NetworkRail

Consulting

Car Derailment Investigation

On the SRT System within the TTC Network

23 August 2023

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Contents

1. Summary

On the 24th of July 2023 at approximately 6:45pm a southbound SRT train leaving Ellesmere Station became uncoupled and derailed.

Network Rail Consulting (NRC) has been tasked with compiling the following data as part of the investigation:

- Track Patrolling – defect discovery and evidence of training and mentoring;
- WAY111 – track Inspection training module;
- Defects – current and historic defects held within the MAXIMO system;
- Defect type – in accordance with the Toronto Transit Commission (TTC) defect standard; and
- Asset Defect Management – in accordance with TTC defect codes and timescales

The report will also provide recommendations to address gaps and / or to improve current procedures where required.

1.1 Track Inspection Regime on the SRT

The SRT system, approximately 13km long, consisting of north and south bound tracks, is inspected on foot by track patrollers every 72hours, during daylight hours from Kennedy Station to McCowan Yard.

The track patrollers report to the Senior Foreperson within the Track Inspection team.

Defects are recorded by the patrollers and then inputted into the MAXIMO database system with the correct defect code, and then checked off by the Senior Foreperson for validity and correct reporting. The system then creates a work order for removal.

1.2 Track Inspection Training and Mentoring

The training is generic for all TTC subway routes and instructs the personnel in aspects of locating and finding defects within the track bed and its components.

The TTC training for Track Inspection is called WAY111 and is carried out by the Operations Training Centre (OTC) and TTC hands-on training centre. There are three parts to the training.

- Introduction to Track Patroller Position;
- Track System Components; and
- Defect Detection and Response.

The recertification training is WAY211 and the standard states this is required every two years, this has one part to it as it is a recertification.

The WAY111 was introduced in 2010 and was computer-based training along with document script-(paper documents) In 2021 the computer-based system was defunct, and since then, the training has been all document scripted (paper documents only)

To obtain track inspection training since 2010, the TTC standards required the trainee to obtain a track mechanic grade and complete the training within 12 months of being mentored in the track inspection group.

The SRT route is highlighted in the WAY111 training and students are shown the layout of the reaction rail accompanied with select photos. This provides the students a base degree of what the reaction rail is and also showcases its various components. WAY111 is a 5 day course with a written test upon conclusion. The passing mark is 16 out of 20 or 80%. If the trainee scores between 70% and 80% a test rewrite will be arranged at a future date. If the trainee scores lower than 80% on the rewrite, the trainee fails and must take the course again at a future date.

1.3 Defects on the SRT

All track defect reported by the patrollers are recorded in the TTC's defect database system known as MAXIMO. This is reported by the patrollers after their inspection has been completed.

The Patrollers record all defects on each inspection and update MAXIMO with any changes. The patrollers will also assign each defect with one of the following colour codes to indicate level of priority and removal timescales as laid out by TTC track standards. Defects entered into MAXIMO are done via a number which corresponds to the color code

- 1 Red – Emergency (removed as soon as practicably possible)
- 2 Yellow – 10 days
- 3 Blue – 45 days; and
- 4 Brown – One year

There is also a Track Condition Alert (TCA), which sits between Blue and Yellow, to highlight more significant blue defects (note: this is not listed as a defect code). Track Condition Alerts have a two to three-week removal period before a RSZ may be introduced. TCA's are there to highlight a more severe blue defect.

2. Review of Findings

The following section reviews the three parts of the summary.

2.1 Track Inspection Regime on the SRT

There were no anomalies found with the track inspection dates, as recorded on the 9-week plan from the Senior Track Inspection Engineer.

The SRT was being inspected at its mandated 72-hr frequency and on the day of the derailment as part of that plan.

The patrollers did not report anything on that inspection that they perceived to be a danger to trains.

2.2 Track Inspection Training and Mentoring

The table below shows the patrollers that currently conduct foot inspection across the TTC subway system.

Table 2.1 TTC Track Patrollers

Employee ID	First Name	Last Name	Track Patroller Certified
51591	[redacted]	[redacted]	6-Dec-02
53383	[redacted]	[redacted]	15-Mar-17
54931	[redacted]	[redacted]	
56854	[redacted]	[redacted]	12-Mar-21
59540	[redacted]	[redacted]	19-Nov-21
59975	[redacted]	[redacted]	20-Aug-21
66965	[redacted]	[redacted]	4-Apr-14
67134	[redacted]	[redacted]	15-Nov-19
67197	[redacted]	[redacted]	
67588	[redacted]	[redacted]	4-Oct-19
67619	[redacted]	[redacted]	
67681	[redacted]	[redacted]	4-Oct-19
67947	[redacted]	[redacted]	26-Oct-12
67961	[redacted]	[redacted]	22-Oct-21
68810	[redacted]	[redacted]	12-Feb-21
69069	[redacted]	[redacted]	
69079	[redacted]	[redacted]	
69180	[redacted]	[redacted]	
69882	[redacted]	[redacted]	22-Oct-21

Employee ID	First Name	Last Name	Track Patroller Certified
70547	[redacted]	[redacted]	
70671	[redacted]	[redacted]	19-Nov-21
72891	[redacted]	[redacted]	19-Nov-21
73080	[redacted]	[redacted]	
73354	[redacted]	[redacted]	20-Aug-21
73489	[redacted]	[redacted]	
75081	[redacted]	[redacted]	
75301	[redacted]	[redacted]	
75554	[redacted]	[redacted]	12-Feb-21
75646	[redacted]	[redacted]	
77066	[redacted]	[redacted]	
77860	[redacted]	[redacted]	20-Aug-21
79306	[redacted]	[redacted]	
79550	[redacted]	[redacted]	
80055	[redacted]	[redacted]	
83487	[redacted]	[redacted]	

All patrollers have attended the WAY111 training course, *the names without dates are those currently undergoing mentorships before taking their WAY111 course, and do not carry out patrols but walk with a qualified patroller under their tutelage.*

Henceforth, when an employee attends the WAY111 course, they have the knowledge to inspect the track to a satisfactory level and may do so without any further training or instruction.

While the WAY111 training does review the SRT set up, it does not inform the patroller on what to inspect in relation to the reaction rail and the dangers with reaction rail defects.

None of the trained patrollers has undertaken the recertification course in the last few years as it deemed as not mandatory at this time, The Senior foreperson conducts a mandated mentoring exercise for the patrollers, on the TTC form QA-7 but this is more around the safety aspects of being track side rather than the quality of track inspection.

2.3 Defects on the SRT

The review of the MAXIMO defect database on the SRT revealed the following:

- There are circa 800 separate defects in the MAXIMO data base for the SRT, which cover ALL track defects, rails, joints, ballast, fencing, structures, walkways, power rails, components,
- 139 defects that relate to the “reaction rail” of any type including within that:
  - 77 defects refer to “polished top cap” type defects.

- 28 defects refer to "missing / loose T bolt type defects.

The spread of the defects is across the whole SRT system, on both north and south bound tracks. With the 77 polished top cap defects, there are:

- 37 on the Northbound
- 40 on the Southbound

This is evidence that across the SRT, the LIM on the train is striking the top cap and not just in certain areas, leading to other areas of derailment concern where the same combination of defect may occur.

It's also evident that the track patrollers do not understand the impact of 'combination defects' in relation to the reaction rail, and although many defects are reported, they are reported separately, and the risk factor goes unrecognised,

The table below shows the 77 defects referring to “polished cap”.

Table 2.2 “Polished Cap” Defects

Location	Asset	Defect #	Track	Dir.		To	Summary	Component	Failure Code	Admin Group	Report Date	Changed Date
SRT-LINE	SRT-NB	M-213166	Scarborough Centre to McCowan	NB	15+800	15+800	MOWIS-213166.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/3/21 00 00	5/11/22 18 14
SRT-LINE	SRT-NB	M-171131	Scarborough Centre to McCowan	NB	15+920	15+950	MOWIS-171131.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	2/8/17 00 00	5/11/22 19 12
SRT-LINE	SRT-NB	M-213283	Midland to Scarborough Centre	NB	14+654	14+654	MOWIS-213283.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/6/21 00 00	5/11/22 19 51
SRT-LINE	SRT-NB	M-195137	Midland to Scarborough Centre	NB	14+570	14+570	MOWIS-195137.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/2/19 00 00	5/11/22 17 17
SRT-LINE	SRT-NB	M-196119	Midland to Scarborough Centre	NB	15+428	15+428	MOWIS-196119.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/23/19 00 00	5/11/22 20 07
SRT-LINE	SRT-NB	M-195299	Midland to Scarborough Centre	NB	14+374	14+374	MOWIS-195299.Reaction Ra l.Polished Top Cap.at a joint (facing)	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/5/19 00 00	5/11/22 17 17
SRT-LINE	SRT-NB	M-211437	Midland to Scarborough Centre	NB	15+222	15+222	MOWIS-211437.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	11/13/20 00 00	5/11/22 17 24
SRT-LINE	SRT-NB	M-211660	Midland to Scarborough Centre	NB	14+746	14+746	MOWIS-211660.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	11/19/20 00 00	5/11/22 19 11
SRT-LINE	SRT-NB	M-212400	Midland to Scarborough Centre	NB	14+622	14+622	MOWIS-212400.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/10/20 00 00	5/11/22 19 22
SRT-LINE	SRT-NB	M-212398	Midland to Scarborough Centre	NB	14+832	14+832	MOWIS-212398.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/10/20 00 00	5/11/22 19 51
SRT-LINE	SRT-NB	M-215699	Kennedy (SRT) to Lawrence East	NB	10+996	10+996	MOWIS-215699.Reaction Ra l.Broken/Missing T-Bolt.top cap polish also 2 t bolts loose	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	3/22/21 00 00	5/11/22 19 14
SRT-LINE	SRT-NB	M-212397	Midland to Scarborough Centre	NB	14+848	14+848	MOWIS-212397.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/10/20 00 00	5/11/22 19 22
SRT-LINE	SRT-NB	M-212396	Midland to Scarborough Centre	NB	15+224	15+224	MOWIS-212396.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/10/20 00 00	5/11/22 17 39
SRT-LINE	SRT-NB	M-214028	Midland to Scarborough Centre	NB	15+068	15+068	MOWIS-214028.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	2/2/21 00 00	5/11/22 18 14
SRT-LINE	SRT-NB	M-216299	Midland to Scarborough Centre	NB	14+364	14+364	MOWIS-216299.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	4/15/21 00 00	5/11/22 19 10
SRT-LINE	SRT-NB	M-204657	Midland to Scarborough Centre	NB	14+750	14+750	MOWIS-204657.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	5/17/20 00 00	5/11/22 18 07
SRT-LINE	SRT-NB	M-204658	Midland to Scarborough Centre	NB	15+064	15+064	MOWIS-204658.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	5/17/20 00 00	5/11/22 19 09
SRT-LINE	SRT-NB	M-211428	Ellesmere to E lesmere	SB	13+600	13+600	MOWIS-211428.Reaction Ra l.Broken/Missing T-Bolt.major top cap polish due to broken t bolt	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	11/12/20 00 00	5/11/22 19 10
SRT-LINE	SRT-NB	579982	Midland to Scarborough Centre	NB	14+856	14+856	Reaction ra l top polish approaching end	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	6/22/23 14 27	7/25/23 13 24
SRT-LINE	SRT-NB	M-212395	Lawrence East to Ellesmere	NB	12+074	12+074	MOWIS-212395.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/10/20 00 00	5/11/22 19 46
SRT-LINE	SRT-NB	M-214400	Lawrence East to Ellesmere	NB	12+710	12+710	MOWIS-214400.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	2/14/21 00 00	5/11/22 19 33
SRT-LINE	SRT-NB	579730	Lawrence East to Ellesmere	NB	12+678	12+678	End cap Polishing / L fting	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	6/10/23 14 33	6/10/23 15 10
SRT-LINE	SRT-NB	M-209211	Kennedy (SRT) to Lawrence East	NB	10+992	10+992	MOWIS-209211.Reaction Ra l.Broken/Missing T-Bolt.Top Cap po ishing on the Reaction Rail jo	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/14/20 00 00	5/11/22 17 38
SRT-LINE	SRT-NB	M-213539	Kennedy (SRT) to Lawrence East	NB	10+680	10+680	MOWIS-213539.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/15/21 00 00	5/11/22 17 44
SRT-LINE	SRT-NB	M-213165	Kennedy (SRT) to Lawrence East	NB	10+990	10+990	MOWIS-213165.Reaction Ra l.Polished Top Cap.3 loose t bo tsäjust and levelfbp cap polish	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/3/21 00 00	5/11/22 17 43
SRT-LINE	SRT-NB	M-213281	Kennedy (SRT) to Lawrence East	NB	10+682	10+682	MOWIS-213281.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/6/21 00 00	5/11/22 17 43
SRT-LINE	SRT-NB	M-213080	Kennedy (SRT) to Lawrence East	NB	10+684	10+684	MOWIS-213080.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/31/20 00 00	5/11/22 19 09
SRT-LINE	SRT-NB	M-216715	Kennedy (SRT) to Lawrence East	NB	11+066	11+066	MOWIS-216715.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	4/27/21 00 00	5/11/22 19 13
SRT-LINE	SRT-NB	M-218507	Kennedy (SRT) to Lawrence East	NB	9+964	9+964	MOWIS-218507.Reaction Ra l.Polished Top Cap.T-bolt also loose.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	7/14/21 00 00	5/11/22 19 09
SRT-LINE	SRT-NB	M-218749	Kennedy (SRT) to Lawrence East	NB	10+630	10+630	MOWIS-218749.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	7/26/21 00 00	5/11/22 17 55
SRT-LINE	SRT-NB	M-167370	Kennedy (SRT) to Lawrence East	NB	10+738	10+738	MOWIS-167370.Reaction Ra l.Polished Top Cap.Level & AdjustÄlert!!	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/4/16 00 00	5/11/22 20 07
SRT-LINE	SRT-NB	M-209416	Kennedy (SRT) to Lawrence East	NB	10+725	10+725	MOWIS-209416.Reaction Ra l.Polished Top Cap.started chipping on top cap	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/20/20 00 00	5/11/22 19 37
SRT-LINE	SRT-NB	M-182586	Ellesmere to Midland	NB	13+958	13+958	MOWIS-182586.Reaction Ra l.Polished Top Cap.ADJUST AND LEVEL	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/16/18 00 00	5/11/22 20 07
SRT-LINE	SRT-NB	M-183550	Ellesmere to Midland	NB	13+944	13+944	MOWIS-183550.Reaction Ra l.Polished Top Cap.Adjust and level	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	11/18/18 00 00	5/11/22 17 17
SRT-LINE	SRT-NB	M-182532	Midland to Scarborough Centre	NB	14+390	14+390	MOWIS-182532.Reaction Ra l.Broken/Missing T-Bolt.top cap polish	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/13/18 00 00	5/11/22 19 10
SRT-LINE	SRT-NB	M-212002	Ellesmere to Midland	NB	13+968	13+968	MOWIS-212002.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	11/28/20 00 00	5/11/22 17 43
SRT-LINE	SRT-NB	579981	Ellesmere to Midland	NB	14+030	14+030	reaction rail top polish approaching end	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	6/22/23 14 23	6/22/23 14 54
SRT-LINE	SRT-NB	M-191564	Ellesmere to Midland	NB	13+980	13+980	MOWIS-191564.Reaction Ra l.Polished Top Cap.Level and Adjust	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	7/7/19 00 00	5/11/22 17 11
SRT-LINE	SRT-SB	M-213492	Scarborough Centre to McCowan	SB	15+940	15+940	MOWIS-213492.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/14/21 00 00	5/11/22 19 22
SRT-LINE	SRT-SB	M-213648	Midland to Scarborough Centre	SB	14+900	14+900	MOWIS-213648.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/20/21 00 00	5/11/22 19 51
SRT-LINE	SRT-SB	M-213649	Midland to Scarborough Centre	SB	15+066	15+066	MOWIS-213649.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/20/21 00 00	5/11/22 17 43
SRT-LINE	SRT-SB	M-213237	Midland to Scarborough Centre	SB	14+479	14+479	MOWIS-213237.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/5/21 00 00	5/11/22 19 22
SRT-LINE	SRT-SB	M-213311	Midland to Scarborough Centre	SB	14+478	14+478	MOWIS-213311.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/8/21 00 00	5/11/22 19 46
SRT-LINE	SRT-SB	M-213313	Midland to Scarborough Centre	SB	14+816	14+816	MOWIS-213313.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	1/8/21 00 00	5/11/22 19 10
SRT-LINE	SRT-SB	M-212852	Midland to Scarborough Centre	SB	14+480	14+480	MOWIS-212852.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/24/20 00 00	5/11/22 19 51
SRT-LINE	SRT-SB	M-213050	Midland to Scarborough Centre	SB	14+925	14+925	MOWIS-213050.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/30/20 00 00	5/11/22 19 51
SRT-LINE	SRT-SB	M-214083	Midland to Scarborough Centre	SB	15+064	15+064	MOWIS-214083.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	2/4/21 00 00	5/11/22 17 43
SRT-LINE	SRT-SB	M-204569	Midland to Scarborough Centre	SB	15+252	15+252	MOWIS-204569.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	5/13/20 00 00	5/11/22 19 09
SRT-LINE	SRT-SB	M-217125	Midland to Scarborough Centre	SB	15+232	15+232	MOWIS-217125.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	5/14/21 00 00	5/11/22 19 27
SRT-LINE	SRT-SB	M-205219	Midland to Scarborough Centre	SB	15+000	15+000	MOWIS-205219.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	5/31/20 00 00	5/11/22 18 20
SRT-LINE	SRT-SB	M-217898	Midland to Scarborough Centre	SB	15+338	15+338	MOWIS-217898.Reaction Ra l.Polished Top Cap.@joint	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	6/16/21 00 00	5/11/22 17 29
SRT-LINE	SRT-SB	M-207592	Midland to Scarborough Centre	SB	15+362	15+362	MOWIS-207592.Reaction Ra l.Polished Top Cap.Level & Adjust	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/5/20 00 00	5/11/22 19 20
SRT-LINE	SRT-SB	M-219123	Midland to Midland	SB	14+225	14+225	MOWIS-219123.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/12/21 00 00	5/11/22 19 37
SRT-LINE	SRT-SB	569565	Lawrence East to Lawrence East	SB	11+750	11+750	Top Cap Polishing	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	7/26/22 14 29	7/26/22 16 29
SRT-LINE	SRT-SB	M-209465	Lawrence East to Lawrence East	SB	11+755	11+755	MOWIS-209465.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/22/20 00 00	5/11/22 19 37
SRT-LINE	SRT-SB	M-195378	Lawrence East to Ellesmere	SB	13+204	13+226	MOWIS-195378.Reaction Ra l.Polished Top Cap.level and adjust	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/7/19 00 00	5/11/22 19 13
SRT-LINE	SRT-SB	M-195376	Lawrence East to Ellesmere	SB	13+450	13+450	MOWIS-195376.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	10/7/19 00 00	5/11/22 17 09
SRT-LINE	SRT-SB	M-214368	Lawrence East to Ellesmere	SB	12+892	12+892	MOWIS-214368.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	2/13/21 00 00	5/11/22 17 29
SRT-LINE	SRT-SB	M-216729	Lawrence East to Ellesmere	SB	12+136	12+136	MOWIS-216729.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	4/29/21 00 00	5/11/22 18 20
SRT-LINE	SRT-SB	580346	Lawrence East to Ellesmere	SB	13+512	13+512	Reaction Rail Top Polish Raised 1/2 inch on the approach end	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	7/9/23 14 08	7/9/23 14 39
SRT-LINE	SRT-SB	M-219370	Lawrence East to Ellesmere	SB	13+444	13+444	MOWIS-219370.Reaction Ra l.Polished Top Cap.Top cap polishing T Bo t missing	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/21/21 00 00	5/11/22 17 34
SRT-LINE	SRT-SB	M-219371	Lawrence East to Ellesmere	SB	13+512	13+512	MOWIS-219371.Reaction Ra l.Polished Top Cap.Top Cap High	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/21/21 00 00	5/11/22 17 55
SRT-LINE	SRT-SB	M-192649	Lawrence East to Ellesmere	SB	11+970	11+970	MOWIS-192649.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/5/19 00 00	5/11/22 19 12
SRT-LINE	SRT-SB	M-194439	Lawrence East to Ellesmere	SB	13+130	13+130	MOWIS-194439.Reaction Ra l.Polished Top Cap.continue to monitor	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/16/19 00 00	5/11/22 19 09
SRT-LINE	SRT-SB	M-212353	Kennedy (SRT) to Lawrence East	SB	10+990	10+990	MOWIS-212353.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	12/9/20 00 00	5/11/22 17 33
SRT-LINE	SRT-SB	M-219373	Kennedy (SRT) to Lawrence East	SB	10+550	10+550	MOWIS-219373.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/21/21 00 00	5/11/22 17 54
SRT-LINE	SRT-SB	M-167371	Kennedy (SRT) to Lawrence East	SB	10+730	10+730	MOWIS-167371.Reaction Ra l.Polished Top Cap.under more gate bridge	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/4/16 00 00	5/11/22 19 56
SRT-LINE	SRT-SB	M-209289	Kennedy (SRT) to Lawrence East	SB	10+550	10+550	MOWIS-209289.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/16/20 00 00	5/11/22 19 10
SRT-LINE	SRT-SB	M-209294	Kennedy (SRT) to Lawrence East	SB	10+660	10+660	MOWIS-209294.Reaction Ra l.Polished Top Cap.polish top cap on rr joint	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/16/20 00 00	5/11/22 18 43
SRT-LINE	SRT-SB	M-209466	Kennedy (SRT) to Lawrence East	SB	11+190	11+190	MOWIS-209466.Reaction Ra l.Polished Top Cap.T-bolt Missing	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/22/20 00 00	5/11/22 18 13
SRT-LINE	SRT-SB	M-168373	Kennedy (SRT) to Lawrence East	SB	10+730	10+730	MOWIS-168373.Reaction Ra l.Polished Top Cap.polished top cap ab need to be lowerd	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	9/27/16 00 00	5/11/22 17 09
SRT-LINE	SRT-SB	M-186500	Ellesmere to Midland	SB	13+720	13+720	MOWIS-186500.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	2/18/19 00 00	5/11/22 19 17
SRT-LINE	SRT-SB	M-215044	Ellesmere to Midland	SB	14+190	14+190	MOWIS-215044.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	3/3/21 00 00	5/11/22 19 30
SRT-LINE	SRT-SB	M-216453	Ellesmere to Midland	SB	13+950	13+950	MOWIS-216453.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	4/20/21 00 00	5/11/22 19 11
SRT-LINE	SRT-SB	M-219125	Ellesmere to Midland	SB	13+760	13+760	MOWIS-219125.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/12/21 00 00	5/11/22 19 09
SRT-LINE	SRT-SB	M-219124	Ellesmere to Midland	SB	13+933	13+933	MOWIS-219124.Reaction Ra l.Polished Top Cap.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	8/12/21 00 00	5/11/22 17 38
SRT-LINE	SRT-SB	M-211427	Ellesmere to E lesmere	SB	13+600	13+600	MOWIS-211427.Reaction Rail.Po ished Top Cap.Alert! Adust & Level.Tbo t also loose.	TRK-REACTION-RAIL	REACT ON-RAIL	INSP-TRK	11/12/20 00 00	5/11/22 19 11

The oldest recorded defect was in 2016, for polished top cap.

The table below shows the defects referring to “missing / loose” T-Bolts.

Table 2.3 Defects of “Missing / Loose” T-Bolts

Work Order	Classification	Location	Asset	Defect #	rack	Dir		o	Summary	Component	Failure Code	Admin Group	Report Date	Changed Date
8 690	TRK-VISUAL	SRT-L NE	SRT-SB	M-219372	Kennedy (SRT) to Lawrence East	SB	10 992	10 992	MOW S-219372.React on Rail.Broken/Missing T-Bo t.Top Cap Polshing T Bolt missing	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/21/21 00:00	5/11/22 19:3
79273	TRK-VISUAL	SRT-L NE	SRT-SB	M-219291	Lawrence East to El esmere	SB	13	13	MOW S-219291.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/18/21 00:00	5/11/22 18:53
82128	TRK-VISUAL	SRT-L NE	SRT-NB	M-21706	Lawrence East to El esmere	NB	13 510	13 510	MOW S-21706 .React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	5/12/21 00:00	5/11/22 19:16
77200	TRK-VISUAL	SRT-L NE	SRT-SB	M-216393	Lawrence East to El esmere	SB	12 0	12 0	MOW S-216393.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	/17/21 00:00	5/11/22 18:07
85395	TRK-VISUAL	SRT-L NE	SRT-NB	M-215702	Kennedy (SRT) to Lawrence East	NB	10 135	10 135	MOW S-215702.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	3/22/21 00:00	5/11/22 19: 6
81868	TRK-VISUAL	SRT-L NE	SRT-NB	M-215699	Kennedy (SRT) to Lawrence East	NB	10 996	10 996	MOW S-215699.React on Rail.Broken/Missing T-Bo t.top cap polish also 2 t bo ts loose	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	3/22/21 00:00	5/11/22 19:1
75050	TRK-VISUAL	SRT-L NE	SRT-SB	M-212851	Mid and to Scarborough Centre	SB	1 706	1 706	MOW S-212851.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	12/2 /20 00:00	5/11/22 17:29
78377	TRK-VISUAL	SRT-L NE	SRT-NB	M-212805	E lesmere to Midland	NB	13 696	13 696	MOW S-212805.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	12/22/20 00:00	5/11/22 18:28
80181	TRK-VISUAL	SRT-SB	M-211 28	E lesmere to El esmere	SB	13 600	13 600	MOW S-211 28.React on Rail.Broken/Missing T-Bo t.major top cap polish due to broken t bo t	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	11/12/20 00:00	5/11/22 19:10
75853	TRK-VISUAL	SRT-L NE	SRT-NB	M-209837	Lawrence East to El esmere	NB	11 870	11 870	MOW S-209837.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	10/2/20 00:00	5/11/22 17:38
80132	TRK-VISUAL	SRT-L NE	SRT-SB	M-209362	Kennedy (SRT) to Lawrence East	SB	9 700	9 700	MOW S-209362.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	9/19/20 00:00	5/11/22 19:10
75665	TRK-VISUAL	SRT-L NE	SRT-NB	M-209211	Kennedy (SRT) to Lawrence East	NB	10 992	10 992	MOW S-209211.React on Rail.Broken/Missing T-Bo t.Top Cap po ishing on the Reaction Ra l jo	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	9/1 /20 00:00	5/11/22 17:38
8 515	TRK-VISUAL	SRT-L NE	SRT-NB	M-207726	Kennedy (SRT) to Lawrence East	NB	11 306	11 306	MOW S-207726.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/9/20 00:00	5/11/22 19:33
8 75	TRK-VISUAL	SRT-L NE	SRT-NB	M-2075 7	Kennedy (SRT) to Lawrence East	NB	9 860	9 860	MOW S-2075 7.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/3/20 00:00	5/11/22 19:33
7680	TRK-VISUAL	SRT-L NE	SRT-NB	M-2075 6	Kennedy (SRT) to Lawrence East	NB	9 886	9 886	MOW S-2075 6.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/3/20 00:00	5/11/22 17:55
79730	TRK-VISUAL	SRT-L NE	SRT-NB	M-2075 5	Kennedy (SRT) to Lawrence East	NB	10 236	10 236	MOW S-2075 5.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/3/20 00:00	5/11/22 19:09
77 20	TRK-VISUAL	SRT-L NE	SRT-NB	M-2075	Kennedy (SRT) to Lawrence East	NB	10 618	10 618	MOW S-2075 .React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	8/3/20 00:00	5/11/22 18:07
8 268	TRK-VISUAL	SRT-L NE	SRT-SB	M-206967	Kennedy (SRT) to Lawrence East	SB	11 10	11 10	MOW S-206967.React on Rail.Broken/Missing T-Bo t. m ssing T-Bolts	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	7/18/20 00:00	5/11/22 19:30
78 82	TRK-VISUAL	SRT-L NE	SRT-SB	M-20 123	Kennedy (SRT) to Lawrence East	SB	10 550	10 550	MOW S-20 123.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	5/1/20 00:00	5/11/22 18:35
80520	TRK-VISUAL	SRT-L NE	SRT-SB	M-185513	Lawrence East to El esmere	SB	13 99	13 99	MOW S-185513.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	1/16/19 00:00	5/11/22 19:11
78955	TRK-VISUAL	SRT-L NE	SRT-SB	M-183779	Lawrence East to El esmere	SB	13 500	13 500	MOW S-183779.React on Rail.Broken/Missing T-Bo t.react on rail l fting on corner due to mi	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	11/23/18 00:00	5/11/22 18:
80 75	TRK-VISUAL	SRT-L NE	SRT-NB	M-182532	Mid and to Scarborough Centre	NB	1 390	1 390	MOW S-182532.React on Rail.Broken/Missing T-Bo t.top cap polish	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	10/13/18 00:00	5/11/22 19:10
72932	TRK-VISUAL	SRT-L NE	SRT-SB	M-173272	Lawrence East to El esmere	SB	13 080	13 080	MOW S-173272.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	6/3/17 00:00	5/11/22 17:07
86 3	TRK-VISUAL	SRT-L NE	SRT-NB	M-173270	Lawrence East to El esmere	NB	13 018	13 018	MOW S-173270.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	6/3/17 00:00	5/11/22 20:01
81670	TRK-VISUAL	SRT-L NE	SRT-SB	M-162761	Kennedy (SRT) to Lawrence East	SB	11 218	11 218	MOW S-162761.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	12/28/15 00:00	5/11/22 19:13
72 53	TRK-VISUAL	SRT-L NE	SRT-NB	M-1 5302	Kennedy (SRT) to Lawrence East	NB	10 811	10 811	MOW S-1 5302.React on Rail.Broken/Missing T-Bo t.	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	7/26/13 00:00	5/11/22 17:0
971 53	TRK-VISUAL	SRT-L NE	SRT-SB	576700	Lawrence East to El esmere	SB	12 160	12 160	Missing T-bo t	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	/22/23 12: 9	/22/23 13:31
5081908	TRK-VISUAL	SRT-L NE	SRT-SB	580753	Kennedy (SRT) to Lawrence East	SB	10 920	10 920	Missing T Bolt	TRK-REACT ON-RA L	REACTION-RAIL	INSP-TRK	7/27/23 15:08	7/27/23 15: 0

The oldest defect reported was in 2013 for missing T bolts.

In 2023, there has only been five new reported defects out of the 139 “reaction rail” defects.

Over the last two years there has been seven restricted speed zones imposed on the SRT, mostly for reaction rail maintenance as shown below. Five of these were imposed in 2023.

Table 2.4 Seven Restricted Speed Zones Imposed on the SRT

Work Order	Classification	Location	Asset	Track	Dir.	From	To	Summary	Failure Code	Report Date	Reported By
5068417	TRK-RSZ	SRT-LINE	SRT-SB	Kennedy (SRT) to Lawrence East	SB	11+750	11+600	Lose Broken Reaction Rail anchor bolts	TRACK	7/14/23 11:20	KCHAPMAN
4637905	TRK-RSZ	SRT-LINE	SRT-NB	Ellesmere to Scarborough Centre	NB	14+000	14+500	Removed Reaction rail	REACTION-RAIL	7/6/22 10:42	TJ BR L
4637929	TRK-RSZ	SRT-LINE	SRT-NB	Ellesmere to Scarborough Centre	NB	14+000	14+500	Removed Reaction rail - Created by mistake (RSZ req'd)	REACTION-RAIL	7/6/22 11:00	TJ BR L
5003425	TRK-RSZ	SRT-LINE	SRT-SB	Midland to McCowan	SB	15+650	15+434	Reaction Rail lifted	TRACK	5/19/23 12:12	LBADENOC
5047529	TRK-RSZ	SRT-LINE	SRT-SB	Kennedy (SRT) to Lawrence East	SB	11+750	11+650	Reaction rail anchor replacement	TRACK	6/27/23 04:40	RBRITTON
4932202	TRK-RSZ	SRT-LINE	SRT-SB	Kennedy (SRT) to Lawrence East	SB	11+676	11+466	Loose/Broken reaction rail	TRACK	3/22/23 07:03	TJ BR L
4931496	TRK-RSZ	SRT-LINE	SRT-NB	Lawrence East to Ellesmere	NB	11+790	11+950	Reaction rail lifting, making contact with train due to loose anchors	TRACK	3/21/23 14:46	NFOLEY

This does indicate that the track patrollers do act on what they believe are unsafe defects around the reaction rail, as RSZ’s have been implemented for reaction rail defects. Although nothing of concern was noted on the morning of the derailment or the previous 72hr inspections.

There is also a Top High Spot Test conducted by the vehicles department, which takes height measurements in reference to the running rail from the top of the running rail to the reaction rail. This is a quarterly report which is sent to Maintenance Engineering, and since November 2022 to April 2023, there have been no reportable faults as shown in Table 2.5 below.

Table 2.5 Height measurement report from November 2022 to April 2023

November 18th 2022 - Results

Southbound McCowan to Kennedy

LOCATION	Chainage (±20m)	Height (mm)	Date of Visual Confirmation	Date of Confirmed Repair
No High Spots Identified				

Northbound Kennedy to McCowan

LOCATION	Chainage (±20m)	Height (mm)	Date of Visual Confirmation	Date of Confirmed Repair
No High Spots Identified				

February 10th 2023 - Results

Southbound McCowan to Kennedy

LOCATION	Chainage (±20m)	Height from TOR (mm)	Date of Visual Confirmation	Date of Confirmed Repair
No High Spots Identified				

Northbound Kennedy to McCowan

LOCATION	Chainage (±20m)	Height (mm)	Date of Visual Confirmation	Date of Confirmed Repair
No High Spots Identified				

April 14th 2023 - Results					
Southbound McCowan to Kennedy					
LOCATION	Chainage (±20m)	Height from TOR (mm)	Date of Visual Confirmation	Additional Notes	Date of Confirmed Repair
No High Spots Identified					

Northbound Kennedy to McCowan					
LOCATION	Chainage (±20m)	Height from TOR (mm)	Date of Visual Confirmation	Additional Notes	Date of Confirmed Repair
No High Spots Identified					

These reports show no high spots detected.

3. Summary of Evidence

Although the root causes of the derailment are still being investigated by third parties, the following can be attributed to the accident (all part of the recommendations in the section below).

- Lack of sufficient training on the reaction rail
- Prioritizations of reaction rail defect;
- Removal of reaction rail defects;
- Focusing only on red and yellow defects; and
- Gaps in the TTC track standards;
- Relying solely on patrollers inspecting the track and having no mandated hierarchy for track inspection

4. Recommendations

Given that the SRT system is being decommissioned in November 2023, the recommendations made here may not be pertinent for the SRT system but for the other systems within the TTC subway.

4.1 Track Inspection Regime on the SRT

4.1.1 Down grading the 72hr inspection frequency?

72-hr track inspection is across ALL the TTC subway system. This is valid in select areas where there is high traffic, special track layout and tight curves. However, some sections could be reviewed and reduced.

This would need a comprehensive review of the track and its defect type, track geometry, RSZ's and renewal history.

This would give the patrollers a better view of deteriorating defects, as currently they see defects every 72hrs, this leads to a false knowledge of what is happening with the defect, the worsening may go unnoticed due to familiarity.

4.2 Track Inspection Training and Mentoring

4.2.1 New Training Protocol

The TTC and OTC training department are in the process of upgrading the Track Inspection training at the present time, into a 5-day program which includes a more detailed section of the SRT (until its decommissioning).

The new training is both classroom and field training, using computer-based graphics and videos to ensure a better level of knowledge is reached.

I have been in discussions with both parties on this using Network Rail type training structures to ensure the level of training is sufficient and that all employees taking the training are recorded and mapped to ensure recertification and mentoring also takes place.

The 5-day program will allow for more detailed training on various parts of the system, and although the SRT will be decommissioned, it will provide more confidence in the patroller's knowledge.

It is also important the correct personnel are being trained, and not fast-tracked into patroller positions—to reiterate, this will be better managed under the new training protocol.

I have recommended to the training department that *'combination defects'* and the risks of such defects are trained to the patrollers. Realising the impact of multiple defects in the same location would change the priority and could require an RSZ.

4.2.2 Proposed Hierarchy of Inspection

In early 2023, I expressed my concern to Track about restricting track inspections to patrollers only. The following hierarchy of inspection was proposed to address this issue:

- Track Patrolling;
- Road master section inspection (currently happening, but no structured plan);
- Track Manager inspection; and
- Engineering inspection.

All will have different timescales and look for higher levels of work but will be a thorough inspection regime akin to Network Rail UK.

It is important that the people responsible for the management of track are also out on track. Currently at the TTC, this is not happening enough to ensure that the track management understand the state of the system. Below are tables with the proposal of change.

Table 4.1 New Structured Regime Responsibility and Frequency

New Structured Regime	Responsible	Frequency
L1 BVI (Basic visual Inspection)	Track Patrollers	72hrs
L2 Senior FP inspection	Senior Forepersons/ Forepersons (Track Inspection)	8 week
L3 Road Masters Inspection	Road Masters	26 week
L4 Track Managers Inspection	Track managers/ assistant	52 week
L5 Maint Engineering Inspection	ME Team	52 Week

Table 4.2 Output Required Accountability and Auditable Trail

Output Required	Accountable	Auditable Trail
BVI – No change to current inspection regime	Senior Track Inspection Engineer (STIE)	Yes as current practice
SFP – Approximately one inspection a week for each line RM with regular "beats"	Track Manager	Yes via completed form and visible plan
RM – One inspection a week on average	Track Manager	Yes via completed form and visible plan
TM - Spread out across the year, to be done under own protection arrangements	Head of Track	Yes via completed form and visible plan
ME – Spread out across the year, to be done under own protection arrangements	Manager Track and Structure Maintenance Engineering	Yes via completed form and visible plan

4.3 Defects on the SRT and Other Lines

4.3.1 Revised Defect Priority Regime

In early 2023, I investigated the defect and priority classification and presented a revised defect priority regime to TTC Track and Engineering as the defect numbers throughout the TTC system are far higher than expected, currently around 12,000 in total for all defect types, thus making effective defect planning impossible to reduce the number.

Using colour codes is not an effective way to manage defects. Instead, I proposed using a monthly coding system which allows a better level of planning for the more severe defects and allows for defects to be moved up the priority scale as reported by the patrollers.

This would use the following codes in the table below:

Table 4.3 New Defect Codes Alongside Old Coloured Codes

New	Old	Defect type	Hierarchy of Non-compliance
M0	Red / Yellow	Broken rail, RSZ, NDT urgent defect,	Strict dates for removal if missed line to be closed
M1	TCA	RSZ, NDT defect, Growing mud-spots, Severe track deflection	Strict dates for removal, if missed, reduced RSZ defected recorded as M0
M2	Blue	Defects that need removing whilst in infancy stage	Strict dates for removal, if missed RSZ applied and defect recorded as M1
M6	Blue	All other defect types	To be reviewed on level 2 and 3 track inspections and elevated to M2 as required and strict dates applied
M12	Brown		Reviewed on Level 2/3 inspections (see table 4.1)
M99	Brown	All minor defects (clip out, tie that is defective but not ineffective)	"Nice to do" work when in area doing more onerous tasks

Currently defects other than emergencies are classed 'blue' or 'brown' which is not productive in defect planning as one blue defect cannot be differentiated between another.

If the above-mentioned track inspection regime were in place, the Roadmasters and track manager would use this set-up to move defects as required, as their knowledge of degradation should be of a higher level than the patrollers.

4.3.2 Defect Planning

It is evident that the timely planning of defects is poor—the defects removed are either emergency or RSZ defects and others are going unplanned. It recommended that the track manager has more input into the defect planning process and the closing out of defects is poor as asset management isn't controlled.

There are 870 reported defects in total on the SRT for example, which given the short length of the route is a high number, and as recommended below needs to be reviewed for validity as there is a certainty that there are duplicate defects and previously removed defects that haven't been closed out in the system.

Most of the night-time work undertaken across the whole subway system is to remove NDT rail defects, change longer strings of rail including restraining rails and to remove wet spots.

There is a record of completed work orders on the SRT over the last 5 years, in relation to reaction rail maintenance and replacement of components, the majority of these were immediate action defects where RSZ's have been imposed, given the historical date of the defects on the SRT its evident that the defects are not prioritized for removal on the scheduled date.

The Track Manager would benefit from having an assistant (preferably a subject matter expert) to review and then implement a more robust method of asset management. Particularly in defect planning and removal. Currently there are numerous roles having input of how this is managed, including, the track manager, Road masters, Planners, and track inspection engineer.

4.4 Next Steps and Future Defect Reported Process

4.4.1 Gannett Fleming SRT Track Inspection before reopening

I recommend that the defects located by Gannett Fleming during their inspection will need to be repaired before opening, along with a re-brief to the patrollers on the reaction rail and its components before they start the inspection process again.

It would also be recommended that the SRT opens at a reduced speed of 25kph over its entire length and an experienced track / engineer to ride on the front of the first train in each direction to acknowledge overall condition of track. It may be so also beneficial to have the top cap sprayed white and inspected on the day of opening to ascertain strike points and base immediate maintenance in those areas.

4.4.2 Defect Database Refresh on the SRT

Also, a refresh of the SRT defect database is highly encouraged—particularly concerning the reaction rail, using the defects discovered in the recent inspections by Gannett Fleming and TTC engineering team. This would give assurance that the most onerous are captured and prioritized correctly. There is the aforementioned "defect sweep" carried out by the Track Inspection Senior Foreperson but given the age of some of the reported defects on the SRT, I would recommend this procedure is reviewed for its validity.

4.4.3 Complete TTC System Defect Database Inspection

I would recommend that the entire defect database (MAXIMO) is reviewed as a lot of the data was transferred over from MOWIS, without being cleansed, to provide assurance that the defects are:

- Existing in track;
- Correctly prioritized;
- Remove duplicate entries; and
- Removed from the system if not visible in track.

This could be achieved in various ways with various results. The most productive measure is to walk the entire system to: (1) determine track defects, (2) use the recommended defect priority codes, and (3) upload into a fresh database within MAXIMO once completed from Day Zero.

The current database would be archived for audit purposes.

4.4.4 Improved TTC track standards

Many of the TTC standards are incomplete in explaining how limits and exceedances are managed, and need to be reviewed to provide assurance that the TTC processes are followed, and the process can then be audited and updated where required, having a standards writer could assist the TTC in structuring a Standards database, and a library where standards are stored and controlled. Having a designated hierarchy of who controls and updates is also required for responsibilities and accountability.

The track standards need to be clear on what course of action needs to be taken in relation to track patrollers discovering defects, with defect exceedance limits clearly stated and what is the required action, whether it's a restricted speed zone for example.

This needs to relate across the whole TTC subway system, covering all track types, and exceedance limits.

4.5 Conclusions

It is clear that the reaction rail and its components was the primary cause of the derailment, data shows that the track patrollers were identifying reaction rail defects and taking safety precautions were they deemed necessary.

The omission of detailed standards for SRT reaction rail and its exceedance limits lead to a degree of uncertainty on how to maintain the reaction rail defects.

Asset data management required more stringent management to control the quality of data held within the MAXIMO data base, to recognise and remove more onerous defects the above recommendations will assist in that.

Reducing the reliance on the track patrollers by installing a hierarchy of track inspection will greatly improve the knowledge of track condition.

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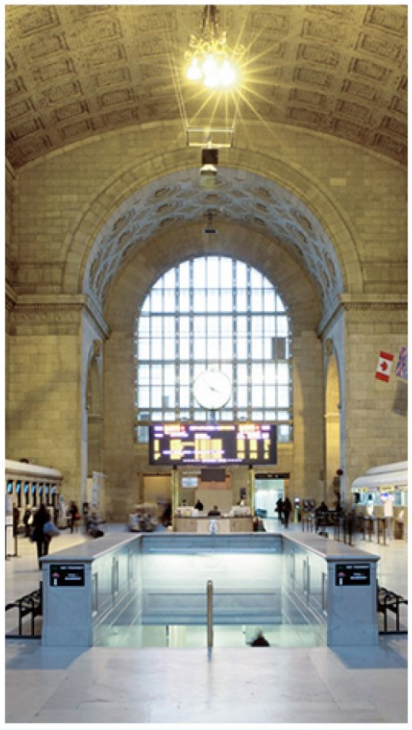

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