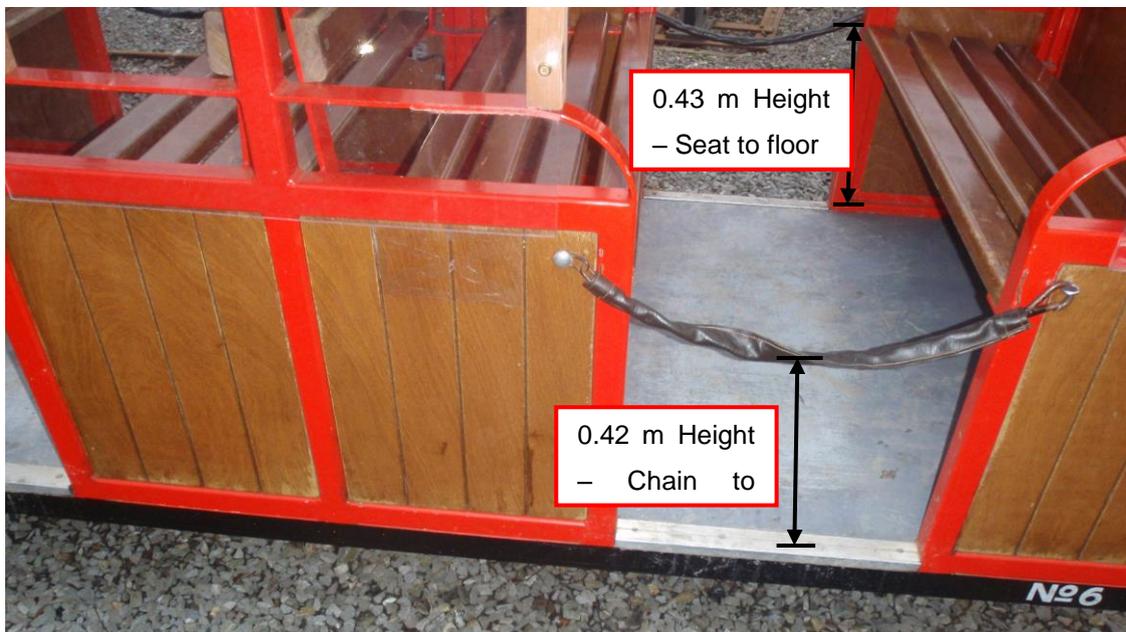


Figure 10 – Heights, from floor, of seat and chain

DLR's Safety Management System

General

47 DLR commissioned a safety consultant and training company, to develop the SMS for the operation of the railway and associated safety documentation. DLR published the document, 'Difflin Light Railway Safety Management System', March 2014, with a second revision published on the 14th April 2014, which was the revision in operation at the time of the incident; and will be referred to as DLR SMS for the remainder of this report.

48 The DLR SMS is a ninety-five page document with eleven sections, as follows:

- 1.0 – Safety Policy,
- 2.0 – Organisation,
- 3.0 – Competence Assessment Process/Training & Operating Instructions,
- 4.0 – Maintenance & Inspection,
- 5.0 – Changes to Rolling Stock,
- 6.0 – Emergency Plans and Procedures,
- 7.0 – Accident & Incident Procedures,
- 8.0 – Risk Assessments,
- 9.0 – Consultation,
- 10.0 – Auditing of the SMS,
- 11.0 – Visiting Groups.

49 The document lacks clarity in many areas e.g. areas of responsibility have not been clearly assigned to any person/role.

50 This section of the report outlines some of the key information, related to the accident, from the DLR SMS.

Safety Policy

51 Section 1.0, Policy, states that DLR's policy is to "ensure, as far as is reasonably practicable, the health, safety and welfare at work of all staff, volunteers, passengers and all persons who visit the railway".

Organisation

52 Section 2.0, Organisation, of the DLR SMS states that the Estate Manager:

- Arranges “risk assessments to be conducted for the railway and where there are changes to systems and procedures”,
- Consults “with individual employees on health and safety issues which affect them and take appropriate action arising out of consultation”,
- Ensures that appropriate training is provided to employees as necessary,
- Ensures only competent persons with adequate knowledge and experience conduct engineering and maintenance on the locomotives and rolling stock.

53 Although it does not identify specifically who is responsible for the issuance of the DLR SMS, the DLR SMS states “Arrange for the distribution of the Safety Management System to all employees. All written instructions are contained within the Safety Management System”.

54 In terms of employee’s responsibilities, the DLR SMS states that:

- “All personnel within DLR will read/understand the SMS and carry out all works/ tasks in accordance with the SMS”;
- “All maintenance personnel will work in a safe manner at all times”;
- Staff should “not take unnecessary risks, which would endanger yourself or others”;
- All staff “to report accidents/dangerous occurrences”.

55 Section 2.0 of the DLR SMS states that “Doors on the enclosed carriages are closed; safety chains are secured across the door openings of the open carriages, before the train is allowed to commence its journey”; however, it does not directly specify who is responsible for ensuring the door is closed or the safety chains are secure.

Competence Assessment Process/Training

Documentation

56 Section 3.0 of the DLR SMS, Competence Assessment Process/Training, outlines the competence process for staff at DLR.

57 The DLR SMS states that all staff are assessed on their knowledge of the DLR (including all company operating procedures, railway operating instructions and railway drivers rules) and the relevant operating instructions and emergency plans, and are safety inducted, and trained in “basic safety” during induction.

58 The DLR SMS identifies 'operational roles' and 'safety critical roles'. The safety critical roles are the roles of drivers, guards, maintenance personnel and supervisors; and that these employees will be "trained by a senior member of staff (or consultant) that is experienced and competent in the systems". THE DLR SMS further states that "when the trainer deems that the trainee has reached the appropriate standard, the competency of the staff shall be assessed by the owner/estate manager (or other suitable person appointed by them" and issued with a certificate of competence. Safety critical staffs are subject to re-assessment every three years. The DLR SMS also states that safety critical staff will be subject to continuous assessment of competence, using the companies operating procedures and rules, and that these are briefed at commencement of employment and on commencement of each new season.

59 In terms of the requirements specific to drivers, they are:

- Trained: "to the requirements and standards specified by the appropriate manufacturers and suppliers, and assessed for these roles and noted as competent for the duties trained";
- "Taken through the railway rules and operating manuals of the train"
- Trained by the "supplier of the trains and by the owner and supervisors".

60 In terms of records, the DLR SMS states that all "training and competence records are maintained". The records of 'safety critical roles' are maintained in the 'Training File', which recorded the date of assessment and re-assessment. A register is also retained of all training with the dates of training/ expiry dates and re-training dates included.

61 Where there are changes to procedures, the changes are conveyed to staff through safety briefings and the staff notice board.

Application

62 Formal records exist, from 2015, showing that permanent staffs were assessed on their knowledge of the DLR, relevant operating instructions; emergency plans, and were safety inducted or trained in "basic safety" as set out in DLR SMS (paragraph 58). However, no record was provided to illustrate continuous assessment of staff or that they were re-briefed at the commencement of the 2017 season (paragraph 58).

63 The Driver did confirm to the RAIU that the Estate Manager had briefed him verbally, specifically on working at night before the Santa Express commenced.

64 The driver involved in the incident, was briefed, assessed and inducted as outlined above, on the 20th May 2015, however, he was not continuous assessed or re-briefed as set out above.

65 In addition, there was no evidence provided to the RAIU to show that any additional seasonal staffs were subject to the same assessments and inductions as set out in DLR SMS (paragraph 58).

Operating instructions

Documentation

66 Section 3.0 of the SMS also includes the 'Operating Instructions For Passenger Trains', some of the key information, relevant to this accident, outlined in the DLR SMS are as follows:

- The entire line should be checked daily prior to passenger operating,
- The maximum speed, is 10 mph (16 km/h), with some speed restrictions of 5 mph (8 km/h),
- Whistles /horns should be sounded at all roads and pathways,
- Drivers "to keep a sharp lookout at all times",
- Passengers are to be supervised whilst at the station,
- Passengers are to be "instructed to remain seated and to keep their arms, legs and heads within the width of the carriage at all times",
- The driver should "check that passengers are seated and keeping their limbs and heads within the width of the train",
- All doors must be closed and safety chains secured before the train starts.

67 Section 3.0 also includes a 'Driver Checklist' which contains mainly instructions for the operation of the diesel train, but also includes instructions to "announce departure on estate radios" and "sound the horn before movement".

68 In conjunction to the two above sections, there are 'Railway Drivers Rules' which include:

- Maximum speed limit of 10 mph (16 km/h) and 5 mph (8 km/h) speed restriction;
- All doors and chains to be secured before operation of trains;
- Passengers to be advised to remain seated throughout the journey and arms, legs and heads to be within the carriage.

Application

69 In terms of the 'Driver Checklist' (paragraph 67), there is a copy of the driver checklist posted inside the locomotive cab.

70 In terms of the 'Railway Drivers Rules' (paragraph 68), the actions taken by the driver on the day of the accident will be outlined in the 'Events before, during and after the accident' section of this report (paragraphs 99-116).

Emergency Plan & Procedures

71 Section 6.0, 'Emergency Plan & Procedure Roles' sets out the responsibilities of staff in the event of an accident or other dangerous occurrence.

72 Once the Estate Manager is notified of an emergency, the Estate Manager will:

- Notify station personnel/train drivers/maintenance as appropriate,
- Liaise with the emergency services and keep a log of personnel present,
- Complete the 'Railway Accident/Incident Report',
- Notify the CRR, RAIU and the Health and Safety Authority (HSA).

73 The DLR SMS does state that an exclusion zone should be set up around the area to prevent passengers/staff from entering affected areas; however, it does not specify who is directly responsible for this.

74 The DLR SMS states that:

- Should a person be injured, an ambulance should be called immediately,
- First aid should be administered by qualified first aiders,
- In the case of minor injuries, a doctor should be called.

Applications

75 The actions taken on the day of the accident will be outlined in the 'Events before, during and after the accident' section of this report (paragraphs 99 -116).

Risk assessments

Documentation

76 Section 8.0 of the DLR SMS, Risk Assessment Procedures, states that DLR will complete a description of the railway operations carried out at the railway; and that the Estate Manager and Supervisors (with the assistance of staff from each department) are responsible for the assessment and risk assessment of these work areas, identifying the control measures and signing the risk assessment.

77 To carry out the risk assessments, the Estate Managers, supervisors and relevant departmental staff members:

- Carry out a “walk around of all areas of the railway”,
- Examine “all activities undertaken by the railway identifying risks that exist within the railway”,
- Review existing safety measures within the railway for adequacy,
- Identify control measures to reduce identified risks,
- Develop a risk matrix to determine the hazard ratings,
- Ensure that all risks are reduced to as low a level as reasonably practicable,
- Monitor the risk assessment “continuously”,
- Review identified risks every 12 months,
- Re-examine the risk assessment when there is a change of operations or activities.

78 The DLR SMS includes a risk assessment, carried out in January 2014), for five different work locations, namely the: Train Platform/Station Area; Train Line; Steam Loco; General Area; Shed Area. Under the Train Platform/Station Area work area.

79 The risk assessment identifies a total of twelve hazards under the five different work locations (paragraph 78), nine of which concern members of the public, with only five hazards related to train travel. These five hazards include:

- Passengers Slips, Trips & Falls,
- Passengers falling out of trains,
- Speed Limit,
- Derailment of train,
- Trains approaching Station.

80 In terms of the identification of hazards and risks, the risk assessment identifies “passengers falling out of trains” (Figure 11) as a hazard; however, using the normal definitions of hazard and risk, “passengers falling out of trains” would be a risk, the hazard could be identified as ‘open carriages’. The risk assessment does not identify the open carriages as a hazard.

SAFETY MANAGEMENT SYSTEM		DIFFLIN LIGHT RAILWAY					
Work Location: Train Platform / Station Area		Date of Assessment: Jan 2014		Date of Review: Jan 2015			
Hazard	Risk	Who is at Risk	Controls in Place	Risk Rating	Additional Controls Necessary	Responsible Person	Sign-Off Date
Passengers falling out of trains	Entrapment Serious Personal Injury	Passengers	All doors to carriages securely closed prior to departure. Child protection safety on all emergency exits. Guards on trains at all times during tour.	Medium	All passengers instructed when embarking train that they are to remain seated throughout the journey. This is also printed on tickets. Driver regularly checks to ensure that all passengers are seated. Trains runs at designated speed limit at all times.	Management Drivers Assistant Station Staff	

Figure 11 – Exert from risk assessment “Passengers falling out of trains”

81 For this “hazard”, the risk assessment identified “Controls in Place” as:

- All doors to carriages securely closed prior to departure,
- Child protection safety on all emergency exits,
- Guards on trains at all times during tour.

82 Additional controls deemed necessary by DLR’s risk assessment (to be carried out by the management, drivers/assistant and station staff) were:

- All passengers instructed when embarking train that they are to remain seated throughout the journey,
- Driver regularly checks to ensure that all passengers are seated,
- Trains run at designated speed limit at all times.

Application

83 The DLR SMS states that the risk assessment will be monitored continuously and reviewed every twelve months (paragraph 77); however, the latest versions of the risk assessment, prior to the accident was in January 2014. No evidence has been provided to the RAIU to illustrate continuous monitoring or annual reviews of the risk assessment.

84 The actions taken on the day of the accident in relation to the “Controls in place”, this will be discussed in the ‘Events before, during and after the accident’ section of this report.

85 In addition, DLR have partially addressed the need of passengers to remain seated” through placing notices on the end wall of each carriage, which states “Passengers must remain seated at all times. To avoid injury, please your arms, legs and head inside the carriage whilst the train is in motion”, (Figure 12.)



Figure 12 - Notice to passengers displayed on each carriage

Auditing of the SMS

Documentation

86 Section 10.0, Auditing of the SMS, of the DLR SMS requires that the SMS be:

- Reviewed periodically and revised: where necessary; where new infrastructure or new types of rolling stock are introduced; or, if instructed by the CRR,
- Reviewed by the owners/managers and staff annually,
- Audited to ensure that the practices and procedures in the SMS are implemented and ensure its effectiveness.

Application

87 DLR have provided no evidence to illustrate that the DLR SMS was reviewed annually or internally audited for its effectiveness.

88 At the time of the accident, although not on the day of the occurrence, DLR had been subject to periodic inspections by the CRR (paragraphs 89 - 97).

Regulatory oversight by the CRR

89 DLR is issued a Safety Management Certificate to operate by the CRR following a conformity assessment of their SMS. The CRR is responsible for the regulatory oversight of the SMS.

90 In 2006 the CRR³ become aware of DLR and meet with staff from DLR and advise DLR of their requirement to submit a Safety Case to the CRR; which results in DLR submitting a Safety Case and CRR issuing a letter of acceptance.

91 In February 2010, the CRR undertook their first inspection of the DLR, and noted that:

- Two open coaches have had roof's fabricated to guard against cinders from the steam locomotive,
- The train line, near the water, should be closely monitored for movement or loss of ballast, and where appropriate the line could be slewed away from the water's edge.

92 In 2012, the CRR advised DLR that they would be auditing their operation, and this audit was conducted with the co-operation of DLR. The CRR report 'Review of the Heritage Railway Safety Management' (to be referred to as the 'CRR DLR Report' for the remainder of this report) was published, based on this audit, which noted the following in relation to the risk assessments "The risk assessment contained in the safety case considers only main hazardous events, the most serious and high level. There is nothing to indicate that all the risks for all work activities undertaken have been assessed". The audit made a number of recommendations based on a number of findings, including a recommendation on the findings of the risk assessment.

93 In May 2013, the CRR undertook a follow-on inspection of DLR focussing on any actions taken as a result of the CRR DLR Report.

94 In August 2015, the CRR undertook another inspection audit, which identified a number of *minor non-compliances* related to the DLR SMS, namely that there was no evidence of:

- Rolling stock examinations taking place,
- Annual review of risk assessments,
- The DLR SMS being reviewed periodically.

95 An *Improvement Plan* request was issued, on the 15th September 2015, requesting a response within a month. However, DLR responded almost five months late, advising that corrective actions would be taken by the 31st May 2016.

³ CRR was known as the RSC at this time.

- 96 On the 19th August 2016 the CRR undertook a further inspection of DLR and re-iterated the previous minor non-compliances. In addition, the CRR noted a further non-compliance over new rolling stock that had not been approved for service and requested a response from DLR on these findings by the 25th August 2016.
- 97 This resulted in the CRR issuing an *Improvement Notice* related to the non-compliance related to the new rolling stock by serving DLR with direction that DLR withdraw the new un-authorised rolling stock from service. DLR submitted a request for approval of the new rolling stock on the 25th November 2016.
- 98 The CRR reviewed the submission from DLR and issued an interim *Letter of Acceptance* for the rolling stock until January 2017.⁴

⁴ Note in April 2017 the CRR issued a Letter of Acceptance (i.e., not interim) for the two pieces of rolling stock.

Events before, during and after the accident

Events before the accident on Saturday 17th December 2016

99 On the 17th December 2016, a family of nine (including 5 adults and 4 children) arrived at Oakfield Park Estate for a pre-booked Santa Express excursion. The booking was made on the Oakfield Park website.

100 At approximately 16:15hrs, the family, along with other members of the public, boarded the scheduled Santa Train at Oakfield Park Station. The Santa train was in the configuration of one locomotive, two open carriages, and one closed carriage. The family sat in the open carriages adjacent to the locomotive. There was no Guard travelling on train⁵.

101 The train departed from Oakfield Park Station and travelled out to Santa's Grotto and exited the train at the designated drop-off/pick-up location (Figure 8).

102 Upon attending Santa's Grotto the family walked back to the designated drop-off/pick-up location, via a gravel walkway; and once instructed to do so, the family boarded the train to return to Oakfield Park Station.

103 The family sat in same open carriages for return journey. Two children sat facing two Adult Family Members and beside each other. Girl A was sat on the left hand side of the coach, see Figure 13.

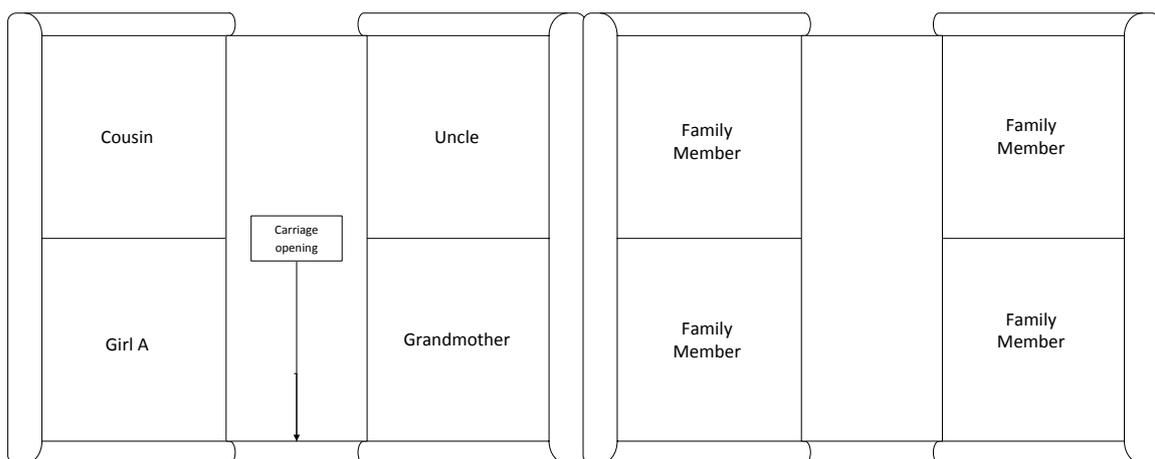


Figure 13 - Seating positions within the carriage

⁵ As required as a control measure for the prevention of the hazard of 'passengers falling out of trains' as identified in the risk assessment.

104 Girl A was seated with her back to the locomotive with the legs swinging freely or the tip of her toes touching the floor, as there was an approximate gap of 0.1 m from her feet to the floor level⁶, see Figure 14.

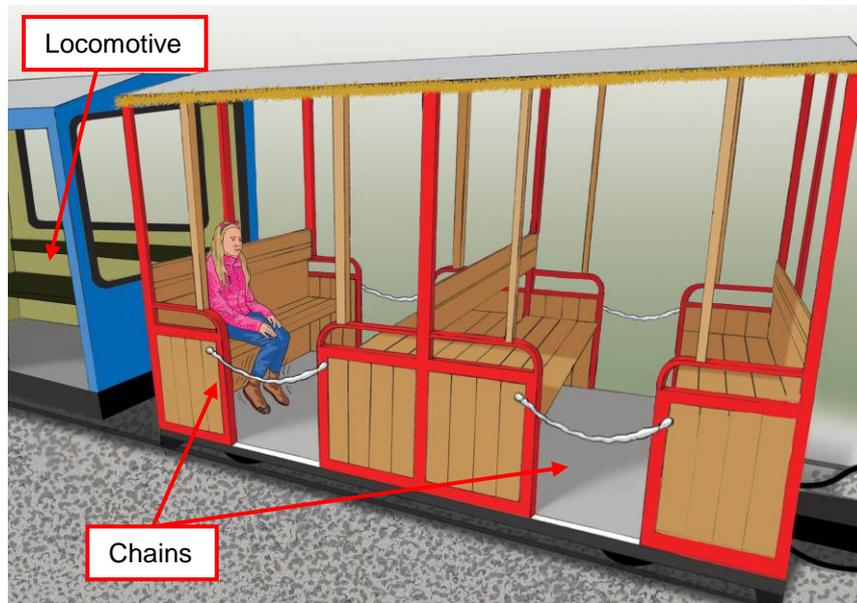


Figure 14 – Girl A positioning in the open carriage

105 The Driver did the pre-departure checks and walked along the train checking safety chains, before taking his place in the locomotive. A Guard was not present on the train.

106 Just after 17:00 hrs the train departed the designated drop-off/pick-up point and almost immediately began to negotiate right hand curve around Trout Lake curve, (Figure 15).



Figure 15 –Trout Lake Curve

⁶ Based on her measurements

Events during the accident on Saturday 17th December 2016

107 As the train was travelling, Girl A was seated (as reported by witnesses), and momentarily leaned forward to clean her new boots with her hand, see Figure 16.



Figure 16 – Girl A leaning forward

108 The speed at the time was estimated by numerous witnesses to be approximately walking pace, the line speed on the curve is 5mph.

109 As the train was turning on the apex of the curve, Girl A was experiencing minor cornering forces⁷, which would encourage an unbalanced Girl A to the outside of the carriage, resulting in her falling over the chain and out of the carriage, see Figure 17.

110 It should be noted that figures 15 and 16 are for illustrative purposes only and the scenario is based on witness evidence collected by the RAIU, and the conclusion is based on the balance of probabilities. For clarity other passengers have been left out of the illustration.

⁷ Girl A (mass of 23kg) experienced an average acceleration of 0.206m/s² which would have resulted in a force of 4.7N (1kg bag of flour exerts 10N of force on a table). Using the maximum calculations, Girl A experienced a maximum acceleration of 1.2 m/s² which would have resulted in a force of 27.6N.



Figure 17 – Girl A falling over the chain

111 Once outside the confines of the train, Girl A's puffy jacket became entangled in the 'C' channel beam on the end of the carriage (paragraph 43) and dragged her along the gravel, see Figure 18.

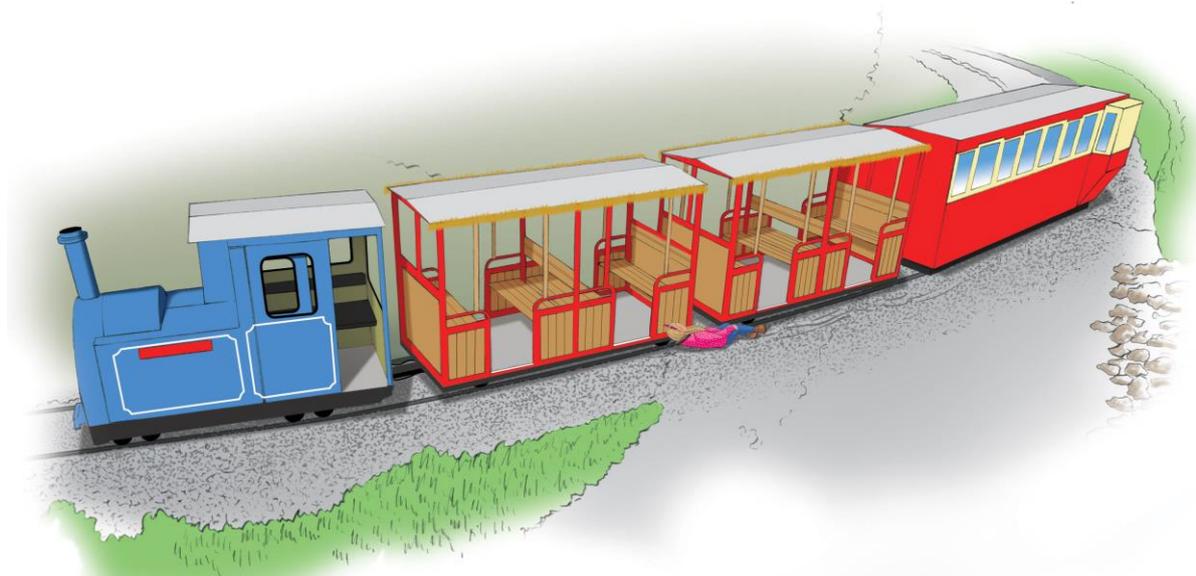


Figure 18 – Girl A being dragged along the gravel

Events after the accident

112 Girl A's family members shouted and banged on coach to alert the Driver to stop; who promptly stopped. Family members got out of the train before it came to a halt to attend to her.

113 The Driver used a two way estate radio to alert the Estate Manager of the accident and the need for a First Aider to attend. The Estate Manager located the First Aider and both attended the scene which was a short walk from the main station office.

114 After an initial examination at the scene by the First Aider, Girl A was taken in an estate vehicle (all-terrain vehicle) to a large accessibility toilet to allow the First Aider to assess her injuries. The First Aider determined that further medical advice should be sought and contacted Now Doc for medical advice but the connection dropped mid call.

115 A decision was then taken by the family to call an ambulance rather than try and reconnect to Now Doc service. ('Now Doc' is an out of hours General Practitioner Service)

116 The ambulance arrived after approximately ten minutes and took Girl A to Letterkenny Hospital. Girl A was released and transferred by agreement with Medical Staff to the care of Ulster Hospital Dundonald, (which was closer to her home) where she had a skin graft procedure on the Wednesday requiring an overnight stay, and continues to attend as an outpatient at The Royal Victoria Hospital, Belfast for follow up outpatient care.

Analysis

Infrastructure

117 The accident occurred on a curve that was being negotiated at low speed; this unfortunately would mean any “unsecured load” could fall to the outside of the open carriage (paragraph 38-39).

118 Whilst the condition of the track infrastructure was not found to have contributed to the accident; the fact that the train was negotiating a right hand curve was relevant as passengers would have experienced minor cornering forces (paragraph 40) as the train travelled around the curve.

119 The cornering force would have the effect of moving passengers seated on the outside of the curve towards the side of the carriage.

Rolling Stock

120 The rolling stock was well presented and appeared well maintained (paragraph 43).

121 Open carriages are common in the heritage market and it was noted that a chain over the door was added to the carriage post manufacture (paragraph 46). This was in this instance too low to restrain a seated person from falling out.

122 The condition of the rolling stock is not thought to have directly contributed to the accident; however, the fact that the carriage was an open type carriage allowed Girl A to fall out of the train. In addition, the presence of the ‘C’ channel (paragraph 43) may have further contributed to her injuries given the fact that Girl A became entangled and was dragged along the gravel path (paragraph 111).

123 The position of the chain, partially restraining Child A resulted in Child A falling close to the carriage and subsequently being caught in the ‘C’ Channel of the carriage.

DLR's SMS

General

124 The overall DLR SMS is a 95 page document, with many typographical and grammatical errors with some areas lacking clarity; - Roles and responsibilities are not clearly defined.

Organisation

125 Section 2.0, of the DLR SMS 'Organisation' sets out some of the roles and responsibilities for the staff of DLR, however, it does not assign certain tasks to individuals e.g. the DLR SMS states that the DLR SMS should be issued to all employees but does not assign the task clearly to an individual in this section (paragraph 53); however, it could be inferred that this task rests with the Estate Manager.

Competence Assessment Process/Training

126 Section 3.0 of the DLR SMS, 'Competence Assessment Process/Training', outlines the competence process requirements for staff at DLR. In terms of the application of these requirements, permanent staff (including the driver) do receive initial training and basic induction, however, they are not subject to continuous assessment and are not re-briefed at the commencement of each season (paragraph 62-64). In addition, seasonal staffs were not subject to the same assessments and inductions (paragraph 65).

Operating instructions

127 Section 3.0 also includes the 'Operating Instructions For Passenger Trains', including instructions, checklists and rules for drivers, with some of the main requirements being posted in the locomotives to act as a reminder to drivers (paragraphs 66-69).

Emergency Plan & Procedures

128 Section 6.0, 'Emergency Plan & Procedure Roles' sets out the responsibilities of staff in the event of an accident or other dangerous occurrence. There appears to be some confusion in relation to the actions to be taken in the event with an injury, as the DLR SMS states that an ambulance should be called in the case of any injury, however, it further states that a doctor should be called in the event of a minor injury (paragraph 74).

Risk assessments

129 Section 8.0 of the DLR SMS, Risk Assessment Procedures, states that DLR will complete a description of the railway operations carried out at the railway to identify control measures and create a risk assessment (paragraph 76).

130 The DLR SMS states that the risk assessment should be monitored continuously and reviewed every twelve months, however, this was not carried out by DLR (paragraph 77), since its latest development in 2014. Also, the risk assessment remained unchanged despite the CRR identifying it as an area requiring action to be taken in 2015 (paragraph 94) and 2016 (paragraph 96).

131 The risk assessment only identifies a few high level risks which would affect members of the public (paragraph 79); and, it is clear that the assessors do not have a clear understanding of hazards and risks (paragraph 80) as they have presented the 'passenger falling out of trains' as a hazard instead of a risk (paragraph 80).

132 One of the control measures for 'passengers falling out of trains' requires that "guards on trains at all times during the tour" (paragraph 81). However, this did not occur on the day of the accident (paragraphs 100 and 105).

133 It should be noted, that one of the positives, in relation to the communication of passengers remaining seated is that DLR have erected numerous signs in relation to this (paragraph 85).

Auditing

134 DLR has provided no evidence in relation to any internal audits of the DLR SMS being carried out, as required (paragraph 87).

Regulatory oversight by the CRR

135 The CRR is responsible for the regulatory oversight of the DLR SMS (paragraph 89). In 2006, DLR submitted their Safety Case to the CRR, which was accepted (paragraph 90); and in 2010, the CRR carried out an inspection of the DLR, noting a number of issues related to the infrastructure and rolling stock (paragraph 91).

- Two open carriages had roofs fabricated to guard against coal cinders from the steam locomotive.
- The rail line near the lake was to be monitored for the movement or loss of ballast and where appropriate the line should be slewed away from the water's edge.

136 The CRR carried out an audit on DLR in 2012, which identified a number of issues with the risk assessment and made a number of recommendations (paragraph 92). Again, in 2015, the CRR identified issues related to the risk assessment and the DLR SMS (paragraph 94); which resulted in the CRR requesting an Improvement Plan (paragraph 95); and, ultimately resulted in the issuance of an Improvement Notice (paragraph 97).

Actions of parties on the day of the accident

Emergency Response

137 Emergency response was initiated by the Driver via the estate two way radios following the procedures as laid out in DLR's SMS. The driver contacted the Estate Manager and informed him of an accident at the curve around Trout Lake. The Driver reported the accident and requested a first aider attend the scene.

138 This initial response activity followed the process and responsibilities are defined in section six of the SMS. The Driver followed the requirements of the SMS by contacting the Estate Manager and requesting a First Aider, as per his role, see paragraph 12.

139 First aid was administered in a large public toilet on site. Whilst the accessibility toilet provided a private space and access to running water, it is not a dedicated first aid area.

140 The First Aider contacted *Now Doc*: an out of hours General Practitioner Service and then switched to calling an ambulance when the phone call could not be connected.

141 If external resources are needed to treat the injury the decision to call an ambulance as the primary one would be best practice. The SMS states that "*Emergency services will be called*" this could be clarified and be more descriptive, see paragraph 74.

142 Post-accident the SMS states that the "*All accidents as required under current Health & Safety Legislation will be reported to the Health and Safety authority and to the RSC and RAIU...*" this was not adhered to (paragraph 72). In early January the relevant authorities made contact with DLR searching for details of an accident that had allegedly occurred. After this contact DLR engaged with the relevant authorities.

Cause of the fall

143 Due to the height of the seat relative to the length of the Girl A's legs the child was likely in one of two seated positions, either:

- Leaning against the edge lips of the seat with their toes making contact with the floor for balance;
- Sitting with their back against the seat back, which would have left her legs hanging freely as they were not long enough to touch the ground (this is the most likely positioning given the witness testimony);

144 Both positions would have had the child in a secure position, to withstand any experienced cornering motion from being on a train negotiating a curve (paragraph 40).

145 Girl A with a mass of approximately 23kg experiencing an average acceleration of 0.206m/s^2 would have resulted in a force of approximately 4.7N (A 1kg bag of flour exerts 10N of force on a table top.) The max recorded instantaneous acceleration experienced was 1.2m/s^2 which would have resulted in an experienced force in the region of 27.6N. (This is also known as jerk rate).

146 Witness statements indicated that Girl A leaned forward to clean some dirt/debris off of her new shoes. As Girl A's legs were swinging freely while seated, the legs would tend to go back under the seat as Girl A leaned forward. This in turn would exaggerate how far Girl A would have to lean to get to the shoe. As Girl A was right handed, she would have had to reach across her body, initially rotating towards the outside of the carriage, to clean her left shoe.

147 This motion would have changed the centre of gravity of Girl A and combined with a cornering force would have caused the unstable Girl A to roll forward, off her seat and towards the outside of the carriage.

148 As the safety chain was approximately the same height as the seating position of Girl A, Girl A would have slipped over the chain in one fluid motion.

Conclusions

149 DLR appears to be a well-run heritage railway with the infrastructure maintained in good serviceable condition that did not contribute directly to the accident (paragraphs 36-42); and the rolling stock maintained in good order with typical design and construction methods for this type of heritage railway (paragraphs 43-46).

150 Whilst the infrastructure and rolling stock did not have any design or upkeep issues that resulted in unsafe conditions; the train travelling on a curve and the open door rolling stock design, coupled together, with the girl being unbalanced allowed the accident to occur.

151 A fully seated individual is unlikely to fall out of a slow moving vehicle without a considerable external force. Children unable to have their feet on the floor when seated are at higher risk as their positioning can leave them unstable.

152 Girl A's sudden movement attempting to clean her shoe, resulted in an unstable condition, that meant minimal force was required to roll Girl A out of the seat. Girl A being in an unstable position was unable to withstand normal swaying movement of a train in motion (paragraphs 143-148). Better direct supervision of the girl could have mitigated this risk.

153 In terms of the DLR SMS, the requirements of the DLR SMS were not fully adhered to, in that the:

- All roles and responsibilities are not clearly defined leaving certain responsibilities open to interpretation (paragraph 126),
- Staff were not briefed / re-briefed seasonally in accordance with the DLR SMS (paragraph 127),
- Risk assessments were not written to best practice, were not reviewed annually as required and contained mitigations that were not present (paragraphs 131-133),
- Emergency plan not carried out as laid out in Section 6.0 (paragraph 129),
- The accident was not reported to the CRR or RAIU as per section 8.0 (paragraph 142).

154 Regulatory oversight identified similar issues and malfunctions within the management of risk on three separate audits. They were regularly highlighted as minor non-compliances by the CRR (paragraph 137) however insufficient action was taken to resolve these identified issues.

Immediate cause, contributory factors and underlying causes, root causes and additional observations

155 The immediate cause of the accident was that a small child fell out of an open carriage of a moving train as it was travelling around a curve. Contributory and underlying to this occurring were the fact that:

- **CF-01 – There were insufficient physical safeguards to prevent small children, whose feet do not touch the ground in a seated position in a coach, from falling from an open carriage.**
- **CF-02 – There were insufficient procedural safeguards to identify risks of a child falling from the train.**

156 The root cause associated with this accident:

- **RC-01 – The existing risk assessment, within the Safety Management System’s documentation, did not identify the risk posed by small children.**

157 Additional observations, made by the RAIU during their investigation, include:

- **AO-01 – DLR were not fully adhering to the requirements of the SMS, in that they failed to carry out the emergency plan as required after the occurrence of an accident, they did not report the accident to the RAIU or CRR; staff were not seasonally re-briefed; risk assessments were not reviewed periodically nor was a Guard on board for the tour as called for by DLR SMS.**
- **AO-02 – There was no dedicated first aid location sited at DLR to treat injuries.**

Relevant actions taken or in progress

Actions taken by DLR

158 DLR have advised the RAIU that the following actions have been taken in relation to this accident:

- Taken pictures of a reconstruction scene of incident;
- Revised and re issued SMS to CRR for review;
- An asset condition assessment report conducted by the original equipment manufacturer.

Actions taken by CRR

159 CRR have advised the RAIU that the following actions have been taken in relation to this accident:

- Upon receiving notification of the occurrence, the CRR undertook a Post Incident Inspection that focused on DLR's compliance with its approved SMS.
- DLR have provided the CRR with an improvement plan which the CRR are satisfied with, four outcomes are currently open, with the CRR awaiting completed evidence forms.
- Emailed clarifying definitions, by emailing relevant sections of legislation.
- Emailed contact details of other Heritage railway organisations in order to exchange their experiences and ideas on how they manage and implement their SMS's
- Undertaken to inform other Heritage railway organisations of S.I. 258 of 2014, and to make them aware of the definitions and obligations used within.
- The CRR recommended that an additional inspection takes place in December 2017 at the commencement of the Santa Expresses a follow up to the four outstanding issues on the improvement plan.

Safety recommendations

General description

160 In accordance with the Railway Safety Act 2005 (Government of Ireland, 2005) and the European Railway Safety Directive (European Union, 2004), recommendations are addressed to the national safety authority, the CRR. The recommendation is directed to the party identified in each recommendation.

161 As there was insufficient physical or procedural safeguards to prevent small children, whose feet do not touch the ground, from falling from an open carriage (CF-01, CF-02), the RAIU make the following safety recommendation:

DLR should review the physical and procedural safeguards for the operation of their trains, to prevent small children whose feet do not touch the ground in a seated position, from falling from open carriages.

162 The DLR SMS failed to fully identify all the risks associated with operation of their trains (RC-01); in addition, there were several other issues identified with the DLR SMS (AO-01); as a result the RAIU make the following safety recommendation:

DLR should review their risk assessment process to ensure that all reasonably foreseeable risks associated with the operation of trains are identified and suitable control measures identified.

DLR should review the DLR SMS, in its totality, and ensure that there are internal monitoring procedures that mandates the periodic checking of application of SMS processes and practises.

163 In relation to the absence of a dedicated first aid location (AO-02), the RAIU make the following safety recommendation:

DLR should review their responsibilities under the Safety and Welfare at Work Regulations as to dedicated First Aid areas.

Additional information

List of abbreviations

CF	Contributory factor
CRR	Commission for Railway Regulation
DTTAS	Department of Transport, Tourism and Sport
DLR	Difflin Light/Lake Railway
M	Metre
No.	Number
RAIU	Railway Accident Investigation Unit
RA	Risk Assessment
RU	Railway Undertaking
SMS	Safety Management System
SI Units	International System of Units
TSR	Temporary Speed Restriction
UF	Underlying factor

Glossary of terms

Accident	An unwanted or unintended sudden event or a specific chain of such events which have harmful consequences including collisions, derailments, level-crossing accidents, accidents to persons caused by rolling stock in motion, fires and others.
Contributory Factor	Factors relating to actions taken by persons involved or the condition of rolling stock or technical installations.
Extensive damage	Damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
Hazard	A potential source of harm or adverse health effect on a person or persons.
Immediate cause	Direct and immediate causes of the occurrence including contributory factors relating to actions taken by persons involved or the condition of rolling stock or technical installations.
Improvement Plan	Under Section 76 of the Railway Safety Act, the inspector may give a direction in writing to a railway undertaking requiring the submission to the inspector, within a time specified in the direction, a plan specifying the remedial action proposed to be taken to rectify the matters set down in the direction.
Improvement Notice	Under Section 77 of the Railway Safety Act - A written direction, from a CRR inspector, when a RU or other person is contravening or has contravened or is failing to comply or has failed to comply with any of the provisions of the Railway Safety Act or has failed to submit or implement an appropriate

	Improvement Plan. The Improvement Notice gives particulars of the reasons as to why the RU or person has failed to submit or implement an Improvement Plan, and direct that railway undertaking or person to remedy the alleged contraventions by a specified date.
Incident	Any incident, other than an accident or serious accident, associated with the operation of trains and affecting the safety of operation.
Infrastructure Manager	Organisation that is responsible for the establishment and maintenance of railway infrastructure, including the management of infrastructure control and safety systems.
Line-of-sight	A method of working trains where the driver observes the line for obstructions on the line and controls the speed of their train appropriately.
Method Statement	A document that details the way a work task or process is to be completed. The method statement should outline the hazards involved and include a step by step guide on how to do the job safely.
Minor non-compliance	The CRR define a minor non-compliance as an area of non-compliance with a railway organisation's internal standard, an applicable external standard, or legislation that is evidence of a sporadic lapse in implementation of a system or deviation from a system.
National safety authority	The national body entrusted with the tasks regarding railway safety in accordance with European directive 2004/49/EC.
Now Doc	Out of hours GP cover to provide access to urgent family doctor services outside of normal surgery hours.
Points	Track consisting of switches and crossings forming connections between lines.
Railway Undertaking	Organisation that operates trains.
Risk	Likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard.
Risk Assessment	Where the severity of the Hazard and its potential outcomes are considered in conjunction with other factors including the level of exposure and the numbers of persons exposed and the risk of that hazard being realised.
Root cause	Causes related to framework conditions and application of the SMS.
Serious accident	Any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to 5 or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety, where extensive damage means damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
Serious injury	Any injury requiring hospitalisation for over 24 hours.
Standard	A document that mandates technical, operational or managerial requirements.

Underlying cause Causes related to skills, procedures and maintenance.

References

DLR (2014), SMS

CRR (2012), Review of the Heritage Railway Safety Management.