

WMSC Commissioner Brief: W-0207 – Derailments – near future Potomac Yard Station – September 13, 2022

Prepared for Washington Metrorail Safety Commission meeting on March 7, 2023

Safety event summary:

A Metrorail tamper derailed twice on September 13, 2022 on the mainline tracks that were being built to connect the future infill Potomac Yard Station to the existing Blue and Yellow Line tracks.

A Metrorail contractor had placed sub-ballast, ballast, rails and ties. The large amount of ballast (rocks) placed by a subcontractor the day before these derailments covered the ties and all or nearly all of the rails, obstructing the ties and rails, including joint bars, from view. Metrorail, the lead contractor, and the subcontractor did not raise any concerns about this. Metrorail had expected the contractor to also conduct the tamping work required to put the tracks and ballast in the proper alignment and settlement. However, the contractor's tamper unit did not meet Metrorail safety requirements and therefore Metrorail vehicles personnel correctly did not allow the contractor to operate that tamper until the safety issues were addressed. Rather than waiting for those issues to be addressed, Metrorail assigned its own tamper and crew to go to the work area (which was part of a long-term shutdown established for the tie-in work) and begin tamping to attempt to maintain planned schedules. The crew was not able to inspect the rails prior to work due to the significant amount of ballast, and did not receive information from Metrorail or the contractor about any special steps required to carry out the work. Metrorail generally instructs tamper operators to attempt to complete tamping in a single pass, however new construction may require the operator to limit automated alignment processes and to conduct multiple passes. Metrorail did not know the maximum allowable cross level for the vehicle to operate safely.

At 3:15 a.m., the tamper derailed. This was identified in the work area and was later eventually reported to the Maintenance Operations Center at 3:59 a.m. and to a Rail Operations Control Center Operations Manager at 4:14 a.m. Interviews by Metrorail safety personnel at the scene identified that the tamper's automated systems had indicated that the total elevation change required for both rails was approximately 9 inches, which is a relatively large amount. The Equipment Operator stated that they set the tamper to raise the track in 2-to-3 inch increments. As the Equipment Operator was using the tamper to lift the running rail, the unit derailed over a rail joint supported by a joint bar. At that time, the remaining amount of ballast continued to obstruct a full view of the joint bar.

Metrorail vehicles personnel inspected the tamper unit at the work site, and did not identify any damage. Track conditions were varied, which is expected during early stages of track construction but may have contributed to the derailment, but the way that the track was set up prior to tamping was unusual for Metrorail's tamper and crew. Track and Structures personnel recorded the tamper operating screen which indicated the left rail was 8.80 inches and the right rail was 5.28 inches below the necessary level. Metrorail Car Track Equipment Maintenance personnel and Track and Structures personnel believed that original layout of the tracks contributed to the derailment by not ensuring they were as properly positioned as possible initially.

Metrorail stated to the WMSC that it would implement safety mitigations such as operating at a slower speed and limiting the elevation change of the rails to 1.25 inches per pass, which would then require multiple passes over the work area by the next tamper crew that was arriving to continue this work. Metrorail re-railed the vehicle at approximately 7:30 a.m.



At 12:10 p.m., the Mobile Command Manager reported that the tamper derailed again in the same area. This was reported to the Maintenance Operations Center at 12:41 p.m. The tamper had made one pass over the area safely adjusting the running rail elevation, which helped some of the ballast settle further. The tamper derailed when moving back to the starting point.

The settlement of the ballast showed that the joint bar was attached with only a single bolt on each side of the joint, rather than the two required for Metrorail construction. It also demonstrated that there were mismatched rail ends at this joint. Personnel had not further inspected the joint bar after it became visible. Metrorail vehicle analysis showed that the tamper suspension on the side of the wheel climb appeared to be unloaded. The suspension loaded normally in an area with less extreme cross level differences. The left running rail was still high, and the elevation varied through the area of the derailment. Each of these, in combination with the excessive movement of the rail joint, likely contributed to the derailment.

In addition to the safety mitigations added earlier in the day, Metrorail then added two additional bolts to the joint bar to reduce the movement of the joint while the tamper was being used.

With the additional mitigation in place, the tamping crew completed their assigned work.

Following the derailment of the Metrorail tamper, and following a re-inspection of the contractor's tamper on September 14, the day after the derailments that still identified some deficiencies, Metrorail granted a waiver to the contractor's tamper to permit it to operate in the Metrorail system without meeting all safety requirements. Initially, the waiver allowed use of the vehicles only within the construction area, which would have required the contractor to transport the vehicles to the work area using a highway/roads rather than on the rails. A later version of the waiver that was signed permitted the vehicles to be moved from the Alexandria Rail Yard to the Potomac Yard Station construction site as long as they were escorted by a Metrorail prime mover vehicle. This was permitted with the remaining safety deficiencies of the tamper having marker lights that do not switch with direction, but remain red, and the regulator having rear markers that do not illuminate or operate directionally and the tow eyes/tow bar not compliant with Metrorail safety requirements. The contractor used that tamper for additional work on the opposite track from the derailments beginning that day, September 14, 2022. Metrorail's Capital Delivery Department stated during the investigation that the contractor's tamper would not have derailed under the same conditions, however there is no evidence that the tampers have such differing capabilities.

The WMSC visited the derailment site on September 14, 2022 to further verify the bolts were in place on the joint bar and to further understand the track conditions.

Probable Cause:

The probable cause of this event was Metrorail's insufficient construction planning and specifications, insufficient oversight of contractors, and lack of job-specific hazard identification and mitigation to ensure the safety of personnel.

Corrective Actions:

Metrorail committed to Track and Structures personnel performing their own inspection of a work area and conducting any required preparatory work prior to assisting with any new track construction activities. Future projects that require WMATA personnel to perform tasks in support of contractor-led track construction must include a documented work



planning process and sign-off by involved WMATA departments prior to work commencing. (Status: Expected completion date March 31, 2023)

For future projects, update contract document to include a reinspection requirement for sub-ballast compaction that is completed more than three months prior to ballast application. (Status: Expected completion date March 31, 2023)

For new track construction, require joint bar installation to be consistent with TRST 1000 Track Maintenance Standards Vol 2 requirements. (Status: Expected completion date March 31, 2023)

Include "Contractor Rail Vehicle Inspection Program" requirements in contract award packages. (Status: Completed)

WMSC staff observations:

The Chief Engineer, Vehicles (CENV) report identified important recommendations that would serve as critical corrective actions, yet Metrorail did not initially include these corrective actions in this investigation. This includes CENV requesting the operational limits for the tamper from the manufacturer, specifically the maximum allowable cross level for the vehicle while in work mode. CENV also recommended ensuring that prior to track installation new track sub-ballast is graded to within the tamping vehicles capabilities to reduce tamping time and derailment risk. In areas with excessive cross level change, the report recommended use of a spotter to check for wheel climb or suspension unloading so that the operator can stop prior to derailment. The report also recommended that when track geometry is at or beyond the reading limit of the vehicle, operators lift the track in multiple passes.

As Metrorail did not have a documented maximum operational cross level for the tamper, Metrorail should fully consider any similar operational restrictions and provide adequate training and information to operational personnel to ensure their safety and the safety of Metrorail systems.

Metrorail's vehicle inspection teams properly ensured that the contractor's tamper unit was not permitted to operate in the Metrorail system without meeting safety requirements. Other Metrorail personnel rushed, without planning or sufficient communication and guidance, to put Metrorail's tamping crew to work in the area in an effort to maintain work schedules.

Metrorail can further mitigate risks by effectively overseeing the work of its contractors (and subcontractors) and ensuring that contractor personnel overseeing subcontractors also understand these responsibilities. This includes the opportunity to act when personnel observed the overage of ballast placed the day before these derailments, to identify compromised rail joints, and to ensure that the sub-ballast and sub-grade are properly constructed including the appropriate levelling.

Following the derailments, as Metrorail implemented safety mitigations recommended by subject matter experts, the vehicle had been inspected, other necessary investigative activities had been completed, movement of the vehicle would require travel over other active mainline track, movement continued at low speed, and as the conditions of the track could only be addressed using a tamper, the WMSC did not object to Metrorail's decision to then continue the tamping activities with operational restrictions in place.

The WMSC is concluding a previously scheduled safety audit of Metrorail's Roadway Maintenance Machine program. Draft and final reports are expected in the coming months.



Washington Metropolitan Area Transit Authority Department of Safety (SAFE) Office of Safety Investigations FINAL REPORT OF INVESTIGATION A&I E22593/E22595

Date of Event:	September 13, 2022		
Type of Event:	Derailment		
Incident Time:	03:15 & 12:10 hours		
Location:	Potomac Yard Authorized Construction Site (ACS)		
Time and how received by SAFE:	03:59 & 12:58 hours – Mission Assurance		
	Coordinator (MAC)		
WMSC Notification Time:	04:29 & 13:02 hours		
Event Scene Release:	04:29 & 13:05 hours		
Responding Safety Officers:	WMATA: OSI/OSO		
	WMSC: None		
	Other: None		
Rail Vehicle:	Plasser Tamper Unit T006		
Injuries:	None		
Damage:	None		
Emergency Responders:	CTEM, CENV, TRST		
SMS I/A Number	20220913#102838MX		

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Potomac Yard ACS – Derailment

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Abbreviations and Acronyms

ACS	Authorized Construction Site
САР	Corrective Action Plan
ссти	Closed-Circuit Television
CENV	Vehicle Program Services
СТЕМ	Car Track Equipment Maintenance
DGMTS	Dulles Geotechnical and Materials Testing Services
MAC	Mission Assurance Coordinator
MOC	Maintenance Operations Center
MSRPH	Metrorail Safety Rules and Procedures Handbook
МТРО	Metro Transit Police Department
NOAA	National Oceanic and Atmospheric Administration
OSI	Office of Safety Investigations
OSO	Office of Safety Oversight
POD	Point of Derailment
RTC	Rail Traffic Controller
RTRA	Office of Rail Transportation
ROCC	Rail Operations Control Center
ROIC	Rail Operations Information Center
SAFE	Department of Safety
SMS	Safety Measurement System
TRST	Office of Track and Structures
WMATA	Washington Metropolitan Area Transit Authority
WMSC	Washington Metrorail Safety Commission
WWPL	Wayside Work Planning

Washington Metropolitan Area Transit Authority Department of Safety – Office of Safety Investigations

Executive Summary

*Note that all times listed are approximate and may contain minor variations due to differences between systems of record. *

On Tuesday, September 13, 2022, at 03:15 hours, a Plasser Tamper (T006), operated by a Track and Structures (TRST) Equipment Operator derailed at CM C1 458+50 within the Authorized Construction Site (ACS). The ACS site supervisor notified the Maintenance Operations Center (MOC) of the derailment at 03:59 hours. They reported that the derailment occurred while the unit was tamping new track.

At 04:14 hours, the Radio Rail Traffic Controller (RTC) advised the Rail Operations Control Center (ROCC) Operations Manager (OM) of the incident. At approximately the same time, the Mission Assurance Coordinator (MAC) advised the on-call SAFE Director, who began dispatching members of the Office of Safety Oversight (OSO) and the Office of Safety Investigations (OSI) to the scene. At 04:29 hours, the MAC advised the Washington Metrorail Safety Commission (WMSC) of the incident.

The on-scene investigation revealed that the Tamper unit derailed on a newly constructed section of track and was in the process of tamping the ballast to bring the track into required specifications for passenger service. Field interviews indicated that prior to the derailment, the Tamper unit indicated an elevation change of approximately nine inches was required for both rails. While the unit was lifting the running rail, the unit derailed over a rail joint that was supported by a joint bar. The amount of ballast over the derailment area precluded a full inspection of the joint bar, during both derailments.

The track and sub-ballast, ballast and track laying were conducted by an authorized WMATA contractor; however, the contractor's Tamper unit was not yet certified by WMATA to operate on mainline tracks. TRST's Tamper unit was utilized to continue the track construction until the contractor tamper's deficiencies were corrected.

Following field interviews, on-scene investigation, and WMSC ESR, the unit was rerailed by the Car Track Equipment Maintenance (CTEM) re-railing team. The unit was inspected for damage by CTEM and Vehicle Program Services (CENV) personnel. Measurements of the track gauge were captured, however a visual observation of the running rails indicated significant cross level deficiencies, which is expected as part of new track construction. Tamping and ballast regulation are part of the track construction process used to bring the tracks into a performance standard.

WMATA leadership and Office of Safety Investigations consulted with the WMSC on allowing the unit to continue operating within the ACS, given the nature of the derailment (track construction). The WMSC offered no objection to allowing the unit to continue working. Mitigations were developed, including making multiple passes over the area to be tamped, operating at a slower speed, and limiting the elevation change per pass to 1.25 inches.

At 12:41 hours, Wayside Work Planning (WWPL) personnel advised the Maintenance Operations Center (MOC) of a second derailment of T006 that occurred at approximately 12:10 hours at the same approximate location. OSO, OSI, CTEM and TRST personnel returned to the scene to conduct a second investigation. Prior to the second derailment, the tamper unit made a successful pass over the area and adjusted the running rail elevation. This resulted in some ballast settlement, which further revealed the joint bar at the area of the point of derailment (POD). The joint bar was supported by a single bolt on each side of the joint. Field interviews indicated that the Equipment Operator was following the prescribed mitigations after the first derailment. While the unit was at its point of rest, track gauge and cross level measurements were captured. They indicated that the left running rail was still high, and elevation varied through the area of the derailment. This cross-level variation, coupled with the movement at the rail joint likely contributed to the unit derailing again.

Personnel on site prescribed adding additional bolts to the joint bar to reduce the movement of the joint while the Tamper moves over it. The additional mitigation was shared with the WMSC, who did not object to rerailing and continuing the track construction with the T006 unit. The unit was rerailed again by CTEM personnel. Two additional joint bar bolts were added, and the unit continued to work without issue.

The probable cause of this event was a combination of track deficiencies, including cross level and elevation changes over a short distance, which are inherent during track construction. Insufficient joint support also likely contributed to the derailments. Post-incident field inspections by CENV and evaluation of the T006's design did not find significant evidence to show that a vehicle deficiency contributed to the derailments.

Incident Site

Potomac Yard ACS Chain Marker C1 458+50 Chain Marker C1 454+00 - 460+00

Field Sketch/Schematics



* Not to Scale. Red star notates approximate site of both derailments.

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Purpose and Scope

This incident investigation and candid self-evaluation aim to collect and analyze available facts, determine the probable cause(s) of the incident, identify contributing factors, and make recommendations to prevent a recurrence.

Investigation Methods

Upon receiving notification of the derailment events on September 13, 2022, SAFE dispatched a cross-functional team to assess the scene and conduct a subsequent investigation. SAFE team members worked with relevant WMATA subject matter experts to review the incidents' facts and data.

The investigative methodologies included the following:

- Physical Site Assessment
- Informal and Field Interviews Collected through conversations with individuals during the investigation to provide background and supporting information. Written statements were also reviewed from personnel present during the event.
- Documentation Review A collection of relevant work history information and process documentation contained in Metro systems of record. These records include:
 - Metrorail Safety Rules and Procedures Handbook (MSRPH)
 - National Oceanic and Atmospheric Administration (NOAA)
 - MOC Assistant Superintendent Summary Log
 - CTEM (Car Track Equipment Maintenance) Work Orders
 - CENV Derailment Report
 - Potomac Yard ACS Temporary Order T-22-30
 - Sub-Ballast Compaction Record
- System Data Recording Review A collection of information contained in Metro Data Recording Systems. This data includes:
 - Audio Recording System (ARS) playback [Radio and Landline Communications]

Investigation

First Derailment

On Tuesday, September 13, 2022, at 03:15 hours, a Plasser Tamper (T006) derailed at approximately Chain Marker (CM) C1 458+50.



Figure 1: Tamper T006 as it appeared, on scene, oriented travelling south towards the site for Potomac Yard station along Track 1.

Consultation of the ARS and conversations with personnel on scene confirmed that the ACS Supervisor advised that Tamper T006 derailed from Track 1 of the Potomac Yard ACS at CM C1 458+50 at 03:15 hours, while tamping new track.



Figure 2: Tamper T006 point of rest, front left side.

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 Reviewed By:
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Figure 3: Tamper T006 point of rest, front right side.

The ACS Supervisor explained the Tamper Equipment Operator worked with two Spotters and was responsible for operating the Tamper in order to straighten and level track by tamping ballast underneath. The ACS Supervisor stated the work conducted was part of a project to re-align and extend existing track in order to run through the future site of the Potomac Yard Station.

The ACS Supervisor stated they did not believe the Operator was at fault due to the nature of the derailment, which they explained was out of the Operator's control. The ACS Supervisor stated the Tamper Operator was not removed from service for post-incident toxicology test for this reason.

The Tamper Operator stated they were assigned to drive and operate the Plasser Tamper T006, initially in "transport" or "record" mode; a modality affiliated with recording data and analyzing the track where it lays against where it is required to be.

The CENV derailment report explained that the tamper uses an onboard geometry computer to evaluate the track's existing geometry against the required track design geometry. "Based on a calculated differential, the vehicle performs adjustments semi-automatically to lift and laterally shift the tracks between the trucks using thousands of pounds of force. Once positioned, the vehicle then tamps the ballast to lock the tracks geometry in place and moves forward to begin the cycle again. In extreme conditions, though not optimal, new construction may require the operator to limit the automated alignment processes and perform the alignment in multiple passes."

On scene, the Tamper Operator stated they were tasked with conducting two passes of the area designated between CM 463+50 to 426+00 while in "record" mode.

The Tamper Operator stated that after the evaluation passes, they commenced tamping; the process of gradually lifting track up to the pre-designated height in small increments, at the CM C1 463+50. The Tamper Operator stated they set the Tamper to tamp and raised the track in 2–3-inch increments, moving in the direction of the future Potomac Yard Station, over every rail tie.

The Tamper Operator stated at approximately 03:15 hours, at CM C1 458+00, they felt the Tamper lurch forward and come to a stop. The Tamper Operator stated they then halted the vehicle and turned it off to assess what had occurred.

The Tamper Operator stated they observed the Tamper had derailed towards the front of the vehicle. The Tamper Operator stated they were uncertain as to how the derailment occurred.

A review of the ROIC Report determined at 04:03 hours the Assistant Operations Manager (AOM) of the ROCC, the MAC and the Metro Transit Police Department (MTPD) were notified of the incident.

At 04:14 hours, the RTC advised the ROCC Operations Manager of the incident. At approximately the same time, the MAC advised the on-call SAFE Director of the derailment, who began dispatching members of OSO and OSI to the scene. At 04:29 hours, the MAC advised WMSC of the incident.

Personnel from CTEM arrived on scene and were able to re-rail T006 at 07:31 hours. Multiple CTEM personnel believed the derailment was caused by issues with how the track was originally laid out, prior to tamping efforts.

TRST personnel on scene conducted track measurement to assist in determining the root cause of the derailment. Upon measuring multiple points along the track, including the point of derailment, TRST confirmed the gauge (spacing) between each running rail did not contribute to the derailment.



Figure 4: TRST personnel determine the track gauge point of derailment at 56 and 1/6th of an inch distance between the left and right running rail.

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TRST also downloaded the operating screen at the point of derailment. The Tamper recorded the height (elevation) deviation of the left and right tracks was 8.80 inches and 5.28 inches, respectively.

1261	
	CURVE INFORMATION
	CLIEVE INFORMATION
	Actual Throws Range From1.73 To 2.75 Throw Limit Settings Min927 77 Max 999777
	Lift Maximum LEFT 8.80 Right 5.28
ľ	RESTRICTIONS RESTRICTIONS
ntl	1 From 0,865 To 0,900 (116.0- 120.6) H V BOTH H&V
hr	Point 1 Stat 15.0 Location 0.112 Boint From 1. Formation
ate	Point 2 Stat 47.0 Location 0,351 Point Type 2, Spiral/Curve
Dē	Point 3 Stat 81.0 Location 0,604 Point Type 3, Curve/Spiral
	SUPERELEVATION POINTS
	Point 1 Stat 15.0 Location 0,112 Point Type 1, Tangent/Spiral
	Point 2 Stat 47.0 Location 0,351 Point Type 2, Spiral/Curve Point 3 Stat 81.0 Location 0.604 Point Type 3 Curve/Spiral
	Point 4 Stat 113.0 Location 0,843 Point Type 4, Spiral/Tangent
	TRACK CONFIGURATION
	TypeFromTo LengthCurvature Speed Superelevation
	MP FEET MP FEET FEET Deg: Min Inches MPH Inches
+	Spiral 0, 112 0, 351 239 1/50 in/ft
- 1	Curve 0, 351 0, 604 254 1:38 0.76 82 4.75
	Jirai 0, 843 239 1/50 in/ft Tangent 0, 843 0,1007 164 0:00 0.00
1	
	Print Exit
1	
Ť	ALV 1.03 Surf L. 1.48 Lift L. 0.00 Throw M. 1.03
0.	76 XLV H. 0.00 Surf R. 0.55 Lift R. 0.00 Throw F. 1.03
04000	

Figure 5: TRST personnel downloaded data from the Tamper and were able to determine a significant disparity between the left and right running rails' elevation (cross-level).

Both CENV and TRST personnel on scene agreed the rate of height disparity due to the initial laying of the track may have contributed to the derailment of the Tamper.

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The oncoming shift assigned to operate Tamper T006, along with CAPD leadership, identified an immediate prevention and mitigation strategy that involved tamping at 1.25 inches per pass instead of the normal maximum of three inches in order to avoid further derailment and the Tamper was put back to work.

WMATA leadership and OSI consulted with the WMSC on allowing the unit to continue operating within the ACS, given the nature of the derailment (track construction). The WMSC offered no objection to allowing the unit to continue working. Mitigations were implemented, including making multiple passes over the area to be tamped, operating at a slower speed, and limiting the elevation change per pass to 1.25 inches.

Second Derailment:

A review of the ARS and the ROIC Report determined at 12:10 hours, the Mobile Command Manager reported that at a speed of approximately three miles per hour (MPH), Tamper T006 derailed between CM C1 454+00 - 460+00. The TRST Supervisor on scene reported that the front trucks of T006 derailed while the Tamper was in performance of its duties.



Figure 6: Tamper T006, second derailment.



Figure 7: Overage of ballast observed on Track 2 (left side of image) in area opposite of the derailment. Track 1 (right side of image) shows results of tamping activity.

At 12:41 hours, WWPL advised the MOC of a second derailment of Tamper T006 that occurred at 12:10 hours between CM C1 454+00 - 460+00. At 12:45 hours, the RTC notified the AOM of the derailment.

At 12:52 hours, the MAC advised OEP of the second derailment and that there were no injuries or damage to property. At 12:58 hours, the MAC advised the SAFE on-call director of the incident. The on-call Director advised the MAC that the WMSC had been notified.

OSO, OSI, CTEM and TRST personnel returned to the scene to conduct a second investigation. Prior to the second derailment, the tamper unit made a successful pass over the area and adjusted the running rail elevation. This resulted in some ballast settlement, which further uncovered the joint bar at the area of the POD.

The joint bar was supported by a single bolt on each side of the joint. Field interviews indicated that the Equipment Operator was following the prescribed mitigations following the first derailment. While the unit was at its point of rest, track gauge and cross-level measurements were captured. They indicated that the left running rail was still high and varied through the area of the derailment. This cross-level variation, coupled with the movement at the rail joint likely contributed to the unit derailing again.



Figure 8: Mismatched rail joint, with joint bar at the POD.

Personnel on site prescribed adding additional bolts to the joint bar to reduce the movement of the joint while the Tamper moves over it. The additional mitigation was shared with the WMSC, who did not object to rerailing and continuing the track construction with the T006 unit. The unit was rerailed again by CTEM personnel. Two additional joint bar bolts were added, and the unit continued to work without issue.

At approximately 15:30 hours, Tamper T006 was re-railed by CTEM.

Following the event, the contractor's Tamper unit was certified by CTEM and was used to perform tamping activity on Track 2.

No Closed-Circuit Television (CCTV) footage exists of either image as there were no cameras or power present at the site during the incident.

Time	Description
03:59:44 hours	ACS Supervisor reported to the ROCC Tamper T006 derailed from Track 1
	of the Potomac Yard ACS at CM C1 458+50 between 03:10 and 03:20 hours,
	while working. [Phone]
04:14:10 hours	RTC advised the ROCC Operations Manager of the derailment. [Phone]
04:14:34 hours	MAC advised the on-call SAFE Director of the derailment. [Phone]
04:15:46 hours	MAC advised the on-call SAFE Officer of the derailment at CM C1 458+50. [Phone]

Chronological Event Timeline

Time	Description
04:29:43 hours	MAC advised WMSC of the derailment. [Phone]
04:32:21 hours	The ROCC Director advised the Operations Manager to reduce the severity of the incident classification to "A3" in the ROCC Alert due to no report of injuries, damage, or service impact. [Phone]
12:41:51 hours	WWPL advised the MOC of a second derailment of Tamper T006 that occurred at approximately 1210 hours between CM C1 545+00 – 550+00 (would later be corrected to 454+00 – 460+00). [Phone]
12:45:15 hours	RTC advised the ROCC AOM of a second derailment of Tamper T006 that occurred at approximately 1210 hours between CM C1 545+00 – 460+00 (would later be corrected to 454+00 – 460+00), no injuries reported. [Phone]
12:52:42 hours	MAC advised OEP of the second derailment, no injuries or damage reported. [Phone]
12:58:43 hours	MAC advised SAFE on-call director of the second derailment, no injuries or damage reported. The SAFE on-call director stated WMSC had been notified and that OSO was on scene. [Phone]
13:02:24 hours	MAC left a voicemail for WMSC of the re-rail of T006 and subsequent second Derailment. [Phone]
13:11:09 hours	MAC advised the MTPD watch commander of the second derailment. [Phone]
13:14:08 hours	MAC contacted OSO personnel on scene in reference to re-railing T006 a second time. [Phone]

Vehicle Program Services (CENV) Report

A review of the CENV Report determined there were no mechanical faults to Tamper T006 and it was in "work" mode at the point of initial derailment. The report stipulated that while in "work" mode, the Tamper's front suspension is unlocked in order for the tamper to be able to conduct the tamping. This, in turn, reduces the rigidity of the vehicle.

The CENV Report further determined that after the second derailment, track measurements identified a cross-level change of approximately 3.5 inches over 33 feet leading to the point of derailment. No damage was done to the Tamper.

The CENV Report also determined track testing conducted after rerailing the vehicle after the second derailment and inspection of the suspension found that the suspension, on the side of wheel climb, appeared to be unloaded. Once the vehicle was moved to a less extreme area the suspension loaded normally. Additionally, a joint with mismatched rail ends was located approximately two feet away [as noted in previous sections, the joint was supported by a joint bar].

The report concluded that excessive cross level change (3.5 inches over 33 feet) and a mismatched rail joint within the work area is likely the root cause of these derailments.

Potomac Yard Construction (PYC):

PYC personnel were on the scene of the incident. The PYC Project Manager advised that their team was responsible for oversight of the contract, however, they subcontracted the laying of track and ballast to G.W. Peoples Construction.

POTOMAC YARD
CONSTRUCTORS
A JOINT VENTURE
NEW EMPLOYEE SAFETY ORIENTATION PROJECT SAFETY RULES ** EMPLOYMENT & SUBCONTRACTOR RESPONSIBILITY
ALL EMPLOYEES WILL ABIDE BY THE JOINT VENTURE HAZARD COMMUNICATION PROGRAM (AND COMPLIAN
WITH FEDERAL OSHA STANDARD 1926.59) AND BY THE FOLLOWING RULES:
I. Hard hats and Safety Vests & Eye glasses shall be worn by all employees without exception. Each project off shall have a supply of hard hats & PPE for visitors on the project.
 Dress properly, Wear appropriate work clothes, gloves and shoes or boots. Loose clothing and jewelry should r be worn. Use address
 Use additional face protection (shield) where there is a danger from flying objects or particles such as wh grinding, chipping, burning and welding, etc. A If you are in the such as th
 All injuries. No matter how slight, must be reported to your foreman and or superintendent. Fighting or horseplay will not be tolerated
 Substance abuse on the project will not be tolerated. Understand that you must be "Fit for Duty "and not und the influence of Illegal drugs or alcohol.
 Make sure back-up warning devices on equipment are always in working order; Always make eye contact w operator- Small site lots of large equipment on site Be alert to present the present of the present of
10. Report any unsafe act or condition to your foreman and/on such as the second secon
11 You must attend Toolbox Talks and Safety Training as Scheduled by Halmar International
12. It is your responsibility to report all accidents, injuries, hazardous conditions, broken or defective self-
equipment IMMEDIATELY to your direct supervisor.
cleared fit tested
14. Must follow follow follow
15. Must have Current Materia and a first
16. No use of headphones to lister to main in a second for one year.
17. No Use of cell phones.
I have had a to a
I know where the
l understand the safety data sheets for my work are kept.
I understand that All melo and precautions to be taken when working.
All workers on site MUST have received an OSHA 10 br training 8 will blid to
Lunderstand the second se
the Site Safety Orientation for the Potomac Yards Metrorail Station Project
Print Name: Trade:
Signed: Date:
Oriented Employee #

Figure 9: Potomac Yard Construction Safety Orientation required to be signed by all personnel entering the site. (*Blank*).

Incident Date: 09/13/2022	Time: 03:15/12:10 hours	Draft
Final Report – Derailment		Revie
E22593/E22595		Appr

Drafted By:	SAFE 705 – 11/10/2022	Page 17
Reviewed By:	SAFE 70 - 02/17/2022	
Approved By:	SAFE 70 - 02/17/2022	

The PYC Project Manager advised G.W. Peoples laid the track and ballast the day prior to the event. The PYC Project Manager stated the ballast laid appeared to be excessive and obstructed the view of the crossties and joint bars.



Figure 10: G.W. Peoples installing track on September 12, 2022, in the area of the derailment. Arrow pointing at Track 1.

Sub-Ballast Compaction Record (CAPD):

The sub-ballast compaction record provided by CAPD, conducted by Dulles Geotechnical and Materials Testing Services (DGMTS), determined compaction over a number of different areas, within the project. In reference to the initial derailment site, the report articulated on December 14, 2021, backfill and compaction were conducted between CM 457+00 and 460+00 by a smooth drum roller and steel plate temper.

The report also articulated the compacted area was tested and scored 100% on the maximum dry density requirement as determined by Modified Proctor Method ASTM D1557/AASHTO T180.

The Sub-Ballast backfill material moisture was corrected by burning method at the field. Placement and compaction of fill material was performed as per Project Specification 31 23 00 Grading, Excavation and Backfilling.



Figure 11: The site of the compaction conducted on 12/14/2021.

CAPD Response

CAPD stated another Tamper, a Harsco MK IV was scheduled to complete the work at Potomac Yards Station, the day of the incident. CAPD stated this Tamper was not utilized due to it failing certification by CTEM, which is required for all contractor-owned equipment.

CAPD stated that on September 14, 2022, the Harsco MKIV Tamper was certified and completed tamping without incident. Their assessment of the event indicated that the Harsco Tamper was better suited to traverse the constructed track and would not have derailed under the same conditions.

Research into both Tampers' capability to traverse the significant the cross-level variations identified revealed no corroborating evidence for this claim.

<u>Weather</u>

On September 13, 2022, at the time of the incident, NOAA recorded the temperature as 64° F, with light rain in places and with an average of 64% humidity and an average windspeed of 4.8 MPH. Weather was not a contributing factor in this incident (Weather source: NOAA – Location: Washington, DC)

Human Factors

Evidence of Fatigue

The biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied for this event as no signs or symptoms of fatigue were self-reported during the course of the interviews. Further, all personnel interviewed reported having an adequate, ongoing sleep schedule.

Fatigue Risk

The biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied for this event as no risk was assessed based on the information gathered.

Findings

- Tamper T006, while in "work mode," derailed twice on September 13, 2022; once at approximately 03:15 hours (CM C1 458+50) and again at approximately 12:10 hours in approximately the same location (CM C1 454+00 460+00).
- On-scene observations by responding personnel and the CENV Report concluded the most likely cause of the derailment on both occasions was excessive rate of cross level change (3.5 inches over 33 feet of track) and a mismatched rail joint within the work area.
- Insufficient joint support also likely contributed to the derailments due to an insufficient number of bolts installed in the joint bar.
- PYC observed an excess of ballast on the track after G.W. Peoples initially laid both the ballast and the track.
- While not found to be contributory to the event, CAPD provided a sub-ballast compaction report that articulated the sub-ballast was installed appropriately; however, the latest assessment was conducted on 12/14/2021.
- No Human Factors were identified as being contributory to the derailments.
- No vehicle deficiencies were identified by responding CENV and CTEM personnel.
- No individuals were injured, and no property was damaged as a result of either incident.

Immediate Mitigation to Prevent Recurrence

- Prior to the first derailment, the Tamper was set to tamp 2-3 inches of track per pass; however, a decision was implemented to continue to run the Tamper set to 1.25 inches to avoid future derailment, after the first derailment. This was not fully effective, as a second derailment occurred.
- Additional joint bar bolts were installed at the running rail joint to prevent additional movement of the running rails in the derailment area. The joint bar was not accessible following the initial derailment due to the amount of ballast covering the area.
- For future projects, if called to assist new track construction, TRST will perform their own inspection of the work area and perform any required preparatory work prior to undertaking the nominated task.

Probable Cause Statement

The probable cause of this event was a combination of track deficiencies, including cross level and elevation changes over a short distance, which are inherent during track construction. Insufficient joint support also likely contributed to the derailments. Post-incident field inspections by CENV and evaluation of the T006's design did not find significant evidence to show that a vehicle deficiency contributed to the derailments.

Corrective Action Code	Description	Responsible Party	Due Date
102838_SAFE CAPS_CAPD _001	Future projects that require WMATA personnel to perform tasks in support of contractor-led track construction must include a documented work planning process and sign-off by involved WMATA departments prior to work commencing.	CAPD	03/31/2023
102838_SAFE CAPS_CAPD _002	For future projects, update contract document to include a reinspection requirement for sub-ballast compaction that is completed more than three months prior to ballast application.	CAPD	03/31/2023
102838_SAFE CAPS_CAPD _003	For new track construction, require joint bar installation to be consistent with TRST 1000 Track Maintenance Standards Vol 2 requirements.	CAPD	03/31/2023
102838_SAFE CAPS_CAPD _004	Include "Contractor Rail Vehicle Inspection Program" requirements in contract award packages.	CAPD	Completed

Recommended Corrective Actions

Appendices

Appendix A – Temporary Order T-22-30 (Redacted)



Washington Metropolitan Area Transit Authority

METRORAIL SAFETY RULES AND PROCEDURES HANDBOOK

TEMPORARY ORDER

NO. T-22-30 ACS Limits for South of National Shutdown	Approved Date: Monday, August 22, 2022
Affected Rule/SOP: MSRPH Section 5 – Clause 5.4.1 "What is the Roadway?"	Effective Date: Saturday, September 10, 2022
	Rescinded Date: Wednesday, September 28, 2022

TO: All Personnel

Scope:

Temporary Order (TO) T-22-30 is to provide an exception to the MSRPH Section 5 Roadway Worker Protection (RWP), clause 5.4.1 "What is the Roadway?" during the Blue/Yellow Line Shutdown south of National Airport Station.

Purpose:

The purpose of TO T-22-30 is to establish the limits for the Authorized Construction Site (ACS) within the South of National shutdown, starting on September 10 (after revenue service and Yard rebalancing has been completed) and ending on September 28th at 06:00 before re-energizing the ACS area upon completing track construction and rail systems work.

TEMPORARY ORDER

Page 1 of 7

Temporary Order Details:

The area of Potomac Yard, C line 407+00 to 529+30, on both Track 1 & 2, is an Authorized Construction Site under Potomac Yard Constructors' (PYC) purview from 9/10/2022 at 01:00 and ending before re-energization of the ACS area upon the completion of track construction, and rail systems work.

PYC's point of contact is I

Once ACS is established, PYC will be responsible for communication if emergency response is required within ACS. However, as per the criticality chart below, Rail Operation Control Center (ROCC) will only take over Command, Control, and Coordination of Emergencies within the ACS during a Level 3 emergency.

Chart of Criticality					
Level 1	Employees or Contractors requiring First Aid.				
Level 2	2 Equipment Derailment/Collision.				
	Smoke and minor fires, visible short distance				
	Employee medical transport				
Level 3	Death or severe injury to customers, contractors, or employees.				
	Flood condition that endangers customers or employees.				
	Fires that may potentially result in death/injuries and, or damage to property				
	Any other emergency that poses life-threatening conditions.				

Procedure:

In the case of level 1, PYC will provide first aid treatment and inform SAFE and the project team. In the case of level 2, PYC's first call of response will be direct to the emergency services i.e., 911 and at the same time, WMATA on duty inspector will notify MTPD on 202-962-2121, and then notify SAFE/OEP at SAFE and project team must always be informed, and all accident/incidents be recorded, documented, and disclosed to SAFE and project team on request. In case of a derailment – contractor will maintain the scene until further notice from the WMATA Project Office and/or WMATA SAFE.

PYC shall maintain, in chronological order, a detailed record of all activities occurring during an incident/accident:

TEMPORARY ORDER

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For level 1 criticality:

- The Date/Time the incident/accident occurred
- The employee and company name
- Description of what, how, and when the incident/accident happened
- · What body part injured (non-life threating conditions)

For level 2 criticality:

- The Date/Time that the incident/accident occurred
- The employee and company name
- · Description of what, how, and when the incident/accident happened
- If person required transportation to a hospital, provide the hospital name, supervisor name, ambulance unit number/ID
- What body part was injured (non-life threating conditions)

In case of level 3 criticality accident, PYC's first call of response will be directly to the emergency services (i.e. 911) and at the same time, WMATA on duty inspector will notify ROCC ROCC WILL take full control of the site and all regular MSRPH procedures will apply. SAFE and project team must always be informed, and all accident/incidents be recorded, documented, and disclosed to SAFE and project team on request.

Assets in/out of service (within ACS)

C12 Braddock Road, C12 TCR, C12 TBS, C11 TPSS, C11 TCR, C11 TBS

- · Stations, power, and train control facilities fully de-energized
- Fire alarm and emergency phones will be out of service

Authorized Construction Sites are not Roadway

An 'Authorized Construction Site' is **NOT** considered the roadway. An ACS is a work area where **safety is the full responsibility of the contractor** and does not require the contractor to follow Metro safety procedures, including use of Metro access or safety escorts nor support from Metro roadway safety personnel, including RWIC, Watchman/Lookout, and AMF. Metro maintains the authority to establish safety protections for ACS, regularly inspect work conducted within ACS to ensure adherence to scope, schedule, OSHA compliance and manage the movement of equipment and rail vehicles into and out of the ACS. RWP training is not required for personnel working within an ACS.

TEMPORARY ORDER

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Note: All personnel, including WMATA personnel, seeking to enter the ACS must coordinate access through the responsible Contractor and follow their established safety procedures. *Non-PYC personnel not directly supervising or supporting the contractor shall not enter an ACS without express, written permission of the WMATA Project Manager.* There will be no access to the station for any purpose other than the direct supervision or inspection of the contractor, this includes the use of the station facilities.

ACS Area: Potomac Yard Metro Station Project, Starting September 10, 2022

The area of Potomac Yard, C line 407+00 to 529+30, on both Track 1 & 2 is an Authorized Construction Site under Potomac Yard Constructors' (PYC) purview from 9/10/2022 at 01:00 and ending prior to re-energization of the ACS area upon the completion of track construction and rail systems work. The entire South of National area will be physically and electrically isolated prior to establishing the ACS area.

- Specific boundaries: The ACS is a single location with limits between National Airport and Braddock Road Stations, chain markers 407+70 to 529+30.
- Physical isolation: WMATA will take the following actions to physically isolate the Authorized Construction Site:
 - 2.1. WMATA will install a cross tie barrier with a WMATA lock, PYC lock, chain, Lights, and mat at 529+30 and another at 407+70.
 - 2.2. Mobile Command will instruct crews working in adjacent territory on where mats, lights and work limits are to be established to maintain safe distances between work zones.
 - 2.3. PYC staff will access the site via existing Traction Power Sub Station access road and Potomac Yard Construction Entrance on Potomac Greens Drive.
- Electrical isolation: WMATA will take the following action to electrically isolate the Authorized Construction Site in accordance with SOP 2.
 - 3.1. Traction power will be de-energized.
- 4. Mobile Command Coordination:
 - 4.1. Upon completion of the physical & electrical isolation processes, Crew Support Personnel (CSP) on duty supervisor will notify MCC that the ACS has been physically and electrically isolated.

TEMPORARY ORDER

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5. Work Equipment:

5.1. Large equipment will enter and exit the ACS via the Potomac Yard Construction Entrance on Potomac Greens Drive. Hi-rail and rail bound equipment will enter from the J03 Tail Track and the C99 Yard at the beginning of the ACS.

6. Access:

- 6.1. Contractors are required to enter and exit the ACS through the Potomac Yard Construction Entrance on Potomac Greens Drive.
- 6.2. Parking areas PYC-1 PYC-4 are designated in the Emergency Response Access Plan (Exhibit D). Non-Rail construction vehicles will be within PYC-2 Parking Lot. PYC-4 Parking Lot & PYC-3 Parking Lot will be used for other crafts not actively working on the cut-over scope. PYC-1 Parking Lot will be for WMATA and PYC Project Management Staff.

7. WMATA Reinstatement Plan:

- 7.1. Prior to re-energization of the ACS area upon the completion of track construction and rail systems work, the ACS arrangements will be terminated, all safety protections and temporary infrastructure will be removed.
- 7.2. After removal of the ACS set-up, the rail will be re-energized for the dynamic testing phase of the cut-over to begin. This phase is planned to end on October 22, 2022.

Points of Contact

Senior Program Manager	
Construction Manager	

TEMPORARY ORDER

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Figure 1, ACS Map 1 of 2



Figure 2, ACS Map 2 of 2

TEMPORARY ORDER

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Executive Summary

At approximately 3:15 hours on the morning of September 13th, 2022, within the Potomac yard station tie-in Authorized Constriction Site (ACS), Tamper T006 Derailed. (Figure 1 & 2).





Figure 1 – Tracks in derailment area

Figure 1 - T006 Derailed truck

Inspection of the vehicle revealed no issues which could have contributed to the incident, but, as outlined in the findings below, the vehicle was likely working on new track with high cross level change. Subsequently, after the initial investigation and rerailing, the vehicle was authorized to return to work under operational restriction. The vehicle completed another tamping pass of the area and derailed again, in the same location as the previous derailment. Evaluation of the vehicle and roadway revealed again that excessive cross level change and a mismatched rail joint within the work area were likely the cause of these derailments.

Introduction

At approximately 0315 hours on the morning of September 13th, 2022 Tamper T006 Derailed near chain marker 458+00 while tamping within the Potomac yard station tie-in ACS. SAFE released the vehicle to CTEM at approximately 0600. CTEM rerailed the vehicle at approximately 0730, after which a post incident inspection and track test was conducted. No issues or damage were reported during rerailing or inspection.

The vehicle was authorized to return to work under operational restriction. The vehicle completed another tamping pass of the area and derailed again, in the same location as the previous derailment. This derailment occurred at approximately 1230 hours. SAFE released the vehicle to CTEM at approximately 1350 hours. CTEM rerailed the vehicle at approximately 1500 hours. Again, a post incident inspection and track test were conducted. No issues or damage were reported during rerailing or inspection.

Tamper T006 was being used to align the new track for the Potomac yard tie-in. The vehicle has two modes: travel; for transporting the vehicle across the rail to a work area; and work, for aligning tracks. When T006 is in work mode and tamping the suspension is locked out to increase total vehicle rigidity.

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This information is proprietary to the Washington Metropolitan Area Transit Authority (WMATA). No reproduction is allowed without prior written consent. When the vehicle is moved in work mode, the front suspension in unlocked.

The tamper uses an onboard geometry computer to evaluate the track's existing geometry against required track design geometry. Based on a calculated differential, the vehicle performs adjustments semi-automatically to lift and laterally shift the tracks between the trucks using thousands of pounds of force. Once positioned the vehicle then tamps the ballast to lock the tracks geometry in place and moves forward to begin the cycle again. In extreme conditions, though not optimal, new construction may require the operator to limit the automated alignment processes and perform the alignment in multiple passes.

Findings of Investigation

Work began by using the onboard geometry computer to evaluate the new track. The computer evaluated the geometry and during the tamping process the vehicle experienced the first derailment midway through the first tamping pass.

After the initial investigation and rerailing, the vehicle was authorized to return to work under the restriction that the operator lift the track in multiple passes, up to 1 inch of total lift per pass, until they were within 1 inch of the desired geometry. Then the operator would be allowed to perform computerevaluated lift and lining alignment.

After being authorized to return to work the vehicle completed another tamping pass of the area. Per the restriction outlined above, when moving the vehicle back to the starting point, it derailed again, in the same location as the previous derailment.

Post incident inspection of the vehicle was conducted with no damage found. The track was inspected using a track gauge and it was found that the area leading to the point of derailment (POD) had a change in cross level of 3 1/2 inches over 33 feet in the direction of travel. This area is depicted below in Figure 3.



Figure 3 - Derailment area

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This information is proprietary to the Washington Metropolitan Area Transit Authority (WMATA). No reproduction is allowed without prior written consent. Track testing conducted after rerailing the vehicle and inspection of the suspension found that the suspension, on the side of wheel climb, appeared to be unloaded. Once the vehicle was moved to a less extreme area the suspension loaded normally. Additionally, a joint with mismatched rail ends was located approximately two feet away, on the opposite rail of the initial POD (Figure 4).



Figure 4 - Mismatched rail ends at joint

Conclusion

Excessive cross level change and a mismatched rail joint within the work area is likely the root cause of these derailments.

Recommendations

- CENV to request the operational limits, specifically the maximum allowable cross level of the vehicle while in work mode, from the manufacture.
- It is recommended that prior to track installation, new track sub ballast is graded to within the tamping vehicles capabilities to reduce tamping time and derailment risk.
- In areas with excessive cross level change, it is recommended that the operator use a spotter to check for flange climb or suspension unloading.
- When track geometry is at or beyond the reading limit of the vehicle, it is recommended that TRST operators lift the track in multiple passes.

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Dulles Geotechnical and Materials Testing Services, Inc. (DGMTS)								
14	155 SULLYFIELD	O CIRCLE, SUITE H, CHA	NTILLY, VA 201	51		PH	ONE: 703-99	9-3207
DAILY FIELD REPORT (DFR) DFR No. 288								
NON-CONFORMANCE NOTED D NO J YES if yes, NCR No Pa				Page No	1 of 3			
Time In	12:00 PM	Time Out	3:30 PM	30 PM Total Site Time 3.5 h			Date	12-14-2021
Travel Time	-	Reason for Travel	Compaction Testing				Weather	Clear
Project Name Potomac Yard Station H		Project No.		19094				
General Contractor Potomac Yards Constructors (PYC) GC			GC Representative					
Contractor Performing Reported Work		Potomac Ya Constructor	tomac Yards Instructors (PYC)		Location Main Station		tion	

Backfill & compaction for the Main Station Electric Trough between. Sta. 457+00 and 460+00. Compaction test summary sheet attached.

Backfill and compaction performed for the Main Station Electric Trough between. Sta. 457+00 and 460+00. The backfilled Sub-Ballast material was compacted using smooth drum roller and steel plate temper B4.

Utilizing the Nuclear Gauge Method (ASTM D 6938), the compacted area was tested. Test results met 100% maximum dry density requirement as determined by Modified Proctor Method ASTM D1557/AASHTO T180. The Sub-Ballast backfill material moisture was corrected by burning method at the field. Placement and compaction of fill Material was performed as per Project Specification 31 23 00 Grading, Excavation & Backfilling (IFC).

Applicable Specifications						
х	31 23 00 Grading, Excavation	& Backfilling (IFC).				
Inspector/Technician				Signature/Date	12-14-2021	
Re	viewed By (Name)			Signature/Date	12-14-2021	



Appendix D – Root Cause Diagram



Root Cause Analysis

