



Board Report

File #: 2016-0636, File Type: Informational Report

Agenda Number: 35

SYSTEM SAFETY, SECURITY AND OPERATIONS COMMITTEE JANUARY 19, 2017

SUBJECT: OFFICE OF THE INSPECTOR GENERAL REPORT ON REVIEW OF METRO SAFETY CULTURE AND RAIL OPERATIONAL SAFETY

ACTION: RECEIVE AND FILE

RECOMMENDATION

RECEIVE AND FILE report on **Review of Metro Safety Culture and Rail Operational Safety**.

ISSUE

On February 26, 2015, MTA Board directed the Inspector General to:

- I. Conduct research into an appropriate zero-tolerance policy for Red Light violations for our Rail and Bus system and return to the Board in March with such a policy for consideration; and
- II. Retain an independent consultant with expertise in safety culture and rail operational safety to conduct a review of MTA rail operations and management, including a root-cause analysis of the Red Light violations committed over the past two years.

DISCUSSION

- I. Zero-tolerance policy for red light violations
 - i. Metro's Office of the Inspector General (OIG), pursuant to the Board's directive and the OIG mission, conducted research on a zero-tolerance policy for red light violations and reported to Metro Board on March 2015. We found that:
 1. Metro does not have a policy called "zero-tolerance" for red light violations. However, Metro has safety related policies and procedures to guide Metro management, rail operators, and bus operators for their operations of Metro rail and bus systems.
 2. Under our agreements with the Unions representing operators, red light violations are now designated as "major" violations. They were previously designated as "minor" infractions.
 3. Metro has a progressive discipline policy for red light or signal violations in writing for bus and as a practice for rail.

ii. We made recommendations to the Board:

1. Operations should provide to the Board, at least quarterly, a report on major rule violations, dispositions, recidivism, claims for property and personal injury categorized by type of violation, historical and current, so that trends can be identified to determine if the new Union contract discipline policy is having a positive effect and reducing injuries to the public.
2. The Safety Committee receive periodic technology and maintenance reports to better address monitoring of technology as it relates to safety operations.

II. Review of Metro Safety Culture and Rail Operational Safety

The OIG, pursuant to the Board's directive and the OIG mission, conducted a study of Metro Rail red light violations including root causes of any violations in the last two years, and an analysis of Metro's safety culture and rail operational safety including infrastructure issues, operator training, use of efficiency testing, and effectiveness of discipline. The purpose of the study is to self-police and promote safety to avoid incidents similar to those at other transit properties and address concerns in the industry across the nation about the quality of safety programs, transit agencies' cultures and its effect on transit agencies' performance, as well as the proliferation of red signal violations. The OIG has a role in monitoring safety in general and making recommendations for improvements where indicated.

The OIG prepared a comprehensive statement of work (SOW) for a Request for Proposal (RFP) and hired The Wathen Group (TWG), which formed a team of experts who have experience in both rail transportation and safety, to perform this review.

i. Report Summary

TWG conducted an extensive data and document review including red signal violations that occurred between July 1, 2013 and June 30, 2015. Based on OIG direction, TWG:

1. Conducted interviews with various levels of management at Metro and Los Angeles Department of Transportation (LADOT);
2. Facilitated nineteen Metro Rail employee focus groups;
3. Surveyed Metro Rail employees;
4. Conducted an extensive document review;
5. Conducted field observations between February and May 2016 to assess Metro Rail's safety culture; and reviewed the red signal violations that occurred over a two-year period;
6. Made recommendations that address the issues found in this review.

The consultant team completed the review and prepared a comprehensive report on Metro's safety culture and rail operational safety. TWG grouped the review results into six

sections:

- Section A. Safety Culture
- Section B. Red Signal Violations
- Section C. Safety Assessment of Infrastructure Elements
- Section D. Technology
- Section E. Operations and Maintenance
- Section F. Human Resources

Section A: Safety Culture Assessment

The review found that Metro Rail has made positive changes towards creating an informed culture comparing performance and perceptions over a four-year period. Compared to the 2012 survey, there have been significant improvements in all rail safety areas. However, as the rail system continues to expand and add new employees at all levels, it will be limited in its ability to improve without an additional systematic analysis of performance, trends and investigation of incidents and accidents, as well as clarify roles and responsibilities, identify, and enforce key accountabilities with performance metrics that measure field employees, management, and department performance in Operations. Some key findings include:

1. Metro does not have a central or consistent employee information data base regarding service related information, discipline/grievance records and absenteeism, making it difficult to link employee based information to operating and safety performance to identify patterns that may contribute to unsafe practices and/or facilitate positive performance.
2. Metro Rail Management proactively focuses on the red signal violations, but TWG found investigations information lacks documentation and analysis of conclusions.
3. There are mixed results on whether employees are regularly reporting consistent near misses. Better reporting of near misses is a best practice that will enable the agency to identify hazards proactively to further lower the risk of an incident or accident.
4. Metro should improve the perception of consistent treatment and discipline of employees.
5. Metro is moving in positive directions about the quality of the safety training programs. 75.9% of employee surveys said it was either “Excellent” or “Good”, up from 69.9% in 2012.

Section B: The Red Signal Violations

A major focus of the study was to review the red signal violations that occurred between July 1, 2013 and June 30, 2015 and determine trends and root causes. The key findings in this area are:

1. Metro Rail has no central employee discipline data base.
2. Investigative reports for red signal violations are not prepared in compliance with the

Agency's guidelines. Generally, the root cause is listed as "operator inattention" with no contributing factors listed. Three main categories of factors that may have contributed to the red signal violations:

- 1) Current operating practices
- 2) Existing signal configurations and/or infrastructure
- 3) Operating rules and procedures

Section C: Safety Assessment of Infrastructure Elements

TWG reviewed the rail system to identify the locations where the highest number of violations occurred. TWG also reviewed grade crossing and traffic signal equipment at ten rail/vehicle intersections where there is a higher likelihood of accidents. The key findings in this area are:

1. Some signals were not installed at the left side of the track in accordance with standards.
2. Some locations have poor visibility of signal, signage, and limit lines.
3. Lack of coordination between interlocking signals and bar signals at intersections.
4. Lack of consistency in the configuration of signage, street markings, pedestrian barriers, traffic control devices, and traffic enforcement devices at locations.

Section D: Technology

This section provides a summary of TWG's investigation of various systems and industry practices for the purpose of identifying technologies, procedures and processes that can be implemented to mitigate red signal violations and enhance safety of operation. TWG's general approach is based on the premise that it is necessary to combine technical innovation with compatible operating practices in order to achieve effective results. Proven technologies, when combined with modified operating practices, can reduce red signal violations and enhance safety of operations. In this area, Metro should:

1. Establish an operating plan to implement the new SCADA/CTC system with automatic route setting and modify operating rules and procedures.
2. Consider the installation of dispatch indicators at terminal stations to facilitate the implementation of an Automatic Dispatching System (ADS).

Section E: Operations and Maintenance

TWG reviewed and assessed various elements of rail operations, operating rules and procedures, signal maintenance and Metro's efficiency testing program. TWG's main objective was to identify issues that have an effect on the safety and reliability of train service. The key findings in this area are:

1. Metro does not have an effective process to manage LADOT bar/traffic signal and

- reduce operator violations.
2. The dispatching procedure put pressure on Train Operators to leave the station on schedule and other distractions may cause the operators to fail to establish a route, and falsely expect the leaving signal to clear.
 3. The operating rules and procedures do not define "Limit Lines", but rather define a "Fouling Point Marker" that is similar in shape to limit lines.
 4. The impact of signal failures on train operations is not clearly and consistently reflected in the Main Line Incident Status Log Reports.
 5. Metro Rail's current Efficiency Testing Program does not effectively support operator rule compliance nor is it aligned with industry best practices.

Section F: Human Resources

A well performing organization has a commitment to have effective human resources policies and practices. TWG reviewed Metro's selection criteria for Rail Operators, the quality of safety training and current discipline policies as potential deterrents for red signal violations. TWG also reviewed the discipline policies/practices at thirteen other transit agencies as a comparison and benchmark. The key findings in this area are:

1. Some employees were concerned about the negative impact on the new accelerated operator classes needed to meet the tight timetables for initiating start-up services. Metro has added more on-the-job training.
2. Some employees expressed that more train vehicle training would be helpful to better support new operators on the rules and procedures.
3. Metro offers a robust series of training programs for rail transportation employees and supervisors with a strong focus on safety and operations.

ii. Recommendations

This report contains 117 recommendations to improve Metro's rail safety culture and minimize red signal violations. The report also makes 55 site specific recommendations to improve infrastructure and safety at specific locations. TWG's recommendations are cited throughout the report and are summarized in Appendix 1 - Schedule of Recommendations. The following are key recommendations:

1. Create a centralized computerized employee data base of all employee records, absenteeism, discipline, etc. Assign responsibility and accountability for managing and monitoring individual employee performance.
2. Conduct a root cause training program for all supervisors and managers.
3. Develop and implement a communications program directed at management, supervision and employees to ensure more consistency with policies and procedures.
4. Discuss red light violations at monthly management team meetings and quarterly review patterns of violations by work units to look for trends.
5. Issue more comprehensive red signal violation reports that include the underlying facts,

- data and circumstances associated with the violation and all contributing factors.
6. Develop an Accident/Incident Investigation Guide that defines the organizational roles and responsibilities for accident and incident investigations.
 7. Undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.
 8. Establish an operating plan to implement the new SCADA/CTC system. The operating plan should be based on a consistent approach to automatic route setting and include any required modifications to operating rules and procedures.
 9. Hold discussions with LADOT regarding the root causes for the poor reliability of bar signals, and develop an action plan to address bar/traffic signal failures.
 10. Survey signal locations and repaint Blue, Expo and Gold Lines "Limit Lines" as needed. Describe the "Limit Line" and associated rule in the Operating Rules & Procedures/SOPs.
 11. Capture train delays and other service impacts caused by signal failures. The data should be used in on-time performance analysis and to establish metrics for signal maintenance.
 12. Re instruct controllers to document infrastructure failures like signals on the incident status log reports.
 13. Continue to update Metro's Rail Efficiency Testing program consistent Federal Railroad Administration (FRA) rules.
 14. Consider focusing new operator training on the rules and characteristics specific to their assigned line instead of general training.
 15. Conduct improved root cause-based investigations and comprehensively identify contributing factors. Signal violation training should be updated to reflect these factors.
 16. Blue/Expo Line - Metro should consider the installation of approach signals on a case by case basis in the approach to home signals in street running territory.
 17. Consider modifying interlocking signals at intersections on the Blue/Expo Line with automatic route settings as already implemented on the Gold Line.
 18. Consider implementing an Automatic Train Dispatching System (ATD).
 19. Provide training modules to train operators that focus on site specific situations where interlocking signal and bar signal could conflict.
 20. Instruct controllers to inform train operators when switching modes of operation of an interlocking from "Automatic" to "Central".

iii. Management Response to Report

In late September 2016, we provided Metro Operations and Corporate Safety management with a draft report. On October 12, 2016, TWG and OIG met with Operations and Corporate Safety management to discuss the report. Management generally agreed with the report and stated that they will develop an implementation plan for many of the recommendations in the next 60 days.

NEXT STEPS

Metro management should:

- Assign an individual responsible for championing the Agency review and analysis of the findings and recommendations in the report and taking appropriate actions;
- Complete the Schedule for Tracking Metro's Proposed Actions in response to the recommendations provided in Appendix 1 of the Report as it makes determinations about the recommendations;
- Periodically report to the Metro Board during the coming year on the progress of reviewing, analyzing, and making a determination on each recommendation; and
- Periodically report to the Metro Board on the implementation of any actions Metro determined to take on the recommendations.

ATTACHMENTS

Attachment A - Report on Review of Metro Safety Culture and Signal Violations

Attachment B - Response from Operations Department

Prepared by: Andrew Lin, Audit Manager, (213) 244-7329
Yvonne Zheng, Senior Manager, Audit, (213) 244-7301

Reviewed by: Karen Gorman, Inspector General, (213) 922-2975



Karen Gorman
Inspector General/Chief Ethics Officer/
Chief Hearing Officer

**Los Angeles County
Metropolitan Transportation Authority
Office of the Inspector General**

**Review of Metro
Safety Culture And Rail
Operational Safety**

Report No. 17-AUD-04

December 22, 2016





Metro

Los Angeles County
Metropolitan Transportation Authority

Office of the Inspector General
818 West 7th Street, Suite 500
Los Angeles, CA 90017

213.244.7300 Tel
213.244.7343 Fax

December 21, 2016

Metro Board Members

Re: Report on Metro Safety Culture and Rail Operational Safety (17-AUD-04)

Dear Metro Board Members:

The Metro Office of the Inspector General, pursuant to the Board's directive and the OIG mission, conducted a study of Metro rail red light violations including root causes of any violations in the last two years, and an analysis of Metro's safety culture and rail operational safety including infrastructure issues, operator training, use of efficiency testing, and effectiveness of discipline. The purpose of the study is to self-police and promote safety to avoid incidents happening similar to those at other transit properties and address concerns in the industry across the nation about the quality of safety programs, the nature of transit organizations culture and its effect on transit agency's performance, as well as the proliferation of red signal violations. The Office of the Inspector General has a role in monitoring safety in general and making recommendations for improvements where indicated.

The OIG prepared a comprehensive statement of work (SOW) for a Request for Proposal (RFP) and hired the Wathen Group (TWG), which formed a team of experts who have experience in both rail transportation and safety, was hired to perform this review.

The attached report contains the results of the consultant's analysis and assessment of Metro's safety culture and rail operational safety in six areas: (1) Safety Culture, (2) Red Signal Violations, (3) Safety Assessment of Infrastructure Elements, (4) Technology, (5) Operations and Maintenance, and (6) Human Resources. The report also contains 117 recommendations to improve Metro's rail safety culture and minimize red signal violations, and 55 site-specific recommendations to improve infrastructure and safety at specific intersections.

The consultant found Metro has a good safety culture that has continued to improve since a prior review in 2012. There can always be improvement, and some of their key recommendations are:

1. Create a centralized computerized employee data base of all employee records, absenteeism, discipline, etc. Assign responsibility and accountability for managing and monitoring individual employee performance.
2. Conduct a root cause training program for all supervisors and managers.
3. Develop and implement a communications program directed at management, supervision and employees to ensure more consistency with policies and procedures.
4. Discuss red light violations at monthly management team meetings and quarterly review patterns of violations by work units to look for trends.
5. Issue more comprehensive red signal violation reports that include the underlying facts, data and circumstances associated with the violation and all contributing factors.
6. Develop an Accident/Incident Investigation Guide that defines, the organizational roles and responsibilities for accident and incident investigations.
7. Undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.

8. Establish an operating plan to implement the new SCADA/CTC system. The operating plan should be based on a consistent approach to automatic route setting and include any required modifications to operating rules and procedures.
9. Hold discussions with LADOT regarding the root causes for the poor reliability of bar signals, and develop an action plan to address bar/traffic signal failures.
10. Survey signal locations and repaint Blue, Expo and Gold Lines "Limit Lines" as needed. Describe the "Limit Line" and associated rule in the Operating Rules & Procedures/SOPs.
11. Capture train delays and other service impacts caused by signal failures. The data should be used in on-time performance analysis and to establish metrics for signal maintenance.
12. Reinspect controllers to document infrastructure failures like signals on the incident status log reports.
13. Continue to update Metro's Rail Efficiency Testing program consistent Federal Railroad Administration (FRA) rules.
14. Consider focusing new operator training on the rules and characteristics specific to their assigned line instead of general training.
15. Conduct improved root cause-based investigations and comprehensively identify contributing factors. Signal violation training should be updated to reflect these factors.
16. Blue/Expo Line - Metro should consider the installation of approach signals on a case by case basis in the approach to home signals in street running territory.
17. Consider modifying interlocking signals at intersections on the Blue/Expo Line with automatic route settings as already implemented on the Gold Line.
18. Consider implementing an Automatic Train Dispatching System (ATD).
19. Provide training modules to train operators that focus on site specific situations where interlocking signal and bar signal could conflict.
20. Instruct controllers to inform train operators when switching modes of operation of an interlocking from "Automatic" to "Central".

Further recommendations are listed in the Report's Appendix 1, Schedule of Report Findings and Recommendations. Management generally agreed with the report. They stated that they will devise an implementation plan for many of the recommendations in the next 60 days.

We thank Mr. Gallagher and Mr. Kildare and their teams for providing great cooperation and enthusiasm in tackling this project with us.

This report will be on the January board meeting agenda for presentation by the OIG and consultant. To give you a greater lead time to review it, I am sending it to you now.

Sincerely,



Karen Gorman
Inspector General

cc: Board Deputies

Attachments: Report on Review of Metro Safety Culture and Rail Operational Safety

22 December 2016



LA Metro Safety Culture and Rail Operational Safety Review



Table of Contents

Introduction:	Page
Executive Summary	02
Section A: Safety Culture	
Employee Feedback	15
Safety Culture Assessment	24
Conclusion	35
Section B: Red Signal Violations	
Condition of Investigation and Reports	40
Patterns of Red Signal Violations	43
Contributing Factors	45
Section C: Safety Assessment of Infrastructure Elements	
Assessment of Metro Rail Signal Configuration	57
Assessment Methodology	58
APTA Peer Recommendations	60
Assessment of Automatic Train Protection System	61
Effectiveness of Automatic Train Protection System	62
Rationale for Not Implementing ATP in Street Running Territory	64
Safety Risks for Not Implementing ATP in Street Running Territory	65
Should Metro Implement ATP in Street Running Territories?	68
Assessment of Crossing/Traffic Signal Installations at Rail/ Vehicle Intersections	70
Review of Sample Intersections	73
Section D: Technology	
Technology Mitigation for Inconsistent Operation	78
Technologies to Enforce 'Red' Aspects	81
Additional Technical Alternatives	84
Section E: Operations and Maintenance	
Bar Signal Violations	86
Train Dispatching at Terminal Stations	90
Operating Rules and Procedures	93
Manual Block Operation	93
Limit Lines vs. Fouling Point Markers	94
Planned Revisions to Operating Rules & Procedures and SOPs	95

Table of Contents

	Page
Section F: Human Resources	
Selection Criteria	112
Training	113
Discipline	115
Attachment A	
Abbreviations	129
Appendix	
1. Schedule of Report Findings and Recommendations	133
2. List of Reference Documents and those Individuals Interviewed	148
3. Focus Groups	153
4. 2016 Los Angeles Metro Rail Employee Survey	155
5. Comparison of 2012 and 2016 Surveys: Key Findings	172
6. Status of Actions from 2012 SSE Report	175
7. APTA Peer Review Report	179
8. Check List for Signage, Street Marketing and Traffic Equipment	196
9. Assessment of Signage, Street Markings and Traffic Control Devices at Ten Intersections	204
10. High Priority Locations - Analysis of the Configurations and Equipment at the Signal Locations	289

Introduction

Executive Summary

LA Metro Safety Culture and Rail Operational Safety Review

Executive Summary

The Metro Office of the Inspector General, pursuant to the Board's directive and the OIG mission, is conducting a study of Metro rail red light violations including root causes of any violations in the last two years, and an analysis of Metro's safety culture and rail operational safety including infrastructure issues, operator training, use of efficiency testing, and effectiveness of discipline.

The Metro Office of the Inspector General issued an Request For Proposal (RFP) and hired, The Wathen Group (TWG), to assist in conducting the assessment of Metro Rail's safety culture and a review of the Red Signal Violations (RSV) that occurred between July 1, 2013 and June 30, 2015. The purpose of the study is to self police and promote safety to avoid incidents happening similar to those at other organizations in the nation and address concerns in the industry across the nation about the quality of safety programs, the nature of transit organizations culture and its effect on transit agencies performance, as well as the proliferation of red signal violations. The Office of the Inspector General has a role in monitoring safety in general and making recommendations for improvements where indicated.

Since this study began, the Federal Transit Administration (FTA) requested information about such occurrences from its grantees across the nation for the past year. The FTA issued Safety Advisory 16-1 to request that State Safety Oversight Agencies (SSOAs) work with their Rail Fixed Guideway Public Transportation Systems (RFGPTS) to obtain information regarding stop signal overruns during calendar year 2015.

The Metro Rail Safety Culture effort offers an opportunity to review the current situation and conduct careful analysis to support the agency in addressing contributing and root causes, mitigating issues and implementing strategies for continual improvements. This initiative also provides a longitudinal perspective of Metro Rail's culture with the results of the employee survey that we conducted. The survey is an abbreviated version of the one done for Metro in 2012. The response for the current survey was 75% of the field employees versus the lower 12% response rate in 2012, offering a strong sense of how the employees perceive Metro Rail's culture currently. This review is more comprehensive than FTA's Advisory 16-1 directed.



In the timeframe of releasing the RFP for the work, the Board selected a new CEO to lead the organization. The new CEO also selected a COO as a new leader for the agency's operations. The new COO has initiated a variety of changes to create a more functional organization. Early in his tenure, the CEO identified safety and security as the agency's number one priority as he reissued the Systems Safety Program Plan (SSPP) and directed implementation of several new safety and security related initiatives.

To perform the work specified in the OIG's RFP, TWG has:

1. Conducted a series of interviews with various levels of management at Metro including members of the executive level, Metro Rail management, and Los Angeles Department of Transportation (LADOT) representatives
2. Facilitated nineteen Metro Rail employee focus groups
3. Conducted a survey of Metro Rail field employees
4. Conducted an extensive document review
5. Conducted field observations between February and May 2016 to assess Metro Rail's safety culture and to review the red signal violations that occurred over a two-year period and make recommendations that address the issues raised in this review

TWG grouped the review results into six sections:

- A. Safety Culture
- B. Red Signal Violations
- C. Safety Assessment of Infrastructure Elements
- D. Technology
- E. Operations and Maintenance
- F. Human Resources



Summary of Key Findings

Section A: Safety Culture Assessment

The review found that Metro Rail has made positive changes towards creating an informed culture by comparing performance and perceptions over a four-year period. Compared to the 2012 survey, there have been significant improvements in all rail safety areas. However, as the rail system continues to expand and add new employees at all levels, it will be limited in its ability to improve without an additional systematic analysis of performance, trends and investigation of incidents and accidents, as well as clarify roles and responsibilities and identify key accountabilities with performance metrics that measure supervisory/management performance as they oversee operations.

Based on the review, TWG have the following key findings:

- 1.** Metro Rail still has some challenges in transitioning to the highest level of a learning culture. It does not have a central or consistent employee information data base regarding service related information, discipline/grievance records and absenteeism, making it difficult to link employee based information to operating and safety performance to identify patterns that may contribute to unsafe practices and/or facilitate positive performance.
- 2.** While we applaud Metro Rail Management's efforts to proactively focus on the red signal violations, we found the actual investigations were lacking documentation. Few of the reports identified contributing causes. Without effective root analysis conducted and documented as management conducts investigations, the agency cannot effectively mitigate and address the issues related to these violations and other non-compliant actions and to further contribute to an optimal learning culture.
- 3.** There are mixed results on whether employees feel comfortable reporting unsafe conditions. In the focus groups, a majority indicated that they do not report "near misses". In contrast, in the survey results employees indicated that they have reported "near misses". The Corporate Safety Department does track "near misses" that are reported through the SAFE-7 form process, which is the agency prescribed process. However, there does not seem to be a consistent organization wide understanding of the findings and process. Having a rigorous and systematic process for documenting such incidents that are consistently communicated is considered a best practice as it enables the agency to identify hazards comprehensively and address them proactively to further lower the risk of an incident or accident.



4. Based upon our interviews, review of documents, focus group discussions, and survey results, we found mixed feedback about how discipline is administered. There is a perception of inconsistent treatment of employees and that discipline is levied inconsistently.

5. The survey results demonstrated positive directions about the quality of the safety training programs. When employees were asked to rate the overall quality of initial safety training during their first few months on the job, 75.9% of respondents said it was either “Excellent” or “Good” up from 69.9% in 2012.



Section B: The Red Signal Violations

A major focus of our study was to review the red signal violations that occurred between July 1, 2013 and June 30, 2015 and determine trends and root causes. Based on our review and analysis, we have the following key findings:

- 1.** Metro has no central employee data base. Various parts of the Metro organization have different information, with no central system that captures all employees' records.

- 2.** Investigative reports for red signal violations are not prepared in compliance with the agency's guidelines. Generally, the root cause is listed as "operator inattention" with no contributing factors listed. "Operator inattention" may not be the actual root cause. Based on our own analysis and review of the APTA Peer Review's findings, we identified the following three main categories of factors that may have contributed to the red signal violations:
 - a.** Current operating practices
 - b.** Existing signal configurations and/or infrastructure
 - c.** Operating rules and procedures



Section C: Safety Assessment of Infrastructure Elements

We reviewed the rail system to identify the locations where the highest number of violations occurred. The locations that we identified were consistent with Metro’s list of “priority signal locations”. Our team also reviewed grade crossing and traffic signal equipment at ten rail/vehicle intersections where there is a higher likelihood of accidents. Based on our review, we have the following key findings:

1. Signal installations at certain locations do not provide sufficient operating information to train operators.
2. Many signal locations do not adhere to the signal installation standards that require installation of signals at the left side of the track.
3. Certain locations have poor visibility of signal aspects.
4. There is a lack of coordination between interlocking signals and bar signals at intersections.
5. Many locations have poor visibility of limit lines.
6. There is a lack of consistency in the configuration of signage, street markings, pedestrian barriers, traffic control devices, and traffic enforcement devices.
7. Signage at certain locations is not visible due to graffiti and other obstructions.



Section D: Technology

During our review we considered technologies, procedures and processes that could mitigate red signal violations and enhance safety of operations. Our general approach is based on the premise that it is necessary to combine technical innovation with compatible operating practices in order to achieve effective results. Proven technologies, when combined with modified operating practices, can reduce red signal violations and enhance safety of operations. In this regard, Metro can:

- Establish an operating plan to implement the new SCADA/CTC system based on a consistent approach to automatic route setting that should include any required modifications to operating rules and procedures.
- Consider the installation of dispatch indicators at terminal stations to facilitate the implementation of an Automatic Dispatching System (ADS).



Section E: Operations & Management

We reviewed and assessed various elements of rail operations, operating rules and procedures, signal maintenance and Metro's efficiency testing program. Our main objective was to identify issues that have an effect on the safety and reliability of train service. Based on our review, we have the following key findings:

1. Metro does not currently have a process to manage bar/traffic signal violations.
2. Metro personnel indicated initial poor reliability of bar signal operation.
3. Review its current operating practice of delegating train dispatching responsibilities to Rail Operators.
4. The current dispatching procedure increases pressure on Train Operators to leave the terminal station on schedule and the distraction of other tasks may cause the operator to fail to establish a route and falsely expect the leaving signal to clear.
5. The operating rules and procedures do not define "Limit Lines", but rather define a "Fouling Point Marker" that is similar in shape to limit lines.
6. Metro does not appear to have established performance metrics for managing its signal maintenance program.
7. The impact of signal failures on train operations is not clearly and consistently reflected in the Main Line Incident Status Log Reports.
8. Metro Rail's current efficiency testing program does not effectively support operator rule compliance nor is it aligned with industry best practices.
9. Metro has recognized the need to develop a more robust rules compliance program and is in the process of initiating changes to the program.



Section F: Human Resources

A well performing organization has a commitment to have effective human resources policies and practices. For the purpose of this study, we reviewed the selection criteria for Rail Operators, the quality of safety training and current discipline policies as potential deterrents for red signal violations, and reviewed the discipline policies/practices at thirteen other properties to provide a comparison and benchmark for Metro. Based on our review, we have the following key findings:

1. Both Supervisors and Rail Operator groups expressed concern about the new accelerated operator classes needed to meet the tight timetables for initiating start-up services, and they expressed concerns about the potential negative impact on delivering new service. Metro has added more on-the-job training to address this issue.
2. Light rail operators and staff stated that, given the challenges and complexities of the system, especially on the Blue Line where the majority of signal stop violations have occurred, more time operating the vehicle in training would be helpful to better support new operators on the operating rules.
3. Metro offers a robust series of training programs for rail transportation employees and supervisors with a strong focus on safety and operations. The CEO changed the interval of safety training to have each operator and controller receive training annually under the “Sustaining Safe Operations in Rail Transit Delivery”.
4. As a result of the work of the Red Signal Task Force, the training now includes a section on signal violations.

Recommendations:

Our report contains 117 recommendations to improve Metro’s rail safety culture and minimize red signal violations. The report also makes 55 site specific recommendations to improve infrastructure and safety at specific intersections. Our recommendations are cited throughout the report and are summarized in Appendix 1 - Schedule of Recommendations. The following are key recommendations that address the findings listed in the executive summary:

1. Set a priority to create a centralized computerized employee data base that includes all employee records, absenteeism, discipline, etc., with established responsibility and accountability for



managing and monitoring individual employee performance, as well as identifying agency trends to address.

- 2.** Conduct a root cause training program for all supervisors and managers. Designate a responsible and accountable party to conduct quality control of incident and accident reports for compliance with the SSPP requirements to ensure all incident and accident investigations have clearly identified root causes.
- 3.** Develop and implement a communications program directed at management, supervision and employees to ensure more consistency with policies and procedures.
- 4.** Institute a quarterly review of the patterns of discipline by work units to look for trends of consistent administration and include as a topic for the regular management team meetings.
- 5.** Modify the current practice by issuing a more comprehensive red signal violation report that includes the underlying facts, data and circumstances associated with the violation and all contributing factors to a red signal violation.
- 6.** Capture in the Signal Violation Reports operating data collected by SCADA including mode of operation and signal status.
- 7.** Develop an Accident/Incident Investigation Guide that defines, in one document, the specific organizational roles and responsibilities for the accident and incident investigation process.
- 8.** Implement modifications to certain elements of the existing signal installation for the purpose of providing additional operating information to train operators.
- 9.** Undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.
- 10.** Establish and implement a maintenance program to eliminate graffiti at traffic signs at various intersections.
- 11.** Establish an operating plan to implement the new SCADA/CTC system, first on the Red Line, then on the Light Rail network. The operating plan should be based on a consistent approach to automatic route setting and should include any required modifications to operating rules and procedures.



- 12.** Implement a process to manage bar/traffic signal violations as intensively as rail signal violations.
- 13.** Hold discussions with LADOT regarding the root causes for the poor reliability of bar signals, and develop an action plan to address bar/traffic signal failures.
- 14.** Discuss with LADOT measures that would improve the visibility of bar signals at certain locations, either through increased brightness or through the use of a different color.
- 15.** Survey all signal locations at the Blue, Expo and Gold Lines and make corrective actions as necessary to repaint “Limit Lines”. Also provide a description of the “Limit Line” and associated rule in the Operating Rules & Procedures/SOPs.
- 16.** Consider the establishment of a process to capture train delays and other service impacts caused by signal failures. The collected data should be used in on-time performance analysis and to establish metrics for signal maintenance efforts.
- 17.** Re instruct controllers to document infrastructure failures like signals on the incident status log reports.
- 18.** Continue its initiative to update its Rail Efficiency Testing program consistent with the scope of requirements as specified in the Federal Railroad Administration (FRA) mandated program under 49 CFR Part 217 Railroad Operating Rules. The new program should be risk-based and include a documented program plan with clear accountability within Operations for the management of the program.
- 19.** Explore the feasibility of designating new operators by assigned line location upon entering training and focusing their training on the rules, procedures and characteristics specific to the respective line.
- 20.** Commit to conduct improved root cause-based investigations and the discipline of comprehensively identifying contributing factors. The section on signal violation training should be updated to reflect those factors.



Coordination of Report with Metro Management

In late September 2016, we provided Metro Operations and Corporate Safety management with a draft report. On October 12, 2016, TWG and OIG met with Operations and Corporate Safety management to discuss the report. Metro Rail management generally agreed with the report and stated that they needed more time to review and analyze the findings and recommendations. Operations will respond on its plan for implementing the recommendations in sixty days.





Result of Review & Recommendations

Section A: Safety Culture

Section A: Safety Culture

In assessing Metro Rail's safety culture, we used three methods of assessment:



1) Direct observations and field visits.



2) Interviews and focus groups.



3) An employee survey.

Employee Feedback

Our team interviewed a cross section of Rail Operations management and agency leadership, held employee focus groups and conducted an employee survey as part of assessing Metro Rail's safety culture.

Management Interviews

During this work, we interviewed over three dozen Metro managers and agency executives. *See Appendix 2 for list of those interviewed.* Based upon interviews, we identified themes and issues relevant to our project.

1. Some respondents see inconsistent culture: Some attribute it to the inception of Metro as a bus company with the rail organization still evolving. There is a sense that leadership needs to create a more mature and sophisticated rail organization.
2. Consensus that the safety culture could improve: One example cited the length of time in advancing the passenger barrier system project planned for the Blue Line in response to the extent of the accidents over the past two years, suggesting the improvements should happen at a faster pace given the seriousness of the situation.
3. Benchmark organizations with strong ingrained safety cultures were identified: BART (San Francisco) where safety and safety culture is taught at the onset of employment and continually reinforced; SEPTA (Philadelphia) has key elements of a strong safety culture; and MTR (Hong Kong) has developed a strong safety culture foundation through the establishment of structured communications processes designed to actively engage the workforce on safety continuous improvements.
4. All of the management employees interviewed identified examples of how they are working to improve safety. However, there was not a uniform understanding of the importance of safety culture to an organization or how to go about improving safety culture.



Actions Cited that Support an Improved Safety Culture

- 1.** The recent reorganization of the Operations Department along functional lines to strengthen capacity to deliver infrastructure improvements and good operations.
- 2.** Among the discipline changes in the new labor contract, red signal violations now are major violations and added a provision that allows management to use a last chance agreement as part of the discipline levied under certain cases in agreement with the union. Management is leaning towards using the change in levying a seven-day discipline for a first offense red signal violation and a fifteen-day suspension with a voluntary last chance agreement for second offenses.
- 3.** Discipline was changed from a demerit based approach to systematic tracking of violations.
- 4.** The new CEO early in his tenure issued agency directives to emphasize safety and security as the number one priority, established an annual operator refresher training and initiated annual awards to acknowledge strong safety programs and operating performance. He directed the installation of protective barriers on the buses for bus operators and increased a focus on emergency management training/drills.
- 5.** The Agency's System Safety, Security, and Operations Committee was restarted on May 23, 2016 which includes direct reports of the COO and the Chief Risk, Safety and Asset Management, and their direct reports making it a more expanded group.
- 6.** There is a perception by some personnel that the DuPont Safety Prevention Program Metro used some years ago that trained supervisors and managers on how to identify hazards and provide effective feedback is still well ingrained.
- 7.** The availability of a Safety Improvement Fund which is available annually to address issues identified by the Location Safety Committees (LSCs).
- 8.** The use of the SmartDrive system onboard buses has effectively improved operator performance for bus operations. Metro will be adding the SmartDrive system onboard the rail cars as well.

Areas Cited that Limit an Effective Safety Culture

- 1.** A perception that there is no shared understanding of what the safety culture is and who is responsible for it.



2. A sense that more employee empowerment is needed.
3. There is a lack of consistency and conflicting information in the various employee information systems (attendance, accidents, discipline) and correct information is not easily accessible.
4. The LSC effectiveness is inconsistent.
5. The agency does not currently have a safety recognition program. Metro did have a safety recognition program in place for over ten years prior to suspending it in FY 2016 to review options for improving the recognition programs. Metro plans to initiate a pilot program testing three vendor programs to determine which would be most effective for the agency.
6. Inconsistent labor relations practices: Labor relations is developing a training program for supervisors.
7. Inconsistent learning from accidents/violations: Metro could do a better job of using “lessons learned” from incidents to make changes in operations/organization.
8. Inconsistent accountability at the management level: Need to identify strategies including use of performance reviews to create more consistency.
9. No current practice for giving safety messages at meetings: This used to be the practice and can help promote needed safety messages and highlight important safety issues.
10. More observations/field supervision is needed.
11. Mixed level of performance in the Rail Operations Control Center (ROC): Concern about inconsistent quality of Controllers; no difference in hierarchy among Field Supervisors, Yard Dispatchers and Controllers.

Focus Groups

We held nineteen employee focus groups within work groups representing rail transportation, rail vehicle maintenance, maintenance of way and supervisors from all lines with approximately 130 employees participating. *See Appendix 3 for the list of focus groups.*



Approach

In each session that lasted 1½ to 2 hours, we initially provided an overview about the Reason framework for creating an effective safety culture that our team used in assessing Metro's safety culture. We provided the participants with index cards and asked them to identify what is working to support a strong safety culture and what areas need improvement. We then collected the notes and reviewed them anonymously to demonstrate that we did not plan to attribute the comments to individuals or individual work groups in order to create an open and candid session among each group. Only one group declined to discuss certain issues. Otherwise, we found the groups very open and thoughtful in their discussions. Taking the notes, we worked with the groups to identify issues/patterns and concerns which became the key findings for this part of our assessment.

Highlights of Focus Groups

The employees participating in the nineteen focus groups identified strengths and areas needing improvement. The major issues identified are below.

Strong Support for Metro/Positive View of Future

1. We observed passion and pride in the organization consistently throughout the sessions.
2. The expansion in the rail system is generally seen as a positive as it offers opportunities for career advancement and job security.
3. Approximately a third of the groups expressed a positive sense of team work within their work units.

Concern about Metro's Future

- Concern that the current pace of expansion is creating stresses for the agency, stretching its resources and threatening its capacity to deliver effective service.



Safety as Priority

Pros

1. Strong acknowledgment that safety is a priority and the employees felt that safety has improved over the past few years. Throughout the sessions, the employees identified examples of how they have experienced safety improvements, as well as identified areas that could improve that focus. Regardless of job categories, employees identified Personal Protective Equipment (PPEs) as being readily available and if not, once they identified a need they generally received the safety gear in a good time frame. The majority of the work units identified existence of weekly safety meetings as an example of safety being a priority.
2. With the exception of the transportation groups, the employees concurred on several areas that demonstrate safety first including the use of SAFE-7 forms, the existence of LSCs, sharing daily safety tips, conducting job briefings, and the availability of PPEs.
3. In the Wayside sessions, participants identified the availability of the Protran device and other worker protection along the railroad right-of-way (ROW) often acknowledging experiencing a major improvement over the past years in safety and worker protection along the ROW.

Cons

1. Specific to safety related matters, participants claimed that short cuts are taken in the course of work along the rail right-of-way. There is the perception of inconsistent follow up when unsafe actions/hazards are identified both informally and via the SAFE-7 form. There was little knowledge if minutes from the safety meetings were produced and or disseminated, as well as lack of knowledge of the status of SAFE-7 list of resolved and unresolved issues. Across the Wayside groups, they also mentioned inconsistent compliance with Standard Operating Procedure (SOP) noting how work is scheduled and conducted on the system particularly in providing access to contractors.

Employee Safety Meetings

1. The groups responding did differ on their assessment of the quality of the safety meetings: ranging from a strong sense of employment engagement to limited engagement and complaints of irrelevant topics on the meeting agendas.
2. None of the operators who participated in the sessions identified the weekly safety meetings as an example of how safety is a priority. They did indicate their awareness of the sessions. Their lack



of attention on these meetings is probably the result of their work schedules so it is more challenging to get a critical mass of train operators at any one time for such sessions.

Communications

- Rail Alert, a relatively new document provides information about incidents and accidents and steps taken to address the type of incident, is distributed to employees across the rail system. This document was noted in several groups as a good addition for sharing information.

Mixed Perceptions Regarding Supervision/Management Effectiveness

1. In about a third of the sessions, the groups identified supervisory and management effectiveness with employees feeling empowered to make decisions and if needed were willing to identify assignments and or procedures that they felt created an unsafe situation.
2. In the majority of the sessions, there seemed to be issues with employees experiencing less than effective supervision and management. In addition, there were complaints about limited sharing of information within lines and across the organization citing poor communications, inconsistent reaction to employee feedback, limited sharing of information and lack of two-way discussion.
3. Employees expressed an interest in having an opportunity to provide input in changes to train schedules, feedback about specifications for new procurements and other work processes.
4. There has been significant turnover among the management positions, which may be contributing toward the sense of inconsistency. In addition, we heard in one of the supervisory sessions that the bus system offered a more comprehensive supervisory training compared to the rail training where the focus was considered less comprehensive and more “on the job”.
5. Across work groups, there is a perception of inconsistent treatment of employees and specifically the perception that discipline is levied inconsistently. We heard often that there was a sense of “favoritism” shown for some employees and not for others.

Mixed Perceptions of Training

1. There was conflicting feedback about the quality and effectiveness of training programs. The operators and supervisors were aware the annual refresher training began at the new CEO’s direction which was seen as a positive addition. Some employees were very positive about the training, while others requested more. Some expressed concern about a focus in getting classes done without ensuring



that employees gain the right level of proficiency. In contrast, the Wayside Traction Power groups were very proud of having successfully advocated for additional courses and as a result had an instructor assigned to their location with lots of technical training available.

2. One of the supervisory groups was very complimentary of the improved quality in the instruction department for transportation as a result of a change in personnel and the addition of new and improved technology for teaching purposes. They, however, expressed concern about the accelerated new operator classes to meet the tight timetables for initiating start-up services and the potential negative impact on delivering new service. It was difficult to see clear patterns in the differing perceptions of training.

Rail Operations Control Center

1. Focus group participants identified that the ROC, and its personnel have inconsistent performance. Employees often noted that there were some really good controllers and some poor ones. They attributed poor performance to limited experience in rail operations, and limited familiarity with the physical characteristics of the lines. They also commented about poor communications stating that controllers at times sound hesitant in providing direction, using inappropriate tone and language on the radio and not treating operators consistently. Both the Metro Maintenance of Way (MOW) and Transportation Departments expressed a lack of confidence with the ROC due to such inconsistencies.
2. In one session, a Wayside employee reported a situation that occurred when they were told that a track was out of service, but, as they began to mobilize to do work, a train came through. This close call or “near miss” was not reported. As one data point this suggests that unreported close calls or “near misses” may still be occurring.

Quality of Radio System

- Groups across all job categories expressed frustration with poor radio transmission at various times and locations which create problems with the controllers, operators and wayside personnel being able to communicate effectively and consistently. There is the perception that the new radios were a low bid procurement and that the agency is not receiving the quality it needs. However, in one of the supervisory sessions, an individual suggested that it may be a matter of installing additional repeaters along the system.



Security Along the ROW/Presence of Homeless Persons on the System

- Across the work units, they identified public and employee security risks on board trains and along the right-of-way with the perception that the issues were either not responded to at all or in a timely manner. Those comments were consistent with the sense of pride in the rail system. They expressed concern for their fellow coworker's and the public's personal security when riding trains, working and traveling through stations, and along the right-of-way. They identified the presence of homeless persons on the trains and along the right-of-way and lack of full CCTV coverage and surveillance particularly during the evening hours. The lack of security presence suggesting the need for greater emphasis in the evening hours.

Survey

TWG team developed an abbreviated survey based upon the one that the Sam Schwartz team administered in 2012 as part of their work assessing Metro's Bus and Rail safety cultures. We used a subset of the questions from that survey and added three open ended questions to test the validity of the findings from the groups. *See Appendix 4 for copy of the survey distributed.* We worked with Metro personnel to prepare and distribute the written surveys to all nineteen Rail Operations employee locations for the Rail operations employees to complete anonymously. Bus operations employees were not included for this survey. The survey was distributed April 12th with a return request by April 29th. Of the 1,650 surveys distributed, we received 1,251 completed surveys with a high response rate of 75%.

In contrast for the 2012 survey, we received 745 completed surveys with a response rate of 12%. For the 2016 survey the average response rate on the questions ranged from 91% to 96% with the exception of questions 11a-c where a response was only recorded if it applied to that employee. We attribute some level of the strong response rate with the 2016 survey to the extra pay. However, the fact that the response rate to the questions was also high and the answers were generally positive, indicates a more engaged workforce than existed in 2012. That is also consistent with the strong sense of pride exhibited by the employees during the focus group discussions. *See Appendix 6 for full 2016 survey results.*



Highlights of the Survey Results

Positive results were seen in all areas:

1. Employees have received good initial safety training within their first few months and during their first year on the job. They were positive about the quality of the refresher training as well. Over 87% responded that they had received refresher training over the last three years. In 2012, 69% respondents stated that they had received such training.
2. Metro effectively communicates safety rules, procedures and changes, so that employees understand the risks that they may encounter on the job. The respondents considered the methods that Metro uses for communicating changes to safety procedures and rules were effective and the ratings improved from 62% to 74% in comparing 2012 to 2016.
3. Employees tend to follow safety rules and procedures and believe their co-workers do as well. The survey results also indicated a sense of trust which has improved since 2012 by almost 10% positive shift in ratings.
4. Employees are confident that Metro has their safety in mind. They generally consider the safety rules relevant for creating a safe work environment.
5. Employees are comfortable reporting unsafe work conditions and know they each have a role to play in ensuring a safer workplace. There is a mixed view about whether employees are reporting “near misses” and close call incidents. Some reported experiencing such incidents and reporting the them while others did not report such incidents.
6. The no-blame approach encourages employees to learn from past incidents to ensure a safer workplace.
7. There is a general feeling that a shared set of values is making Metro a safer place to work.

Compared to the 2012 survey, there have been significant improvements in most Rail Safety work areas in 2016.



Safety Culture Assessment

Based upon feedback from management interviews, focus group feedback and the survey results, we assessed our findings using Dr. James Reason's framework. Metro specified the use of the Reason framework for assessing the organization's safety culture. We have used it and supplemented it with a broader organizational culture framework and references from two Transportation Cooperative Research Program (TCRP) Reports: Report 149, "Improving Safety Related Rules Compliance in the Public Transportation Industry" and Report 174, "Improving Safety Culture in Public Transportation".

Reason's Framework

Dr. Reason's framework identifies five elements that define an organization's safety culture. *See diagram below.* They include:

- An informed culture
- A reporting culture
- A learning culture
- A flexible culture
- A just culture



Figure 1. Dr. Reason's Framework

It is important to point out that an organization's safety culture is really a subset of the organization's culture. In fact, some excellent work done by The Gallup Group based upon findings from longitudinal surveys of cross section of industries demonstrate strongly that an organization culture that emphasizes strong employee engagement results in improved productivity, strong safety performance and a high level of customer satisfaction. Our team's own experience in the public transportation industry supports the Gallup report.

TCRP, Report 174, Pg. 17
State of the American Workplace, Employee Engagement Insights for U.S. Business Leaders, The Gallup Group, 2013



In Reason's framework, the first four elements of learning, reporting, flexible and just culture feed into and support the fifth: the informed culture. When an informed culture is in place, the organization has a strong safety culture which contributes to the limitation of organizational accidents. *"In an informed culture, the organization collects and analyzes relevant data and actively disseminates safety information. Individuals who manage and operate the organization's safety system know the human, technical, organizational, and environmental factors that determine the safety of the system. All members of the organization understand and respect the hazards of operations and are alert to the system's potential vulnerabilities"*.

A learning culture *"encourages use of safety information to draw conclusions about necessary changes and incorporates a willingness to implement major reform when change is required"*.

With a reporting culture, *"an environment is cultivated that encourages employees to report safety issues without fear of punishment. Employees know that confidentiality will be maintained and that, when they disclose safety information, management will act to improve the situation"*.

With a flexible culture, *"the organization and employees are able to adapt effectively to changing needs and demands. For example, the organization may shift from a hierarchical structure to a flatter, or more horizontal than vertical, structure for more decentralized problem-solving capability"*.

With a just culture, *"unintentional errors or unsafe acts are not punished. Deliberate, reckless and indefensible acts are considered unjustifiable and that place the organization and individuals at risk are subject to disciplinary action. A just culture... promotes mutual trust"*.

We used the Reason framework and the findings from our intelligence gathering from our document reviews, field visits, interviews, focus groups and the survey results to assess the current situation at Metro Rail. We have grouped the findings from those efforts by the major components of the Reason framework as described below.



Informed Culture

Our review found Metro has transitioned to a more informed culture since 2012 with the organization demonstrating greater focus on collecting and analyzing relevant data and sharing it throughout the organization. Metro's establishment of the Red Signal Task Force is an example of creating a forum to analyze the information and issues related to signal violations. The Task Force brought together a cross section of Rail Operations Management to review all red signal violations for the period from 2009-2014. They identified several patterns, took actions and widely shared the information including:

- “Operators at risk” those with most of the violations were employees with two or less years of service operating on multiple lines and employees with one or less years of service on one line. These two groups had 70% of the violations. As a result, Metro has changed its supervisory riding program to observe recently hired employees' operating performance more frequently. They have increased the number of times that a supervisor rides with a rail operator from three times (at 30 days, 60 days, and 90 days' intervals) in the first year of service to a two-year period with two additional check rides.
- “Hot spots”, the eleven most “at risk” locations where the most red signal violations occurred. Metro has taken actions to address some of the deficiencies they found. Later in this report, we also discuss the priority hot spots in more detail.

Management has been transparent in sharing the information they collected as part of this effort. The trends related to “operators at risk” and the “hot spots” most “at risk” locations have been shared widely through a number of outlets. For example, charts showing the trends for both sets of information are on display through the agency and most specifically at train operator locations. They are also presented and discussed during the annual safety training program.

The Red Signal Task Force's work and the sharing of the results is a good example of how Metro Rail demonstrates transition to a more informed culture. The Rail Alerts and Flash Reports, provide information about incidents, accidents, changes to operations and regularly identifies lessons learned from incidents and accidents on Metro's transit system. The documents are distributed at sign up times with the employees required to sign off that they have received them. Our team reviewed ten recently issued Rail Alerts and other communications and found them effective. Division level briefings further reinforce the changes.

Adherence to Safety Policies, Procedures and Rules

The survey results demonstrated a strong sense of adherence to policies, procedures and rules which substantiates that Metro management is explaining these well and sharing the rationale for new ones.



Of the 95.8% of employees who responded when asked if they personally follow workplace safety rules and procedures, the median response was same as in 2012 which is “Very Closely”. Also 92.7% of the respondents believe that their coworkers are almost as diligent. They believe that their coworkers “very closely” to “somewhat closely” follow workplace safety rules and procedures, an increase from 87.9% in 2012.

In response to the statement, “*Many of the Metro’s workplace safety rules have little to do with really keeping workers safety*”, over 68% of the respondents feel positive about the relevance of the rules in place to keep employees safe.

The survey found that 85.1% of the respondents agree that Metro ensures employees understand the risks and the rationale behind the safety rules. At a 99% level of confidence, this represents a significant improvement from the 2012 percentage of 72%.

Values, Attitudes and Behavior

Over 75% of the respondents said that “*Metro and its employees have a shared set of values, attitudes and behaviors that... make Metro a safer place to work*”. This is an 8% improvement from 2012 when 67% agreed to this statement. Having such a perception that personnel have a shared set of values, attitudes and behavior for creating a safe place to work is an important indicator of how effective communications, employee engagement and training has become for this shift in perception to occur.

Communication

About 83.4% of the respondents agree Metro is effective in communicating safety procedures and rules to new employees. There was an increase of 7.4% in the percentage of “Yes” from 2012 to now.

Since the 2012 survey, respondents who agreed that the methods Metro uses to communicate changes to safety procedures and rules to all employees are effective improved from 62% to 74%.

Metro Rail has sought to improve the practice that it collects and analyzes data and information about safety related matters. Rail Alerts and Flash Reports, further enhance the traditional publications of bulletins and general orders with communications for all employees describing incidents/accidents that have occurred with lessons learned and/or description of changes to address a future problem of that nature. Not only did management identify that medium, but it was often noted in employee focus group sessions.

In about a third of the sessions, the groups identified supervisory and management effectiveness with employees feeling empowered to make decisions and if needed were willing to identify assignments and/or procedures that they felt created an unsafe situation.



Areas Needing Improvement

Finding:

A1. In contrast in the majority of the sessions, there seemed to be issues in experiencing less than effective supervision and management. In addition, there were concerns about limited sharing of information within lines and across the organization citing poor communications, inconsistent reaction to employee feedback and limited sharing of information and lack of two-way discussion. There is inconsistent follow up when unsafe actions/hazards are identified both informally and via the SAFE-7 form. There was little knowledge if minutes from the safety meetings were produced and/or disseminated, as well as lack of knowledge of the status of SAFE-7 list of resolved and unresolved issues.

Across the wayside groups, employees also noted inconsistent compliance with SOPs particularly in how work is scheduled and conducted on the system.

While the Corporate Safety Department indicated that they have conducted the Safety and Health Assessment Review Program (SHARP), the annual assessment of the LSCs, the past years did not include such a complete focus. Metro plans to hire an outside consultant to conduct a comprehensive review of the effectiveness of each LSC. The LSCs are the key forum for reinforcing the value of employee engagement which is critical in creating a strong safety culture as demonstrated in the Gallup ongoing tracking polls.

Under the CEO's leadership, the agency has instituted new safety awards to recognize strong safety performance in work groups.

Recommendations:

1. Reinstitute the comprehensive SHARP review to assess the effectiveness of the LSCs. We also recommend that the Metro Safety Committee review these assessments annually to identify areas that are working and those needing improvements and providing feedback to applicable management with lesson learned for those most effective local groups.
2. Managers' and other leadership's performance reviews should include a performance measure linked to an effective review in the annual SHARP and Agency committee's review.
3. With the new agency safety awards, Metro management should include metrics that reflect the ratings from the SHARP review as part of the evaluation of the groups considered and recognized to further reinforce the value of this annual review.



Learning Culture

We also observed improvements in the employees' sense of how much of a learning culture exists at Metro Rail from the question below. However, there seems to be room for improvement in this area. Just under 60% of the respondents feel that they have the ability to improve safety rules. Additionally, employees from only one division disagreed with the statement.

There was a significant change in the general sentiment with regards to Metro learning from accidents and using it to prevent recurrences. In response to the statement, "*Metro learns from accidents and incidents and uses what has been learned to prevent recurrences*". The overall percentage ratings improved from 21.6% in 2012 to 31.8% "Agree" in 2016. This trend offers a sense that employees are experiencing a positive response in regard to accidents and incidents.

Safety Training

Finding:

A2. There was a strong sense in the focus groups and survey results that the training programs are effective for the most part. The introduction of the annual refresher program is expected to reinforce the programs and updates.

The survey results demonstrated positive directions about the quality of the safety training programs. When employees were asked to rate the overall quality of initial safety training during their first few months on the job, 75.9% of respondents said it was either "Excellent" or "Good" up from 69.9% in 2012. The median overall response remained "Good".

However, there are still approximately 25% of the respondents that answered "Fair" to "Poor", suggesting that based on the sample, a comparable percentage of the field employees do not have the same experience as the majority have of the quality of the programs.

When asked how they rate the overall quality of additional safety training received during their first year on the job, 74.6% of respondents said it was "Excellent" or "Good". The median overall response remained "Good". This is another indication of a positive perception of the quality of the safety training.

When asked if they had received refresher safety training in the last three years, 87.1% responded that they received refresher training compared to 69% in 2012.

These results suggest that almost all employees are receiving ongoing safety training. These results can be



expected to improve over time with the recent addition of annual refresher safety training a relatively new leadership initiative.

We expect with the introduction of SmartDrive that Rail Operations supervision and management can further reinforce the learning culture as it is based upon a coaching approach with the availability of videos. We heard during our management interviews that the implementation of SmartDrive for Bus Operations has become an effective tool for coaching operators about their driving and safety related performance. We also heard in focus group sessions that the use of videos in training has enhanced class room instruction as well.

Areas Needing Improvement

Findings:

A3. Metro Rail still has some challenges in transitioning to the highest level of a learning culture. Metro does not have a central or consistent employee information data base regarding service related information, discipline/grievance records, absenteeism. This makes it difficult to link employee based information to operating and safety performance to identify patterns that may contribute to unsafe practices and/or facilitate positive performance. Currently that information is maintained at the division level which is not conducive to ensuring a consistent manner for accessing and tracking overall performance. We understand that there are plans to develop an improved and centralized system.

A4. While we applaud Metro Rail Management efforts to proactively focus on the red signal violations, we found the actual investigation documentation lacking. Few of the reports identified contributing causes. Without effective root analysis conducted and documented as management conducts investigations, the agency cannot effectively mitigate and address the issues related to these violations and other non-compliant actions and to further contribute to an optimal learning culture. There is a risk that without a more rigorous investigation process and documentation, red signal and other violations will continue and when not addressed could become more serious.

A5. A key element to monitoring operating and safety performance in the transit industry is the use of robust operating efficiency programs to monitor operator and controller performance. Our observations and discussions with management found that Metro's efficiency program is not as robust as it should be. That was also identified in the American Public Transportation Association (APTA) review. Metro is currently revising the operator efficiency system with a target for implementation in December 2016. See more detail on efficiency testing under Section E, Operations and Maintenance. In addition, Rail Operations is developing a new software program that will allow supervisors to monitor and track the new testing and operator performance in the field on computers. The Corporate Safety Department is recruiting an



additional field person to cover weekends and evenings to monitor operations. These two initiatives are important in creating an optimum learning situation and providing feedback for rail operators and controllers in order to gain consistent standards of employee performance.

Recommendations:

4. Set a priority to create a centralized and computerized employee data base that includes all employee records, absenteeism, discipline, etc., with established responsibility and accountability for managing and monitoring individual employee performance, as well as identify agency trends to address.
5. Conduct a root cause training program for all supervisors and managers.
6. Designate a responsible and accountable party to conduct quality control of incident and accident reports for compliance with the SSPP requirements to ensure the all incident and accident investigations have clearly identified root causes and contributing causes.
7. Revise the efficiency testing program. See more detail in Section E - Operations and Maintenance.

Reporting Culture

There was positive feedback about the nature of the reporting culture. Overwhelmingly across job classifications and organizational lines, there is a strong acknowledgment that safety is a priority and the employees feel that the agency's safety performance has improved over the past few years. Metro Rail has demonstrated a positive transition in the reporting culture with most employees acknowledging they can report unsafe conditions and/or stop work if they exist without punishment. We found that the survey results further substantiate that finding and demonstrate a positive reporting culture. Over 93% of respondents "Strongly Agree" or "Agree" with the statement, *"I am strongly encouraged to report unsafe conditions"*. That represents a 5.4% increase in the sentiment since 2012.

There is a strong sense that management and supervision are open to hearing about potentially hazardous conditions and respond favorably. In response to the statement, *"In my workplace, management and supervision have an "open door" policy on safety issues and act quickly to correct safety problems when identified"*, the overall response improved from 25.2% in 2012 to 32.8% in 2016.

The survey asked if Metro workers have full authority to stop service or work at any time if they observe a hazardous condition, the median response was "strongly agree". From 73.2% in 2012, 85.5% of respondents now "strongly agree" or "agree" to knowing they have the authority to take action. Employees take more ownership in looking out for safer work conditions.



Over 80% of the respondents agreed with the statement, *“In my workplace, management, supervision, and workers know what we are doing: we trust each other; we work together; we know how to work safely; and we do it”*. That represents an over 10% improvement from 2012.

“Near Misses”

Finding:

A6. There is mixed results on whether employees feel comfortable reporting unsafe conditions. In the focus groups, a majority indicated that they do not report “near misses”. While Metro Rail has a process with the SAFE-7 Form, employees do not use it consistently for that purpose. Across work groups, there was lack of recognition that “near miss” reporting is a Metro Rail policy. In fact, Metro revised its System Safety Program Plan (SSPP) that includes a policy on “near misses” that stipulates that employees reporting “near misses” will not be punished. In one session, a Wayside employee reported a situation that occurred when they were told that a track was out of service, but as they began to mobilize to do work, a train came through. This close call or near miss was not reported. The survey results demonstrate some of the contrast. In the recent survey, 46.5% of the respondents reported having experienced a close call on the job where someone came close to being seriously injured. In 2012, 45.1% reported experiencing a close call. In the recent survey, of those who experienced a close call on the job, 71.9% of respondents said the incident was formally reported; up from 58.5% in the previous survey.

Having a rigorous and systematic process for documenting such incidents and communicated consistently is considered a best practice as it enables the agency to identify hazards comprehensively and address them proactively to further lower the risk of an incident or accident.

Respondents in the work categories of Electricians, Facilities Systems Technicians, Property Main, Rail Body Repairer, Rail Electric Communications Inspector, Signal Inspector and Track Inspector Positions reported that they had not experienced a close call.

Given the mixed messages related to reporting “near misses” it is worthy to note that the response rate was 71.9% which may reflect that this is an opportunity for Metro to consider options for formalizing a process. The majority of respondents felt that the reason to report was attributable to something other than the options given. Of the four options given, “No Harm - No Foul” was the most common reaction followed by “Nothing Would Be Done Anyway” and “Fear of Discipline”. Median response for one Division was “Just Too Much Trouble”; another Division reported “Nothing Would Be Done Anyway”.

Similar to 2012, the overall median and mean response to *“Management takes a no blame/no discipline approach if workers voluntarily report ‘near misses’”* was “Agree”. However, it’s worth noting in both



years, the response rate to this question was lower than the norm at 88.6%.

Compared to 2012, nearly 13% more respondents “Strongly Agree” or “Agree” with management’s role in encouraging voluntary accident reports. Those positions that do not feel that management takes a “no blame” approach include CCTV Operators, Custodians, General Service Supervisors, Lead Electricians, Service Attendants, Traction Power Supervisors and Wayside Systems Manager.

Continual Improvement

Throughout the focus group sessions, employees identified examples of how they have experienced improvements as well as identified areas that could improve that focus. Regardless of job categories, employees identified PPEs as being readily available and if not, once they identified a need they generally receive the safety gear. The majority of the work units identified the existence of weekly safety committees as an example of safety as a priority and how the organization works to share information about changes, as well as responds to employee suggestions.

Recommendation:

8. Although Metro did revise the System Safety Program Plan in December 2015, Metro Rail would benefit in further clarifying and promoting the agency policy and procedures for “near miss” reporting program. Central to this effort should be the development and implementation of a communications program directed at management and supervision who receive some of the information, as well as the employees to ensure more consistency with policies and procedures.

Just Culture

Finding:

A7. Based upon our interviews, review of documents and focus group and survey results, we found mixed feedback about how discipline is administered. There is a perception of inconsistent treatment of employees and that discipline is levied inconsistently. We heard often that there was a sense of “favoritism” shown for some employees and not for others. This was further substantiated in the survey question where 53.7% of respondents felt Metro’s primary focus in dealing with accidents or incidents is to discipline individuals. Metro could work harder in making employees feel their priority is to prevent recurrences as rather than disciplining individuals involved in an incident.

The sense of inconsistent treatment may be the result of ongoing changes in management and supervision, recent changes in the contract provisions and the lack of central, comprehensive employee and discipline



data base that enable leadership and the Human Resources Department to review patterns and monitor for consistent administration.

Recommendation:

9. Institute a quarterly review of the patterns of discipline by work units to look for trends of consistent administration and include as a topic for the regular management team staff meetings.

Flexible Culture

Metro Rail organization is demonstrating a flexible element of its culture as it has demonstrated a willingness to change based upon feedback from external industry resources and new leadership. The fast pace of the rail system expansion is further requiring such flexibility. Based upon our reviews, Metro Rail demonstrated that it has an element of a flexible culture as there was strong sense across groups that improvements had been made in operations and safety while still acknowledging there was room for improvement.

Continual Improvement

From feedback across levels of employees from frontline to leadership, there were numerous examples that the organization had improved its response to operations and safety issues. Such examples were:

- An overwhelming sense that the conditions for Wayside workers were significantly improved and that safety was the highest priority. This area was identified as needing improvement in the Sam Schwartz report. From the feedback through the management interviews and focus group sessions, Metro Rail has taken specific actions to address any negative perception of conditions for the wayside workers.
- The employees also noted positive changes generally and many cited the addition of the annual refresher safety program that the CEO introduced early in his tenure.
- The agency has demonstrated its willingness to reach out to industry experts to assist them in assessing various programs and have used the reports and recommendations to improve its operations. For issues related to safety programs and culture, Metro Rail reached out to APTA to review red signal violations and safety practices and to the Sam Schwartz Company to assess Bus and Rail safety cultures. Metro has for the most part been effective in responding to recommendations and taking actions with a number of initiatives and programs underway to address the recommendations in those reports.



Responsibility/Accountability

Metro did not have a responsible party designated to track progress on the actions on report recommendations so we could not readily determine the status of those recommendations. In the course of our work, we were able to determine that the vast majority of the recommendations were responded to and addressed. *See Appendix 7 for the Sam Schwartz report recommendations and status and Appendix 8 for the APTA Peer Review recommendations and status.*

Finding:

A8. Without stronger sense of responsibility and accountability for such efforts, progress towards change will be limited. Metro Rail is still a relatively young organization and growing at a record pace with the Rail organization still evolving. There was also a sense that employees experienced differences in performance and direction depending upon the division leadership and supervision. Our team observed significant turnover in management ranks which does not support the creation of consistent oversight and management. Under new leadership for operations and ongoing changes in rail operations management, there are some challenges in developing a cohesive team, identifying and reinforcing priorities and establishing performance based metrics to create consistencies across divisions and job classifications. The recent reorganization along functional line should strengthen organizational capacity to deliver infrastructure improvements and to improve operations.

Recommendations:

- 10.** Rail operations organization should seek to identify responsibilities and accountabilities for monitoring and tracking progress on various outside initiatives including this report and recommendations. *See Appendix 1 for spreadsheet the findings and recommendations.*
- 11** The COO should seek to clarify the organization's structure, roles and responsibilities, key metrics, and performance expectations for the management team's performance reviews that includes key safety and operating metrics, etc., derived from the SHARP reports, discipline, and efficiency testing.

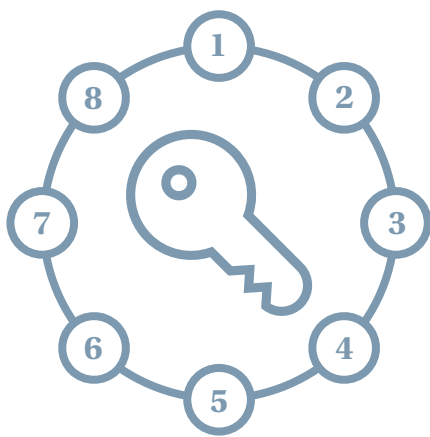
Conclusion

An effective safety culture and strong safety performance is found when the elements of a learning, reporting, just and flexible culture support contribute to an informed culture. In comparing focus group and employee survey results, we see an organization evolving along a continuum in a direction towards having a more effective safety culture.



Metro Rail has made positive changes towards creating an informed culture as comparing performance and perceptions over a four-year period demonstrates movement in a positive direction. However, as the rail system continues to expand and add more new employees at all levels, Metro Rail will be limited in its ability to improve without additional systematic analysis of performance, trends and investigation of incidents and accidents, as well as clarity of roles and responsibilities and identification of key accountability with performance metrics for measuring supervisory/management performance as they oversee operations.

While the Reason Framework offers an approach to identify progress on a continuum from negative to positive trends for embracing the various components of a safety culture, we also supplemented the Reason framework with those key components of a safety culture as identified as in place in best practices of effective safety culture in the TCRP report on, *“Improving Safety Culture in Public Transportation”*. Those eight components (see Figure 2 below) that are in place in organizations with an effective safety culture include:



- 1) Strong leadership, management and organizational commitment to safety
- 2) Employee/union shared ownership and participation
- 3) Effective safety communications
- 4) Proactive use of safety data, key indicators and benchmarking
- 5) Organizational learning
- 6) Consistent safety reporting and investigations for prevention
- 7) Employee recognition and rewards
- 8) High level of organizational trust

Figure 2. Key Components of Safety Culture

Using that framework, Metro Rail demonstrates progress in embracing those dimensions as described below.

Strong Leadership, Management and Organizational Commitment to Safety - We found leadership, management and organizational commitment to safety reinforced by the CEO’s early directions about safety and security as Metro’s number one priority. He not only issued statements but matched action to that focus implementing numerous initiatives to incorporate that focus into the organization. What is compelling about his directions and new programs is that employees at all levels cited references to those efforts. The positive trend in the survey results demonstrate that the field employees are seeing changes in the commitments and actions to support safety as the top priority. In addition, the reinstatement of the Agency Safety Committee, that includes key agency leadership and management, is also an important



step in linking the leadership to the LSCs and reinforce leadership and management's commitments.

Employee and Union Shared Ownership and Participation - The LSCs have union representation institutionalizing their participation in the local safety work. We did see a trend that suggests there may still be a need for improvement relating to the continuing long period it takes to resolve grievances.

Effective Safety Communications - We observed the effective use of communications of safety related messages with the Rail Alerts and Flash Reports and the dialogue between supervision and employees in the LSC meetings and job briefings. The survey results also overwhelmingly demonstrated that the employees found communications effective. Over 83% of the respondents agree that Metro is effective in communicating safety procedures and rules, up over 7% from the 2012 results. The only area that continues to be inconsistent with these findings is the large number of employees in the focus groups who reported not being aware of the results of LSC meetings minutes or the results of SAFE-7 reports.

Proactive Use of Safety Data, Key Indicators and Benchmarking - We did not see as much evidence of the use of such measurement systems, although we are aware that under the new CEO's direction work is underway to develop a more robust system. Benchmarking provides the opportunity to measure and assess the effectiveness associated with the implementation of priority programs and initiatives as well as learn from other organizations experiencing similar safety and service related performance challenges.

Organizational Learning - This component is analogous to Reason's "learning culture" component as described above in that section. This is an area that would benefit from improvement in creating more rigorous investigations to ensure that the agency effectively identifies root and contributing causes to address deficiencies and "learn" from incidents and accidents that occur.

Consistent Safety Reporting and Investigation for Prevention - This component is analogous to Reason's "reporting culture". We saw this practiced strongly at Metro Rail. With the exception of the inconsistency in practice with the "near miss" reporting policy.

Finding:

A9. Employee Recognition and Rewards - Metro Rail acknowledged that this is an important component for reinforcing positive safety performance and is taking steps to establish a recognition and reward program. Prudently they have decided to test several models to determine the best fit for the organization. They are currently conducting three pilot programs with different vendors for that purpose. The recently added organization safety award is a positive step in reinforcing the work unit's effectiveness in both creating safety related programs and having strong safety metrics.



High Level of Organizational Trust - We observed a number of examples of strong sense of trust across much of the organization. The survey results further demonstrated that with the response to the statement, “In my workplace, management, supervision and workers know what we are doing; we trust each other; we work together; we know how to work safely; and we do it”. We saw a strong positive shift from the 2012 results of over 10% increase to 80.7% of all respondents who “Strongly Agree” or “Agree” in the recent survey.

Recommendations:

- 12.** With the high level of respondents for this survey, Rail operations leadership has the opportunity to gain insights about how field employees perceive safety related efforts but also broader issues related to management style and communications. We recommend that Rail operations leadership review the detail of the survey results by divisions and disciplines to identify areas of effective performance and those areas needing support and coaching to continue to increase the effectiveness of the safety culture agency wide. It is clear that many of the programs implemented over the past four years are effecting positive changes. However, there are still a range from 4% to 26% of respondents across the questions who are not experiencing improvements. In some cases, we saw differences at the division and work classifications levels in survey results as we did during the focus group discussions. We recommend that the Rail Operations leadership in cooperation with Corporate Safety Department work with each division to review the details at those levels and identify areas that improved and those needing improvement and assist them in creating action plans for continuing to improve safety related performance.

- 13.** We recommend implementing a safety recognition program to reinforce positive safety behavior at the individual and work unit. As Metro reviews the results of the three pilot programs, they should consider the key elements that make for effective recognition programs. This is particularly important as the agency looks to reinforce the positive work it has accomplished and provide incentives for employees and supervisors to modify behavior towards the more positive trends we have observed. Those elements include:
 - Management support is visible.
 - Achievement criteria must be clear and precise with objective metrics.
 - Incentive cycle or monitoring period must be defined.
 - Process must be transparent to the employees.
 - Eligibility to participate must be defined.
 - Incentive programs can be tiered but the tiers and performance expectations must be well defined.



Result of Review & Recommendations

Section B: Red Signal Violations

Section B: Red Signal Violations

A major focus of our study was reviewing the red signal violations that occurred between July 1, 2013 and June 30, 2015 to determine trends, root and contributing causes, and make recommendations towards minimizing red signal violations to the extent possible. While we were able to identify trends and, to some extent, root and contributing causes, Metro's files were not complete and the investigation reports did not for the most part identify contributing causes. We identified four incidents where we were unable to identify all the information about the violations. Currently Metro does not have a central information system that reports attendance, accidents and discipline. As a result, management does not have a comprehensive tool that provides adequate data needed in the administration of discipline for red signal violations and other non-compliant actions that create unsafe conditions over time and erode the organization's safety performance.

Condition of Investigations and Reports

Findings:

B1. Metro has no central employee data base. Various parts of the Metro organization have different information, with no central system that captures all employees' records. For example, days of suspension sometimes are recorded in the attendance system. We also found different information with the operating divisions versus what was available with labor relations. To create the Red Signal Violation Matrix (RSVM) (see Figure 3 on Page 43) and to provide a comprehensive review of red signal discipline, we found the information needed to complete are fragmented and extremely difficult to obtain.

B2. Investigative reports for red signal violations are not prepared in compliance with the agency's guidelines. Metro has been proactive in developing additional guidance for front line supervision and management staff concerning the gathering of incident information related to possible contributory causes such as fatigue factors, rules/procedures, systems and equipment, operator history, and external factors. However, the reports do not comply with the report requirements to identify contributing causes. Most included root causes but did not include contributing causes. The fact that "High Priority Locations" sustain repeated red signal violations is an indication that there are other very significant factors that contribute to the violations. It is important that contributing factors to a violation are identified at the time of the incident in order to have clear understanding of all the factors contributing to the violation and develop and implement complete and effective mitigation strategies.



Generally, the root cause is listed as “operator inattention” with no contributing factors listed. “Operator inattention” may not be the actual root cause. The industry has identified numerous reasons for operator inattention including but not limited to fatigue, illness, etc. For example, a recent investigation of red signal violation at WMATA, found that the operator was in a hurry to take his lunch break and missing the signal indication as he focused on matters other than operating the train since the investigators, in this case probed in more detail, were very precise about what created the “operator inattention”. An analysis of the red signal violations data shows that approximately 80% of the red signal violations are indicated to be caused by “Operator Inattention”.

Metro is currently using a RSV Report format that lists nine classifications for root causes/contributing factors. The current Metro accident investigation processes are documented within its SSPP, Appendix C and in its 238 pages of Rail Operations SOPs. It was noted that Rail Operations Supervisors receive 4-8 hours of initial accident and incident investigation training. However, there is not sufficient detail in these documents to identify the post-accident and incident information gathering process needed to support the identification and assessment of both primary and contributing causes.

Once the violation report is completed, Metro holds a hearing attended by representatives from Rail Operations, ROC, Corporate Safety, Superintendent of Rail and Signal Maintenance for certain incidents.

At the hearing, the investigating committee reviews Supervisory Control and Data Acquisition (SCADA) data, dash camera videos, the operator’s testimony, employment history, and other relevant information. Upon conclusion of the hearing, the results are summarized in an abbreviated report without any of the underlying factual details. Further, the underlying documents, data and information are kept by the various groups with no central archive for the additional documentation.

The “abbreviated” reports are focused more on the disciplinary results of the hearing and the operator’s history, and less on the underlying incident facts and any contributing factors. If there is a subsequent need to review the circumstances related to a specific incident, it is necessary to request the pertinent data and information from the various groups involved in the original investigation.

The RSV reports do not capture important operating data that is provided by the SCADA system. For example, the reports do not always indicate the mode of operation at the time of the incident (Central vs Automatic), and why the violated signal was not clear. This data is important when performing analysis of the contributing factors for the violations. It should be noted that upon requesting certain historical SCADA data, we were advised that based on current document retention policy, routine data collected by the SCADA system is kept for only one year.



Recommendations:

14. Metro should re-train its managers and supervisors on root cause analysis with an emphasis on identifying contributing factors.
15. Metro should modify the current practice, and issue a more comprehensive red signal violation report that includes the underlying facts, data and circumstances associated with the violation and all contributing factors to a red signal violation.
16. Metro should capture in the Signal Violation Reports operating data collected by SCADA including mode of operation and signal status.
17. Metro should maintain operating data collected by the SCADA system for five years.
18. Metro should consider the development of an Accident and Incident Investigation Guide that defines, in one document, the specific organizational roles and responsibilities for the accident and incident investigation process. The purpose of the investigation process is to gather and assess the facts and evidence for effective analysis in order to determine the primary cause and contributing factors of an accident and incident and to develop practical, corrective measures to prevent or reduce the possibility of a recurrence. The objective of the proposed manual is to guide Metro staff through the investigative process of gathering, documenting, and assessing the facts and evidence.

It is proposed that this document include a clear and concise description of the type of information to be gathered and documented. It should include the questions to ask and the information to be documented on topics including but not limited to fatigue and alertness. *(Note: Metro has developed a checklist on this topic for supervisory personnel).* Additional topics include:

- Vigilance and attention
- Situational awareness
- Experience and line familiarization
- Knowledge of procedures
- Stress
- Use of over the counter medications
- Schedule compliance challenges
- Weather conditions
- Visibility
- Vehicle speed
- Vehicle defects
- Signal type and location
- Traffic conditions
- Pedestrian traffic
- Passenger related issues
- Radio communications / other possible distractions



19. Once the proposed Accident and Incident Investigation Guide is completed, all appropriate supervisory and management personnel should be trained on their respective accident and incident investigation roles and responsibilities and should they receive refresher training on these provisions on an ongoing basis to support their consistent and desired application.

Patterns of Red Signal Violations

In our review of the red signal violations as captured in Figure 3, “Matrix of Red Signal Violations”, we found several patterns.

Figure 3

Incident ID	Employee Number	Date of Hire	Date of Rail Certification	Date of Incident	Type	Line	Signal	Run-Thru?	Repeat Violation	Hearing Date	Disciplinary Action	Charged Absences	Missouts	Time between RSV
2339316	29239	9/23/01	4/15/12	7/1/13	RSVM	Blue	7th/Metro 2S	?	Yes	ND	ND	6	1	
2353512	30408	12/10/06	10/8/10	8/16/13	RSVM	Gold	Ditman 2N	No	Yes	8/29/13	30 Day S	15	4	10 months
2356106	25628	9/27/98	7/4/04	8/23/13	RSVM	Gold	Ditman 2N	No	No	8/29/13	5 Day S	3	0	?
2356445	30048	12/19/04	3/12/09	8/23/13	DSC	Blue	Washington	Yes	No	ND	ND	6	5	
2359259	73478	8/22/10	6/17/12	8/31/13	RSVY	Blue	Sig. 5N Main Yard	?	?	ND	8 Day S	3	2	
2361294	35362	3/18/02	6/14/12	9/5/13	RSVM	Blue	Washinton 2S	Yes	No	9/26/13	5 Day S	6	4	
2365773	74528	7/28/08	1/24/13	9/18/13	RSVM	Blue	7/M 2S	Yes	No	ND	ND	4	0	
2396191	9118	6/17/02	9/14/12	12/8/13	RSVY	Blue	Sig. 25 Main Yard	No	No	ND	ND	4	0	No mention of 12/8/13 RSV or discipline - Yard Controller / Operator communications issue.
2401617	7301	2/12/05	12/8/09	12/22/13	RSVM	Blue	Venice 2S	No	No	2/7/14	5 Day S	5	0	
2403841	16188	7/9/89	12/21/00	12/29/13	RSVM	Blue	Junction 8N	Yes	Yes	1/10 or 22/14	5 Day S	6	1	Additional RSV on 10/7/15 with 10/27/15 hearing with 5 day susp but does not show on attd record.
2403845	28011	3/28/99	6/12/12	12/29/13	SO	Expo	4N Degnan	Yes	Yes	1/22/14	C	3	3	3 months
2404777	72828	4/19/09	10/25/13	1/1/14	RSVM	Blue	Maple 4N	Yes	No	1/22/14	5 Day S	7	3	
2410959	25309	6/8/97	4/1/13	1/18/14	RSVM	Blue	7/M 4S	Yes	Yes	2/7/14	5 Day S	2	11	7 months
2414720	18010	5/19/91	4/6/13	1/28/14	RSVM	Blue	Maple 2S	No	No	ND	ND	6	4	
2420442	34098	12/14/03	10/8/10	2/13/14	RSVM	Blue	Pico 5N	Yes	Yes	2/2-/14	5 Day S	33	12	1 year 4 months
2423811	NC	5/11/86	1/25/13	2/21/14	RSVM	Blue	Florence 2S	No	N/A	N/A	5 Day S	N/A	N/A	
2432120	34427	10/1/01	10/8/10	3/15/15	RSVM	Blue	Pico 5N	Yes	No	3/21/14	5 Day S	1	0	
2441775	30193	8/21/06	11/4/11	4/10/14	RSVM	Blue	22nd St. Interlocking	?	Yes	8/15/14	ND	6	4	Prior RSV listed on 12/5/11 and listed as pending
2446861	14377	8/9/87	1/4/00	4/23/14	SO	Blue	55th St	Yes	No	5/9/14	3 Day S	4	0	
2448879	75147	6/17/08	1/31/14	4/29/14	RSVM	Blue	Washington 5N	Yes	No	5/9/14	5 Day S	1	4	
2463230	28942	8/9/99	7/26/13	6/1/14	DSC (SCADA)	Blue	3S 7th Metro	Yes	Yes	ND	ND	0	0	
2473300	16987	4/28/91	2/2/14	6/26/14	RSVM	Gold	Ditman 2N	No	No	8/14/14	2 Day S	5	0	
2479971	28011	1/12/98	6/12/12	7/10/14	SO	Blue	Manville	Yes	Yes	7/18/14	3 Day S	0	0	6.5 months
2483041	25309	5/1/91	4/1/13	7/16/14	RSVM	Blue	Maple 2S	No	No	9/5/14	ND	2	0	
2485925	18282	6/4/90	9/14/12	7/24/14	RSVM	Expo	National 4N	No	No	ND	ND	8	1	
2491647	75241	7/28/08	7/26/14	8/8/14	RSVM	Blue	7/M 1S	?	Yes	ND	ND	28	5	45 days
2514606	28562	6/11/00	5/1/13	10/5/14	RSVM	Red	WWo8	Yes	?	ND	ND	2	3	

ND: None Documented; S: Suspension; C: Counselling; NC: Not Charged.



Incident ID	Employee Number	Date of Hire	Date of Rail Certification	Date of Incident	Type	Line	Signal	Run-Thru?	Repeat Violation	Hearing Date	Disciplinary Action	Charged Absences	Missouts	Time between RSV
2516211	72727	1/8/'07	11/4/'11	10/8/'14	RSVM	Blue	Washington 5N	?	No	12/18/'14	5 Day S	10	0	
2516848	74776	5/5/'08	7/12/'14	10/10/'14	RSVM	Gold	Pico Aliso 2S	Yes	No	ND	ND	1	0	New rail operator
2521078	75241	7/28/'08	7/26/'14	10/20/'14	RSVM	Blue	Pico 5N	Yes	Yes					
2521475	23195	6/1/'06	5/1/'14	10/21/'14	RSVM	Red	WWo8	Yes	No	11/6/'14	3 Day S	8	0	
2529442	25804	6/1/'04	5/1/'14	11/11/'14	RSVM	Blue	Pico 5N	Yes	Yes	11/21/'14	3 Day S	9	5	Record shows RSVs 7/30/11 (note rail op date) & 11/11/14 & both are listed as pending. No suspension time shown on attendance record for either incident.
2538388	73801	9/24/'07	7/26/'14	12/6/'14	RSVM	Gold	SMV 4S	Yes	No	12/18/'14	3 Day S	2	1	RSV charged as unavoidable in accident record. Hearing record on 12/15/14 resulted in 3 day suspension. No suspension time indicated on attendance record. One other pending accident on 1/6/15 not defined. Returned to bus during probation.
2569789	35250	1/1/'05	6/1/'12	3/6/'15	SO	Blue	Gage	?	No	ND	5 Day S	0	0	
2572152	14841	5/15/'88	4/1/99	3/12/'15	RSVM	Blue	Pico 5N	?	No	ND	3 Day S	5	0	7 years
2575016	25084	8/23/'93	7/12/'13	3/20/'15	RSVM	Green	Washington WEO6	No	No	6/9/'15	ND	4	0	
2586050	75638	8/21/'11	1/1/'14	4/20/'15	RSVM	Red	WWo8	Yes	No	5/20/'15	3 Day S	4	0	
2587251	29323	8/19/'98	10/1/'04	4/23/'15	RSVM	Gold	Pico Aliso 2S	Yes	No	5/20/'15	3 Day S	0	1	
2589433	70230	10/1/'78	'04/'07	5/19/'15	RSVM	Gold	Atlantic 4N	Yes	?	ND	ND	2	0	
2602487	80691	9/1/'13	3/1/'15	6/5/'15	RSVM	Blue	Venice 4N	No	No	ND	Not Charged; C	1	1	6/5/15 RSV listed as unavoidable, no hearing date and no suspension level

ND: None Documented; S: Suspension; C: Counselling; NC: Not Charged.

- There were a total of 40 red signal violations: 22 red signal violations between July 1, 2013 through June 30, 2014, and 18 red signal violations between July 1, 2014 and June 30, 2015.
- Of the 40 red signal violations, 22 violations were categorized as “run through” and 7 of those violations were made by operators with repeat violations. Eleven of the red signal violations were categorized as “crossing the critical line and stopping” and one was made by an operator with repeat violations.
- There was no record for whether there was a run through or “crossing the line” for the remaining seven (18%) of the 40 red signal violations.
- Those employees who had repeat signal violations had a higher number of absences and miss outs than the group that had one violation. For the group as a whole, the average number of charged absences was 3.46 days and the average number of miss outs was 0.9 days. Employees with repeat violations, however, had average 5.25 days charged absences and 1.0 average days’ miss outs. These results imply that there may be a correlation with poorer employee performance. In order to determine a relationship, the period of analysis needs to be expanded and include data from employees with no



signal violations in the same period.

- The time between repeat violations ranged from 1.5 months to 84 months with an average of less than 23 months.

Contributing Factors to Red Signal Violations

This section provides a summary of the factors that have contributed, or could contribute, to red signal violations within Metro's network. As indicated above, the RSV Reports indicate that the root cause for most of the violations is attributed to operator inattention. However, these reports do not identify the specific factors that could have contributed to the violations. The patterns of red signal violations show that there are concentrations of violations at certain locations, during certain modes of operation as well as during the performance of certain operating functions. Also, our analysis and findings by the APTA Peer Review Panel indicate that certain aspects of the signal infrastructure have contributed to the violations. Further, certain violations are directly related to the operating rules and procedures currently employed by Metro at the various lines. Accordingly, there are diverse set of factors that can affect the occurrence of a red signal violations. These factors can be categorized as follows:

- Factors related to current operating practices.
- Factors related to existing signal configurations and/or infrastructure.
- Factors related to operating rules and procedures.
- Other miscellaneous factors.

It should be noted that in other sections of this report, we have discussed various issues that have affected red signal violations. The findings from these sections are included in this section without repeating the analysis. Where a new factor is introduced, full analysis is provided.

Contributing Factors Related to Operating Practices

The following contributing factors related to operating practices have been identified:

Finding:

B3. Inconsistent route setting for interlocking signals.

Current Metro operating practices employ a number of alternate processes and technologies to establish routes at interlocking signals. In general, there are two modes of operation for interlocking control:



- **Central Control** - ROC Controllers are responsible for establishing routes, and
- **Automatic** - Train Operators are responsible for establishing routes.

However, some interlocking locations have only one mode of operation (Central). At locations where two modes of operation are provided, the ROC Controllers are responsible for selecting the specific mode of operation for each interlocking location. Further, when an interlocking location is set to “Central” Control, an interlocking route can be fletted (re-establish itself), or the route can be manually established for each train.

Establishing a route under “Automatic” mode varies from line to line:

- **Red Line:** Train Operators activate push buttons located on the track to establish routes.
- **Blue/Expo Line:** When a train is located at a Train to Wayside Communication (TWC) location, a Train Operator can establish routes by activating cab controls.
- **Gold Line:** Routes are established through “Approach Clearing” design, where a route is established when a train occupies the approach track circuit. Alternatively, a route can be established by a Train Operator at a TWC location.
- **Green Line:** Automatic routing based on TWC route ID.

The responsibility for establishing routes is split between Train Operators and ROC Controllers. While controllers have operating information regarding the mode of operation for each interlocking location and the status of signal fletting, train operators rely on Controllers for such information as a result. Train Operators use radio communication with controllers to determine the status of a route or a signal at an interlocking location.

The ROC Controller SOPs provide some general guidance related to the preferred mode of operations for various interlockings. Similarly, the Train Operator SOPs explain in general terms the various types of route setting for different lines. Although train operators should wait for signals to clear, a lack of communication, or miscommunication could contribute to a false expectation on the part of the train operator that a signal will clear. Further, a change from operating norm could contribute to such false expectation. For example, if a signal is normally fletted, train operators are used to this signal being clear if there are no trains ahead. If the fleet is dropped or cancelled, there could be a false expectation that the signal would clear, especially if the train operator is focusing on bar signals.



While the stated root cause for many of the violations is “Operator Inattention”, it is necessary to identify and mitigate contributing factors. From a Rail Operator’s point of view, there are two main operating factors that can influence the operator’s action:

- Consistency of the process for establishing routes at various locations, and
- A clear indication as to when it is necessary for a Rail Operator to establish a route.

TWG believes that this inconsistent operating practice for route setting is a contributing factor to red signal violations. This is consistent with one of the main findings of the APTA Peer Review Panel that Rail Operators operate with the assumption that a signal would be clear or would change to a clear position.

In Section D, TWG sets forth a discussion and analysis of potential technologies that can mitigate this contributing factor. There are proven technologies, when combined with modified operating practices that can reduce red signal violations and enhance safety of operations.

Recommendation:

- 20.** Metro should consider the implementation of proven technologies, when combined with modified operating practices, that can reduce red signal violations and enhance safety of operations.

Finding:

B4. Train dispatching at terminal stations

As indicated in Section E, approximately 19% of violations occur at the leaving signals of terminal stations. TWG has explained that the current operating practice of delegating the train dispatching responsibilities to train operators is contributing to red signal violations. The current dispatching procedure increases pressure on Train Operators to leave the terminal station on schedule and the distraction of other tasks may cause the operator to fail to establish a route and falsely expect the leaving signal to clear. In addition, there is inconsistency related to the dispatching function, as ROC Controllers occasionally perform this function. This inconsistent operating practice can sometime lead to miscommunication between train operators and ROC controllers and contribute to RSVs.

Recommendations:

- 21.** Metro should consider eliminating its current operating practice of delegating train dispatching responsibilities to train operators.



22. Metro should investigate various automatic dispatching technologies that are driven by the operating schedule, and which activate indicators at terminal stations or on train operator displays to instruct train operators when to close train doors and depart terminal stations. It should be noted that under such systems, the train operator is still responsible for closing the doors, and use caution if a passenger is still trying to board the train.
23. Metro should review the scope of work for its current project to provide a new SCADA system, and investigate the feasibility of expanding the scope of work to provide automatic dispatching functions at terminal stations.
24. Metro should investigate the capabilities of the TWC equipment for various car classes to communicate automatic dispatching data to on-board equipment. Alternatively, Metro should investigate the installation of platform indicators that can be interfaced with the SCADA system to provide train dispatching information to train operators.
25. Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central”, and confirm that normal mode of operation is “Central”.

Contributing Factors Related to Infrastructure:

The following contributing factors related to operating practices have been identified:

Finding:

B5. Lack of standards for placement, design and installation of wayside signals

Metro’s existing signal installations were provided by separate construction authorities executing various capital projects without the benefit of significant input from rail operations, signal maintenance or a centralized Metro engineering group. As a result, the existing signal installations do not have common standards. The variations among site specific installations on various lines include differences in signal indications (aspects), signal placement, installation standards, and signal configurations. This has necessitated the development of diverse operating rules and procedures and, in certain cases, site specific SOPs.



Examples of the variances between signal installations include:

Although Metro has adopted a standard to install wayside signals on the left side of the track, many signal locations include right hand signals. This could lead to confusion on the part of train operators, especially at locations where normal and reverse running signals are installed side by side. Metro’s representatives indicated that the main reason for this deviation is to separate interlocking signals from traffic signals. However, it should be noted that reverse running signals are facing opposite to train traffic, and should not be visible to automobile drivers.



There is a lack of standards regarding the placement of wayside signals versus the Rail Operator’s direct line of sight. Signal height, for example, varies from location to location and in some cases a signal is raised in an attempt to differentiate it from an adjacent signal. This condition was also observed by the APTA Peer Panel.



There is a lack of standards regarding the configuration of signal equipment at a signal location. For example, the relative location of the signal head versus the location of the insulated joint. On the Gold Line, insulated joints are located in advance of the signal head. However, on the Expo Line insulated joints are located after the signal head. It is important to establish an installation standard for insulated joints relative to the location of associated signal to ensure proper operation. A misplaced insulated joint could result in the cancellation of a signal in front of a train.



There is a lack of standardization regarding signal aspects and associated operating rules. Metro plans to modify the existing signal aspects on the Blue Line (Green/Red aspects) to be compatible with the signal aspects on the Gold Line (Green/Yellow/Red aspects).



Recommendations:

26. Metro should establish a set of standards, with associated standard drawings, to regulate the placement, configuration, installation, and aspects of wayside signals.
27. All new and modernized signal installations should adhere to Metro's standard drawings.

Finding:

B6. Insufficient operating data provided to train operators

As discussed in various sections of this report, under normal operating conditions, train operators are responsible for establishing interlocking routes and clearing signals. However, during certain operational conditions, ROC controllers perform this function. The existing signal infrastructure does not provide indications to train operators as to when they are responsible to establish routes versus when this function is being performed by Controllers. This situation combined with a lack of verbal communication, or miscommunication between train operators and controllers could contribute to a false expectation on the part of the train operator that a signal will clear. In turn, this contributes to red signal violations.

Recommendations:

28. Metro should consider implementing modifications to certain elements of the existing signal installation for the purpose of providing additional operating information to train operators.
29. Site specific recommendations related to this contributing factor are included in the individual reports for priority signal locations (PSL) (*see Appendix 11*). As an example of a site specific recommendation at Wilshire/Western (Red Line), the following recommendation is made:
 - “Metro should consider modifying the design of the motorman pushbutton to include an indicator. The indicator would be activated from the ROC to instruct the train operator to establish a route at Signal 8 when required”.

Finding:

B7. Lack of integration or coordination between interlocking signals and bar signals at intersections:

As discussed in Section E, and in individual site reports for the Priority Signal Locations (*see Appendix 10*), the lack of coordination between interlocking signals and bar signals at intersections contribute to



red signal violations. This is the case because interlocking signals and bar signals operate independently and could provide conflicting aspects at an intersection. This contributing factor was also identified in the APTA Peer Review report. As discussed in our detailed responses to the Peer Review’s observations and recommendations in Appendix 8, resolving this issue is challenging because:

- LADOT is not modifying its traffic light installation to coordinate the clearing of an interlocking signal and a bar signal at an intersection, and
- Preconditioning interlocking signals to clear based on the clearing of bar signals could decrease the reliability of interlocking signals and could introduce delays in the movement of trains through intersections.

Recommendation:

- 30.** Metro should focus part of train operator training on site specific locations, wherein a conflict could exist between interlocking signals and bar signals.

Finding:

B8. Lack of coordination between gate indication and interlocking signal indication

This contributing factor is unique to locations at the boundary between Automatic Train Protection (ATP) and street running territories. One such location is the interlocking south of Washington Station at the Blue Line. (See Appendix 10). As explained in the site specific report for this priority signal location, it is difficult to coordinate the crossing gate indication with an interlocking signal indication. This is because the gate indication is provided for both directions of traffic, while an interlocking signal is related to a single traffic direction. Further, the text for the gate signal flashing yellow indication does not take into consideration a configuration similar to the installation at the Washington Station. In the event the interlocking signal is displaying a “stop” indication, and the gate signal is displaying a “Flashing Yellow” indication (Resume Normal Speed), there is a potential for a train operator to disregard the stop indication at the interlocking signal and to proceed past it.

Recommendations:

- 31.** Metro should review the text of the rule associated with the crossing gate, and make appropriate modifications.
- 32.** Metro should survey interlocking signals affected by this operating condition to determine if



modifications are warranted.

Finding:

B9. Poor visibility of signal aspects at certain locations

As discussed in the site specific reports for PSLs (*see Appendix 10*), the TWG team observed during site visits that a number of wayside interlocking signals have poor visibility. This is due to various factors including obstruction of the signal by other equipment, placement of a signal on a curve and height or orientation of the signal head. Poor visibility of signal aspects is a contributing factor to red signal violations because a train operator may not notice the signal in time to stop the train before overrunning the signal.

Recommendations:

- 33.** Site specific recommendations for individual signal locations are provided in the individual reports for PSLs. (*See Appendix 10*).
- 34.** In general, Metro should undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.

Finding:

B10. Ability of train operators to switch to “Street Running” mode within ATP territory

Rail Operators are able to switch to “Street Running” mode within ATP territory. One violation incident occurred when a Rail Operator switched his cab control to street running mode while in cab signal territory and moved past a failed crossing gate. (*See Appendix 11*). The operator technically should not have been able to do this without a Cab Cut-Out. In the event a train does not receive a speed code within ATP territory, the operating rules and procedures provide two alternatives for a train operator to move the train:

- Operate the train under “stop & proceed” mode upon receiving permission from the ROC. The train speed will be limited to 10mph, or
- Operate the train under “Cab-signaling Bypass” mode upon receiving permission from the ROC, and normally under manual block operation.

*The Operating Rules and Procedures include two rules related to crossing gate indications for the Gold Line. There are no corresponding rules for the Blue/Expo Line.



There is no operating scenario that will require a train operator to switch to “Street Running” mode within the ATP territory.

Recommendation:

- 35.** Metro should investigate the technical conditions that led to the ability to switch to street running mode, and implement the required modifications to ensure that train operators are not able to switch to “Street Running” mode while operating in ATP territory.

Finding:

B11. Lack of consistent train location indication within street running territory at the ROC

As indicated in more details in Section E and in individual site specific reports for PSLs, (*see Appendix 10*) train location information within street running territories is not provided consistently at indication panels and work stations at the ROC. Controllers need accurate and complete train location information to safely perform their duties and responsibilities. In the absence of train location data, ROC controllers could err during the execution of an operating function or procedure, which could lead to safety issues, including violations of red signals.

Recommendation:

- 36.** Metro should consider the installation of train detection equipment through the entire street running territory to provide train location information to ROC controllers.

Contributing Factors Related to Operating Rules & Procedures

The following contributing factors related to operating rules and procedures have been identified:

Finding:

B12. Manual Block Operation

As explained in Section E, Manual Block Operation is an operating rule that governs the movement of trains under certain operating conditions. The current operating practices permit the establishment of a manual block operation between two consecutive stations with an interlocking in between. This could contribute to red signal violations under certain operating scenarios.



Recommendations:

37. Metro should review its operating rules and procedures pertaining to manual block operation, and make needed clarifications that address this operational issue.
38. Metro should consider revising the current practice of including an interlocking within a manual block limit. Under such operating conditions, the manual block should be split into two manual blocks, wherein the first manual block ends at an interlocking signal, and the second manual block starts at the interlocking signal.

Finding:

B13. Description for “Limit Lines” vs “Fouling Point Markers”

Limit Lines are provided at insulated joint location to delineate the location where a train should stop in the approach to a red signal. Section E explains that the current operating rules and procedures do not define “Limit Lines”, but rather define a “Fouling Point Marker” that is similar in shape to limit lines. Further, the TWG team observed that Limit Lines are poorly visible and some are fading at certain field locations. Although, there is no documented violation wherein a poorly visible Limit Line has contributed to the violation, a poorly visible Limit Line and/or the lack of proper definition in the operating rules and procedures could contribute to future violations.

Recommendations:

39. Metro should survey all signal locations at the Blue, Expo and Gold Lines and make corrective actions as necessary to repaint “Limit Lines”.
40. Metro should consider painting all “Limit Lines” with reflective paint.
41. Metro should provide a description of the “Limit Line” and associated rule in the Operating Rule & Procedures and SOPs.
42. Metro should provide different markings to differentiate between a “Limit Line” and a “Fouling Point Marker”.



Other Contributing Factors

The following issue was identified as a potential factor that can contribute to red signal violations:

Finding:

B14. Performance issues with new digital radio communication system

During discussions with Metro management and throughout the focus groups sessions, TWG was informed that the new digital radio communication system has had a number of performance issues, including:

- Dead spots.
- Fading out, causing poor communication between ROC Controllers and Rail Operators.
- Blocked calls due to proximity of two radios.

Many supervisors and operators believe the new system is much less satisfactory than the system it replaced. While there has not been a documented violation wherein radio communication was an issue, radio performance issues could cause misunderstandings between Controllers and Rail Operators, which in turn could lead to violations of operating rules including red signal violations.

Recommendation:

- 43.** Metro should make every effort to address digital radio communication issues and improve the system.





Result of Review & Recommendations

**Section C: Safety Assessment of
Infrastructure Elements**

Section C: Safety Assessment of Infrastructure Elements

In order to provide a comprehensive assessment of the safety of rail operation on the various Metro lines, and as required by the Statement of Work, the TWG team reviewed various elements of Metro's infrastructure. The review included interviews with Metro's operating, engineering and maintenance personnel, inspection of physical installations, observations of rail operation at the various lines as well as at the ROC and examination of various documents. The review was focused on the following elements:

- Metro rail signal configurations, including operational characteristics and maintenance performance.
- ATP system, including its adequacy to provide safe operation at both dedicated right-of-way and street running territories.
- Grade crossing and traffic signal installations at rail/vehicle intersections where there is a higher likelihood of accidents.

The results of our reviews, findings, assessment and recommendations are included in Appendices 8, 9 and 10 and are summarized below:

Assessment of Metro Rail Signal Configurations

The existing signal installations at various Metro lines employ cab-signaling technology for ATP, wherein the tracks are divided into fixed blocks, and wherein track circuits are used to detect the presence of trains in each block. Wayside signals are placed at interlocking boundaries and other locations to control movement of trains throughout the system. A red signal violation occurs when a train operator conducts a train past a signal displaying a "stop" aspect without authorization. Accordingly, the main objectives of the rail signal configuration assessment are:

- Evaluate the effectiveness of rail signal configurations in minimizing red signal violations.
- Determine if there are contributing factors to red signal violations that are present in existing signal installations.

Our analysis identified patterns of red signal violations that show a high frequency of violations at certain locations. As such, in performing this assessment, TWG focused on the signal installations and locations



that experienced the highest number of red signal violations. These installations and locations are identified within the Metro’s organization as PSLs, and are summarized as follows:

Priority Signal Location	Signal ID	Frequency of Red Signal Violations
Red Line, Wilshire/Western	8	6
Blue Line, 7 th & Metro Center	3N	3
	2S	4
	4S	7
Blue Line, Pico Station	5N	9
Blue Line, Maple Interlocking	2S	5
Blue Line, Washington & Flower Junction	8N	8
	2S	3
Blue Line, Washington Station	5N	2
	2S	4
Expo Line, 22 nd Street Interlocking	2S	3
Expo Line, 30 th Street Interlocking	2S	3
Gold Line, Atlantic Station	2N	4
	4N	5
Gold Line, Pico Aliso	2S	2
	4S	2
Gold Line, Ditman Interlocking	2N	9

It should be noted that it is not the intent of this review to perform a comprehensive assessment or analysis of the design and safety of the existing signal installations. However, where appropriate our team made a number of safety observations and reflected these observations in individual site reports.

(See Appendix 10).

Assessment Methodology

Our general approach to review, analyze and assess the priority signal locations includes the following elements:

- Conduct interviews with Metro’s operating, safety and maintenance representatives
- Conduct interview with LADOT representative
- Review signal configuration drawings
- Conduct site visits to priority signal locations
- Review Operating Rules & Procedures and SOPs
- Analysis of the operating characteristics of the signal installation
- Review the findings of the APTA Peer Review Panel
- Review the Stop Signal Working Group documents, and



- Review the technical Provisions for Metro’s Contract to modernize existing SCADA/CTC system

Findings:

The TWG team has evaluated each of the priority signal locations and developed recommendations for reducing the number of violations at each location. The detailed results of this evaluation and analysis are summarized in site specific reports in Appendix 11. During the course of performing this evaluation, the TWG team identified a safety issue at Pico Station, and brought this issue to the attention of Metro. In turn, Metro took immediate action to mitigate the safety issue. The following is a summary of the main findings based on our review and assessment:

- C1.** The signal installation at certain locations does not provide sufficient operating information to train operators.
- C2.** The function of train dispatching at terminal stations is performed manually by train operators.
- C3.** Many signal locations do not adhere to the signal installation standards that requires signals to be installed at the left side of the track.
- C4.** Poor visibility of signal aspects at certain locations.
- C5.** Irregular operation at one signal location (Pico Station, Signal 5N), wherein the signal remains clear for approximately 50 feet after a train passes the signal.
- C6.** Lack of coordination between interlocking signals and bar signals at intersections.
- C7.** Lack of consistency in signal design between various lines, and between signal locations at the same line. This includes different signal aspects, physical height of signal head, and signal control features such as fleeting and approach clearing.
- C8.** Lack of event recorders at certain signal installations.
- C9.** Poor visibility of limit lines at many locations.
- C10.** Lack of coordination between gate indication and interlocking signal indication at one location (Blue Line, Washington Station).
- C11.** The existing signal installation does not provide consistent train detection indication within street



running territory at ROC.

C12. Insufficient sighting distance at certain signals (example: signal 9S at Washington Station).

C13. Lack of enforcement of “stop” aspect at certain locations (example: signal 9S at Washington Station).

C14. Lack of consistency in posting civil speed limits.

APTA Peer Review Recommendations

In response to the increase in red signal violations, Metro requested APTA to conduct a Peer Review regarding an appropriate zero tolerance policy for red light violations on Metro’s bus and rail system. In June 2015, the APTA Peer Review Panel concluded its review and issued a set of observations and safety recommendations that focus on street running with interlocking signals. The TWG team reviewed the APTA observations and recommendations for the purpose of identifying any improvement or changes that Metro can make to enhance safety of operation. A consolidated assessment of APTA Peer Review recommendations is provided in Appendix 8. The following is a summary of our assessment of APTA Peer Review recommendations pertaining to Metro Rail Signal Configurations:

- TWG agrees with APTA’s recommendation for Metro to standardize signal aspect displays at various lines.
- TWG agrees with APTA’s observation that it is difficult to coordinate or integrate the clearing of interlocking signals with the clearing of bar signals at intersections.
- TWG partially agrees with APTA’s observation that signal installations provide good line of sight operation at interlocking signals. As indicated above, and explained in Appendix 10 certain signal locations have poor visibility and/or insufficient sighting distance.
- TWG agrees with APTA’s observation that interlocking signals are not uniformly placed.
- TWG disagrees with APTA’s recommendation to make reverse running signal approach lit.
- While in general TWG agrees with APTA’s recommendation to add approach signals, the decision of whether to add approach signals should be made on a case by case basis and in the context of enhancing the safety of operation in non-ATP, street running territory.



- While TWG agrees in principle with APTA’s observation that relocating reverse running signals will eliminate a contributing factor to red signal violations, Metro should consider relocating reverse running home signals as part of a comprehensive design approach to upgrade the safety of operation in street running territory.

Recommendations:

Specific recommendations to enhance the safety of operation at priority signal locations are provided in the site specific reports (*see Appendix 10*). The following is a summary of our main recommendations based on our review and analysis:

44. Metro should consider implementing modifications to certain elements of the existing signal installation for the purpose of providing additional operating information to train operators.
45. Metro should consider the implementation of an Automatic Train Dispatching (ATD) system.
46. Metro should undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.
47. Metro should modify the signal configuration at signal 5N, Pico Station, to comply with acceptable operating standards.
48. Metro should implement a program to install event recorders at all interlocking locations.
49. Metro should conduct a risk assessment of the operation of Signal 9S, Washington Station, and implement signal modifications as necessary.
50. Metro should install train detection equipment where required to provide visibility of train movements to controllers at the ROC.
51. Metro should investigate the implementation of technologies to provide cab indication/alarm when a train is approaching a red signal.

Assessment of Automatic Train Protection System

The ATP system employed by Metro on various lines is based on cab-signaling technology, where the track is divided into fixed blocks, and where track circuits are used to detect the presence of trains in each block. The ATP system also includes an interlocking control subsystem that ensures safety of operation over



interlocking routes.

Typically, a cab-signaling system includes wayside elements that generate discrete speed commands based on a number of factors including train detection data, civil speed limits, train characteristics, and track geometry data. The speed commands are injected into the running rails of the various cab-signaling blocks, and are received by trains operating on these blocks via pickup coils. A cab-signal system also includes car-borne devices that present speed information to Rail Operators. The car-borne devices ensure that the actual speed of a train does not exceed the safe speed limit received from the wayside. The Metro cab signaling installation incorporates these features.

Although the various cab-signaling systems installed on the various Metro lines are provided by different suppliers, they all provide the basic safety functions required to ensure safe train operation. However, these systems vary in their level of automation and how interlocking routes are established. The basic safety functions provided by an ATP system include:

- Train detection.
- Train separation: Ensuring that trains are separated by a safe distance to prevent rear-end collisions.
- Over speed protection, ensuring that trains do not exceed safe speeds at curves and when making diverging moves at crossovers.
- Protection against opposing and conflicting routes.
- Safe management of traffic patterns.

The TWG team performed an assessment of Metro’s ATP systems for the purpose of determining the following:

- 1) The extent that the ATP system effective as a safeguard to avoid red signal violations and accidents.
- 2) Analyze the reason/rational for not implementing ATP on tracks within street running territories.
- 3) Identify potential impact and risk for not implementing ATP in all main line track areas.
- 4) Determine if Metro should add ATP or other safeguards to track areas without ATP based on industry standards.

Effectiveness of Automatic Train Protection System

Finding:

C15. The ATP system used in the Metro network is adequate as a safeguard to avoid accidents, but it is less effective in avoiding red signal violations.



Under normal operation (absence of failures or special operating conditions), the safety of operation is assured by the ATP system. In the event of a failure, however, the ATP system brings a train to a stop, and it becomes necessary to operate trains under operating rules and procedures. Under certain operating conditions (for example, movement into a tail track), it is necessary to operate trains pursuant to operating rules and procedures. As such, the ATP systems that Metro uses include a number of degraded operating modes to enable trains to continue to move during failure modes, and under special operating conditions. The degraded operating modes include:

- **Stop & Proceed:** Upon receiving permission, a Rail Operator can operate the train at a speed that does not exceed 10 mph.
- **By-Pass:** Upon receiving permission, a Rail Operator can operate the train in Cab-signaling By pass with speed ranging from 10 to a maximum of 25 miles per hour, depending on the operational scenario.

RSVs occur when trains are operating in degraded modes of operation within ATP territory. An analysis of Metro’s RSVs shows that approximately 51% of the total RSVs occur within ATP territory. The percentage of violations within ATP territory varies from line to line as shown in the table below:

Line	% Territory with ATP	% Violations in ATP Territory
Red	100%	100%
Green	100%	100%
Blue	70%	60%
Expo	60%	14%
Gold	80%	20%

While ATP systems employed by Metro are adequate as a safeguard to avoid accidents during normal operation, they are not effective in avoiding red signal violations when trains are operating in degraded modes. TWG did not receive data from Metro as to how often Metro operates in a degraded mode, however, based upon the fact that red signal violations occur and certain moves are routinely performed in degraded modes, one can conclude that train operation in degraded mode is common.

It should be noted that when operating in degraded modes, the safety of operations is dependent on compliance with operating rules and procedures. Therefore, it is critical that the operating rules and procedures be compatible with, and complement the train control system. It is also critical that Operations personnel are well trained on all aspects of ATP system operation, including degraded modes,



as well as operating rules and procedures. Further, it is critical to provide real time operating information to Operations personnel at central control locations.

Recommendations:

- 52.** The decision to implement ATP street running territory should be driven primarily by the need to enhance operational safety and to provide adequate safeguards to avoid accidents, and not to reduce violations.
- 53.** Metro should perform a comprehensive review of operating rules and procedures and SOPs to ensure that all failure modes and operational scenarios are covered with appropriate rules and procedures.
- 54.** Metro should ensure proper training for all Operations personnel on operating rules & procedures and SOPs under ATP related to operation in degraded ATP modes.

Rationale for Not Implementing Automatic Train Protection in Street Running Territory

A review of applicable standards, acceptable practices and industry publications related to the optimum level of signal/train control sophistication reveal that it is up to the transit agency responsible to provide the service to determine the level of signal protection for Light Rail Transit (LRT) operation. The original concept of operation adopted by Metro for its LRT lines was based on providing ATP based on cab-signaling technology in sections with dedicated right-of-way, and to rely on “Line of Sight” operation in street running territories.

The initial installation on the Blue Line did not provide power operated switches and interlocking signals in street running territory. The line was later modified, and interlocking signals were installed. However, no enforcement was provided at interlocking signals, and trailing point protection is based on compliance by train operators to stop at the home interlocking signals.

TWG conducted a number of interviews with Metro’s safety, operating and maintenance personnel to discuss concept of operation, operating rules and procedures, design philosophy and maintenance practices. Further, TWG held a telephone interview with a LADOT technical expert to discuss the synchronized traffic signals in use at street intersections within street running territories, the operation of Bar Signals, and infrastructure employed by LADOT to detect and monitor train movements. The discussions with Metro and LADOT representatives, review of the red signal violation reports and site visits to various locations on the Blue, Expo and Gold Lines reveal the following:



- The aspects displayed at interlocking signals and bar signals are not coordinated, and
- LADOT will not modify its traffic control system to achieve correspondence between the two type signals.

One of the main operating risks present in street running areas is the risk of collision between train and vehicles. The installation of ATP in these areas will result in the display of cab-signaling speed codes in the train operator cab that contradict with bar signals. Providing conflicting instructions to train operators is not desirable, and will increase the risk of violating a bar signal with a potential consequence for a train vehicle collision. Further, unlike interlocking signals that are located at discrete locations, cab-signaling speed commands are continuously displayed in the cab and the potential for conflicting instructions to train operators will be present at all intersections.

Findings:

C16. While the implementation of ATP based on cab-signaling technology in street running territories provides train-to-train and train-to-track protection, it will add risk with respect to train to vehicle collision.

C17. For certain locations at the approach to portals, and approaching sharp curves, there is a need for ATP enforcement. For example, at Pico Station Signal 5N, there is a need to provide ATP enforcement in the approach to the portal.

Recommendations:

- 55.** Metro should assess the safety of operation in the approach to portals and sharp curves, and provide ATP enforcement to enhance operational safety.
- 56.** Metro should ensure proper training for all Operations personnel on operating rules & procedures and SOPs under ATP related to operation within street running territories, and in particular when operating at sharp curves, and approaching portals.

Safety Risks for Not Implementing Automatic Train Protection in Street Running Territory

The safety of operation in non-ATP territory is entirely reliant on compliance with operating rules and procedures. Our team reviewed rail maps for various lines that identify street running track areas not equipped with ATP systems. TWG reviewed and analyzed various sections of street running areas on the Blue, Expo and Gold Lines. In conducting this analysis, our team reviewed track and signal drawings, conducted site visits and held interviews with Metro’s safety, operating and maintenance staff. We found



two different configurations of street running territories:

- The first configuration includes electrified track switches with interlocking signals. Additional signals are provided in the approach to portals and at other locations. Train detection is partially provided in the territory. Bar signals are provided at street intersections by LADOT and other local municipalities. The street running track sections that implement this configuration are:
 - **Blue Line - Within the following areas:**
 - A half mile segment along Flower Street between 12th Street and Washington Blvd.
 - A 1.5-mile segment from just South of Washington Blvd to Washington Station.
 - **Expo Line - Within the following areas:**
 - A half mile segment along Flower Street between 12th Street and Washington Blvd.
 - A three-mile segment from just south of Washington Boulevard to just west of Western Station.
 - The Crenshaw Blvd grade crossing.
 - **Gold Line - Within the following areas:**
 - A half mile segment immediately south of Highland Park Station along Marmion Way.
 - A 1-mile segment from just south of the I-101 bridge near Little Tokyo Station to the Eastside tunnel portal just east of Pico Aliso station.
 - A 2.5-mile segment from the Eastside tunnel east portal on 1st street to the terminus at Atlantic station.
- The Second configuration includes non-electrified track switches without interlocking signals. No train detection is provided in the territory. Bar signals are provided at street intersections. The street running track section that implement this configuration is:
 - **Blue Line - Within the following area:**
 - A 3.5-mile segment comprising track south of Willow Station in Long Beach and through the loop.

The operating characteristics for each of the street running areas, as well as our observations and conclusions related to the various factors that affect the safety of operation in each of the above identified track sections are included in Appendix 11. In general, the following elements affect the safety of operation in street running territories:

- Inconsistent compliance by Rail Operators and Controllers with applicable rules & procedures and SOPs.



- Lack of signs that post-civil speed limits.
- Lack of real time train location information at the ROC.
- Lack of coordination between interlocking and bar signals.
- Inconsistent placement of interlocking signals.
- Inconsistent route setting practices.
- Lack of focus on bar signal violations.

As explained above, in the absence of integrating ATP with Bar Signals operation, ATP based on cab-signaling technology may increase the risk of Bar Signal violations and the potential consequence for train/vehicle collision. Further, ATP is not effective in reducing red signal violations. Therefore, the risk for not implementing ATP in Street Running Territory is more related to train operation during normal or special operating conditions.

Bar Signal violations present a high risk to operation with high exposure due to the large number of rail/vehicle intersections. TWG is advised that LADOT has the capability to generate a daily log of bar signal violations at all intersections, and that such log is available to Metro upon agreement on certain financial conditions. It is prudent for Metro to institute a process to review and investigate bar signal violations and take the appropriate actions to mitigate the risks of these violations.

Based on our analysis of the various street running sections, the operational risks are mainly related to failure to comply with operating rules & procedures and SOPs. The risk increases if there are factors that contribute to the violations. A summary of the operational risks identified in each street running area is summarized in Appendix 11.

Finding:

C18. In general, the following operational risks are present when operating manually within street running territory without ATP:

- Risk of rear-end collision due to failure of train operator to maintain safe distance to train ahead.
- Risk of derailment due to failure of train operator to maintain safe operating speed in areas where the safe operating speed is less than 35 mph.
- Risk of collision or derailment due to failure of train operator to comply with a “stop” aspect at an interlocking signal.
- Risk of rear end collision due to failure of train operator to comply with “stop” aspect at portal signal.
- Risk of head-to-head collision due to error of ROC Controller in managing traffic between two adjacent interlockings, and



- Risk of train-to-train collision due to error by ROC Controller in implementing manual block operation or other special operation.

Recommendations:

- 57.** Metro should quantify the potential impacts and risks of not implementing ATP on all main line track areas.
- 58.** Metro should assess the safety of operation in the approach to portals and sharp curves, and provide ATP enforcement to enhance operational safety.
- 59.** Metro should ensure proper training for all Operations personnel on operating rules and procedures and SOPs related to operation within street running territories, and in particular when operating at sharp curves, and approaching portals.

Should Metro Implement Automatic Train Protection in Street Running Territories?

The main findings related to the implementation of ATP systems in street running territories that are the basis for TWG review are:

Findings:

- C19.** While the ATP systems employed by Metro are adequate as a safeguard to avoid accidents during normal operation, they are not effective in avoiding red signal violations when trains are operating in degraded modes.
- C20.** Real time operating information is not provided to Operations personnel at central control locations.
- C21.** The safety of operations in non-ATP territory is entirely reliant on train operator compliance with operating rules and procedures.
- C22.** The lack of ATP in street running territories increases the risks of train-to-train collisions and train derailments.
- C23.** The lack of enforcement of stop aspects at interlocking signals in street running territories increases the risks of collisions and derailments.



- C24.** Preconditioning interlocking signals to clear based on the clearing of bar signals could decrease the reliability of interlocking signals and could introduce delays in the movement of trains through intersections.
- C25.** LADOT is not modifying its traffic light installation to coordinate the clearing of an interlocking signal and a bar signal at an intersection.
- C26.** In the absence of integrating ATP with bar signal operations, ATP based on cab-signaling technology may increase the risk of bar signal violations and the potential consequence for train and vehicle collisions.

Based on the above findings, we can conclude that there are two conflicting consequences for the deployment of an ATP system that is based on cab-signaling technology within street running territories. More specifically, while the implementation of ATP will have a positive impact on train-to-train and train-to-track safety, it will adversely affect the safety of train/vehicle operations at intersections. There are, however, a number of measures that can be implemented to enhance safety of operations in the short term while evaluating more advanced train control technologies.

Short Term Recommendations:

- 60.** Install speed signs at all locations within street running territories, where the safe operating speed is less than 35 mph.
- 61.** Add ATP enforcement for sharp curves to provide over-speed protection and mitigate the risk of derailment, for example the curve in the approach to Washington Station.
- 62.** Add ATP enforcement to signals protecting the entrance to portals, for example signal 5N at Pico Station.

In addition to these measures, Metro should consider the safety recommendations made in the Assessment of Priority Signal Locations (*see Appendix 11*).

A longer term solution to enhance the safety of operations within street running territories could be based on advanced train control technologies such as Communication Based Train Control (CBTC) or Incremental Train Control System (ITCS). To provide ATP safety functions within street running territories, an ATP system is needed that maintains line of sight operation with ATP oversight. These systems can provide the ATP safety functions without the need to generate train operator displays that could contradict traffic bar signals. Rail Operators would be able to operate trains manually and follow the bar signal aspects at



intersections without the risk of a conflicting indication from an ATP system.

An example of such installation is the Open Control of Train Interchangeable & Integrated System (OCTYS) CBTC system deployed by the RATP. This system is installed on legacy trains to provide added safety for manual train operations. CBTC operates in the background without a train operator display. The train operator operates the train according to operating rules and procedures. CBTC monitors train operation and provides enforcement of red signals, safe train separation and over speed protection.

Long Term Recommendation:

- 63.** As part of a long term Signal Modernization Program, Metro should investigate the implementation of CBTC or ITCS technology as a replacement system for the existing cab-signaling installation. CBTC/ITCS has the advantage of easily interfacing with wayside interlocking signals to provide positive train stops. Also, these systems employ smart trains that determine their own locations, and implement a vital data base that describes the line operating characteristics, including street running territories.

Assessment of Crossing and Traffic Signal Installations at Rail/Vehicle Intersections

There are two main objectives related to the assessment of safety equipment at rail/vehicle intersections:

- 1)** Research through APTA and public data bases to determine industry best practices for lighting, gating, and signage that will discourage public unsafe behavior, and
- 2)** Review sample of 10 rail and vehicle intersections where there is a higher likelihood of accidents with vehicles due to unclear signage, visibility or confusion.

To achieve the first objective, TWG reviewed the following documents:

- Federal Highway Administration (FHWA) - Railroad Highway Grade Crossing Handbook.
- Best Practices in Rapid Transit System Design - A Rapid Transit System design guide for residents, advocates, and policymakers in Montgomery County, MD.
- Recommended Practice for Rail Transit Grade Crossing Public Education and Rail Tress pass Prevention - Volume 3 - Rail Grade Crossings - APTA RT-RP-RGC-002-02.
- Recommended Practice for Rail Transit System Highway Rail Grade Crossing Safety Assessment - Volume 3 - Rail Grade Crossings - APTA RT-RGC-RP-003-03.
- Standard for Rail Transit System Highway Rail Grade Crossing Warning Device Inspection, Testing and Maintenance - Volume 3 - Rail Grade Crossings - APTA RT-RGC-S-001-02.
- Standard for Rail Transit Grade Crossing Warning System Design Criteria, Installation and Operation



- Volume 3 - Rail Grade Crossings - APTA RT-RGC-S-004-03.
- Manual on Uniform Traffic Control Devices (MUTCD) for Streets & Highways - Part 10, Traffic Controls for Highway - Light Rail Transit Grade Crossings.
- CALTRAIN Design Criteria - Chapter 7, Grade Crossings.
- California MUTCD - Chapter 8B, Signs & Markings.
- METROLINK - SCRRRA Highway Rail Grade Crossings - Recommended Design Practices and Standards Manual.
- California MUTCD - Part 3, Markings.
- California MUTCD - Part 8, Traffic Control for Railroad and Light Rail Transit Grade Crossings.
- TCRP - Report 137, Improving Pedestrian and Motorist Safety Along Light Rail Alignments.
- Pedestrian Safety Guide for Transit Agencies - Chapter 3, Actions to Increase the Safety of Pedestrians Accessing Transit.

Based on our review of the above documents, we identified a set of improvements and industry best practices that can be used to enhance the safety of operation at intersections as well as to encourage safe public behavior. Some of the items on this list of improvements are currently being used in a limited scale by Metro/LADOT. The following is a summary of the best practices that are currently being used by the industry to enhance operational safety at intersections:

- The presence of raised median islands on the roadway is extremely effective in reducing the opportunity to drive around lowered automatic gate arms. California MUTCD provides design recommendations for effective median islands.
- The presence of a 12-inch-wide white striping (on both the vehicular side and the edge of the crossing) within the pedestrian crossing area is effective in guiding pedestrians through the passageway.
- Channelization is effective in discouraging unsafe behavior and where the crossing has a significant skew. Channelization normally includes fencing, swing gates, median islands, and various traffic control devices. The main purpose of channelization is to guide pedestrians, including bicycles, to cross the tracks where active warning devices are in place.
- Swing gates should be compliant with the American Disabilities Act (ADA) compliant to allow pedestrians or persons in wheel chairs to exit the crossing by pushing the gate.
- To the extent possible, pedestrian safety buffer zones should be provided to ensure adequate space for a group to stand in safety, a wheel chair to maneuver, and to accommodate slower moving individuals.
- To the extent possible, billboards and sign structures should be eliminated from the vicinity of inter



sections. Such structures can create visibility problems and distract the motor vehicle operator’s attention from the intersection warning devices.

Lighted pedestrian crosswalks provide an effective guide as to where pedestrians should cross at an intersection.



Illuminated active in-pavement marking (IPM) systems, when installed parallel to the light rail transport (LRT) alignment, are effective in alerting vehicle drivers that a train is approaching the intersection. IPM systems discourage vehicle drivers from violating turn signals at intersections. TWG is advised that Metro has installed similar systems at pilot locations.

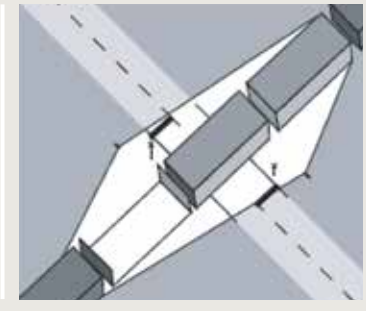
The use of “Blank Out” signs (example an illuminated no turn on red) is effective in advising motorists and pedestrians of increased risk due to the presence of a light rail vehicle (LRV) at a crossing location. TWG is advised that Metro has installed these signs at a number of locations.



The use of “Second Train Signals” is effective in advising motorists and pedestrians that two trains are approaching an intersection. This is an active sign that illuminates when one or two trains are approaching. The sign may be a blank-out LED sign or it may use flashing lights or another type of indication (such as backlit illumination) to an otherwise static sign. TWG is advised that Metro has installed these signs at a number of locations.



Rumble strips are effective in alerting drivers when they leave their lane, infringing on the LRT right-of-way. TWG is advised that Metro has installed curb which they consider better than rumble strips.



The use of additional lighting at intersections is effective in increasing the visibility of crossings to motorists at night. Luminaries are normally directed to the sides of the rail vehicles to increase the conspicuity of the LRVs. Chapter 10 of MUTCD encourages consideration of illumination at and adjacent to the highway-light rail transit grade crossing when transit operations are conducted at night.

Automatic photo enforcement system is effective in deterring motorists from deliberately violating traffic laws at intersections. TWG observed that Metro installed photo enforcement at a number of LRT crossings.



Recommendation:

- 64.** Metro should review each of the above listed best practices against what it has already implemented to identify any remaining locations to improve operational safety at intersections, and encourage safe public behavior.

Review of Sample Intersections

Our approach to carry out the second objective includes the development of a check list of basic requirements for signage, street markings, pedestrian barriers, channelization design, traffic equipment, lighting and traffic enforcement. This check list was then used to review a sample of 10 rail and vehicle intersections. The main premise of our approach is to assess to what extent Metro/LADOT are complying with the basic requirements for safety equipment at intersections. A copy of the check list is attached in Appendix 9.

With respect to the intersection review, Metro did not identify specific intersections, but provided the TWG team with documents that summarized train to vehicle and train to pedestrian accidents within the last few years. Our team then reviewed the accident statistics for the purpose of selecting a sample of 10 intersections based on the following criteria:



- Focus on the Blue Line that has the highest number of accidents.
- Consider the accident history for various intersections.
- Include intersections from different Metro lines.
- Include intersections within Long Beach.
- Include intersections within street running territories, as well as intersections at dedicated right-of-way.

As a result, the TWG team selected the following ten intersections:

Line	Intersection	Operating Condition	Accident History
1) Blue	18th Street & Flower Street	Street running	Sixteen accidents, including one fatality between 2005 to 2014
2) Blue	Pico Blvd. & Flower Street	Street running	Four accidents between 2013-2014
3) Blue	Long Beach Avenue & 20th Street	Dedicated right-of-way	N/A
4) Blue	Long Beach Avenue & 24th Street	Dedicated right-of-way	One accident, including one fatality during 2015
5) Blue	Gage Avenue	Dedicated right-of-way	Seven accidents, including four fatalities between 2005 to 2014
6) Blue	Washington Blvd. & Hooper Avenue	Street running	Three accidents between 2006 to 2015
7) Blue	Long Beach Blvd. & Burnett Street	Street running	Three accidents, including one fatality between 2010 to 2014
8) Expo	Exposition Blvd & Raymond Street	Street running	Six accidents between 2013 to 2014
9) Expo	Exposition Blvd. & Watt Way	Street running	Three accidents between 2014 to 2015
10) Gold	Pasadena Avenue & Monterey Road	Dedicated right-of-way	Two accidents, including one fatality between 2013 to 2014



Our review of the above listed intersections shows that there are two main types of intersections within Metro's network:

- Intersections within street running territories, where the traffic control equipment consists of traffic signals for vehicles, bar signals for trains and traffic signals for pedestrians.
- Intersections within a dedicated right-of-way, where the traffic control equipment consists of grade crossing gates, flashing lights, bells and audible devices, as well as signal indication for trains to proceed through the intersection.

Our team focused on the visible traffic elements at the intersection that could have an impact on public safety behavior including traffic signs, street markings & pedestrian barriers, traffic control devices, visibility and lighting conditions and traffic enforcement devices. Our review did not assess various design aspects of the traffic equipment at an intersection. As a result, our team did not review any aspect of grade crossing designs, compliance with dimension requirements and installation standards, and sequencing of operation of various phases of traffic control implemented at an intersection. Also, we assumed that the traffic control devices installed at an intersection operate as designed and are properly maintained.

To review the selected intersections, TWG used the check list (*see Appendix 8*) it developed based upon best practices to determine the extent to which the intersection complied with basic industry standards. TWG also reviewed available information related to the contributing factors for previous accidents at the intersections. It should be noted that it is difficult and speculative to directly correlate any identified contributing factors with any deficient finding at an intersection. As such, specific findings for each intersection and general recommendations are intended to propose enhancements that would discourage unsafe public behavior. A summary of our review of the identified intersections, including completed check lists are attached in Appendix 9.

Findings:

- C27.** There is a lack of consistency in the configuration of signage, street markings & pedestrian barriers, traffic control devices, and traffic enforcement devices.
- C28.** Signage at certain locations are not visible due to graffiti and other obstructions.
- C29.** There are a number of private driveways on the Blue Line that lack traffic signal protection, although Metro has traffic signs alerting drivers to the LRT ROW.
- C30.** The signage and street markings at certain intersections do not meet minimum standard requirements and acceptable industry practices.



Recommendations:

- 65.** Metro should establish a comprehensive set of guidelines for rail/vehicle intersections that define minimum requirements for signage, street markings, pedestrian barriers, lighting, traffic control devices and traffic enforcement devices. The guidelines should be based on Industry Standards, and should provide an environment that promote public safe behavior.
- 66.** Metro should survey all rail/vehicle intersections to determine if they meet the established guidelines, and should develop a scope of work for each intersection that identifies the work elements required to bring the intersection in compliance with minimum requirements.
- 67.** Metro should establish a Capital Program in conjunction with local municipalities to upgrade the traffic installations at the various intersections based on established scopes of work.
- 68.** Metro should review, evaluate and implement new technologies at rail/vehicle intersections for the purpose of enhancing safety of operation, and encouraging public safe behavior.
- 69.** Metro should conduct a survey of all private driveways that intersect with the right-of-way within street running territory, and develop and implement a plan to mitigate the risks associated with un protected private driveways.
- 70.** Metro should establish and implement a maintenance program to eliminate graffiti at traffic signs at various intersections.





Result of Review & Recommendations

Section D: Technology

Section D: Technology

This section provides a summary of TWG's investigation of various systems and industry practices for the purpose of identifying technologies, procedures and processes that can be implemented to mitigate red signal violations, and enhance safety of operation. Our general approach is based on the premise that it is necessary to combine technical innovation with compatible operating practices in order to achieve effective results. As such, TWG focused on ways to mitigate the operational and infrastructure factors that contribute to red signal violations. More specifically, our investigation focused on the following:

- Addressing inconsistencies in Metro's operation related to establishing routes and dispatching trains at terminal stations.
- Enforcement of red signal aspects within non-ATP territories.

It should be noted that with respect to technologies that can enforce red signal aspects within street running territories, there are operational and infrastructure constraints that makes the implementation of such technologies in Metro's operating environment very challenging. More specifically, certain lines in Metro's network (Blue, Expo & Gold) include track sections with dedicated right-of-way, and other track sections with mixed rail and vehicle traffic (street running). The existing Metro fleet is equipped with cab-signaling on-board devices that provide ATP functions in sections with dedicated right-of-way. The implementation of a separate system within street running territory is challenging because it requires the installation of a secondary system on-board the trains. What is needed is a train control system that can provide the needed ATP functions for both dedicated right-of-way and street running sections.

Technology Mitigation for Inconsistent Operation

Metro is currently employing a diverse set of processes and technologies for controlling train service. More specifically, Metro uses a number of alternate processes and technologies to establish routes at interlocking signals. In general, there are two modes of operation for interlocking control:

- Central Control - ROC Controllers are responsible for establishing routes.
- Automatic - Train Operators are responsible for establishing routes.

However, some interlocking locations have only one mode of operation (Central). At locations wherein two modes of operation are provided, the ROC Controllers are responsible for selecting the specific mode of



operation for each interlocking. Further, when an interlocking is set to “Central” Control, an interlocking route can be fletted (re-establish itself), or the route can be manually established for each train.

Establishing a route under “Automatic” mode varies from line to line:

- Red Line: Train Operators activate push buttons located on the track to establish routes.
- Blue/Expo Line: When a train is located at a TWC location, a Train Operator can establish routes by activating cab controls.
- Gold Line: Routes are established through “Approach Clearing” design, wherein a route is established when a train occupies the approach track circuit. Alternatively, a route can be established by a Train Operator at a TWC location.
- Green Line: Automatic routing based on TWC Route ID.

As indicated above, the responsibility for establishing routes is split between Train Operators and ROC Controllers. Further, while controllers have operating information regarding the mode of operation for each interlocking and the status of signal fletting, train operators rely on Controllers for such information. Train Operators use radio communication with controllers to ascertain the status of a route or a signal at an interlocking location. Although train operators should wait for signals to clear, a lack of communication, or miscommunication could contribute to a false expectation on the part of train operator that a signal will clear. Further, a change from operating norm could contribute to such false expectation. For example, if a signal is normally fletted, train operators are used to this signal being clear if there are no trains ahead. If the fleet is dropped or cancelled, there could be a false expectation that the signal would clear, especially if the train operator is focusing on bar signals.

One of the main findings in the APTA Peer Review Report is that Rail Operators operate with the assumption that a signal would be clear or would change to a clear position. TWG agrees with this finding, and believes that this assumption is driven in part by the inconsistency in which routes are being established. The ROC Controller SOPs provide some general guidance related to the preferred mode of operations for various interlockings. Similarly, the Train Operator SOPs explain in general terms the various types of route setting for different lines.

While the root cause for many of the violations is “Operator Inattention”, it is necessary to identify and mitigate contributing factors. From a Rail Operator’s point of view, there are two main operating factors that can influence the operator’s action:

- Consistency of the process for establishing routes at various locations.
- A clear indication as to when it is necessary for a Rail Operator to establish a route.



While there are a number of proven technologies that are being used by transit agencies for the purpose of automatic route setting, what is critical for Metro is to first decide on an operational concept that will be used consistently. While Metro has diverse operating environments for heavy rail and light rail, available technologies can make differences between the operating environments transparent.

There are two main steps included in automatic route setting. The first step is to establish an identity for the train, and the second step is to establish a route based on the train identity. This two-step process is currently being used by Metro at 7th & Metro Center (Blue/Expo Line) for automatic route setting at Washington & Flower Junction.

There are a number of technical approaches to establish train identities:

- Train identity can be established from the operating schedule when a train departs from the terminal station.
- Train identity can be established by a train operator by activating a push button on the wayside.
- Train identity can be established by a train operator by entering TWC data in the cab.
- Train identity can be provided through the use of active transponders (tags) mounted on trains.

Also, there are a number of technical alternatives to track the identity of a train so that it is used down the line to establish a route:

- Train tracking algorithms implemented in the SCADA system.
- Train identity storage system implemented as part of the field signal installation.
- Wayside tag readers could be used at discrete locations in the approach to signals to establish routes based on tag information.

Metro is currently planning a project to replace the SCADA/CTC system on the Red Line (Contract No. OP39603035). This system will also be implemented on the light rail lines. A review of the technical requirements for this project indicate that the new SCADA system will have the following capabilities:

- Interface with the scheduling system
- Train tracking
- Automatic route setting
- Automatic Dispatching System (ADS)

TWG is of the opinion that this new SCADA/CTC system, which spans both heavy and light rail systems, can provide the needed tools for Metro to implement consistent operation and mitigate factors contributing to red signal violations. This in turn will enhance safety of operations. What is needed is a clear operating



plan and a commitment to modify current operating practices to take advantage of the technical capabilities of the new system. That plan should include any required modifications to operating rules and procedures and SOPs, as well as training for Operations personnel on the new system.

Further, it should be noted that some of the existing infrastructure on vehicles and at stations may not be able to take advantage of the new SCADA functionalities. For example, to implement ADS there is a need for a TWC installation that is capable of two way communications. Metro representatives indicated that not all car classes have this capability. Two-way TWC communication is needed to send dispatch data to trains at terminal stations. An alternative to two-way TWC communication is to provide simple dispatch indicators at stations.

Finding:

- D1.** Proven technologies, when combined with modified operating practices, can reduce red signal violations and enhance safety of operations.

Recommendations:

- 71.** Metro should establish an operating plan to implement the new SCADA/CTC system, first on the Red Line, then on the Light Rail network. The operating plan should be based on a consistent approach to automatic route setting and should include any required modifications to operating rules and procedures.
- 72.** Metro should review its current operating practice of delegating train dispatching responsibilities to Rail Operators. Metro should consider the implementation of an ADS using the tools included in the new SCADA/CTC system.
- 73.** Metro should consider the installation of train dispatch indicators at terminal stations to facilitate the implementation of ADS.

Technologies to Enforce “Red” Aspects

Currently the interlocking signals located in street running territories are standalone signals installed in the approach to switch locations with a limited purpose of preventing opposing and conflicting routes and ensuring proper operation of track switches. These signals, however, are not integrated with the ATP system on the line, and as such there is no enforcement of a “stop” aspect at an interlocking signal. Extending ATP to street running territory has the disadvantage of providing conflicting indications to Rail Operators, which can lead to increased violations of bar signals and the potential consequence for train/

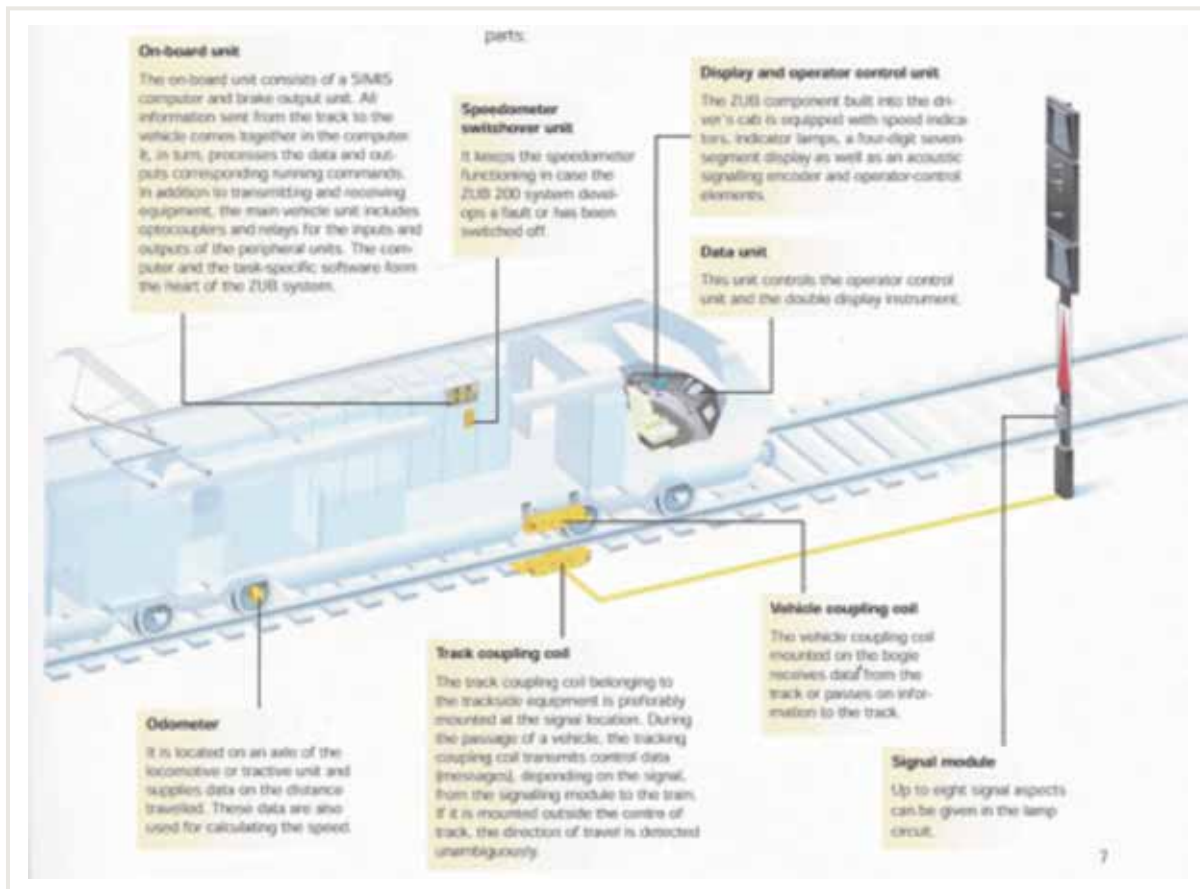


vehicle collision.

There are other available technologies that provide an intermittent ATP system. In effect, these technologies provide a positive stop at the interlocking signals and, if implemented, can mitigate RSVs within street running territories.

One example of these technologies is the Siemens ZUB 200, which is a transponder based system. The ZUB 200 is an overlay installation, where the status of an interlocking signal is fed to an active transponder and/or an inductive loop in the approach to a signal for transmittal to an approaching train. Upon receiving information from wayside transponders and/or loops regarding the status of an interlocking signal ahead, the on-board equipment will generate, and enforce, a stopping profile to ensure that the train stops before reaching a “stop” aspect.

To implement such systems, it is necessary to provide an interface with wayside signal equipment, and to provide a new on-board train control unit. The wayside equipment is limited to transponders installed in the approach to the interlocking signal. The on-board equipment includes a new on-board control unit, a transponder reader and interfaces with the propulsion subsystem, brake control and train operator console.



This transponder based system can provide positive stop operation and achieve the objective of enhancing safety of operation and reducing red signal violations. It is challenging, however, to implement such a system to work in conjunction with Metro’s existing ATP system as it will require maintaining dual control units on board trains.

A second technological approach that is also challenging to implement is to employ microwave to transmit the status of an interlocking signal to an approaching train. This SSC-ATP system from General Electric does not require devices or cables mounted in the track area. Its wayside components are mounted on the track, deriving their power from the existing signals, eliminating the need for new power cables. The system uses microwave technology to transmit signal and track information to the train. Onboard equipment is used to provide a wide range of applications from simple warning devices that the interlocking signal ahead is displaying a “stop” aspect, to an enforcement of the signal aspect.



There are technologies that provide an intermittent ATP system that could enforce “stop” aspects at interlocking signals within street running territories. However, these technologies are difficult to implement in Metro’s operating environment because of the need to coordinate and maintain dual control units on board trains.



Additional Technical Alternatives

Finding:

D2. A third technical approach could be based on leveraging the existing TWC infrastructure to transmit the status of interlocking signals to approaching trains. This concept requires more investigation to determine its feasibility.

A longer term solution to the safety issues in street running territories could be based on advanced train control technologies such as CBTC or ITCS. What is needed to extend the ATP safety functions to street running territories is an ATP system that enables line of site operation with ATP oversight. Such systems can provide the ATP safety functions without the need to generate Rail Operator displays that could contradict with traffic bar signals. An example of such installation is the OCTYS CBTC system deployed by the RATP. This system is installed on legacy trains to provide added safety for manual train operations. CBTC operates in the background without a Rail Operator display. The Rail Operator operates the train according to operating rules and procedures. CBTC monitors train operation and provides enforcement of red signals, safe train separation and over speed protection.

Metro should investigate CBTC or ITCS technology as a replacement system to the existing cab-signaling installation. CBTC/ITCS has the advantage of easily interfacing with wayside interlocking signals to provide positive stop. Also, such system employs smart trains that determine their own locations, and implement a vital data base that describe the line operating characteristics, including street running territories.

Recommendations:

74. Metro should investigate the feasibility of using the existing TWC infrastructure for the purpose of transmitting the status of interlocking signals to approaching trains.
75. Metro should investigate advanced train control technologies (CBTC and ITCS) for the long term modernization of signal installations on the Light Rail System.





Result of Review & Recommendations

**Section E: Operations &
Maintenance**

Section E: Operations and Maintenance

This section summarizes TWG's reviews, investigation and analysis related to the assessment of various aspects of rail operation, operating rules and procedures, signal maintenance and Metro's efficiency testing program. Our main objective in conducting this review is to identify issues that have an impact on the safety and reliability of train service. More specifically:

- Operating practices were assessed for consistency of focus on signal violations, as well as consistency of operation related to route setting, train dispatching and communication between train operators and ROC controllers.
- Operating rules & procedures, and SOPs were assessed for consistency between the various lines, compatibility with operating practices, and compatibility with the physical infrastructure.
- Two months of signal records were reviewed to assess downtime of signal equipment, impact of signal failures on train service, and any impact on red signal violations.
- Metro's efficiency testing program was assessed for adequacy based upon industry standards.

It should be noted that our review, investigation and analysis are limited to those aspects of operation and maintenance that have an impact on, or may contribute to red signal violations. It is not the intent of this review to perform a complete assessment of operating practices, operating rules & procedures, SOPs or signal maintenance practices.

Operating Practices

Bar Signal Violations

Initially TWG was provided with red signal violation data pertaining to rail signals. Additional documents indicated that Metro has taken a number of steps to investigate and mitigate the violations at rail signals. Metro provided documents that indicated its assessment of root causes for the violations. Metro also indicated the specific disciplinary actions taken against the involved train operators. Upon reviewing the Blue Line Main Line Incident Status Reports, TWG realized that there were additional violations associated with bar and traffic signals. During various interviews, Metro's officials indicated that violations associated with bar and traffic signals are treated as a separate category. It was also indicated that most of these violations are excused due to either failure in the LADOT equipment or because of the limitations



inherent in the detection of the violations. This is partially supported by data included in the Incident Status Reports, which reflect numerous incidents of traffic signal failures. These include:

- Bar signal non-cycling
- Dim bar signal
- Dark bar signal
- Flashing traffic signals

Similar to rail signal violations, bar/traffic signal violations present a safety risk and can result in train/vehicle collisions. Furthermore, a high level of bar and traffic signals failures has a detrimental impact on operations and is not helpful to Metro's efforts in ensuring compliance with operating rules and procedures. During interviews with Metro's representatives, there was acknowledgment of the reliability problems associated with bar signals. Metro indicated that Rail Operators are instructed to wait for two to three cycles before requesting verbal authorization to pass a "stop" bar signal.

Currently, LADOT provides real time data that enables Metro to detect bar signal violations at four intersections that are included in a pilot program:

- Grand and Washington
- Los Angeles and Washington
- San Pedro and Washington
- Central and Washington

The pilot installation was implemented approximately five years ago following a collision between a Metro train and an emergency service vehicle. It was a joint effort between Metro and LADOT, and did not require extensive effort to complete. The locations for the pilot installations were chosen based on operational priority and reasonable effort to complete. The installation consisted of running local cables between traffic control boxes and Programmer Logic Controllers (PLC) for the interlocking equipment. Minor software changes in the SCADA system were also required.

The pilot installation, however, is limited in its ability to detect violations in that it does not work for reverse running or for high rail vehicles operating after 2am. In addition, LADOT loop configurations at intersections are such that if a train makes a hard stop near end of an intersection, and then proceeds through the intersection, it may register as a bar signal violation. During discussions with Metro representatives, they indicated that while the reliability of bar and traffic signals has improved, the limitations of the violation detection mechanism still exist.

High rail vehicles are maintenance vehicles that operate at night so as not to interfere with revenue service.



With respect to the feasibility of expanding the pilot installation to all intersections in street running territory, Metro representatives indicated that it will be a major task to provide real time detection of bar signal violations at all intersections. Some locations may require street openings and trenching to install the required cables. Another potential approach to provide real time detection of violations is through the use of an API with the existing LADOT centralized traffic control system. This approach requires more investigation as well as coordination and cooperation between Metro and LADOT.

Metro representatives indicated that Metro has decided not to expand the pilot installation beyond the four locations. However, Metro has not performed a formal evaluation of the pilot installation to assess its effectiveness in enhancing safety of operation. It is important for Metro to formally conclude the evaluation of the pilot installation, and determine the safety benefits derived from real time monitoring of bar signal violations, and if the pilot installation should be expanded to other locations.

Another approach for managing bar signal violations is for Metro to review daily reports generated by LADOT. Initially, TWG was advised that LADOT has the capability to provide Metro with a daily log of Bar Signal violations at all intersections. However, upon further investigation as to why Metro has not established a procedure to review such daily logs, TWG was advised of the following:

- LADOT indicated that although it has the capability to generate a daily log of bar signal violations at all intersections, it does not have the resources to process these reports on a daily basis.
- Metro representatives indicated that while they are aware of the option to review daily logs of bar signal violations generated by LADOT, Metro does not have the resources to review and analyze these logs.

TWG believes that although such daily logs will not provide violation data in real time, they are useful from a safety oversight prospective in identifying train operators who violate bar signals, and allowing Metro to take appropriate proactive action to mitigate the risk of these violations.

With respect to integrating the operation of bar signals with interlocking signals, LADOT has indicated that they will not modify the control logic for the bar signals so that they are coordinated with interlocking signals. LADOT further indicated they are not providing an interface for Metro to use in preconditioning the clearing of interlocking signals. If this interface is implemented, then an interlocking signal at an intersection can only clear when the bar signal at the intersection clears. While this interface can mitigate bar signal violations, it will have no impact on interlocking signal violations. In addition, implementing this interface can result in undesirable effects, such as:

- Reduce the reliability of interlocking signal operation.
- Introduce delays in the operation of trains through an intersection.



Findings:

- E1.** Metro does not currently have a process to manage bar/traffic signal violations.
- E2.** Metro personnel indicated initial poor reliability of bar signal operation.
- E3.** TWG observed poor visibility of bar signals at certain intersections.
- E4.** There are operational limitations related to the detection of bar signal violations in the pilot installation.
- E5.** Metro has not completed a formal evaluation of the pilot installation to detect bar signal violations at four intersections.
- E6.** LADOT has the capability of generating daily logs that reflect bar signal violations at intersections.
- E7.** A concept of operation is needed for Metro to manage bar signal violations.
- E8.** Metro indicated that it lacks the resources required to manage bar signal violations.
- E9.** LADOT indicated that financial arrangements are required before expanding the detection of bar signal violations to other intersections.

Recommendations:

- 76.** Metro should implement a process to manage bar/traffic signal violations as intensively as rail signal violations.
- 77.** Metro should hold discussions with LADOT regarding the root causes for the poor reliability of bar signals, and to develop an action plan to address bar/traffic signal failures.
- 78.** Metro should discuss with LADOT measures that would improve the visibility of bar signals at certain locations, either through increased brightness or through the use of a different color.
- 79.** Metro should formally complete the evaluation of the pilot installation to detect bar signal violations, and determine if the pilot installation should be expanded to other locations.
- 80.** Another potential approach to provide real time detection of violations is through the use of an API



with the existing LADOT centralized traffic control system. This approach requires more investigation as well as coordination and cooperation between Metro and LADOT.

- 81.** Alternatively, Metro should consider using daily logs provided by LADOT to manage bar signal violations.
- 82.** Metro should develop a concept of operation on how to manage bar signal violations. The concept of operation should evaluate the pros and cons of real time bar signal violation detection versus a review of violation logs provided by LADOT.
- 83.** Metro should assess the resources required to manage bar signal violations, and provide additional resources if required.
- 84.** Metro should hold discussions with LADOT to resolve financial issues related to expanding the detection of bar signal violations to other intersections.
- 85.** Metro should develop a plan jointly with LADOT to improve the accuracy of bar signal violation detections.

Train Dispatching at Terminal Stations

Current Metro's Operating Rules and Procedures delegate the responsibility for dispatching trains at terminal stations to train operators. Using motormen push buttons on the Red Line, and cab switches at TWC locations. On the Blue, Expo and Gold Lines, train operators establish the necessary routes at terminal stations to clear leaving signals. Train operators are also responsible to close train doors and depart terminal stations on schedule using their synchronized watches.

Our analysis of RSV data indicates that approximately 19% of violations occur at the leaving signals of terminal stations:

- Red Line, Wilshire/Western Station - Signal 8 (6 violations),
- Red Line, Union Station - Signal 2 (2 violations),
- Blue Line, 7th & Metro Center Station - Signal 2S (4 violations), and
- Gold Line, Atlantic Station - 2N (4 violations) & 4N (5 violations).

It should be noted that while train operators are required to establish routes at leaving signals of terminal stations, the Controllers at the ROC also have the capability to establish these routes, and under certain conditions they do establish the routes. To establish a route from the ROC, controllers change the mode of



interlocking operation from “Automatic” to “Central”, and then establish a route for a train. This operation is not transparent to Train Operators, and in some cases result in false expectation by a train operator that a particular signal would clear.

Based on discussions with Metro’s Operations personnel, and site visits to inspect existing signal installations, there are a number of operating practices that contribute to red signal violations at leaving signals of terminal stations such as:

- Misunderstandings and/or lack of coordination between Train Operators and ROC controllers.
- Pressure on Train Operators to leave the terminal station on schedule and the distraction of other tasks may cause the Operator to fail to establish a route and falsely expect the leaving signal to clear. This supports one of the APTA Peer Review findings, which found train operators sometimes operate under the assumption that a signal would be clear or would change to a clear position.

There are alternative procedures and/or methods to dispatch trains at terminal stations. These include delegating the train dispatching responsibilities to ROC Controllers and/or employing an ADS. These alternate procedures/methods are being used at many transit properties in North America, Europe and Asia. At New York City Transit, for example, dispatchers have the responsibility to activate a “Starting Light”, instructing a train operator to close the train doors and proceed when the leaving signal displays a proceed aspect. In many cases, the activation of the starting lights is coordinated with establishing the needed routes.

Employing an ADS results in consistent operation at terminal station, and will reduce/eliminate the following contributing factors:

- Lack of coordination or misunderstandings between train operators and ROC Controllers.
- Decreased pressure on train operators by reducing their multitasking responsibilities.
- The requirement of certain ADS that the route at the leaving signal be established before authorizing train operators to close the train doors and depart. Such a requirement would eliminate the potential for red signal violations.

Metro is in the process of procuring a new SCADA system from ARINC, which is an Information Technology Division of Rockwell Collins. This new system from ARINC has capabilities for ADS. This system will be implemented first on the Red Line, then it will be activated on the light rail lines. TWG, however, was also advised that not all car classes are equipped with two-way communication through the TWC, which in turn limits the ability to remotely close train doors or provide a cab indication to train operators to close train doors.



Findings:

- E10.** 19% of RSVs occur at leaving signals at terminal stations.
- E11.** Train operators are currently responsible for dispatching trains at terminal stations.
- E12.** The current dispatching procedure increases pressure on Train Operators to leave the terminal station on schedule and the distraction of other tasks may cause the operator to fail to establish a route and falsely expect the leaving signal to clear.
- E13.** ROC Controllers also have the capabilities to clear leaving signals at terminal stations, and from time to time they do perform this function. This inconsistent operating practice can some time lead to miscommunication between train operators and ROC controllers and contribute to red signal violations.
- E14.** Metro is in the process of procuring a new SCADA system from ARINC, which has the potential to provide ADS function.

Recommendations:

- 86.** Metro should consider revising its current operating practice of delegating train dispatching responsibilities to train operators and end that practice.
- 87.** Metro should investigate various ADS technologies that are driven by the operating schedule, and which activate indicators at terminal stations or on train operator displays to instruct train operators as to when to close train doors and depart terminal stations. It should be noted that under such systems, the train operator is still responsible for closing the doors, and use caution if passengers are still boarding a train.
- 88.** Metro should review the scope of work for its current project to provide a new SCADA system, and investigate the feasibility of expanding the scope of work to provide ADS functions at terminal stations.
- 89.** Metro should investigate the capabilities of the TWC equipment for various car classes to communicate ADS data to on-board equipment. Alternatively, Metro should investigate the installation of platform indicators that can be interfaced with the SCADA system to provide train dispatching information to train operators.



90. Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central” and wherein the normal mode of operation is “Central”.

Operating Rules and Procedures

Manual Block Operation

Manual Block Operation is an operating rule that governs the movement of trains under certain operating conditions. This rule is based on the “absolute block” concept, wherein a section of track must be clear of trains before allowing a train to enter the section. A manual block operation is a two-person procedure, wherein a ROC Controller authorizes a train operator to proceed through a manual block pursuant to specific instructions. The procedure for implementation of a manual block operation is set forth in the following documents:

- Section 6 of Metro Rail System Operating Rules
- Train Operator Standard Operating Procedures - Blue/Exposition Line
- Train Operator Standard Operating Procedures - Gold Line
- Train Operator Standard Operating Procedures - Green Line
- Train Operator Standard Operating Procedures - Red Line/Purple Line
- Rail Controller Standard Operating Procedures - CSOP 13

On the Blue Line, a manual block is sometimes defined between two consecutive stations with an interlocking in between. Some violations occur at a red signal located at the interlocking within the manual block limits. It appears that, in some cases, there is a conflict between the authorization to proceed through a manual block, and the presence of a red signal within the boundaries of the block. The operating rules and procedures are silent on this specific operational scenario.

Finding:

- E15.** Current operating practices permit the establishment of a manual block operation between two consecutive stations with an interlocking in between.

Recommendations:

91. Metro should review its operating rules and procedures pertaining to manual block operation, and make needed clarifications that address this operational issue.



- 92. Metro should consider revising the current practice of including an interlocking within a manual block limit. Under such operating conditions, the manual block should be split into two manual blocks, wherein the first manual block ends at an interlocking signal, and the second manual block starts at the interlocking signal.

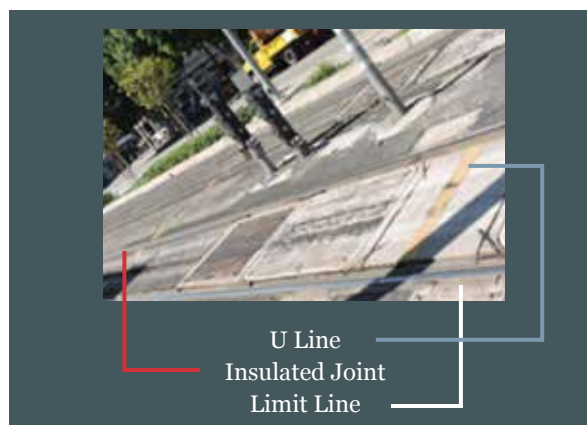
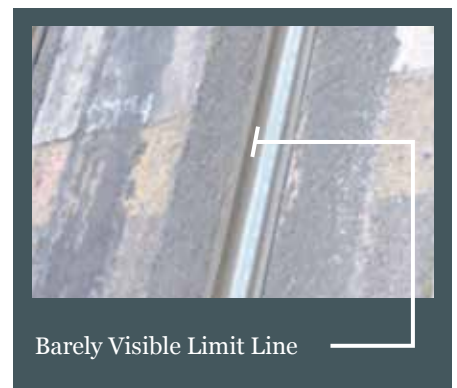
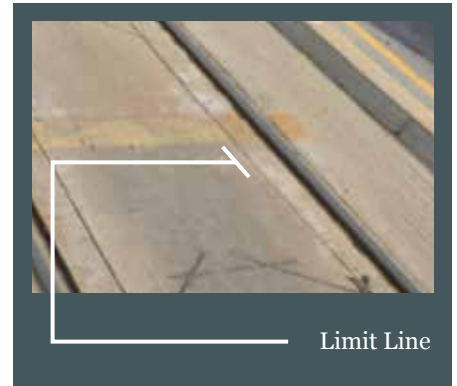
Limit Lines vs. Fouling Point Markers

The existing light rail installations employ a “Limit Line” at each signal location to delineate the location on the track where a train must stop in the approach to a signal that displays a stop aspect. The “Limit Line” is a yellow marking painted across the rails.

Site visits to the Blue, Expo and Gold lines revealed that many of the “Limit Lines” are fading in color, and some are barely visible. Further, the material/paint used to mark the limit lines is not reflective, which makes it difficult to see the lines during night hours.

A poorly visible “Limit Line” could make it difficult for train operators to stop at the desired location in the approach to a signal.

Further, at certain locations on the Expo Line, two yellow lines were observed in the vicinity of a signal location: the “Limit Line”, and a second line passed the signal at an insulated joint location (IJ Line).

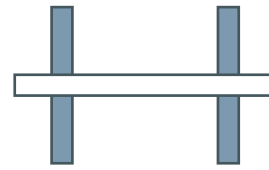


A review of the Operating Rules and Procedures reveal that a “Limit Line” is not defined. However, a “Fouling Point Marker” is described. It is not clear if the “IJ Line” observed at certain locations is actually a “Fouling Point Marker”.



Fouling Point Marker

Location on a track where a stop is required by signal aspect or beyond which movement or storage of rail vehicles will block movement on roadways or other tracks.



Finding:

E16. The operating rules and procedures do not define “Limit Lines”, but rather define a “Fouling Point Marker” that is similar in shape to limit lines.

Recommendations:

- 93.** Metro should survey all signal locations at the Blue, Expo and Gold Lines and make corrective actions as necessary to repaint “Limit Lines”.
- 94.** Metro should consider painting all “Limit Lines” with reflective paint.
- 95.** Metro should provide a description of the “Limit Line” and associated rule in the Operating Rule & Procedures/SOPs.
- 96.** Metro should provide different markings to differentiate between a “Limit Line” and a “Fouling Point Marker”.

Planned Revisions to Operating Rules & Procedures and SOPs

E17. Rail Operations is planning to update and revise the operating rules and procedures, as well as SOPs prior to December, 2016. The current Metro Rail System Operating Rules document is dated May 1, 2013. Over the course of the past three years, bulletins have been issued, as needed, to supplement the rulebook provisions and will be incorporated into the next revision. The current rulebook consolidates the operating rules for all Metro Lines including the Blue, Expo, Gold, Green, Red and Purple. The rule book for the Light Rail Lines was consolidated with the Rail Line rulebook a decade ago in order to reduce duplication and facilitate training requirements. However, the Metro system has continued to grow in complexity over the years, and the Light Rail (Blue, Expo, Gold and Green) operating characteristics are very different from the Metro Rail Red and Purple Lines.



New Operators being trained are required to learn the entire Metro rulebook provisions irrespective of the specific line that they will be ultimately assigned once training has been completed. The rules training is currently 3 weeks in scope with an additional 3 weeks of Line Training in the field. Input from staff and Light Rail Operators stated that more time operating the vehicle in training would be helpful to better support the application of the operating rules given the challenges and complexities of the system (especially on the Blue Line where the majority of the signal stop violations have been occurring). It was also noted that new Operators coming from Bus Operations are less experienced than those in previous years and the level of experience of the Controllers and field supervisors is also reduced from previous years. It should be noted that Operations has taken the initiative to adjust the Operator training program to include more extensive evaluations at 30 and 60 days, return to the classroom at 90 days, and 2 ride evaluations per corridor over a two-year period.

Recommendations:

97. Consistent with industry practice for multimodal systems, Metro should develop a separate rulebook applicable to the Light Rail characteristic and operating requirements to promote a better understanding of the requirements and responsibilities specific to Light Rail operating rules and characteristics.
98. Metro should explore the feasibility of designating new operators their assigned Line location upon entering training and focus the training on the rules, procedures and characteristics specific to the Line they are assigned. The rules training specialization approach should allow for additional in service training hours with a Line Instructor to better familiarize the new Operators with the unique Line characteristics and challenges they will face. It is also recommended that a formalized training program for Line Instructors is developed to support the desired and consistent application of the in-service training segment of the program.

Assessment of Signal Maintenance Records

In order to perform an assessment of signal maintenance, TWG reviewed daily signal reports for the months of August and October 2015, as well as the Main Line Incident Status Log Reports for all Metro Lines during 2015. The main objective for this assessment, as reflected in the statement of work, is to determine whether signal equipment down time is promptly recorded and corrected.



Our approach for the review, analysis and assessment of maintenance records is based on the following activities:

- Review and analyze the total time to repair for the various failure incidents listed.
- Identify the major causes for signal failures.
- Determine if any of the failures has contributed to red signal violations.
- Determine the impact of signal failures on train operation and train delays.
- Identify locations where there is a high frequency of signal failures.

The following is a summary of our reviews, analysis and assessment:

Impact of Signal Failures on Red Signal Violations

The signal maintenance records for the months of August and October, 2015 reflect 108 and 107 incidents respectively. A review of these 215 maintenance failure incidents shows that two incidents resulted in a train passing a red signal. The two incidents identified are:

- August 10, 2015: Incident # 2626239 on the Gold Line, Indiana, where a signal was dropped with a train approaching, and
- October 4, 2015: Incident # 2647159 on the Gold Line, Pico Aliso, where a PLC was rebooted resulting in flashing of a signal in front of a train.

These two incidents were not charged as red signal overruns against the train operators.

Finding:

E18. Signal maintenance failures have minimum impact on red signal violations.

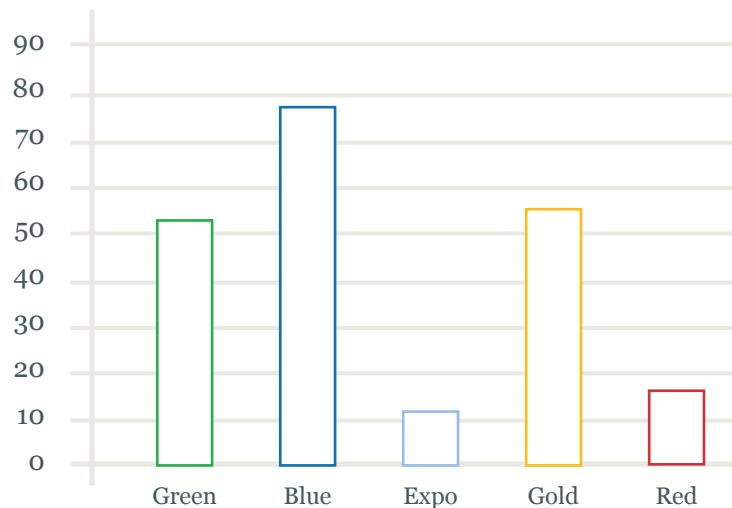
Distribution of Signal Failures for Various Lines

TWG analyzed the maintenance data with respect to failure distribution between the various Metro Lines, time to repair and main causes of signal failures. The following is a summary of our analysis:



Metro Line	Total Failures	Characteristics
Blue	79	<ul style="list-style-type: none"> • Oldest signal installations - placed in service in July 1990 • 22 miles • Cab-signaling • Street running sections
Expo	12	<ul style="list-style-type: none"> • Newest signal installation - placed in service in April 2012 • 8.6 miles • Cab-signaling • Street running sections
Gold	55	<ul style="list-style-type: none"> • Placed in service in July 2013 • 31 miles • Cab-signaling distance to-go • Street running sections
Green	53	<ul style="list-style-type: none"> • Placed in service in April 1995 • 20 miles • Cab-signaling distance to-go • High level of automation • Dedicated right-of-way
Red	16	<ul style="list-style-type: none"> • Placed in service in January 1993 • 17.4 miles • Cab-signaling • Heavy rail installation

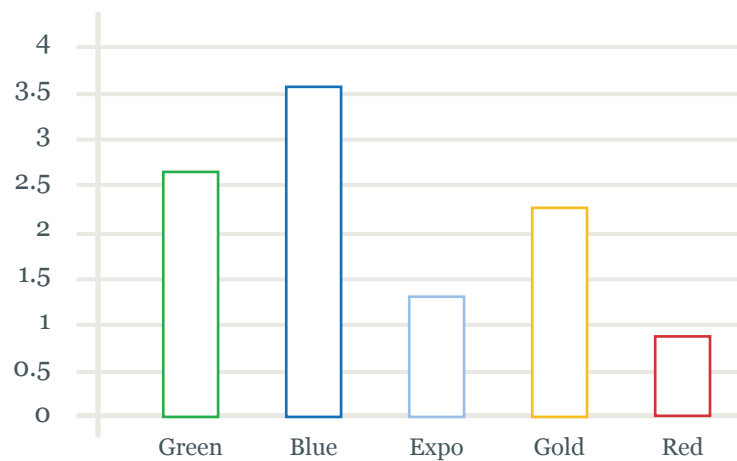
The following chart shows the distribution of signal failures for the various Metro lines:



To get a better representation of the signal failures, the following chart shows signal failing per track mile which will enable a meaningful comparison between the various lines:

Metro Line	Total Failures	Track Miles	Failure/Mile
Blue	79	22.0	3.59
Expo	12	8.6	1.40
Gold	55	31.0	1.77
Green	53	20.0	2.65
Red	16	17.4	0.92

The following graph shows a failure per track mile distribution:



Findings:

An assessment of the normalized signal failure data reveals the following:

- E19.** The Blue Line has the highest failure rate per track mile since it has the oldest installation and its operating environment includes many grade crossings and the associated signal equipment.
- E20.** The Green Line has the second highest failure rate due to repeated failures of electronic equipment, and what appears to be an anomaly at Marine Interlocking, where there is a very high number of failures. This is addressed in more detail in subsequent findings.
- E21.** The Gold Line, with an average failure rate, has signal equipment that is relatively new and the operating environment includes grade crossing operation as well as street running territories.



E22. The Expo Line is the newest Metro Line and is expected to have the lowest failure rate of the light rail installations.

E23. The Red Line has the lowest failure rate of the Metro lines. This is expected due to the protected subway environment

Time to Repair:

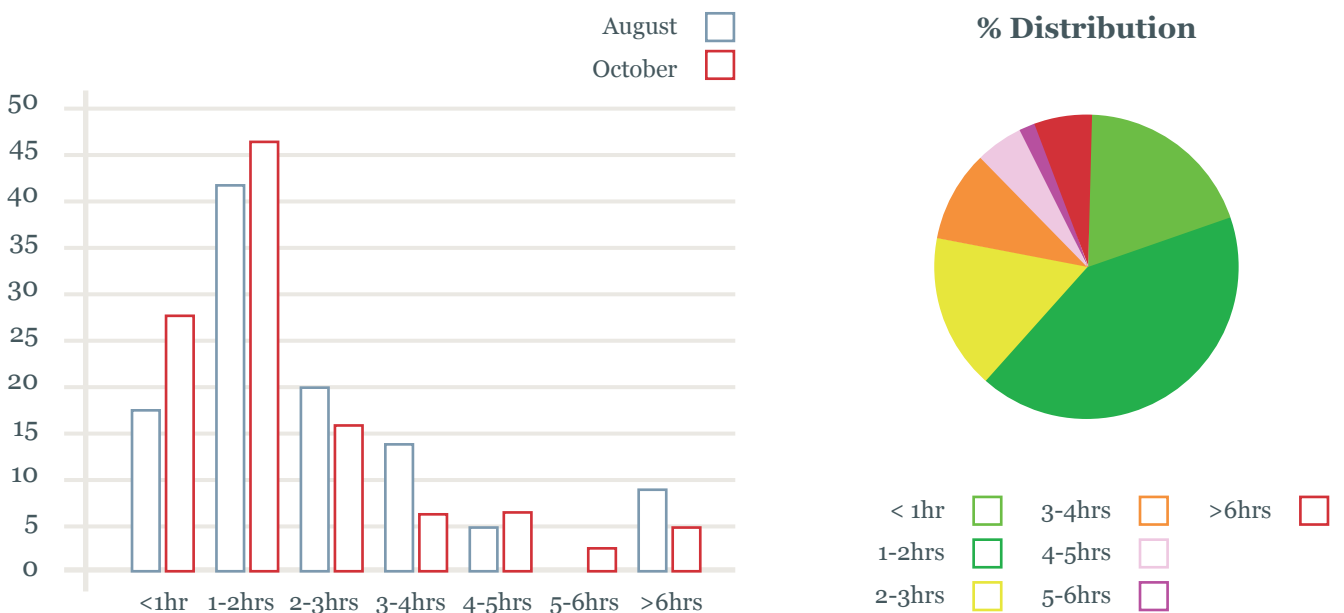
In general, there are a number of factors that impact the time to repair (TTR):

- Travel time between the crew’s deployment location and the site of signal failure.
- Type of signal failure.
- Availability of spare parts.
- Availability of maintenance resources.

A review of the signal maintenance record shows the following distribution of time to repair for the two months provided (August & October 2015):

TTR	< 1 Hr.	1-2 Hrs.	2-3 Hrs.	3-4 Hrs.	4-5 Hrs.	5-6 Hrs.	> 6 Hrs.
Freq	42	88	36	21	11	3	12
%	19.7%	41.3%	16.9%	9.9%	5.2%	1.4%	5.6%

This data is shown on the following graphs:



The above TTR distribution shows that approximately 78% of all signal failures are repaired within 3 hours, including travel time. It is difficult to compare TTRs for various transit properties as many parameters affecting TTR vary from property to property. Metro has not provided TWG with performance metrics related to signal maintenance efforts.

Approximately 5.6% of the incidents have a TTR in excess of six hours. A review of these incidents indicates that the associated signal failures required replacement of signal equipment and adjustments and/or troubleshooting intermittent failures, all of which are normally time consuming tasks.

Finding:

E24. It does not appear that Metro has established performance metrics for managing its signal maintenance program.

Main Causes of Signal Failures

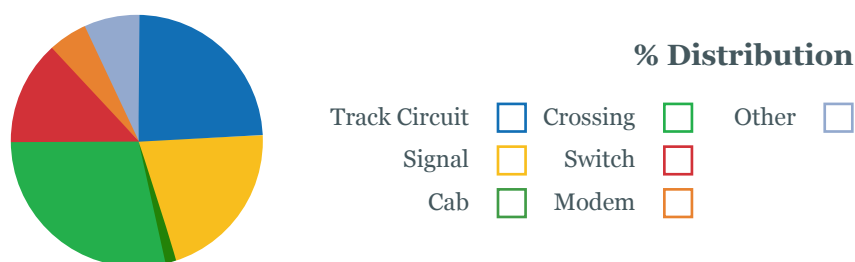
An analysis of the signal maintenance data indicates that the signal failures are caused by the following:

- Track circuit failures
- Signal failures
- Loss of cab-signaling
- Grade crossing failure
- Switch failure
- Modem failure
- Miscellaneous

The distribution of types of signal failures is provided in the following table:

Failure Type	Track Circuit	Signal	Cab	X-ing	Switch	Modem	Other
Frequency	55	39	2	64	27	6	22
%	25.6%	18.1%	0.9%	29.8%	12.6%	2.8%	10.2%

A graphic distribution of the main causes for signal failures is shown in the following chart:



The above distribution shows that over 70% of signal failures are caused by conventional signal equipment including track circuits, signals and grade crossing devices. This demonstrates the advantage of new train control technologies that minimize the use of conventional signal equipment.

Finding:

E25. Over 70% of signal failures are caused by conventional signal equipment including track circuits, signals and grade crossing devices.

Impact of Signal Failures on Train Service

TWG performed a comparison of the failure data included in the daily signal reports with the corresponding data in the Main Line Incident Status Log Reports. The main purpose for this comparison is to determine what impact signal failures had on train service. Overall, the data for the 215 maintenance incidents were reviewed using the incident numbers that are common in both reports. The following is a summary of the findings:

- For 10 of the 215 maintenance incidents, the Main Line Incident Status Log Reports indicated that train service was not impacted by signal failures.
- A general statement that trains were delayed or major delays were encountered is reflected for 10 incidents.
- A quantification of the delays is reflected for 11 incidents.
- The majority of the Main Line Incident Status Log Reports (169 out of 215) do not discuss the impact on train service or any train delays resulting from the maintenance failures.
- 15 maintenance incidents are not reflected in the Main Line Incident Status Log Reports.

It is normally the practice for Operations personnel at the ROC to maintain a record of train delays caused by various factors, including maintenance failures. This data is used in the calculation of on-time performance and to establish metrics related to the effectiveness of maintenance efforts.

Finding:

E26. The impact of signal failures on train operations is not clearly and consistently reflected in the Main Line Incident Status Log Reports.

High Frequency of Signal Failures

A review of the daily signal reports for August, 2015 indicates that 15 of 28 signal failures on the Green



Line occurred at Marine Interlocking. Similarly, for October 2015, 15 of 25 failures occurred at Marine Interlocking.

TWG then reviewed the data included in the Green Line Main Line Incident Status Reports for 2015. We found that approximately 198 signal failures occurred at Marine Interlocking, a much higher than the rate of signal failures than other sections of the Green Line.

Finding:

E27. There was a high failure rate of signal equipment at Marine Interlocking on the Green Line.

Recommendations:

- 99.** Although the majority of signal failures are repaired within a reasonable time, Metro should establish yearly signal performance metrics, including a “Mean TTR” goal for various signal equipment. What is important in monitoring the performance metrics is the performance trend.
- 100.** Metro should investigate maintenance incidents requiring TTRs in excess of three hours, and develop an action plan to reduce TTR.
- 101.** Metro should reinstruct controllers to document infrastructure failures like signals on the incident status log reports.
- 102.** Metro should consider the establishment of a process to capture train delays and other service impacts caused by signal failures. The collected data should be used in on-time performance analysis and to establish metrics for signal maintenance efforts.
- 103.** Metro should investigate the root causes for the high signal failure rate at Marine Interlocking and take appropriate action as necessary.

Efficiency Testing Program

Finding:

E28. Metro Rail’s current efficiency testing program does not effectively support operator rule compliance nor is it aligned with industry best practices. The recent APTA Peer Review concluded that the Metro efficiency testing program needed to be more robust. The APTA Peer Review also noted that an effective efficiency testing program should be designed to “reinforce good practices”.



Our team agrees with the Peer Review’s comments about how the program should be enhanced.

Background: The Federal Railroad Administration’s (FRA) 49 CFR 217 regulations prescribe a program of operational or efficiency testing to determine compliance with operating rules. Since January 1, 2009, this program has been placing emphasis on those operating rules that cause, or are likely to cause, the most accidents or incidents. Each railroad is required to develop a written program of operational tests and inspections. The APTA Peer Review also recommend that the new program include the same scope of the FRA mandated program. Our team agrees with that role as well.

Best Industry Practices for Efficiency Testing Programs

The following table summarizes the scope of program characteristics and railroad industry practices associated with their respective rules compliance programs:

Program	Industry Practices
Initial rules communication	<ul style="list-style-type: none"> • Instructor-led classroom training with scenarios • Computer-based training • Action-based training
Communicating new rules	<ul style="list-style-type: none"> • Track Bulletin • System Bulletin • Timetable Class or video job briefing for major change
Validating rules comprehension	<ul style="list-style-type: none"> • A minimum of biennial rules class and testing • Scenario-based simulator for train handling • Operational/efficiency testing • Monthly meeting of management/labor committee discusses problematic rules • Review test results to identify areas that need more attention
Monitoring adherence	<ul style="list-style-type: none"> • Operational and efficiency testing which may be scenario-based • Review accident and injury data with focus on human-factors accidents • Download locomotive event recorder data to monitor operating and train handling rules • Audit teams to validate testing FRA violations • Review radio transmissions • One-day safety assessment of co-workers
Responding to noncompliance	<ul style="list-style-type: none"> • Discuss test failure with employee immediately so cause can be identified • Progressive discipline per labor agreement • Alternative process with minor, serious and major violation instead of formal investigation • Supervisor interview to determine appropriate actions, e.g. training
Encouraging compliance	<ul style="list-style-type: none"> • Safety briefings • Train supervisors how to coach and counsel employees • Mutual accountability - both supervisor and employee hold each other to standard of accountability • Crew resource management signal awareness forms (conductor records each signal passed) • Safety audit program not part of discipline process • Safety assurance and compliance program at system and division levels • Debriefing of every accident and incident with no discipline attached • 7Cs Program - confirming, correcting, caring, collaborating, coaching, conciliating, clarifying
Evaluating program effectiveness	<ul style="list-style-type: none"> • Relationship between results of operational testing and accidents and incidents and FRA violations • Change in number of accidents and injuries • Change in operational and efficiency test failures • Benchmarking with other railroads
Safety reporting mechanisms	<ul style="list-style-type: none"> • Close call reporting system pilot program • Safety hotline • Open communication between supervisors and subordinates



Railroads are using various proactive strategies for encouraging rules compliance. These include training supervisors on coaching and counseling employees, adopting a policy of mutual accountability between employee and supervisor, conducting safety audits that are not part of the discipline process, and conducting a debriefing of every accident with no discipline attached. The APTA Peer Review also suggest revising the Mystery Rider program to include operator observations. We would caution using such a program, but would suggest that trained personnel/supervision review the operators' train handling related performance. The Mystery Rider program is best used for observing the qualitative elements of customer services, ADA compliance and passenger communications.

While the railroad industry has been characterized by some as having “a culture of blame”, many are working to improve the culture. One such initiative is the Confidential Close Call Reporting System (C3RS) pilot that the FRA is piloting with several railroads to encourage the confidential reporting of “near misses” to identify hazardous situations before an incident or rule violation occurs. Under the program no punitive action is taken.

Some other best practices supporting effective rules compliance and creating safe working environment include such principles:

- Train first line supervisor to deal with individuals that violate an operating rule in a non-confrontational way.
- Implement programs such as job briefings and increased rules classes that promote more communication between first line supervision and employees.
- “Know your people” and “listen to them”. Make sure supervisors are spending time in the field getting to know their employees and talking to them.
- Make sure employees know the rules, the intent of the rules and how the rules are applied.
- To enhance safety and rules compliance to the next level, management has to understand why the violation occurred. An employee's misunderstanding or lack of knowledge should be treated differently than one's conscious disregard of a rule.
- Involve employees in the development of operating rules and procedures.

These principles are consistent with those identified in Section A on safety culture as defined by Dr. Reason's framework for creating an effective safety culture.

Within the transit industry, a number of agencies have established structured programs for assessing rules compliance in a manner similar to those that the FRA requires with the use of efficiency testing programs. Robust efficiency testing programs provide the means to effectively address this requirement and provide a structured way to assess employee performance in the context of the risks associated with each operation. MTA Maryland and the Massachusetts Bay Transportation Authority (MBTA) represent two transit



organizations that have developed documented programs to support rules compliance. Both agencies have implemented safety rules compliance programs for all modes that include a clear definition of program accountability, roles and responsibilities, performing the testing process, documentation of results, corrective actions follow-up, data review and analysis, program quality assurance oversight, and program training requirements. They have developed rules compliance testing procedures to support the desired application and consistency of the information gathering process. Management meets, in both cases, to review the results of the program and focus compliance resources based on identified system risks. The MBTA has established a Safety Rules Compliance Steering Committee represented by senior Operations and Safety staff to oversee its rules compliance program risk based focus, program application, and recommended mitigations.

Current Metro Program

Metro has an efficiency testing program managed by the Rail Transportation Instruction Department, in cooperation with the System Safety Department. Metro has documented efficiency tests plans to assess Operator rules compliance including but not limited to signal tests (Blank out signal and assess compliance to rules), broken gate tests, and slow zone tests (radar speed checks). However, Metro has not documented the scope of its efficiency testing program including applicable roles and responsibilities as a comprehensive plan. As defined in the Metro SSPP dated December 12, 2015, the Rail Transportation instruction staff issues two rules compliance tests from the Metro Rulebook. These tests evaluate operators' knowledge and conformance with the rules. A minimum of 20 operators for each line are randomly selected by Supervisors on each work shift to evaluate compliance to the rules and procedures. Results are documented on a Rail Efficiency Test Sheet that show information for tests completed including the rules being tested, supervisor performing the tests, operators being tested, the test failures noted, and if retesting is needed.

Also, as stated in the Metro SSPP, each Operations Division is responsible for the designated number of efficiency tests to be performed that includes video downloads of operator performance that are also required by the California Public Utilities Commission (CPUC) in accordance with General Order 172. Metro has installed a video-based monitoring system in the operating cabs of each rail car and utilizes this video-based system to supplement the random monitoring and enforcement of its operating rules. Operations staff is also authorized to utilize the video-based system to download and observe 10% of the operators on each line per quarter to determine compliance with General Order 172, and will include, as part of the 10%, incidents involving a derailment, collision, and observed complaint.



Finding:

E29. Metro has recognized the need to develop a more robust rules compliance program and is in the process of initiating changes to the program.

The program will include, but not be limited, to the following elements:

- 1) Testing officer responsibilities to include requirements for program qualifications, training, and documentation in accordance with 49 Code of Federal Regulations (CFR) 217.9, subpart B.
- 2) Testing Program to include documented operational tests and an inspection program in accordance with 49 CFR 217.9, subpart C.
- 3) Records management of the Efficiency Testing Program in accordance with 49 CFR 217.9, subpart D.
- 4) Quarterly Reviews of the effectiveness of the program in accordance with 49 CFR 217.9, subpart E (1) (i).
- 5) Annual Summaries of program tests and inspections in accordance with in accordance with 49 CFR 217.9, subpart F.

Review of Metro’s Testing Records

A review of Metro’s efficiency testing records for 2013, 2014 and 2015 indicated the following minimum number of efficiency tests were performed on each rail line with the failures indicated.

Rail Line Efficiency Tests Performed

Year	Blue		Gold		Green		Red	
	Total	Failed	Total	Failed	Total	Failed	Total	Failed
2013	1170	32	1170	4	1170	0	1170	0
2014	610	4	610	0	610	0	610	0
2015	1200	13	1200	0	1200	4	1200	18
Total	2980	49	2980	4	2980	4	2980	18

Signal Line Efficiency Tests Performed

Year	Blue		Gold		Green		Red	
	Total	Failed	Total	Failed	Total	Failed	Total	Failed
2013	112	14	112	4	112	0	112	0
2014	20	0	20	0	20	0	20	0
2015	20	2	20	0	20	0	20	2
Total	152	16	152	4	152	0	152	2



Finding:

E30. The current efficiency test program does not accurately reflect the level of system-wide compliance to operating rules and procedures given the high number of signal violations occurring over the past several years.

There were an estimated 11,920 rail line efficiency tests performed in 2013, 2014 and 2015 with documented failures totaling 75, or 0.6%. Also, there were a total of 608 signal efficiency tests performed over the three-year period that resulted in 22 failures or 3.6% of the signal testes conducted. The Blue Line had 16 of the 22 signal efficiency testing violations over the three-year period.

Metro Operations, with the support of Corporate Safety, is in the process of updating its program to increase compliance checks on all operating shifts over a 7-day period. Corporate Safety is also in the process of staffing a new position to provide quality assurance oversight of the efficiency testing program, including nights and weekend testing.

The program is currently scheduled to be completed by December 2016.

Recommendations:

- 104.** Metro should continue its initiative to update its Rail Efficiency Testing program consistent with the scope of requirements as specified in the FRA mandated program under 49 CFR Part 217 Railroad Operating Rules. The new program should be risk-based and include a documented program plan with clear accountability within Operations for the management of the program. The proposed Metro program will apply to all departments (e.g., operations, control, wayside, and maintenance) and include both structured and observation-based tests. It is proposed that the program incorporate best industry practices as applicable and include in part:
- a.** Training for the supervisory personnel responsible for conducting the rules compliance tests, response to test rule violations, documentation of the findings, and the management oversight of the program application, focus, results, and follow-up.
 - b.** A description of the testing and documentation requirements. Minimum testing goals will be established for testing officers. Testing goals will be based and linked to noted rules violations, incidents, and accidents including those revealed from lessons learned from industry incidents. Testing goals will be adjusted, based on the data/testing results, quarterly.
 - c.** Management review and analysis of the efficiency rests results and development, implementation



and tracking of approved mitigation measures based on the program results. The data, including results, will be reviewed and reported to affected management staff on an ongoing basis quarterly.

- 105.** Metro should increase its focus on the Blue Line operations as this line represents the greatest risks and challenges to maintain consistently safe performance as highlighted within the scope of this report. It is proposed that the rules compliance focus be directed at designated priority high incident locations.
- 106.** Corporate Safety should continue to be responsible for program quality assurance oversight and to conduct a designated number of internal audits to verify the desired level and quality of program implementation of the approved efficiency testing program.

Rail Operations Control Center

In the course of our interviews with management and the focus groups, we found mixed views of the quality of the performance of ROC, potentially contributing to unsafe practices. Both groups noted that the performance of some controllers was good and poor for others. There was concern about the inconsistent quality of performance and a perspective that there is no difference in hierarchy among Field Supervisors, Yard Dispatchers and Controllers. There was also the suggestion that there should be a progression from the field and yard to Controller. They attributed poor performance to limited experience in rail operations, and limited familiarity with the physical characteristics of the lines. They commented about poor communications stating that Controllers at times sound hesitant in providing direction, using inappropriate tone and language on the radio and not treating operators consistently. Both the MOW and Transportation Department employees expressed a lack of confidence with the ROC due to such inconsistencies.

While this is not within the scope of our work, it was often raised as a perceived barrier for the safe operation of the system. HDR is currently conducting a study of the ROC to determine optimal staffing levels, mix of duties and preparation of a business case for the subsequent recommendations. The study scope will look at human performance, fatigue related issues, workload, business processes and information management system needs. The study will identify the quantitative and qualitative benefits of recommended changes. The study is expected to be completed in November 2016.

Security

Throughout the interviews and focus group sessions, Metro personnel identified concerns with security risks for the public and employees along the right of way and at facilities.



Finding:

E31. Across the work units, public and employee security risks on board trains and along the right-of-way were identified, with the perception that the issues were either not responded to at all or not in a timely manner. Employees expressed concern for their fellow employees' and the public's security riding trains, working and traveling through stations and along the right-of-way. They identified the presence of homeless persons on the trains and along the right of way, lack of full CCTV coverage and surveillance, particularly during the evening hours. One of Metro's leadership team identified concern about whether the headquarters building was secure against acts of violence.

While the issue of personal and public security was not part of the scope of our work, it was a perceived issue in all the employee forums. With the perception that safety is the priority, as indicated throughout the focus group discussions and the improved ratings as evidenced in the survey results, attention to these areas of concern is important.

Across the transportation industry, particularly in the public transportation sector with open access, protection of facilities and right-of-way continues to be a challenge.

Recommendation:

- 107.** If Metro has not already done a risk assessment of its facilities including the headquarters building and right-of-way to determine points of vulnerability, and considered best practices for protection, surveillance, it would be prudent to conduct such a review and or refresh past ones. It should include consideration of handling trespassers including the general public, homeless persons and criminals who may be posing as homeless persons to access the facilities and system. Since this was widely cited in the focus groups, if work is underway to address the perceived deficiencies, Metro may want to communicate efforts to address the presence of trespassers to employees.





Result of Review & Recommendations

Section F: Human Resources

Section F: Human Resources

As part of an effective organization is a commitment to have effective human resources policies and practices. For the purpose of this study, we reviewed the selection criteria for Rail Operators, the quality of safety training and current discipline policies as potential deterrents for red signal violations and reviewed the discipline policies/practices at thirteen other properties to provide a comparison and benchmark for Metro.

Selection Criteria

Findings:

F1. Metro Rail has a practice common at other multimodal agencies of using Bus Operators as its pipeline for “hiring” Rail Operators and Controllers. From focus groups and management interviews, we heard that new Operators coming from bus are less experienced than in previous years and that the level of experience of the Controllers and field supervisors also been reduced from previous years.

In selecting candidates for Bus Operators, Metro has no minimum education requirements, however, it does administer a written test to determine that they have a 10th grade reading comprehension level. In the course of our review, the Human Resources Department conducted a validation test to determine if its written tests accurately demonstrated proficiency of the testers. Using an industry recognized test, Fiesch-Kincaid, the HR Department was able to validate the reading and writing test at an overall 11th grade level of reading comprehension.

F2. In addition, the agency will be piloting a competency based selection processes for Bus Operators, testing three different vendors’ approaches as it seeks to enhance the selection processes. That is a best practice to use in selection processes.

While Metro follows a common practice in the industry of following a career progression from Bus Operator to Rail Operator and Rail Controller positions, there is a growing recognition that they are different sets of competencies and skills required among these positions, and there is greater complexity of operations in rail. As a result, properties like the MBTA in Boston have created separate hiring processes for rail and bus positions.



Recommendation:

- 108.** Metro should explore the feasibility of establishing a separate track for recruiting Rail Operators. This review should take into consideration the introduction of a competency based selection process findings for the three pilot programs based upon three vendors' methodology beginning at Metro.

Training

While there were contrasting feedback about the quality and effectiveness of training programs in the focus group discussions, the survey results indicated a much stronger view of the quality of the safety training. Over 75% of the respondents said the overall quality of the initial safety training was “excellent” or “good”. Approximately 87% of the respondents noted that they received refresher safety training in the past year, in contrast to 69% in 2012.

Some employees were very positive about the training while others requested more. Some expressed concern about getting classes done without ensuring that employees gained the right level of proficiency. In contrast, the Wayside Traction Power groups were very proud of having successfully advocated for additional courses and, as a result, had an instructor assigned to their location with lots of technical training available.

In one of the supervisory groups, they were very complimentary of the improved quality in the instruction department for transportation as a result of a change in personnel and the addition of new and improved teaching technology.

Findings:

F3. Both Supervisors and Rail Operators expressed concern about the accelerated new operator classes needed to meet the tight timetables for initiating start-up services, and they expressed concerns about the potential negative impact on delivering new service. Metro has added more on-the-job training to address this issue. They recently adjusted the operator training program to include more extensive evaluations at 30 and 60 days, a return to the classroom at 90 days, and two ride evaluations per corridor over a two-year period.

F4. New Operators being trained are required to learn the entire Metro rulebook provisions, irrespective of the specific line to which they will be initially assigned upon completion of training. Rules training currently takes three weeks, with an additional three weeks of Line Training in the field. Input from staff and Light Rail Operators stated that more time operating the vehicle in training would be helpful to better support the application of the operating rules, given the challenges and complexities of the system,



especially on the Blue Line where the majority of signal stop violations have occurred.

F5. Metro offers a robust series of training programs for rail transportation employees and supervisors with a strong focus on safety and operations. The CEO changed the interval of safety training to have each Operator and Controller receive training annually under the “Sustaining Safe Operations in Rail Transit Delivery”. In the employee forums, the operators and supervisors were aware of the annual refresher training begun at the new CEO’s direction, which was seen as positive.

F6. As a result of the work of the Red Signal Task Force, the training now includes a section on signal violations. As part of the training, “hot spots” are identified as locations where the majority of violations have occurred. Also patterns are identified about length of service of the employees that have the violations. The training section also includes time for the employees to engage in offering their views about the causes of the violations. While all that is a positive addition, without better information about root causes and contributing factors, there is still a challenge in effecting positive change and effectively reducing violations.

F7. Metro is now adding more “on-the-job” training with an increase in supervisor rides with operators after red signal violations. Metro has plans to purchase a simulator for operator training which, with on-the-job training, are considered effective approaches to training.

F8. Metro has recently approved the expansion of the SmartDrive operator performance system onboard the rail system. Given the effectiveness of using the films available from the bus system for coaching and training, we expect this will provide an additional tool for improved training, coaching and reinstruction. The APTA Peer Review also identified such a program as beneficial for supporting ongoing coaching.

F9. With the extent of multiple signs and various distractions along the ROW particularly at the “hot locations”, and that 80% of the violations are categorized as “operator inattention”, Metro should consider providing some training and orientation about the importance of having situational awareness when operating trains. The APTA Peer Review also recommended a focus on situational awareness as part of the training.

F10. Metro has institutionalized a number of strategies for providing safety awareness programs and periodic reminders with their regular local safety committees. The initiation of the Rail Alerts shares information about accidents and incidents on the property and offers lessons learned and demonstrates the value of sharing such information. That was also demonstrated in the focus group findings and in the employee surveys.



Recommendations:

- 109.** Explore the feasibility of designating new operators by assigned line location upon entering training and focusing their training on the rules, procedures and characteristics specific to the respective line. The rules training specialization approach should allow for additional in-service training hours with a Line Instructor to better familiarize new operators with the unique line characteristics and challenges they will face. As part of a line focused approach, it is also recommended that a formalized training program for Line Instructors be developed to support the desired and consistent application of the in-service training segment of the program.
- 110.** Continue the annual refresher safety training program.
- 111.** With a commitment to conduct improved root cause-based investigations and the discipline of comprehensively identifying contributing factors, the section on signal violation training should be updated to reflect those factors.
- 112.** An addition of some training focused on situational awareness would add value as well address the proliferation of “operator in attention” as the root cause of many of the red signal violations.
- 113.** Additional focus on on-the-job training, supplemented with the use of a simulator, can enhance training and contribute to improved operator performance.
- 114.** The availability of the SmartDrive suite of tools, with a strong focus on tracking performance related issues and the ability to coach and counsel operators, should improve operator performance and significantly enhance training.
- 115.** Continue disseminating safety messages via the Rail Alerts and thru the LSCs.

Discipline

We reviewed discipline records, discipline administration and looked at thirteen peer transit organizations.

As we began our investigation, our effectiveness in understanding the current situation at Metro was limited by the current condition of the employee records. Currently Metro Rail has decentralized record keeping and the quality varies. In addition, there is no centralized comprehensive data base for employee records. Such decentralization makes it difficult to identify trends by employee groups and to monitor employees' performance and behaviors that may provide signals of potential behaviors that, left unaddressed, can contribute to more serious infractions and or non-compliance with operating and safety rules. We



understand that the Human Resources Department is working with the IT Department to create a centralized employee data base.

Both in focus group and survey results, we found a lack of a consistent view of how discipline is administered.

Finding:

F11. Metro negotiated new disciplinary language concerning red signal violations in its last contract negotiation. Article 27, Section 2 of the new SMART contract language states that: “(a) Major infractions of the Authority’s rules may subject the employee to suspension or discharge. However, mitigating circumstances, and other relevant facts will be considered in determining to apply progressive discipline such as coaching, counseling and/or written warnings instead of suspension or discharge when appropriate”.

The first rail major infraction listed is: “Operate a rail vehicle or train past a stop indication”.

“The major infractions in two above will subject employees to the following discipline for repeated violations of the same type:

- 1) First Violation in a floating six-month period: Counseling/training.
- 2) Second Violation in a floating six-month period: Counseling and written warning.
- 3) Third Violation in a floating six-month period or a second violation within six months of receiving a written warning: Two day suspension.
- 4) Fourth Violation in a floating six-month period or another violation within six months of receiving a two day suspension: “Subject to Formal Hearing”.

Finding:

F12. Our review did not find any noticeable change in disciplinary results during the specified period as is illustrated below by the comparison of the four results occurring after March 2015 with the four results preceding that period. (Note: The union agreement was signed on December 19, 2014.)

Incident ID	Violation	Date	Discipline	Repeat Violation
2,516,211	Blue RSVM	10/8/14	5 Day Suspension	No
2,521,475	Red RSVM	10/21/14	3 Day Suspension	No
2,529,442	Blue RSVM	11/11/14	3 Day Suspension	Yes
2,538,388	Gold RSVM	12/6/14	3 Day Suspension	No
2,572,152	Blue RSVM	3/12/15	3 Day Suspension	Yes
2,586,050	Red RSVM	4/20/15	3 Day Suspension	No
2,587,251	Gold RSVM	4/23/15	3 Day Suspension	No
2,602,487	Blue RSVM	6/5/15	Counselling	No



This is a rough comparison because there were only four violations from March 2015 through June 2015 over a four-month period. The four violations prior to the effective date of the new union contract took place from October 2014 through December 2014 over a three-month period.

Survey of Discipline at Peer Agencies

We consulted with staff at thirteen peer agencies that operate both light and heavy rail systems to identify their discipline policies and to compare Metro's policies in the context of best practices. Those agencies included: BART (San Francisco), CAT (Charlotte), CTA (Chicago), DART (Dallas), GCRTA (Cleveland), MBTA (Boston), MARTA (Atlanta), METRO (Houston), MTS (San Diego), SEPTA (Philadelphia), TriMet (Portland, Oregon), UTA (Salt Lake City) and VTA (San Jose).

Highlights of those policies are below.

Bay Area Rapid Transit - BART

BART has a positive discipline policy rather than a corrective discipline policy. Based upon prior arbitration decisions they must review each violation on a case by case basis, it is not "cut and dried". Generally:

- First violation and no damage - Written reminder that stays on the employee's record for nine months.
- Second violation within six months - Written reminder that stays on the record for nine months.
- Second violation within nine months - Decision Making Leave (DML) that stays on the record for twelve months. DML of one day off with pay for the employee to think about whether they want to continue working at BART. A DML stays on the record for one year. If a violation causes serious damage the first violation could start with a DML.

When a RSV occurs, an investigation is performed. The investigation includes, but is not limited to: Fact finding discussion, drug test (depending on damage), logs from the train and computers and check for damage. The union can appeal for arbitration and the arbitration panel consists of two union and two agency members and a neutral party. Whenever a RSV occurs, the employee is re-trained.



Charlotte - CAT

CAT discipline - Passing a signal set at danger “red” is a safety infraction:

- First infraction - 3-day suspension.
- Second infraction - 5-day suspension.
- Third infraction – Termination.
- Safety violations stay on record for three years before dropping off.

When an operator returns to duty from a suspension, they are retrained and must demonstrate that they can safely operate the train to a training instructor.

CAT is a department of the city of Charlotte and state law prohibits them from dealing with unions. However, the agency has an internal grievance policy:

- The supervisor administers discipline.
- The first step appeal is with the General Manager (GM) Rail.
- The third step is with the GM.

Chicago Transit Authority - CTA

CTA’s Corrective Guidelines is an agreement between labor and management through collective bargaining and it applies to all unions at CTA. All red signal violations stay on an employee’s record for 2 years.

- First violation results in a written warning.
- Second violation results in a final written warning and a day suspension.
- A third violation results in a corrective case interview with a supervisor to determine what’s going on and a 3-day suspension.
- When a fourth violation occurs, the employee is removed from service and is referred to the GM with a recommendation for discharge.

Employees can always grieve discipline and about 20-30% go to arbitration. The arbitrators usually side with CTA since it’s a safety issue.



Dallas Area Rapid Transit - DART

DART's discipline for safety violations for someone with no prior safety violations:

- First violation - Supervisor takes the Operator off the train, counsels the Operator and a written warning and retraining are given.
- Second violation - Final written warning and retraining.
- Third violation - 2-day suspension and retraining.
- Fourth violation - Discharge.

Violations stay on an operator's record for 30 months and are removed after that period of time. All violations are grieved and most are upheld.

- First level grievance handled by the manager of the operating facility.
- Second level is handled by the Assistant Vice President.
- Third level is handled by the Vice President Transportation.

Greater Cleveland Regional Transit Authority - GCRTA

Every red signal violation results in some form of formal discipline at GCRTA. The least of which is a DML and the worst case is discharge.

If a DML is issued, the employee is given a day off with pay to decide if they want to continue their employment with GCRTA, and they must commit to follow all policies, procedures and rules. If they are willing to make the commitment they are allowed to return to work, and they are on probation for 1 year. They will be discharged if they have a violation of the employee performance code or company policies that would result in formal discipline. A second signal violation within the year would result in a violation of the DML agreement and the employee would be subject to discharge.

While GCRTA has a multiple step appeal process (Director is first step, Deputy General Manager is second step, Labor Relations is third step) and "everything goes to arbitration". Usually the agency prevails in arbitration and they frequently use a train mock-up to illustrate to the arbitrator how serious the violations are.

Massachusetts Bay Transit Authority - MBTA

The Green line is where most of the problems occur at blocks and traffic lights (some areas on the Green line are getting new technology) and RSVs are reported by operators or by officials witnessing them.



Safety Track Discipline (does not look at attendance or other performance issues) for incidents over a 24-month period:

- First offense - 3 days off with pay.
- Second offense - 10-day suspension without pay.
- Third offense – Termination.

The agency is considering extending the 24-month period to 36 or 48 months.

The operator is removed from service and gets non-operations training and a physical exam. After all of the test results are in, the operator returns to the district and is interviewed, along with the union, and discipline is served immediately. This can take up to 5 to 10 days and the operator is without pay for only suspension time. Before going back to work the operator is retrained.

The operator can grieve the discipline within 15 days from the Division Chief's decision and the agency has 10-15 days to respond. Subsequent levels of appeal are to labor relations, and the GM. If the union votes to take it to arbitration, it typically takes 10 days to go to hearing, but there are not many arbitrations for red signal and safety violations.

Metropolitan Atlanta Rapid Transit Authority - MARTA

When a RSV occurs (either by self-report or reported by central control), the operator is immediately removed from duty by a supervisor and a report is written describing the incident. The operator is placed on administrative leave with pay until the operator, with the union, meets with the superintendent. The agency has five days to complete an investigation including obtaining data from signal boxes, Automatic Train Control (ATC) playback and central control as well as video from cameras on the train and station platforms.

Based upon the investigation and the interview, the superintendent will administer discipline:

- First violation - Five-day suspension. If there is another serious violation, the operator can go back to being a bus operator.
- Second violation within 12 rolling months - Termination. No ability to return to bus operator.

Almost all of the cases go to the grievance process. The grievance is heard first by the General Superintendent, then the Rail Director and the final step is the COO. The union decides whether to take a case to arbitration which can take up to a year. The discipline is usually sustained.



Metropolitan Transit Authority of Harris County - METRO

Until recently, the discipline for interlocking signal violations at METRO was:

- First violation - A five-day suspension and one-day re-training.
- Second violation - Termination or moved to another job at Metro for the second violation. in a 12-month period.

A six-month Memorandum of Understanding (MOU) is currently in effect between METRO and the union which allows for 3 interlocking signal violations in 18 months. At the end of the MOU the impact of the change will be reviewed to determine if it should be continued:

- First offense - Written reprimand and 1-day re-training.
- Second offense - 3 to 5 days' suspension and 2 days re-training.
- Third offense - Termination or moved to another METRO job.

The existence of videos of the interlocking signal violations, downloads from the signal houses and SCADA alarms basically eliminate any grievances. However, this does not stop the operators from filing them and they usually end up losing in all cases.

METRO counts interlocking signal violations but not bar signal violations (overruns at traffic intersections). This is because the data they get is inaccurate and false overruns due to unstable track circuits. They have never had any accidents or incidents at these locations.

METRO has found that new train operators, with two or less years of service, commit 85% of their signal violations. They are currently considering this issue and are looking at their training program and ride checks. They had previously thought that fatigue was the prime cause of signal violations but have now found that violations are due to lack of familiarity with the route, complacency and or lack of attention.

San Diego Metropolitan Transit System - MTS

MTS discipline policy (with a clean record):

- First RSV - 3-day suspension with no more violations in 24 months.
- Second RSV - 4-day suspension.
- Third RSV - Termination. When a third violation occurs the operator is pulled from service immediately and is sent home with a letter for a terminal interview.
- When other discipline violations are combined with RSVs, operators can get additional days of suspension.



- If a RSV occurs within first 6 months, the operator is terminated.

The appeal process takes place with a third violation and is based on the operator's record. No arbitration is given.

Santa Clara Valley Transportation Authority - VTA

Red Signal discipline and all of VTA's discipline, is based upon self-reporting. When an operator with a clean record runs a red signal the operator calls in to OCC. A field supervisor gets on the train and determines if the operator is fit for duty and if so they continue to a relief point. The operator then reports to training and sits with an instructor to go over what happened and how the incident could have been avoided. The operator is retrained and returned to duty.

If the operator has had a prior violation or if there was damage or injuries, there could be discipline. VTA believes that self-reporting does work - there have been only 2 repeat RSVs that were self-reported. Because they know the operator, the Division Superintendent and supervisors conduct the investigation.

When an operator does not self-report the operator immediately meets with a supervisor to determine if they are fit for duty and they are given a drug test. The operator is returned to the division and suspended with paid leave while an investigation is completed. If the review shows that the operator ran a red signal, they are terminated.

When a second RSV is self-reported, the discipline is more severe and would likely result in termination, however it depends upon the situation. A third RSV results in termination.

Due to a prior arbitration finding, VTA cannot apply the same discipline for every violation. They must take into account the length of service, the employee's record, training and any other information that might be relevant to the incident.

All discipline is grieved by the union and most go to arbitration. The agency has 30 days from the date of discovery to administer discipline, the union has 30-45 days to file a grievance and it can take 10 to 30 months for an arbitration panel (6 people) to be formed.

Southeastern Pennsylvania Transportation Authority - SEPTA

When a red signal violation occurs the train is taken to a station, the passengers are removed and a supervisor takes control of the vehicle. The subsequent investigation includes data from the car recorders, wayside recorders, and examination of the track. There are no cameras in the cab. It takes about a week to



complete the investigation and to go to hearing.

The report is sent to the transportation manager who issues a notice of investigation and holds an informal hearing when the employee can make a defense. Then a formal hearing takes place with witnesses and other data, and the hearing officer administers discipline.

The discipline for a red signal violation at SEPTA is separate from other disciplinary actions:

- First violation - 5 days off from work, 4 of which are administrative leave and 1 is without pay.
- Second violation within 2 years - 10 days off from work, 9 of which are administrative leave and 1 is without pay and a mandatory drug and alcohol test is given.
- Third violation within 2 years - Discharge but the employee continues working during the grievance process.

After a third violation there can be a grievance process including a Last Chance Agreement for one time in an employee's career. Grievance hearings for transportation take place every Thursday. The union has 30 days to file for arbitration or a Last Chance opportunity. If the union wants to take it to arbitration they can, but an arbitrator can only rule if the employee committed the violation, not what the discipline should be.

Tri-County Metropolitan Transportation District of Oregon - TriMet

Discipline process for safety violations (assuming a clean record):

- First violation - Reinstruction.
- Second violation - Warning and reinstruction.
- Third violation - Reprimand.
- Fourth violation - Suspension: length of time not specified, but generally 1-3 days.
- Fifth violation - Demotion back to bus operator.

When a violation occurs, rail operations staff conducts an investigation. If an operator's performance is sufficiently egregious (such as resetting a signal without contacting the control center) the operator can be terminated.

Grievance process:

Step 1: Operations Assistant Manager

Step 2: Rail Manager

Step 3: Executive Director for Transportation



Step 4: Arbitration

It can take at least 6 months to go through all steps in the grievance process. The agency tends to bundle grievance cases when they bring in the arbitrators, so some cases can take longer to be heard than others.

Utah Transit Authority - UTA

UTA train operators are encouraged to, and usually do, self-report red signal violations, but operations control can also determine if a RSV occurs.

When an operator, with a clean record, has a RSV they are pulled off the line and they have a conversation with the Operations Manager. They discuss where and why the incident happened, was it caused by the operator or was it the system that caused the violation. There is an investigation by supervision of the incident and during that process the employee is in training.

- First violation - Written notification and retraining and the violation stays on the operator's record for a year.
- Second violation - The employee agrees to and signs a performance agreement that outlines performance objectives, is placed on notice and retrained.
- Third violation in 12 months - The employee is usually terminated.

There have never been any grievances or arbitration for RSVs at UTA.

Best Practices for Discipline Policies for Red Signal Violations

Based upon the review of the thirteen agencies, we found six key principles for establishing a framework best practices for discipline policies for red signal violations:

- 1) There must be a progression of greater penalties from the first violation to termination.
- 2) Progression should be no more than four steps to termination.
- 3) The process of going from initial charges to arbitration decision if the employee appeals to arbitration should take no more than 90 days.
- 4) Suspensions should be served immediately after imposition. Back pay should be awarded by arbitrator if suspension is found not to be justified.
- 5) Long suspensions serve no real purpose. Shorter suspensions effectively demonstrate the seriousness of the violation. They also limit amounts of overtime to replace the employee during the suspension.
- 6) There should be no clean slate established after any set period of time; the progression should be absolute.



None of the transit agencies that we surveyed complied with all of the best practice principles. However, based on our current information, San Diego Metropolitan Transit System comes closest to reflecting those practices. San Diego adheres to the following key principles:

San Diego Adherence to Principles

- There must be a progression of greater penalties from the first violation to termination. Yes.
- That progression should be no more than four steps to termination. Yes, 3 steps.
- The process of going from initial charges to arbitration decision if the employee appeals to arbitration should take no more than 90 days. Expedited Process.
- Suspensions should be served immediately after imposition. Back pay to be awarded by arbitrator if suspension is found not to be justified. Yes.
- Long suspensions serve no real purpose. Shorter suspensions convey the message and do not require the transit agency to expend large amounts of overtime to replace the employee during the suspension. Short suspensions.
- There should be no clean slate established after any set period of time; the progression should be absolute. There is a 24-month time limit on the first step.
- If there are clean slate provisions, the number of disciplinary progression steps for RSVs should be reduced for that time period (e.g., 2 RSVs in a 3-year period results in discharge). No such provision.

Metro

Metro's red signal violation discipline policies are not ideal, but are far from the worst of the other 13 transit agencies surveyed.

With the recent change in the collective bargaining agreement that classifies red signal violations, management can assess 7 days suspension for the 1st offence and a 15 days suspension for the second with a voluntary last chance agreement. The old progression was 5/15/30 day suspension. However, we observed only one 30-day suspension during our review period as noted in the RSVM. That based upon the best practice principles, we found Metro had the following status was for a signal violation combined with another offense.



Metro Adherence to Principles

Findings:

- F13.** There must be a progression of greater penalties from the first violation to termination. Yes.
- F14.** That progression should be no more than four steps to termination. Yes, there are 3 steps.
- F15.** The process of going from initial charges to arbitration decision if the employee appeals to arbitration should take no more than 90 days. Metro has a lengthy process for reaching an arbitration decision. It currently takes an average of 1,087 days to get an arbitration decision for SMART Union employees, which is up from 728 days in 2012. However, there is a reduction in the number of cases going to arbitration over the past three years from a high of 480 in fiscal year 2013 to 202 in fiscal year 2015.
- F16.** Suspensions should be served immediately after imposition. Back pay to be awarded by arbitrator if suspension is found not to be justified. Yes, Metro does this.
- F17.** Long suspensions serve no real purpose. Shorter suspensions convey the message and do not require the transit agency to expend large amounts of overtime to replace the employee during the suspension. Metro has a 7/15-day suspension progression in place.
- F18.** There should be no clean slate established after any set period of time; the progression should be absolute. Metro uses a 6-month floating period, which is a very short time period.
- F19.** If there are clean slate provisions, the number of disciplinary progression steps for RSVs should be reduced for that time period (e.g., 2 RSVs in a 3-year period results in discharge). Metro has no such provision.

Recommendations:

- 116.** Metro should review the status of arbitrations to understand the reasons for the protracted period to reach a decision.
- 117.** As Metro considers future contract changes, it should review the provisions about the “clean slates” provision as that has broader impact on ongoing performance.



Other Related Recommendations:

TWG also identified site specific findings and 55 additional recommendations to improve safety at specific intersections and infrastructure. *We have listed this in Appendix 1.*





List of Abbreviations

List of Abbreviations

General Abbreviations

ADA	=	American with Disabilities Act
API	=	Application Program Interface
ARINC	=	ARINC (Name of Train Control Supplier)
ATC	=	Automatic Train Control
ATD	=	Automatic Train Dispatching System
ATP	=	Automatic Train Protection
APTA	=	American Public Transportation Association
C3RS	=	Confidential Close Call Reporting System
CCTV	=	Close Circuit Television
CBTC	=	Communication Based Train Control
CEO	=	Chief Executive Officer
CFR	=	Code of Federal Regulations
COO	=	Chief Operating Officer
CTC	=	Centralized Traffic Control
CPUC	=	California Public Utilities Commission
DGM	=	Deputy General Manager
DML	=	Decision Making Leave
FTA	=	Federal Transit Administration
FRA	=	Federal Railroad Administration
GM	=	General Manager
HDR	=	HDR (Name of a Consulting Firm)
HR	=	Human Resources
IPM	=	In-pavement Marking
IT	=	Information Technology
ITCS	=	Incremental Train Control System
LACMTA	=	Los Angeles County Metropolitan Transportation Authority
LACDOT	=	Los Angeles County Department of Transportation Authority
LATTC	=	Los Angeles Trade Technical College



LED	=	Light-emitting Diode
LCP	=	Local Control Panel
LRT	=	Light Rail Transport
LRV	=	Light Rail Vehicle
LSC	=	Location Safety Committee
MOU	=	Memorandum of Understanding
MOW	=	Maintenance of Way
MUTCD	=	Manual of Uniform Traffic Control Devices
OCC	=	Operations Control Center
OCTYS	=	Open Control of Train Interchangeable & Integrated System (A train control system based on CBTC technology that is currently in use by RATP)
OJT	=	On the Job Training
PPE	=	Personal Protective Equipment
RFGPTS	=	Rail Fixed Guideway Public Transportation Systems
RFP	=	Request for Proposal
ROC	=	Rail Operations Control Center
ROW	=	Right of Way
RSV	=	Red Signal Violation
RSVM	=	Red Signal Violation
SCADA	=	Supervisory Control and Data Acquisition
SHARP	=	Safety and Health Assessment Review Report
SOP	=	Standard Operating Procedure
SSC	=	Brand Name of a Train Control System from General Electric
SSOA	=	State Safety Oversight Agencies
SSPP	=	System Safety Program Plan
TCRP	=	Transportation Cooperative Research Program
TTR	=	Time to Repair
TWC	=	Train to Wayside Communication
TWG	=	The Wathen Group



Peer Agency Abbreviations

BART	=	Bay Area Rapid Transit (San Francisco)
CAT	=	Charlotte Area Transit (Charlotte)
CTA	=	Chicago Transit Authority (Chicago)
DART	=	Dallas Area Rapid Transit (Dallas)
GCRTA	=	Greater Cleveland Regional Transit Authority (Cleveland)
LADOT	=	Los Angeles Department of Transportation (Los Angeles)
MARTA	=	Metropolitan Atlanta Rapid Transit Authority (Atlanta)
MBTA	=	Massachusetts Bay Transportation Authority (Boston)
METRO	=	Metropolitan Transit Authority of Harris County, Texas
MTA	=	Metropolitan Transit Authority (Maryland)
MTS	=	San Diego Metropolitan Transit System (San Diego)
MTR	=	Hong Kong Transit Operator
RATP	=	Transport Paris
SEPTA	=	Southeastern Pennsylvania Transit Authority (Philadelphia)
TriMet	=	Tri-County Metropolitan Transportation District of Oregon (Portland)
UTA	=	Utah Transit Authority (Salt Lake City)
VTA	=	Santa Clara Valley Transportation Authority (San Jose)
WMATA	=	Washington Metropolitan Area Transportation Authority





Appendix 1

Appendix 1

Schedule of Report Findings and Recommendations

Schedule of Recommendations and Metro’s Proposed Actions to Implement Metro Safety Culture and Rail Operational Safety Review - Report

Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
1	Reinstitute the comprehensive SHARP review to assess the effectiveness of the LSCs; Review these assessments annually to identify areas that are working and those needing improvements and providing feedback to applicable management with lesson learned for those most effective local groups.	A1				
2	Include a performance measure linked to an effective review in the annual SHARP and Agency committee’s review in the managers’ and other leadership’s performance reviews.	A1				
3	Include metrics that reflect the ratings from the SHARP review as part of the evaluation of the groups considered and recognized to further reinforce the value of this annual review.	A1				
4	Set a priority to create a centralized computerized employee data base that includes all employee records, absenteeism, discipline, etc., with established responsibility and accountability for managing and monitoring individual employee performance, as well as identifying agency trends to address.	A3, B1				
5	Conduct a root cause training program for all supervisors and managers.	A4				
6	Designate a responsible and accountable party to conduct quality control of incident and accident reports for compliance with the SSPP requirements to ensure all incident and accident investigations have clearly identified root causes and contributing causes.	A4, B2				
7	Revise the efficiency testing program. <i>See more detail in Section E - Operations and Maintenance.</i>	A5				
8	Develop and implement a communications program for “near misses” policy directed at management and supervision who receive some of the information, as well as the employees to ensure more consistency with policies and procedures.	A6				
9	Institute a quarterly review of the patterns of discipline by work units to look for trends of consistent administration and include as a topic for the regular management team staff meetings.	A7				



Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
10	Identify responsibilities and accountabilities for monitoring and tracking progress on various outside initiatives including this report and recommendations. <i>See Appendix 1</i> for tracking form for the findings and recommendations.	A8				
11	Clarify the organization's structure, roles and responsibilities, key metrics, and performance expectations for the management team's performance reviews that includes key safety and operating metrics, etc., derived from the SHARP reports, discipline, and efficiency testing.	A8				
12	Review the detail of the survey results by divisions and disciplines to identify areas of effective performance and those areas needing support and coaching to continue to increase the effectiveness of the safety culture agency wide.	A8				
13	Implement a safety recognition program to reinforce positive safety behavior at the individual and work unit. The program should consider the key elements such as: Management support is visible, Achievement criteria must be clear and precise with objective metrics, Incentive cycle or monitoring period must be defined, Process must be transparent to the employees, Eligibility to participate must be defined, and Incentive programs can be tiered but the tiers and performance expectations must be well defined.	A9				
14	Train managers and supervisors on root cause analysis with an emphasis on identifying contributing factors.	B2				
15	Modify the current practice, and issue a more comprehensive red signal violation report that includes the underlying facts, data and circumstances associated with the violation and all contributing factors to a red signal violation.	B2				
16	Capture in the Signal Violation Reports operating data collected by SCADA including mode of operation and signal status.	B2				
17	Maintain operating data collected by the SCADA system for five years.	B2				
18	Develop an Accident/Incident Investigation Guide that defines, in one document, the specific organizational roles and responsibilities for the accident and incident investigation process. It should include the questions to ask and the information to be documented on topics including but not limited to fatigue and alertness. Metro has developed a checklist on this topic for supervisory personnel. Additional topics needed include: vigilance and attention; situational awareness; experience and line familiarization; knowledge of procedures; stress; use of over the counter medications; schedule compliance challenges; weather conditions; visibility; vehicle speed; vehicle defects; signal type and location; traffic conditions, pedestrian traffic, passenger related issues; and radio communications, or other possible distractions.	B2				



Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
19	Provide training for all appropriate supervisory and management personnel on their respective accident and incident investigation roles and responsibilities once the proposed Accident/ Incident Investigation Guide is completed.	B2				
20	Implement proven technologies that combine with modified operating practices to reduce red signal violations and enhance safety of operations.	B3				
21, 72, 86	Eliminate current operating practice of delegating train dispatching responsibilities to train operators.	B4, D1, E10, E11				
22	Investigate various automatic dispatching technologies that are driven by the operating schedule and activate indicators at terminal stations or on train operator displays to instruct train operators when to close train doors and depart terminal stations.	B4				
23	Review the scope of work for its current project to provide a new SCADA system, and investigate the feasibility of expanding the scope of work to provide automatic dispatching functions at terminal stations.	B4				
24	Investigate the capabilities of the TWC equipment for various car classes to communicate automatic dispatching data to on-board equipment. Alternatively, Metro should investigate the installation of platform indicators that can be interfaced with the SCADA system to provide train dispatching information to train operators.	B4				
25, 90	Instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from "Automatic" to "Central", and confirm that normal mode of operation is "Central".	B4, E13				
26	Establish a set of standards, with associated standard drawings, to regulate the placement, configuration, installation, and aspects of wayside signals.	B5				
27	Adhere to Metro's standard drawings for all new and modernized signal installations.	B5				
28	Implement modifications to certain elements of the existing signal installation for the purpose of providing additional operating information to train operators.	B6				
29	Modify the design of all new and modernized signal installations with motorman pushbutton to include an indicator, which would be activated from the ROC to instruct the train operator to establish a route at Signal 8 when required. <i>(In Appendix 11)</i>	B6				
30	Focus part of train operator training on site specific locations, wherein a conflict could exist between interlocking signals and bar signals.	B7				
31	Review the text of the rule associated with the crossing gate, and make appropriate modifications.	B8				
32	Survey interlocking signals affected by this operating condition to determine if modifications are warranted.	B8				



Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
33	Provide site specific recommendations for individual signal locations in the individual reports for PSLs. <i>(In Appendix 10)</i>	B9				
34	Undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.	B9				
35	Investigate the technical conditions that led to the ability to switch to street running mode, and implement the required modifications to ensure that train operators are not able to switch to "Street Running" mode while operating in ATP territory.	B10				
36	Install train detection equipment through the entire street running territory to provide train location information to ROC controllers.	B11				
37	Review its operating rules and procedures pertaining to manual block operation, and make needed clarifications that address this operational issue.	B12				
38, 92	Revise the current practice of including an interlocking within a manual block limit. Under such operating conditions, the manual block should be split into two manual blocks, wherein the first manual block ends at an interlocking signal, and the second manual block starts at the interlocking signal.	B12, E15				
39, 93, 100	Survey all signal locations at the Blue, Expo and Gold Lines and make corrective actions as necessary to repaint "Limit Lines".	E13, E16				
40, 49, 94	Paint all "Limit Lines" with reflective paint.	B13				
41, 95	Provide a description of the "Limit Line" and associated rule in the Operating Rule & Procedures/SOPs.	B13, E16				
42, 96	Provide different markings to differentiate between a "Limit Line" and a "Fouling Point Marker".	B13, E16				
43	Make every effort to address digital radio communication issues and improve the system.	B14				
44	Implement modifications to certain elements of the existing signal installation for the purpose of providing additional operating information to train operators.	C1, C20				
45	Implement an Automatic Train Dispatching (ATD) system.	C2				
46	Undertake a program to enhance the visibility of signal aspects, including relocating signals and/or the installation of repeater signals where required.	C7				
47	Modify the signal configuration at signal 5N, Pico Station, to comply with acceptable operating standards.	C5				
48	Implement a program to install event recorders at all interlocking locations.	C8				



Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
49	Conduct a risk assessment of the operation of Signal 9S, Washington Station, and implement signal modifications as necessary.	C12, C13				
50	Install train detection equipment where required to provide visibility of train movements to controllers at the ROC.	C11				
51	Investigate the implementation of technologies to provide cab indication/alarm when a train is approaching a red signal.	C11				
52	Implement ATP street running territory to enhance operational safety and provide adequate safeguards to avoid accidents, and not to reduce violations.	C15				
53	Perform a comprehensive review of operating rules and procedures and SOPs to ensure that all failure modes and operational scenarios are covered with appropriate rules and procedures.	C15				
54, 56, 59	Provide proper training for all Operations personnel on operating rules & procedures and SOPs.	C15, C16, C17, C18				
55	Assess the safety of operation in the approach to portals and sharp curves, and provide ATP enforcement to enhance operational safety.	C17				
57	Quantify the potential impacts and risks of not implementing ATP on all main line track areas.	C18				
58	Assess the safety of operation in the approach to portals and sharp curves, and provide ATP enforcement to enhance operational safety.	C18				
60	Install speed signs at all locations within street running territories, where the safe operating speed is less than 35 MPH.	C19, C23				
61	Add ATP enforcement for sharp curves to provide over-speed protection and mitigate the risk of derailment, for example the curve in the approach to Washington Station.	C19				
62	Add ATP enforcement to signals protecting the entrance to portals, for example signal 5N at Pico Station.	C19				
63	Investigate the implementation of CBTC or ITCS technology as a replacement system for the existing cab-signaling installation.	C21, C22				
64	Review each of the listed best practices and consider implementing them at appropriate locations to improve operational safety at intersections, and encourage safe public behavior. <i>See appendix.</i>	C27				
65	Establish a comprehensive set of guidelines for rail/vehicle intersections that define minimum requirements for signage, street markings, pedestrian barriers, lighting, traffic control devices and traffic enforcement devices. The guidelines should be based on Industry Standards, and should provide an environment that promote public safe behavior.	C27, C30				



Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
66	Survey all rail/vehicle intersections to determine if they meet the established guidelines; Develop a scope of work for each intersection that identifies the work elements required to bring the intersection in compliance with minimum requirements.	C27, C30				
67	Establish a Capital Program in conjunction with local municipalities to upgrade the traffic installations at the various intersections based on established scopes of work.	C27				
68	Review, evaluate and implement new technologies at rail/vehicle intersections for the purpose of enhancing safety of operation, and encouraging public safe behavior.	C27				
69	Conduct a survey of all private driveways that intersect with the right-of-way within street running territory, and develop and implement a plan to mitigate the risks associated with private driveways.	C29				
70	Establish and implement a maintenance program to eliminate graffiti at traffic signs at various intersections.	C28				
71	Establish an operating plan to implement the new SCADA/CTC system, first on the Red Line, then on the Light Rail network. The operating plan should be based on a consistent approach to automatic route setting and should include any required modifications to operating rules and procedures.	D1				
73	Install dispatch indicators at terminal stations to facilitate the implementation of ADS.	D1				
74	Investigate the feasibility of using the existing TWC infrastructure for the purpose of transmitting the status of interlocking signals to approaching trains.	D2				
75	Investigate advanced train control technologies (CBTC and ITCS) for the long term modernization of signal installations on the Light Rail System.	D2				
76	Implement a process to manage bar/traffic signal violations as intensively as rail signal violations.	E1 - E9				
77	Discuss with LADOT regarding the root causes for the poor reliability of bar signals, and to develop an action plan to address bar/traffic signal failures.	E1 - E9				
78	Discuss with LADOT measures that would improve the visibility of bar signals at certain locations, either through increased brightness or through the use of a different color.	E1 - E9				
79	Complete the evaluation of the pilot installation to detect bar signal violations, and determine if the pilot installation should be expanded to other locations.	E5				
80	Provide real time detection of violations through the use of an API with the existing LADOT centralized traffic control system. This approach requires more investigation as well as coordination and cooperation between Metro and LADOT.	E1 - E9				



Rec.#	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
81	Use daily logs provided by LADOT to manage bar signal violations.	E6				
82	Develop a concept of operation on how to manage bar signal violations. The concept of operation should evaluate the pros and cons of real time bar signal violation detection versus a review of violation logs provided by LADOT.	E7				
83	Assess the resources required to manage bar signal violations, and provide additional resources if required.	E8, E9				
84	Discuss with LADOT to resolve financial issues related to expanding the detection of bar signal violations to other intersections.	E8, E9				
85	Develop a plan jointly with LADOT to improve the accuracy of bar signal violation detections.	E1 - E9				
87	Investigate various ADS technologies that are driven by the operating schedule, and which activate indicators at terminal stations or on train operator displays to instruct train operators as to when to close train doors and depart terminal stations.	E14				
88	Review the scope of work for its current project to provide a new SCADA system, and investigate the feasibility of expanding the scope of work to provide ADS functions at terminal stations.	E14				
89	Investigate the capabilities of the TWC equipment for various car classes to communicate ADS data to on-board equipment. Alternatively, Metro should investigate the installation of platform indicators that can be interfaced with the SCADA system to provide train dispatching info to train operators.	E14				
91	Review its operating rules and procedures pertaining to manual block operation, and make needed clarifications that address this operational issue.	E15				
97	Consistent with industry practice for multimodal systems, Metro should develop a separate rule-book applicable to the Light Rail characteristic and operating requirements to promote a better understanding of the requirements and responsibilities specific to Light Rail operating rules and characteristics.	E17				
98	Explore the feasibility of designating new operators their assigned Line location upon entering training and focus the training on the rules, procedures and characteristics specific to the Line they are assigned. The rules training specialization approach should allow for additional in service training hours with a Line Instructor to better familiarize the new Operators with the unique Line characteristics and challenges they will face. It is also recommended that a formalized training program for Line Instructors is developed to support the desired and consistent application of the in-service training segment of the program.	E17				
99	Establish yearly signal performance metrics, including a "Mean TTR" goal for various signal equipment. What is important in monitoring the performance metrics is the performance trend.	E24				



Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
100	Investigate maintenance incidents requiring TTRs in excess of three hours, and develop an action plan to reduce TTR.	E24				
101	Reinstruct controllers on documenting infrastructure failures like signals on the incident status log reports.	E26				
102	Establish a process to capture train delays and other service impacts caused by signal failures. The collected data should be used in on-time performance analysis and to establish metrics for signal maintenance efforts.	E26				
103	Investigate the root causes for the high signal failure rate at Marine Interlocking and take appropriate action as necessary.	E27				
104	Update its Rail Efficiency Testing program consistent with the scope of requirements as specified in the FRA mandated program under 49 CFR Part 217 Railroad Operating Rules. The new program should be risk-based and include a documented program plan with clear accountability within Operations for the management of the program.	E28, E29, E30				
105	Increase focus on the Blue Line operations, especially at designated priority high incident locations.	E30				
106	Continue to let Corporate Safety be responsible for program quality assurance oversight and conduct a designated number of internal audits to verify the desired level and quality of program implementation of the approved efficiency testing program.	E30				
107	Conduct or provide an update on a risk assessment of Metro facilities including the headquarters building and right-of-way to determine points of vulnerability, and considered best practices for protection and surveillance. It should include the consideration of handling trespassers including the general public, homeless persons and criminals.	E31				
108	Explore the feasibility of establishing a separate track for recruiting Rail Operators, which should take into consideration of introducing a competency based selection process for the three pilot programs based upon three vendors' methodology beginning at Metro.	F1, F2				
109	Explore the feasibility of designating new operators by assigned line location upon entering training and focusing their training on the rules, procedures and characteristics specific to the respective line.	F3, F4				
110	Continue the annual refresher safety training program.	F5				
111	Provide signal violation training with the result of root cause-based investigations and contributing factors.	F6				
112	Provide additional training focused on situational awareness that addresses the proliferation of "operator inattention" as the root cause for many of the red signal violations.	F9				
113	Provide on-the-job training, supplemented with the use of a simulator that enhances training and contributes to improved operator performance.	F7				



Rec.#	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
114	Utilize SmartDrive suite of tools to track performance related issues.	F8				
115	Continue disseminating safety messages via the Rail Alerts and thru the LSCs.	F10				
116	Review the status of arbitrations to understand the reasons for the protracted period to reach a decision.	F15				
117	Review the provisions about the “clean slates” provision on the future contract because it has broader impact on ongoing performance.	F18, F19				



Schedule of Report Recommendations and Metro’s Proposed Actions to Implement Metro Safety Culture and Rail Operational Safety Review - Appendix

Rec. #	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
A1	Blue/Expo Line - Metro should consider the installation of approach signals on a case by case basis in the approach to home signals in street running territory. The criteria for the addition of an approach signal should be based on: The need for trailing point protection (when for example the home signal is located close to the trailing point switch), Inadequate sighting distance, or Poor visibility of the home signal aspects.	A7.1				
A2	Gold Line - Metro should consider the installation of approach signals on a case by case basis in the approach to home signals in street running territory, only if the approach clearing limit is extended beyond the approach signal location. The criteria for the addition of an approach signal is the same as above.	A7.2				
A3	Metro should consider relocating reverse running home signals as part of a comprehensive design approach to upgrade the safety of operation in street running territory. The decision to relocate reverse running home signals should be coordinated with other measures such as the installation of approach signals.	A7.3				
A4	Metro should investigate the feasibility and practicality of preconditioning the clearing of an interlocking signal at an intersection based on the clearing of the bar signal at the intersection.	A7.4				
A5	Metro should consider modifying interlocking signals at intersections within the Blue/Expo Line by implementing automatic route setting based on a train occupying the approach track circuit. This approach clearing feature is already implemented on the Gold Line.	A7.5				
A6	Metro should discuss with LADOT the feasibility of modifying the algorithm that detects bar signal violations in order to reduce false violation alarms.	A7.4				
A7	Metro should not employ approach lit signals as a measure to minimize red signal violations.	A7.6				
A8	Intersection #1: 18th St/Flower: Install blank out no left turn sign, Install a second train signal to advise motorists and pedestrians that two trains are approaching an intersection, Install illuminated active in-pavement marking (IPM) systems, and Install traffic enforcement devices.	A9.1				
A9	Intersection #2: Pico & Flower: Implement appropriate measures to ensure safety at the private driveway at the south end of Pico Station.	A9.2				



Rec.#	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
A10	Intersection #3: Blue Line, Intersection of Long Beach/20th St (Washington Station): Install additional signs, street markings & traffic equipment, Implement a channelization scheme to guide pedestrians through the 20 th Street crossing, Implement dynamic information related to approaching trains to inform the public when more than one train is approaching the intersection, and provide a pedestrian traffic button for activation of countdown crossing signals north of Washington Station.	A9.3				
A11	Intersection #4: Long Beach Avenue & 24th St.: Install additional signs, street markings & traffic equipment, Implement a channelization scheme to guide pedestrians through the 20 th Street crossing, Implement dynamic information related to approaching trains to inform the public when more than one train is approaching the intersection.	A9.4				
A12	Intersection #5: Gage Avenue: Install additional signs, street markings & traffic equipment; implement a channelization scheme to guide pedestrians through the crossing. Further, the implementation of dynamic information related to approaching trains will inform the public when more than one train is approaching the intersection.	A9.5				
A13	Intersection #6: Washington & Hooper: Improve the signage and dynamic information provided to the public, as well as the implementation of traffic enforcement measures.	A9.6				
A14	Intersection #7: Long Beach & Burnette: Improve the signage, street markings and dynamic information provided to the public. It is also desirable to implement traffic enforcement measures. Install blank out no left turn sign, a second train signal to advise motorists and pedestrians that two trains are approaching an intersection, illuminated active in-pavement (IPM) systems and traffic enforcement devices.	A9.7				
A15	Intersection #8: Exposition & Raymond: Install blank out no left turn sign, Install illuminated active in-pavement marking (IPM) systems.	A9.8				
A16	Intersection #9: Exposition & Watt: Improve the signage and dynamic information provided to the public; install blank out no left turn sign, second traffic signal to advise motorists and pedestrians that two trains are approaching and illuminated active in-pavement marking (IPM) systems.	A9.9				
A17	Intersection 10: Gold Line, Pasadena & Monterey: Provide clearer street markings in the intersections that designate the track area where pedestrian should be crossing; Implement a second train signal to advise motorists and pedestrians that two trains are approaching the intersection.	A9.10				



Rec.#	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
A18	Modify the design of the motorman pushbutton to include an indicator. The indicator would be activated from the ROC to instruct the train operator to establish a route at signal 8 when required.	A10.1				
A19	Investigate the installation of a repeater signal for signal 8, which would be visible from the train operator's position in the cab.	A10.1				
A20	Investigate the implementation of an Automatic Train Dispatching System (ATD). Typically, an Automatic Train Dispatching system is driven by the operating schedule, and activates an indicator at the terminal station to instruct the train operator when to close the doors and depart the terminal. A current Metro Contract No. OP39603035 will provide the main tools necessary to implement ATD.	A10.1				
A21	Investigate the feasibility of relocating Signal 4S with associated IJ and TWC. Alternatively, install a right hand repeater for Signal 4S.	A10.2				
A22	Clarify who is responsible for establishing routes at leaving signals 1S & 2S.	A10.2				
A23	Investigate the implementation of an Automatic Dispatching System (ATD), which should be coordinated with the route setting of departing signals. A current Metro Contract No. OP39603035 will provide the main tools necessary to implement ATD.	A10.2				
A24	Review the current process for establishing a route at signal 3N, and investigate the feasibility of providing an indicator at the signal to inform the train operator when it is necessary to manually establish a route.	A10.2				
A25	Instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from "Automatic" to "Central", and wherein the normal mode of operation is "Automatic".	A10.2				
A26	Review the current SOPs for terminal operation at 7th & Flower, and make the necessary clarifications/ changes to ensure proper coordination between ROC Controllers and Train Operators.	A10.2				
A27	Repaint the Limit Line at signal 5N.	A10.3				
A28	Conduct braking tests as discussed above.	A10.3				
A29	Install a speed sign of 20 mph in the approach to the portal.	A10.3				
A30	Advance the date of implementing modifications at Signal 5N. The modifications must ensure the safety of operation in the approach to the portal, and protecting a train stopped ahead in the approach to Signal 1N. The modification should also ensure that a train stopping at a relocated 5N will not block the intersection.	A10.3				



Rec.#	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
A31	Metro has revised the text in the SOPs that instruct train operators to operate at 35 mph from Pico station until train is completely inside underground section. If the results of the proposed test indicate a need to change the 20 mph speed limit, then Metro should further modify the text of the SOP as appropriate to ensure safety of operation.	A10.3				
A32	If Metro decides to leave Signal 5N at its current location, then Metro should add a track circuit between the current location for 5N and track circuit 15T. Metro should also investigate the feasibility of adding ATP enforcement at Signal 5N.	A10.3				
A33	Signal maintenance should follow up on the installation of an event recorder to determine the root cause for losing switch indication.	A10.4				
A34	Instruct ROC Controllers to inform train operators any time the fleet feature is cancelled at an interlocking signal that is normally fledted.	A10.4				
A35	Explore the implementation of technologies that will provide a cab alarm when a train is approaching a red signal.	A10.4				
A36	Provide training modules to train operators that focus on site specific situations, wherein interlocking signal and bar signal could conflict.	A10.4				
A37	Investigate alternatives to improve the visibility of Signal 8N.	A10.5				
A38	Implement consistent route setting at least within the same line.	A10.5				
A39	Instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from "Automatic" to "Central", and wherein the normal mode of operation is "Central".	A10.5				
A40	Review the text of the rule associated with the crossing gate, and make appropriate modifications.	A10.6				
A41	Survey Signal location 2S to determine if modification is warranted.	A10.6				
A42	Conduct a risk assessment of the operation of Signal 9S, and implement signal modifications as necessary.	A10.6				
A43	Install train detection equipment at the curve north of Washington Station to provide visibility of train movements to controllers at the ROC.	A10.6				
A44	Relocate the radio sign that is partially obstructing Signal 4N.	A10.7				
A45	Investigate the feasibility of implementing technologies to provide cab indication/alarm when a train is approaching a red signal.	A10.7				
A46	Instruct ROC Controllers to inform train operators any time the fleet feature is cancelled at an interlocking signal that is normally fledted.	A10.8				



Rec.#	Recommendation Description	Related Findings #	Assigned Staff in Charge	Agree or Disagree	Proposed Action	Est. Date Completion
A47	Investigate the feasibility of implementing technologies to provide cab indication/alarm when a train is approaching a red signal.	A10.8				
A48	Instruct ROC Controllers to inform train operators any time the fleet feature is cancelled at an interlocking signal that is normally fleted.	A10.8				
A49	Investigate the implementation of an Automatic Dispatching System (ATD), which should be coordinated with the route setting of departing signals. A current Metro Contract No. OP39603035 will provide the main tools necessary to implement ATD.	A10.9				
A50	Review the current SOPs for terminal operation at Atlantic Station, and make the necessary clarifications/ changes to ensure proper coordination between ROC Controllers and Train Operators.	A10.9				
A51 A53 A55	Instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from "Automatic" to "Central", and wherein the normal mode of operation is "Central".	A10.9 A10.10 A10.11 B4 B13				
A52	Implement consistent route setting at least within the same line. Metro is currently implementing a project to modernize its SCADA/CTC system (Contract No. OP39603035). This project will provide the tools necessary to implement consistent route setting.	A10.11				
A54	Investigate the feasibility of relocating Signals 2N and 4N to the south side of the first Rowan intersection.	A10.11				





Appendix 2

Appendix 2

List of Reference Documents and those Individuals Interviewed

Documents

Two (2) memos dated November 19, 2012 were issued to Transportation Staff by James Woodson, the Interim Executive Director, Transportation, both for Discipline for Avoidable Accidents (12-007, 12-008).

21 Division Communiqué Safe Operation 2010-14

49 CFR Part 217 (Applicable to FRA Efficiency Testing)

APTA Peer Review Report

APTA Rules Compliance Standard RT-S-OP-011-10

Bulwark - Proper use of electrically rated clothing/uniforms

Communiqué 2012-26 Sealed Control Switches

Cost estimates to add distant signals (approach signals)

Cost estimates to implement approach lit signals

Cost estimates to integrate interlocking signals with bar signals

Cost estimates to relocate reverse running home signals

Copy of “near miss” report (SAFE-7) - December 7, 2015.

Daily Signal Reports

Division 21 COMMUNIQUE for Civil Traffic Speeds 2009-006

Efficiency Testing Summary and Results for 2013, 2014, and 2015

Electronic Devices policy

EXPO2 - (New line training regarding equipment) Training on Traction Power Substations, OCS, Train Control, Communications

Foothill - (New line training regarding equipment) Training on Traction Power Substations, OCS, Train Control, Communications

Gold Line Communique 2010-15 Signal Efficiency Testing 112410

Incident reports

Individual operator reports

Industry Publications

Interoffice Memo, dated February 17, 2016, from Mr. Patrick Preusser - Executive Officer

Job classifications position requirements

LA Metro System Safety Program Plan - December 2015.

Local Safety Committee Meeting Minutes



Green Line: 1/27/16

Green Line: 2/17/16

Green Line: 3/23/16

Green Line: 4/22/16

Red Line: 1/28/15

Red Line: 1/27/16

Red Line: 2/24/16

Red Line: 3/30/16

Red Line: 4/19/16

Blue Line: January 2015

Blue Line: 2/24/15

Blue Line: 2/24/16

Blue Line: 3/16

Blue Line: 12/16/16

Gold Line: 12/17/15

Gold Line: 1/21/16

Gold Line: 2/18/16

Gold Line: 3/29/16

Gold Line/Monrovia: 3/16/16

Gold Line/Monrovia: 3/23/16

Gold Line/Monrovia: 4/5/16

Los Angeles County Metropolitan Authority Safety Report: Safety & Health Assessment Review Program (SHARP) - May 20, 2016

Main Line Incident Status Log Reports

Main Line Incident Status Reports

MBL - Siemens Substations

MBTA Safety Rules Compliance Program Inspection Procedure and Form

MBTA Safety Rules Compliance Program SOP OPS-SOP 09-01.01 Dated 11/5/13

MBTA Safety Rules Compliance Steering Committee Meeting Minutes

Memo from Vijay Khawani, Executive Officer, Corporate Safety to All Executive Officers and Managers, re: Pending Safety Issues. July 10, 2012.

Memo from Vijay Khawani, Executive Officer, Corporate Safety and Frank Alejandro, COO to Arthur Leahy, CEO, re: Safety Culture Report Recommendations, December 7, 2012.

Memo from Vijay Khawani, Executive Officer Corporate Safety to All Executive Officers and Manager, re: Flash Report.

Memo dated July 10, 2012, establishing the flash report/rail alert with format for creating each report

Memo from Arthur Leahy to Metro Operations Employees, re: Safety Survey that was an attachment to the 2012 safety survey.



Memo from James Woodson, Interim Executive Director, Transportation, to Transportation Staff, re: Discipline for Avoidable Accidents, November 19, 2012.

Memo from Ricardo Moran to Tamar Fuhrer, Dated January 6, 2016

Memorandum from Ricardo Moran, Dated January 26, 2016

Metro's operating rules and procedure documents

Metro Rail Safety Training for Metro Employees, Contractors and Vendors PowerPoint, Revised

Metro SSPP Dated 12/12/15

MROB 2013-19 Rule 3094 Crossing Gate Signal

MROB 2013-20 Fouling the Track

MROB 2014-04 Protran Warning Devices

MROB 2014-06 WWP New and Revised Rules & Procedure

MROB 2014-07 Wayside Worker Protection New & Revised Rule

MROB 2015-06 Red Flag Light at a Grade Crossing Warning System Malfunction

MROB 2015-07 Grade Crossing Warning System Malfunction

MROB 2016-01 Gold Line Ave 45 Grade Crossing

MROB 2016-04 Crossing Gate Signal, Rule 3094

MROB 2016-08 Restricted Access Signage

MROB 2016-09 Signal Alert Program

MTA Maryland Safety Rules Compliance Program Light Rail Testing Program

Operating Rules & Procedures and SOPs

OSSC Meeting Agenda: 5/23/16

Protran - Early warning electronic system for Roadway Worker Protection

Rail Instruction Communique 2010-02 - Safe Operation

Rail Safety Sustainability Training Guide and Presentation Materials

Rail Transportation Instruction Training Matrix

Rail Wayside Worker Protection Training Class Presentation - April 2014

Red Signal Violation Reports

Red Signal Violation Matrix

ROS CPUC Reportable Accidents

RTIN 2015-01 Derailment

RTIN 2015-02 Unauthorized Mainline Access

RTIN 2015-03 Loss Cab Signal

RTIN 2015-04 Flooded Track, Rail Alert

RTIN 2015-05 Violation of Electronic Devices Policy

RTIN 2015-06 Smoke Detector Alarms and Smoke in Station

RTIN 2016-01 Fouling the Track

RTIN 2016-02 Energizing the Mainline

RTIN 2016-03 Grade Crossing Warning System Malfunctions



RTIN 2016-04 Signal Anomaly

Site Visits Reports - Stop Signal Working Group

Standard Operating Procedures for ROC Observers and Train Operators

Stop Signal Working Group - Summary Meeting Power Point Presentation

Stop Signal Working Group Site Visit Reports

Summary of Metro Blue Line Train/Vehicle and Train/Pedestrian Accidents (July 2005 - December 2015)

Technical Provisions for Contract No #OP39603035

Transportation Cooperative Research Program publications: see culture section when two reports are identified...

Wayside Communique No #12-001

WRIB website

Interview List

Patricia Alexander, Service Operations Superintendent, Rail Transportation

Eddie Boghossian, Director, Corporate Safety

Michael Cano, Assistant to Board Member Michael Antonovich (former)

Conan Cheung, Executive Officer, Finance, OMB

James Gallagher, COO, Transit Operations

Michael Harris-Gifford, EO, Rail Wayside System, Maintenance & Engineering

Karen Gorman, Inspector General, Office of the Inspector General

Don Howley, DEO, Administration, Workforce Services

John Johnson, Services Operations Superintendent, Rail Transportation

Vijay Khawani, EO, Corporate Safety, Safety

Greg Kildare, Chief Risk, Safety & Asset Management Officer, Risk Management

Linda Leone, Director, Transportation Operations, ROC

Jesus Montes, Interim Executive Director, Vehicles Acquisition - Transit Capital Program

Don Ott, Executive Director for Employees and Labor Relations (former)

Patrick Preusser, Executive Officer, Rail Operations (former)

Bruce Shelburne, Senior EO, Rail Operations, Maintenance & Engineering

Sean Skehan, Principal Transportation Engineer, LADOT

Philip Washington, CEO

Charles Weissman, Supervisor Engineer, SCADA System Engineer & Maintenance

Stephanie Wiggins, Deputy CEO

Abdul Zohbi, Manager, Systems Safety, Safety





Appendix 3

Appendix 3

Focus Groups

(Held March 7-11; March 21; March 21-24; April 19, 2016)

Groups Included:

- Rail Fleet Services: Divisions 11, 20, 21, 22, 24 (One session each)
- Rail Transportation: Divisions 11, 20, 21, 22, 24 (One session each)
- MOW-Light Rail: Division 66 (Two sessions)
- MOW: Division 61 (Five sessions)
- Red Line Main Yard: (One session)
- Rail Operations Control Center: Division 60 (One session)
- Rail Supervisors (One session)





Appendix 4

Appendix 4

2016 Los Angeles Metro Rail Employee Survey

August 2016



Introduction

The purpose of the Metro survey is to provide information about employee safety, training and culture; and how employee perceptions have changed since they were last surveyed in 2012.

At the beginning of 2016, a written survey was distributed to 1650 LA Metro Rail Operations field employees of the Los Angeles County Metro to gain insight into the trends and attitudes of safety amongst Metro employees. The survey, similar to the one distributed in 2012, focused on issues relating to:

- Safety training
- Metro's effectiveness in communicating with employees
- Employees' adherence to safety policies, procedures, and rules
- Culture of reporting incidents
- Accidents and employees' impression of Metro's willingness to implement lessons learned
- Values and attitudes (common goal)

Methodology

TWG team developed an abbreviated survey based upon the one that the Sam Schwartz team administered in 2012 as part of their work assessing Metro's Bus and Rail cultures. We used a subset of the questions from that survey and added three open ended questions to test the validity of the findings from the groups. We worked with LA Metro personnel to prepare and distribute the written surveys to all nineteen Rail Operations employee locations for them to return anonymously. Bus operations employees were not included for this survey. The survey was distributed April 12th with a return request by April 29th. Of the 1650 surveys distributed, we received 1251 completed surveys with a high response rate of 75%. In contrast for the 2012 survey, we received 745 completed surveys with a low response rate of 12%. For the 2016 survey the average response rate on the questions ranged from 91% to 96% with the exception of questions 11a-c where a response was only recorded if it applied to that employee. See attachment I for copy of the survey instrument.



Key Findings and Conclusions

		2016 Median	% Yes	2012 Median	% Yes
2	How would you rate the overall quality of the initial safety training you received in your first few months on the job?	Good		Poor	
3	Other than new employee training, how would you rate the overall quality of any safety training you received in that year?	Good		Poor	
4	Have you received any refresher safety training in the last three years?	Yes	87.08%	No	69.00%
5	Would you say the methods Metro uses to communicate safety procedures and rules initially to new employees are effective	Yes	83.40%	No	76.00%
6	Would you say Metro ensures that you understand the risks you face and the rationale behind the safety rules that apply to your workplace?	Yes	85.08%	No	72.00%
7	Would you say the methods Metro uses to communicate changes to safety procedures and rules to all employees are effective?	Yes	74.04%	No	62.00%
8	Do you personally closely follow workplace safety rules and procedures?	Very Closely		Not at all	
9	Do your co-workers closely follow workplace safety rules and procedures?	Not very Closely		Not very Closely	
10a	I am strongly encouraged to report unsafe conditions.	Strongly Agree		Strongly Disagree	
10b	Metro workers have full authority to stop service or work at any time if they observe a hazardous condition.	Strongly Agree		Disagree	
10c	Many of Metro's workplace safety rules have very little to do with really keeping workers safe.	Disagree		Agree	
10d	In my workplace, management, supervision, and workers know what we are doing; we trust each other; we work together; we know how to work safely; and we do it.	Agree		Disagree	
10e	Management takes a no blame/no discipline approach if workers voluntarily report "near misses".	Agree		Agree	
10f	In my workplace, management and supervision have an "open door" policy on safety issues and act quickly to correct safety problems when identified.	Agree		Disagree	
10g	When people ignore safety rules and procedures in my workplace, it is none of my business.	Disagree		Agree	
10h	In my workplace, a worker can get safety rules and procedures changed by making a good case of the change.	Agree		Disagree	
10i	Metro learns from accidents and incidents and uses what has been learned to prevent recurrences.	Agree		Disagree	
11	Have you or one of your co-worker ever had a close call or near miss on the job where during which someone came close to being seriously injured or killed?	No	46.54%	No	
11a	If yes was the incident formally reported?	Yes	71.90%	No	58.00%
11b	If not formally reported, why not?	None of the Above			
11c	Is Metro's primary focus in dealing with accidents or incidents disciplining individuals instead of preventing recurrences?	Yes			
12	In your experience, do Metro and its employees have a shared set of values, attitudes, and behaviors that combine to make Metro a safer place to work than it otherwise would be?	Yes	53.69%	No	67.00%



Positive results were seen in all areas:

- Employees have received good initial safety training within their first few months on the job and have also been given a refresher in the last three years.
- Metro effectively communicates safety rules, procedures and changes and employees understand the risks they may encounter on the job.
- Employees tend to follow safety rules and procedures but have some doubts as to whether their co-workers do.
- Employees are confident Metro has their safety in mind.
- Employees are comfortable reporting unsafe work conditions and know they each have a role to play in ensuring a safer workplace.
- The no-blame approach encourages employees to learn from past incidents to ensure a safer workplace.
- General feeling of shared set of values in making Metro a safer place to work.

The median response across divisions seemed to be consistent with only a few exceptions.

Compared to the 2012 survey, there have been significant improvements in all areas:

- The results to each question in the 2016 survey were compared to the corresponding results in the 2012 survey by performing a difference of means test.
- All responses showed a strongly significant improvement ($p \leq 0.001$) over the 2012 levels.



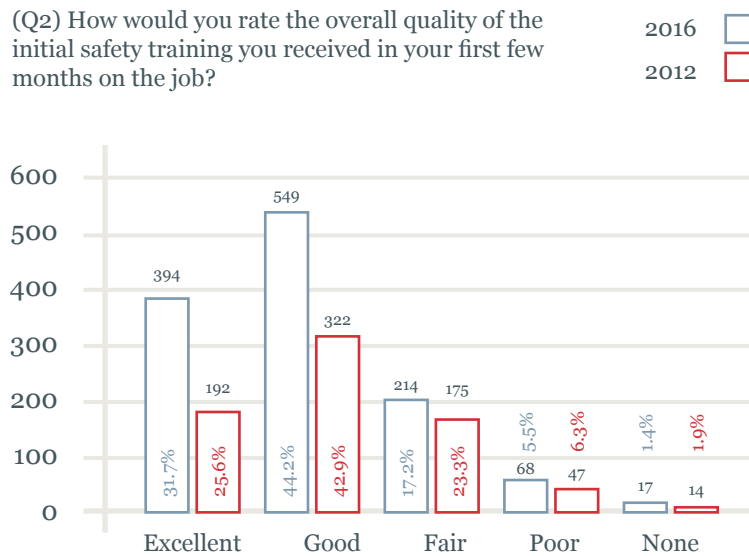
Detailed Results of Survey

Safety Training

When employees were asked to rate the overall quality of initial safety training during their first few months on the job, 75.9% of respondents said it was either “Excellent” or “Good”, up from 68.5% in 2012.

The median overall response remained “Good”.

For computing mean values, a linear scale was assumed whereby 1 = “Excellent” to 4 = “Poor” and 5 = “None”. A t-test on the difference in the mean overall response concludes with 99% confidence the average rating improved slightly from 2.16 in 2012 to 2.01 (“Good”).



When asked how they rate the overall quality of additional safety training received during their first year on the job, 74.6% of respondents said it was “Excellent” or “Good” compared to 53.4% in 2012.

The median overall response received remained “Good”.

Again, the difference in the mean overall response concludes with 99% confidence ($p < 0.001$) the average rating improved from 2.61 in 2012 to 2.05 (“Good”). The survey results show an improvement in overall quality of safety training.

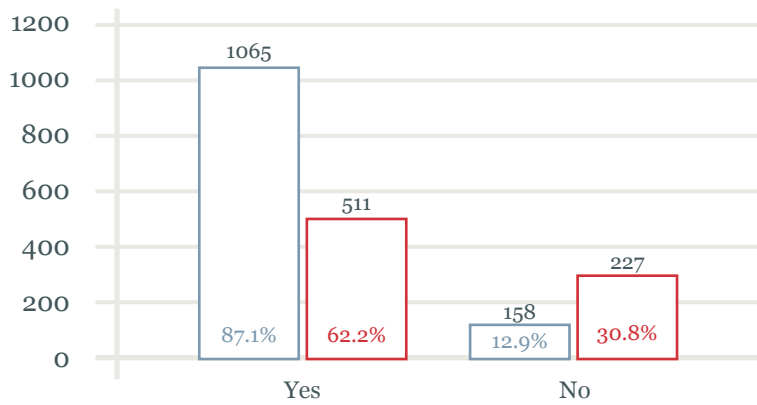


(Q3) Other than new employee training, how would you rate the overall quality of any safety training you received in that year?



Of the 93.7% who responded to having received refresher safety training in the last three years, 87.1% received a refresher compared to 69.2% in 2012.

(Q4) Have you received any refresher safety training in the last three years?

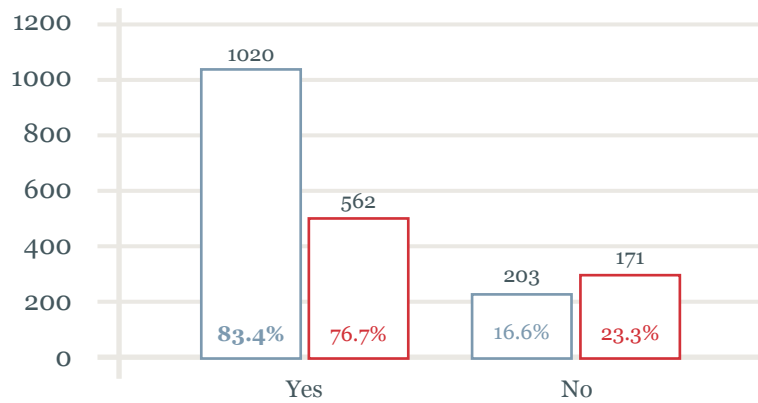


Communication

83.4% of overall respondents agree Metro is effective in communicating safety procedures and rules to new employees. A 6.7% improvement from 2012.

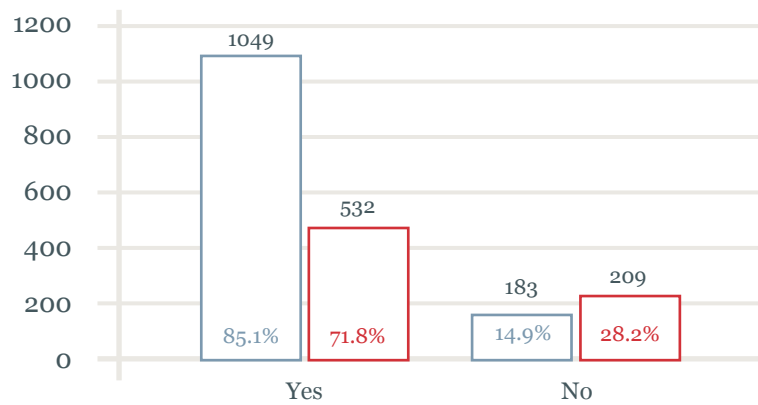


(Q5) Would you say the methods Metro uses to communicate safety procedures and rules initially to new employees are effective? 2016 □ 2012 □



85.1% of the overall respondents agree Metro ensures employees understand the risks and the rationale behind the safety rules. At a 99% level of confidence, this represents a significant improvement from 71.8% in 2012.

(Q6) Would you say that Metro ensures that you understand the risks you face and the rationale behind the safety rules that apply to your workplace? 2016 □ 2012 □

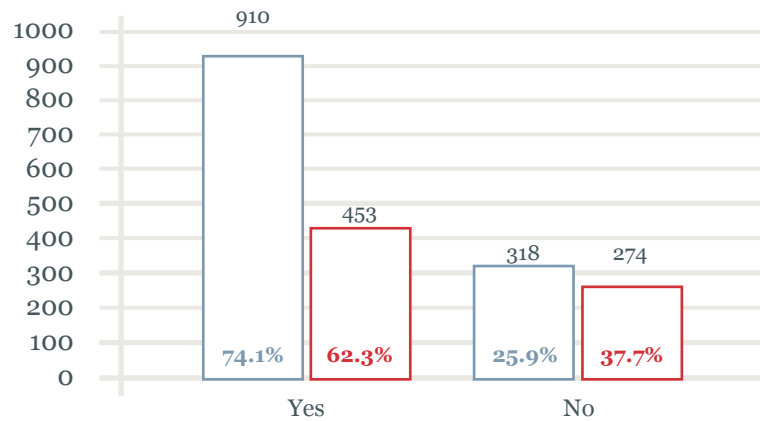


Since the 2012 survey, respondents who agreed methods Metro uses to communicate changes to safety procedures and rules to all employees are effective improved from 62.3% to 74.1%. At a 99% level of confidence, the 11.8% increase is statistically significant.



(Q7) Would you say the methods Metro uses to communicate changes to safety procedures and rules to all employees are effective?

2016 □
2012 □

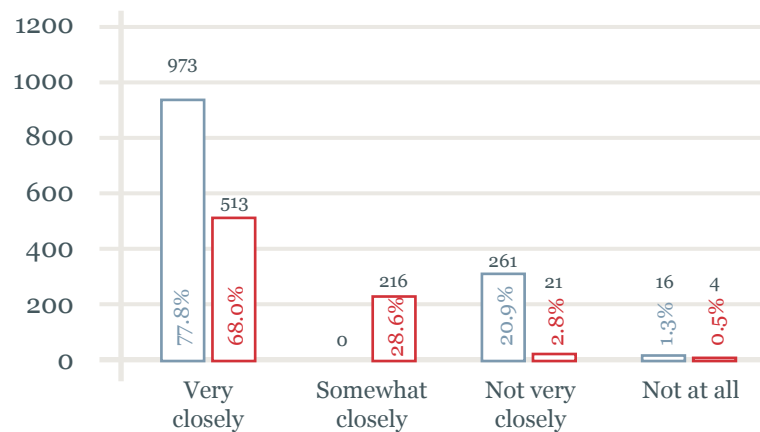


Adherence to Safety Policies, Procedures and Rules

77.8% of the overall respondents in 2016 follow workplace rules and procedures “Very Closely” compared to 68% in 2012. At a 95% level of confidence, this represents a significant improvement in average employee adherence to safety protocol.

(Q8) Do you personally closely follow workplace safety rules and procedures?

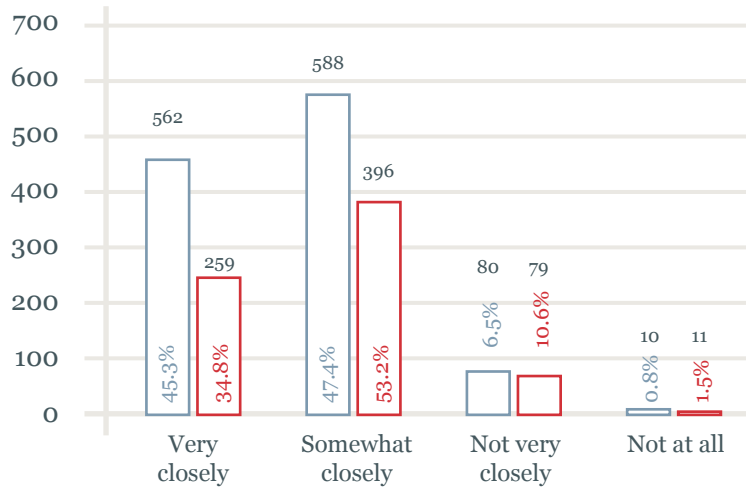
2016 □
2012 □



Of the employees who responded, 92.7% believe their co-workers “Very Closely” to “Somewhat Closely” follow workplace safety rules and procedures, an improvement from 87.9% in 2012; with no change in the median response, “Somewhat Closely”. Unlike the other divisions, the median response for Division 20, 62 and 66 employees was “Very Closely”.



(Q9) Do your co-workers closely follow workplace safety rules and procedures? 2016 □
2012 □

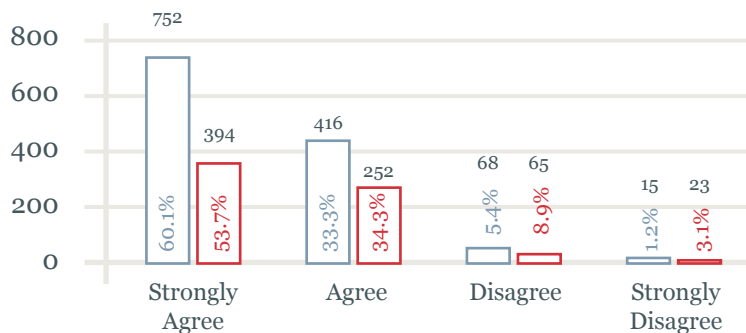


Reporting Culture

93.4% of respondents “Strongly Agree” or “Agree” with the statement “I am strongly encouraged to report unsafe conditions”. There was a 5.4% improvement in this sentiment since 2012.

For computing mean values, a linear scale was assumed whereby 1 = “Strongly Agree” to 4 = “Strongly Disagree”. There was a statistically significant ($p < 0.001$) overall improvement in the mean from 1.61 to 1.48 (trending closer to “Strongly Agree”) in 2016.

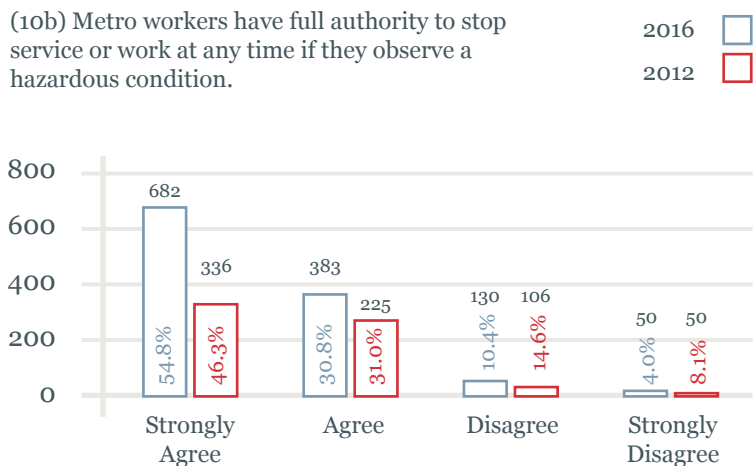
(10a) I am strongly encouraged to report unsafe conditions. 2016 □
2012 □



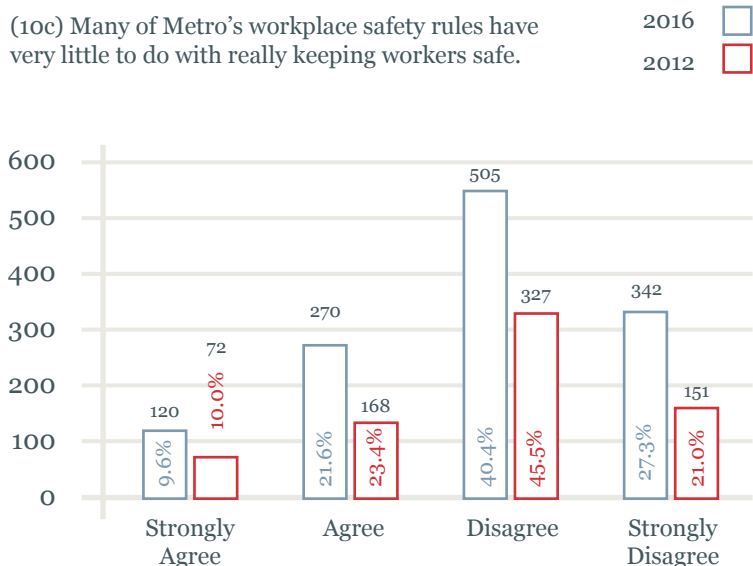
When asked if Metro workers have full authority to stop service or work at any time if they observe a hazardous condition, the median response was “Strongly Agree”. From 77.3% in 2012, 85.5% of respondents now “Strongly Agree” or “Agree” to knowing they have the authority to take action.



There was a statistically significant ($p < 0.001$) overall improvement in the mean from 1.85 to 1.64 (trending closer to “Strongly Agree”) in 2016. Employees take more ownership in looking out for safer work conditions.



No change in the median response of “Disagree” with the statement, “Many of Metro’s workplace safety rules have very little to do with really keeping workers safe”. 68.5% of respondents feel positive about the relevance of the rules in place to keep employees safe, up from 66.6%, a slight but statistically significant improvement.

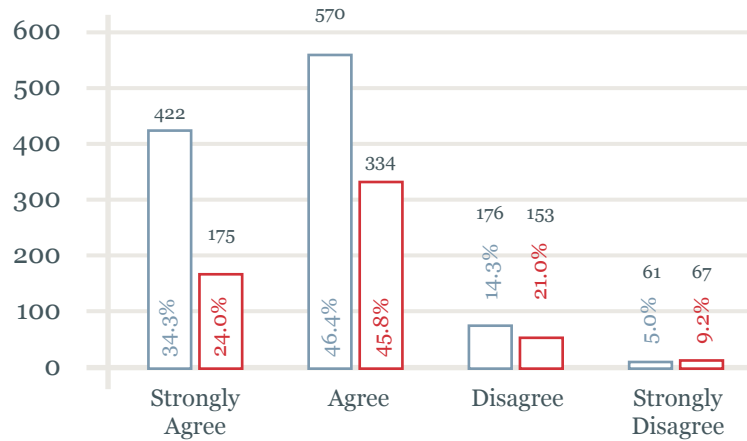


Median response was to “Agree” with the statement, “In my workplace, management, supervision, and workers know what we are doing; we trust each other; we work together; we know how to work safely; and we do it”. Since the 2012 survey, there was a 10.9% increase to 80.7% of all respondents who “Strongly Agree” or “Agree” with the statement.



There was a statistically significant improvement in the overall mean from 2.15 in 2012 to 1.90 (“Agree”) in 2016.

(10d) In my workplace, management, supervision, and workers know what we are doing; we trust each other; we work together; we know how to work safely; and we do it.

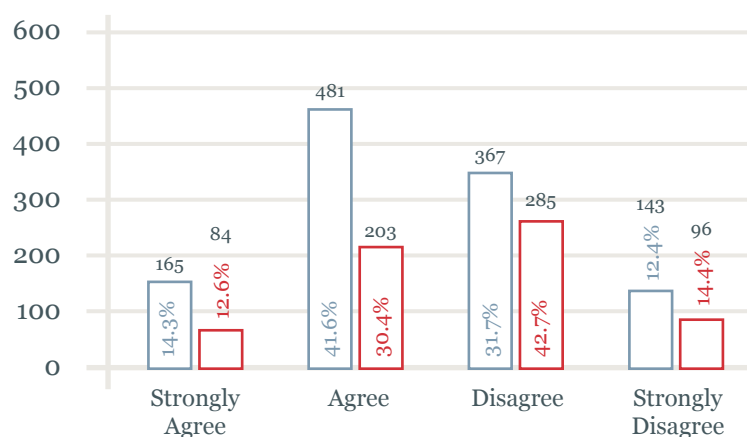


Similar to 2012, the overall median and mean response to “Management takes a no blame/no discipline approach if workers voluntarily report ‘near misses’” was “Agree”. However, it’s worth noting in both years, the response rate to this question was lower than the norm at 88.6%.

Compared to 2012, 10.9% more respondents “Strongly Agree” or “Agree” with management’s role in encouraging voluntary accident reports but there was no statistically significant change (p>0.5) in the overall mean.

The positions who do not feel management takes a no blame approach include CCTV Operators, Custodians, General Service Supervisors, Lead Electricians, Service Attendants, Traction Power Supervisors and Wayside Systems Manager.

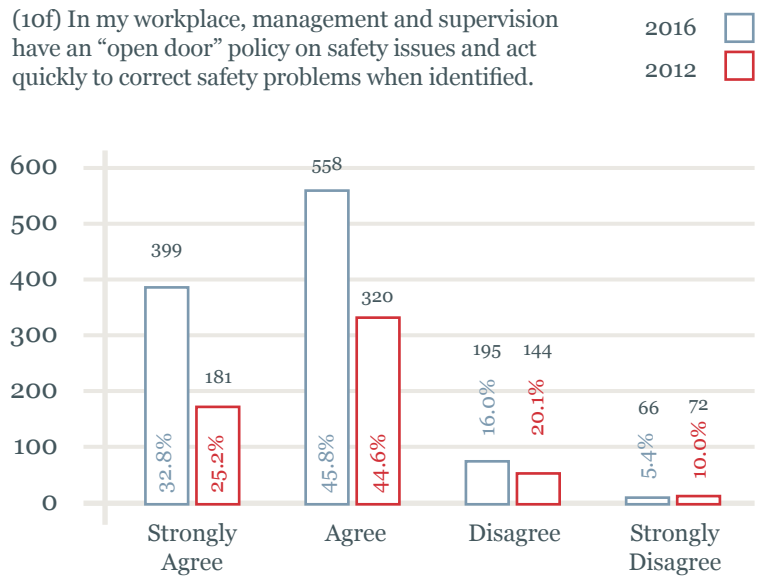
(10e) Management takes a no blame/no discipline approach if workers voluntarily report “near misses”.



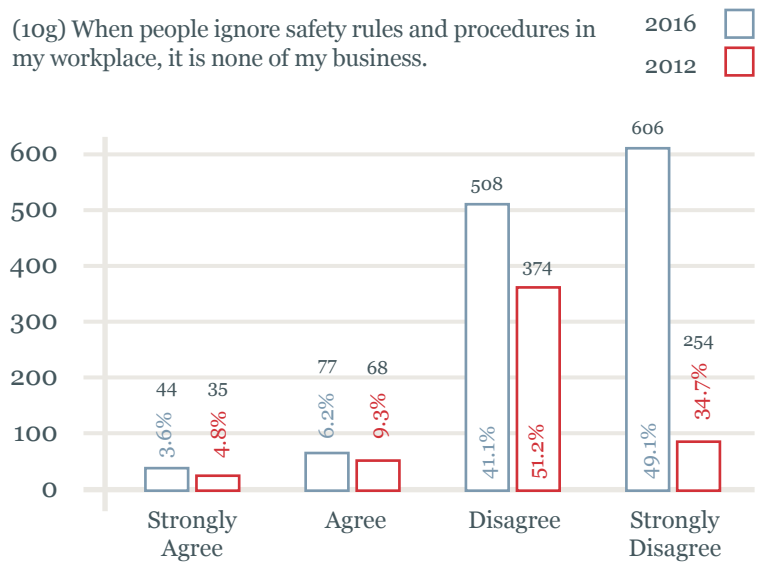
“Agree” was the median response of the employees who responded to the question about management and supervision having an “open door” policy on safety issues.

Compared to 2012, 8.7% more respondents “Strongly Agree” or “Agree” with management’s open door policy.

Overall mean response improved significantly from “Agree” (2.15) towards “Strongly Agree” (1.94) since the last survey.



90.2% of respondents “Disagree” or “Strongly Disagree” to “When people ignore safety rules and procedures in my workplace, it is none of my business”. Similar to 2012, the median response was “Disagree”. In this case, there was a statistically improvement in the overall mean response from 3.16 to 3.36 (“Disagree”).

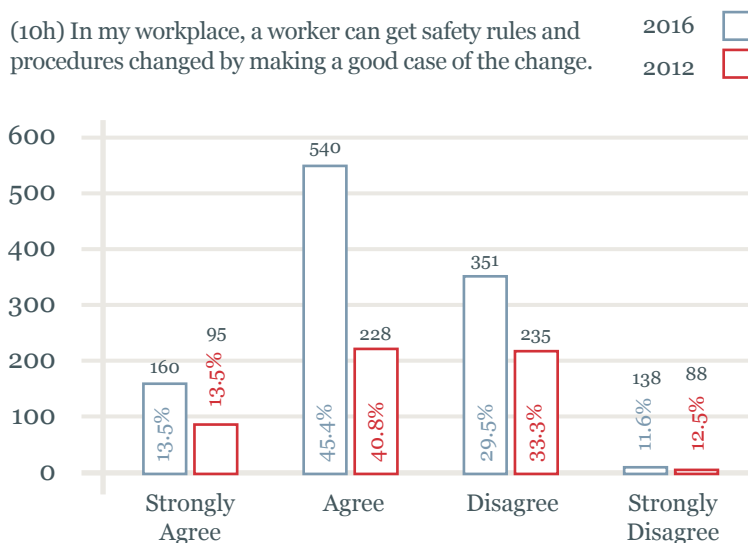


Learning Culture

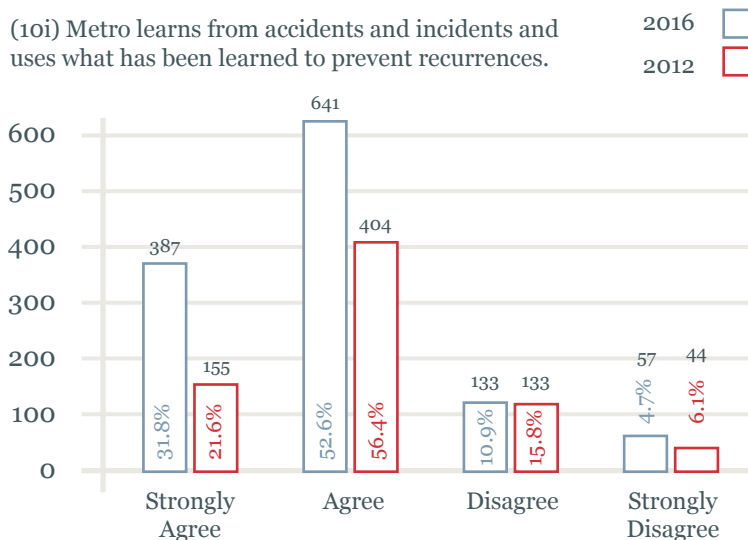
Since the last survey, “Agree” remains the overall median response to these two questions about learning culture.

For computing mean values, a linear scale was assumed whereby 1 = “Strongly Agree” to 4 = “Strongly Disagree”. There was a slight but significant change in the mean response from 2.45 to 2.39.

There is room for improvement as employees who feel they have the ability to improve safety rules represent 58.9% of the respondent, an improvement from 54.2% in 2012. Additionally, employees from Division 60 were the only group to “Disagree” with the statement.

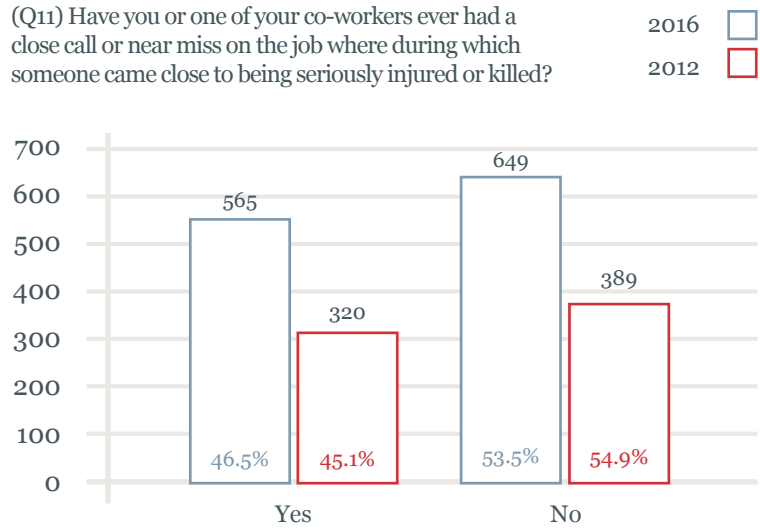


There was a significant change in the general sentiment with regards to Metro learning from accidents and using it to prevent recurrences: 84.4% in 2016 who “Strongly Agree” to “Agree” from 78.1% in 2012. The overall mean improved from 2.06 to 1.89 (“Agree”).



Accidents

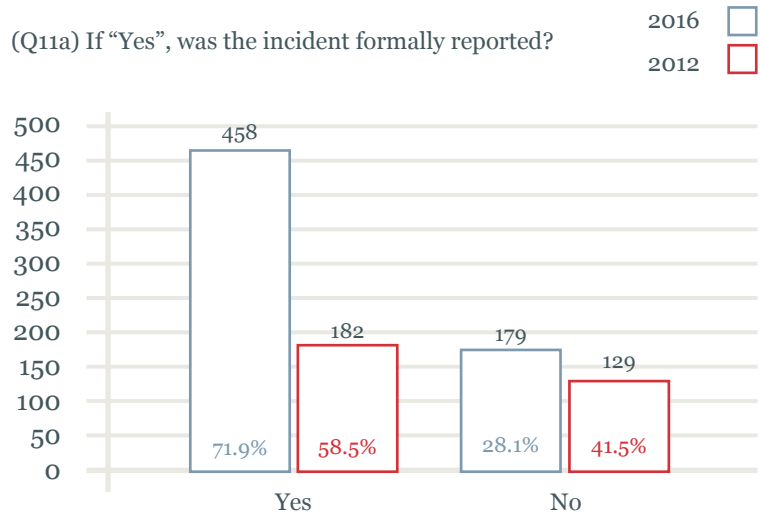
Of the employees who responded, 46.5% had experienced a close call on the job where someone came close to being seriously injured. In 2012, 45.1% was reported.



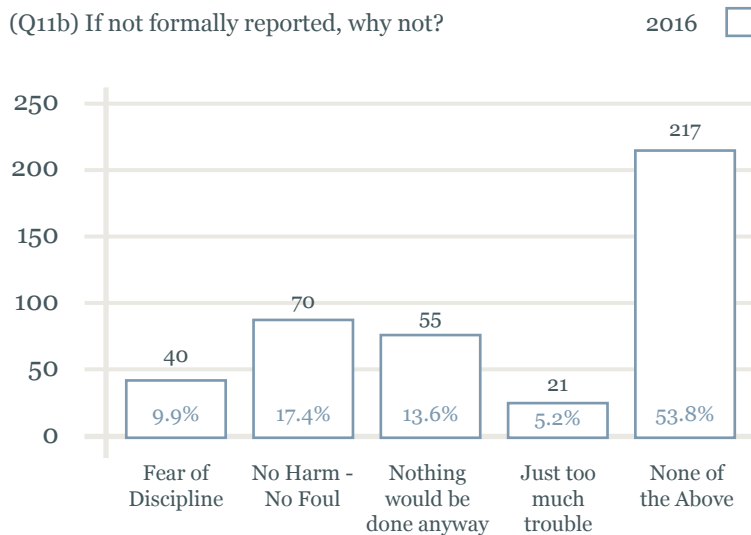
Of those who experienced a close call on the job, 71.9% of respondents said the incident was formally reported; a big improvement from 58.5% in the previous survey.

Electricians, Facilities Systems Technicians, Property Main, Rail Body Repairer, Rail Electric Comm. Inspector, Signal Inspector and Track Inspector Positions did not experience a close call.

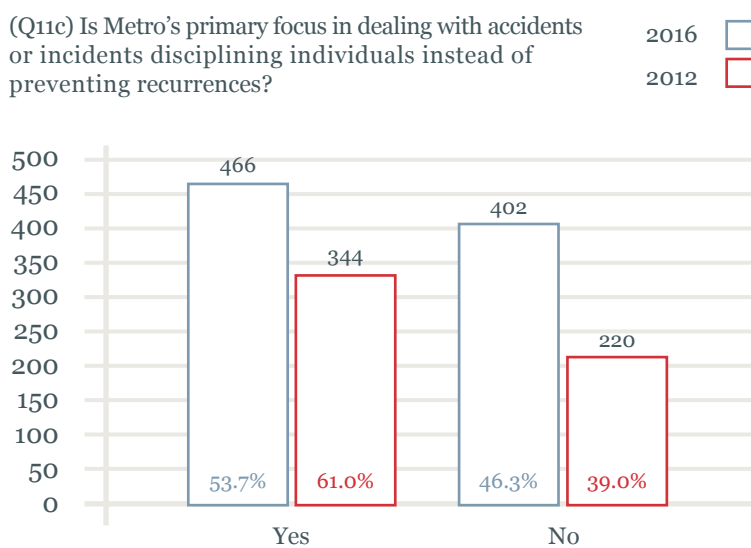
NOTE: The number of employees who responded to this question (637) exceeds those who responded to the previous question as having experienced a close call (565). It could be that those who responded “No” to having a close call also said “No” to formerly reporting the incident. This could imply the percentage of reporting incidents should be higher than reflected.



The response rate was low (30.9%). The majority of respondents felt that the reason to report was attributable to something other than the options given. Of the four options given, “No Harm – No Foul” was the most common reaction followed by “Nothing Would Be Done Anyway” and “Fear of Discipline”. Median response for Divisions 60 was “Just Too Much Trouble”; Division 61 reported “Nothing Would Be Done Anyway”.

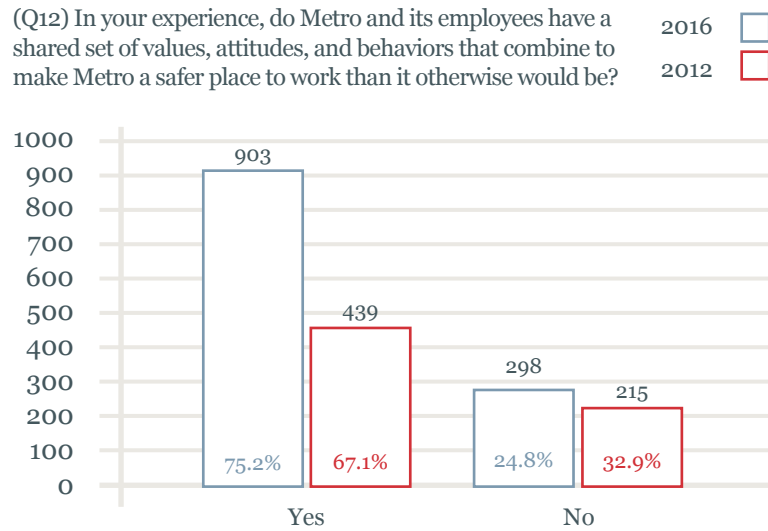


53.7% of respondents feel Metro’s primary focus in dealing with accidents or incidents is to discipline individuals, an improvement from 61% in 2012. Metro could work harder in making employees feel their priority is to prevent recurrences rather than disciplining individuals involved in an incident.



Values, Attitudes and Behavior

75.2% of respondents agree Metro and its employees have a shared set of values, attitudes, and behaviors that combine to make Metro a safer place to work. This is a significant improvement ($p < 0.001$) from 2012 where 67.1% agreed to this statement.





Appendix 5

Appendix 5

Survey Results (2016 and 2012)

		2016						2012					
		Mean	Median	2016 Median	Actual Responses	% Yes or % "1"	% No	Mean	Median	2012 Median	Actual Responses	% Yes or % "1"	% No
2	How would you rate the overall quality of the initial safety training you received in your first few months on the job?	2.01	2	Good	1242	31.7%		2.16	2	Good	750	25.6%	
3	Other than new employee training, how would you rate the overall quality of any safety training you received in that year?	2.05	2	Good	1253	27.9%		2.61	2	Good	859	16.6%	
4	Have you received any refresher safety training in the last 3 years?	1.13	1	Yes	1223	87.1%	12.9%	1.31	1	Yes	738	69.2%	30.8%
5	Would you say the methods Metro uses to communicate safety procedures and rules initially to new employees are effective?	1.17	1	Yes	1223	83.4%	16.6%	1.23	1	Yes	733	76.7%	23.3%
6	Would you say Metro ensures that you understand the risks you face and the rationale behind the safety rules that apply to the workplace?	1.15	1	Yes	1233	85.1%	14.8%	1.28	1	Yes	741	71.8%	28.2%
7	Would you say the methods Metro uses to communicate changes to safety procedures and rules to all employees are effective?	1.26	1	Yes	1229	74.0%	25.9%	1.38	1	Yes	727	62.3%	37.7%
8	Do you co-workers closely follow workplace safety rules and procedures?	1.46	1	Very Closely	1250	77.8%		1.36	1	Very Closely	754	68.0%	
9	Do your co-workers closely follow workplace safety rules and procedures?	1.63	2	Somewhat closely	1238	45.4%		1.79	2	Somewhat closely	745	34.8%	
10a	I am strongly encouraged to report unsafe conditions.	1.48	1	Strongly Agree	1251	60.1%		1.61	1	Strongly Agree	734	53.7%	
10b	Metro workers have full authority to stop service or work at any time if they observe a hazardous condition.	1.64	1	Strongly Agree	1245	54.8%		1.85	2	Agree	726	46.3%	
10c	Many of Metro's workplace safety rules have very little to do with really keeping workers safe.	2.86	3	Disagree	1237	9.7%		2.78	3	Disagree	718	10.0%	
10d	In my workplace, management, supervision, and workers know what we are doing; we trust each other; we work together, we know how to work safely; and we do it.	1.90	2	Agree	1229	34.3%		2.15	2	Agree	729	24.0%	
10e	Management takes a no blame/no discipline approach if workers voluntarily report "near misses".	2.42	2	Agree	1156	14.3%		2.59	3	Disagree	668	12.6%	
10f	In my workplace, management and supervision have an "open door" policy on safety issues and act quickly to correct safety problems when identified.	1.94	2	Agree	1218	32.8%		2.15	2	Agree	717	25.2%	
10g	When people ignore safety rules and procedures in my workplace, it is none of my business.	3.36	3	Disagree	1235	3.6%		3.16	3	Disagree	731	4.8%	
10h	In my workplace, a worker can get safety rules and procedures changed by making a good case of the change.	2.39	2	Agree	1189	13.5%		2.45	2	Agree	706	13.5%	



10i	Metro learns from accidents and incidents and uses what has been learned to prevent recurrences.	1.89	2	Agree	1218	31.8%		2.06	2	Agree	716	21.6%	
11	Have you or one of your co-workers ever had a close call or near miss on the job where during which someone came close to being seriously injured or killed?	1.53	2	No	1214	46.5%	53.5%	1.55	2	No	709	45.1%	54.9%
11a	If yes, was the incident formally reported?	1.28	1	Yes	637	71.9%	28.1%	1.41	1	Yes	311	58.5%	41.5%
11b	If not formally reported, why not?	3.76	5	None of the Above	403	9.9%							
11c	Is Metro's primary focus in dealing with accidents or incidents disciplining individuals instead of preventing recurrences?	1.46	1	Yes	868	53.7%	46.3%	1.39	1	Yes	564	61.0%	39.0%
12	In your experience, do Metro and its employees have a shared set of values, attitudes and behaviors that combine to make Metro a safer place to work than it otherwise would be?	1.25	1	Yes	1201	75.2%	24.8%	1.33	1	Yes	654	67.1%	32.9%





Appendix 6

Appendix 5

Survey Results (2016 and 2012)

	Recommendation	Status (2012)	TWG Review (2016)
1	Provide a comprehensive report to employees on the circumstances surrounding all accidents and incidents involving fatalities or serious injuries.	<p>Completed</p> <p>Established process to disseminate information on employee accidents/injuries.</p>	<ul style="list-style-type: none"> Metro has instituted the Rail Alert which is distributed to all operations personnel. It is a good model for industry. (See attachment A for listing of 10 recently issued alerts).
2	Review the methods used to communicate changes to safety procedures and rules to employees with particular emphasis on such communications with bus operators and wayside workers.	<p>Completed</p> <p>Existing communication tools are consistent with industry practices.</p>	<ul style="list-style-type: none"> Reviewed most recent ten (10) Rail Operations Bulletins. (See attachment A for list of reviewed bulletins).
3	Continue to work on improving the relationship and communications between the Rail Operations Center and wayside workers.	<p>On-going</p> <p>Managers will seek feedback from employees for continuous improvement.</p>	<ul style="list-style-type: none"> Currently in process of recertifying roadway workers. Positive feedback obtained from employee focus groups.
4	Review the quality of safety training provided to wayside workers.	<p>In-progress</p> <p>Training curriculum is being updated.</p>	<ul style="list-style-type: none"> Reviewed training materials. Recertification is underway.
5	Consider making a policy decision to prohibit the use of discipline in the case of any “near miss” or “close call” that is voluntarily reported. This disciplinary prohibition should apply not only to the individual reporting the incident, but also to any other Metro employees that are involved.	<p>Completed</p> <p>Policy has been in effect since 2011.</p>	<ul style="list-style-type: none"> The policy was reaffirmed in the updated SSPP with letter from CEO dated 12/12/15. Information communicated at RAP sessions & LSC meetings; however, this is not a widely embraced policy or practice.
6 & 7	Ensure the integrity of the SAFE-7 procedure and the form itself to indicate that an employee should forward a duplicate copy of the SAFE-7 report to Corporate Safety if a response has not been received 30 days. Investigate allegations that employees in some departments are being discouraged from submitting SAFE-7 forms.	<p>Completed</p> <p>Process and form have been revised. Annual reviews confirmed that SAFE-7 forms are being submitted.</p>	<ul style="list-style-type: none"> Program is managed at local level. Only one submitted to Corporate Safety, Titled: “Investigation of Ramirez Safety Complaint”. (See Attachment B; Letter from CPUC Rep who attends the vast majority of LSC reporting, noted his observation over time that employees are encouraged to submit (see Attachment C). Employees frequently referred to SAFE-7 as a process for raising issues at the local level during the focus groups.
8	Insure that all employees who work with CNG have been appropriately trained by comparing current employee assignments against the training records.	<p>Completed</p> <p>Verified affected employees have received relevant CNG training.</p>	<ul style="list-style-type: none"> Employees are trained on CNG at time of hiring. Corporate Safety provides emergency preparedness training for supervisors every 2 years. Reviewed CNG update on training (See Attachment D for roster).



	Recommendation	Status (2012)	TWG Review (2016)
9	Investigate the problem with artic skidding over pits when it is raining.	In-progress Piloting effectiveness of measures to increase traction at service pit entrances.	<ul style="list-style-type: none"> Contract was issued to resurface shop areas near pits.
10	Review the Maintenance status of bus lifts with particular emphasis on locking mechanisms and insure that there are sufficient jack stands to support all buses if all lifts are in simultaneously.	Completed Verified adequate equipment is available and bus lifts are operational.	<ul style="list-style-type: none"> Maintenance status checked. All lifts are operational except one in Division 15 which Engineering will replace. Corporate Safety has verified that all divisions have adequate jacks.
11	Request all managers to submit a list of outstanding safety issues to Corporate Safety for review and disposition.	Completed List of safety issues was submitted and has been reviewed.	<ul style="list-style-type: none"> Corporate Safety is reissuing. Pending preparation of list as of 6/6/16.
12	Ensure that the required training on any new equipment purchased in fact takes place as required in all purchase contracts with particular emphasis on Wayside employees. For Wayside, determine specifically whether employees have been trained on all significant new equipment acquired in the last five years.	Completed Verified "boilerplate" language is included for all equipment procurements.	<ul style="list-style-type: none"> Examples of training (See Attachment A).
13	Revise the policies, procedures, and rules pertaining to reverse running to require notification of all employees at any time a train is reverse running.	In-progress Rules and procedures are being updated.	<ul style="list-style-type: none"> Completed as MROB 2014-07 Wayside Worker Protection - New & Revised Rules. Also issued as pocket guide.
14	Improve communications between bus operators at the divisions and the Schedules Department, starting with joint discussions of the routes that bus operators perceive as the "worst" at each division.	On-going Managers are being held accountable for improving communications.	<ul style="list-style-type: none"> The SPA group attends the monthly RAP sessions at each division. Also 2 weeks after each shake-up, they schedule a couple of days (4-6 hours at a time) and are available for operator's comments and questions.
15	Open a dialogue between bus operators and representatives of the Sheriff's Department as to how the perceptions of bus operators with respect to their personal security might be improved.	On-going Monthly dialogues are occurring and will continue.	<ul style="list-style-type: none"> Sheriff Department has undercover & uniformed bus riding team that focuses on problem locations & hot spots. Local RAP sessions conducted to solicit regular feedback for LASD.
16	Improve communications with employees on the rationale for disciplinary actions within their divisions or departments.	In-progress Memo to be issued clarifying disciplinary policy.	<ul style="list-style-type: none"> Every operator was issued a copy of new contract dated July 1, 2014 thru June 30, 2017. Division Management and SMART Local chairpersons made themselves available for any questions.
17	Open dialogues with bus and train operators and wayside workers on their perception that Metro concentrates on reasons to blame them for an accident or incident as opposed to preventing a recurrence.	On-going Monthly dialogues are occurring and will continue.	<ul style="list-style-type: none"> Supervisory training provided on conducting investigations. A component that includes effective counselling after investigations would be a positive addition to create consistency in dealing with employees after an accident/incident.
18	Include more hourly employees as Local Safety Committee (LSC) and LSC sub-committee members.	Completed LSC Charter reissued emphasizing front line employee participation.	<ul style="list-style-type: none"> Reviewed six months of meeting minutes and observed ATU & SMART members on committees.
19	Improve the process of communicating LSC activities and achievements to all local employees. Posting minutes on the bulletin board is not sufficient.	No further action Managers are being held accountable for improving communications.	<ul style="list-style-type: none"> LSC minutes are posted consistent with OSHA & CPUC industry standard for communications. Progress on issues shared in monthly RAP sessions. Observed uneven knowledge at local level via focus groups.



	Recommendation	Status (2012)	TWG Review (2016)
20	Clarify the chain of command responsibility for the LSC's above the division level and below the Chief Operations Officer.	<p>On-going</p> <p>Managers are being held accountable for this.</p>	<ul style="list-style-type: none"> Reviewed SSPP, revision 12, revised on 12-12-15; no description of the chain of command above the division level to the COO level or of the Operations Committee recently reinstated.
21	Initiate a campaign to rededicate and reinvigorate the LSC effort by ensuring all required meetings take place, attendance is as prescribed, and the minutes accurately reflect the type and intensity of involvement contemplated by the LSC.	<p>Completed</p> <p>Managers are being held accountable for this.</p>	<ul style="list-style-type: none"> Reviewed last six months of safety minutes - quality varies. Still an opportunity to improve.
22	Ensure that weekly supervisory safety meetings are taking place at all locations.	<p>Completed</p> <p>Recent audit verified safety meetings are held.</p>	<ul style="list-style-type: none"> Annual SHARP audit verified safety meetings are held regularly.
23	Open dialogues with bus and train operators and wayside workers on ways to improve their perceptions of the state of the safety culture in their organizations.	<p>On-going</p> <p>Monthly dialogues are occurring and will continue.</p>	<ul style="list-style-type: none"> Managed via the LSCs, RAP sessions, and continues education. Conduct safety awareness programs and issued periodic reminders. Communique 2012-26 Sealed Control Switches Div 21 COMMUNIQUE for Civil Traffic Speeds 2009-006 Electronic Devices Policy Gold Line Communique 2010-15 Signal Efficiency Testing 112410 Rail Instruction Communique 2010-02 - Safe Operation RTIN 2015-05 Violation of Electronic Devices Policy Wayside Communique No 12-001
24	Establish a separate Board committee to deal exclusively with safety culture issues at Metro.	<p>Completed</p> <p>The System Safety & Operations Committee was established to focus on addressing safety issues on October 27, 2011.</p>	<ul style="list-style-type: none"> Reviewed Board Committee meetings/presentation for 1/21/16, 2/18/16, 3/17/16, 4/14/16, 5/16/16 which contained some good presentations about issues of employee concerns. For example, policing strategies and new technologies in development, and the adverse impact of the presence of homelessness on employees & customers. Sections on compensation claims and customer complaints were not in the detail that made the trends identifiable and/or actionable.





Appendix 7

Appendix 7

APTA Peer Review Report

Documentation:

This document summarizes the results of TWG’s review of the June 2015 APTA Peer Review observations and recommendations.

APTA Observation/Recommendation	TWG’s Evaluation	TWG’s Comments
General		
No evidence of complacency.	Agree	LA Metro management has been proactive in addressing the issue of stop signal violations as demonstrated by the mitigation initiatives being developed and implemented through the interdepartmental Stop Signal Working Group. There is no complacency evident on this topic based on the organizational prioritization assigned to mitigating future violations.
No evidence that on-time performance is influencing safety considerations.	Partially Agree	<ul style="list-style-type: none"> A number of Metro’s representatives expressed that the operating schedule on the Blue Line is tight. This could be a contributing factor to red signal violations, especially at locations where train operators are required to establish their own routes. No evidence that on-time performance is influencing safety considerations on the Expo, Gold and Red Lines. A number of train operators indicated that they find the schedule to be tight, especially under adverse weather conditions. Metro should evaluate the operating schedule on the Blue Line and make adjustments if necessary.
Different interlocking aspect displays on different lines.	Agree	<ul style="list-style-type: none"> Metro is planning an \$82 million project on the Blue Line to modify signal aspects to be compatible with other light rail signal installations. It was indicated by Metro’s representatives that this project also includes modernization of solid state interlocking control installations. The scope of work should be expanded to include work necessary to implement safety recommendations. Metro should expedite the implementation phase of this project.
<p>Traffic lights for motorists and bar signals are operated by local jurisdictions.</p> <ul style="list-style-type: none"> Integration between traffic signals and interlocking signs could create complex situation and cause human errors. 	Agree	<ul style="list-style-type: none"> LADOT will not modify its traffic light installation to coordinate the clearing of an interlocking signal and a bar signal at an intersection. It is possible to precondition the clearing of and interlocking signal at an intersection through a SCADA interface with the bar signals. Preconditioning interlocking signals to clear based on the clearing of bar signals could decrease the reliability of interlocking signals and could introduce delays in the movement of trains through intersections. Metro should consider modifying interlocking signals at intersections (Blue/Expo Line) by implementing approach clearing similar to the Gold Line. An “Approach Clearing” function automatically establishes a route for a train as it approaches an interlocking signal. See Attachment “C”.



APTA Observation/Recommendation	TWG's Evaluation	TWG's Comments
General		
<p>Interlocking and bar signals operate independently:</p> <ul style="list-style-type: none"> • Could provide conflicting aspects to train operator, and • Integrate interlocking and bar signals. 	Agree	<ul style="list-style-type: none"> • LADOT is not willing to modify its traffic light installation to coordinate the clearing of an interlocking signal and a bar signal at an intersection. • It is possible to precondition the clearing of and interlocking signal at an intersection through a SCADA interface with the bar signals. • Preconditioning interlocking signals to clear based on the clearing of bar signals could decrease the reliability of interlocking signals and could introduce delays in the movement of trains through intersections. • Metro should consider modifying interlocking signals at intersections (Blue/Expo Line) by implementing approach clearing similar to the Gold Line. An "Approach Clearing" function automatically establishes a route for a train as it approaches an interlocking signal. • Focus part of train operator training on site specific locations, wherein a conflict could exist between interlocking signals and bar signals. • <i>See Attachment "C".</i>
<p>Operators are trained to observe pedestrian cross walk countdown timer.</p>	Agree	<ul style="list-style-type: none"> • Metro's representatives clarified that Train Operators should follow all signal indications at an intersection and should not be focusing only on cross walk countdown timer.
<p>Integration of the interlocking and bar signals would eliminate the condition where proceed and stop are simultaneously displayed.</p>	Agree	<ul style="list-style-type: none"> • LADOT is not willing to modify its traffic light installation to coordinate the clearing of an interlocking signal and a bar signal at an intersection. • It is possible to precondition the clearing of and interlocking signal at an intersection through a SCADA interface with the bar signals. • Preconditioning interlocking signals to clear based on the clearing of bar signals could decrease the reliability of interlocking signals and could introduce delays in the movement of trains through intersections. • Metro should consider modifying interlocking signals at intersections by implementing approach clearing similar to Gold Line. An "Approach Clearing" function automatically establishes a route for a train as it approaches an interlocking signal. • <i>See Attachment "C".</i>
<p>No written procedures to guide operators on the use of pedestrian count down timers.</p>	Agree	<ul style="list-style-type: none"> • Metro representatives clarified that Train Operators should follow all signal indications at an intersection and should not be focusing only on the cross walk countdown timer. • Metro representatives indicated that no written procedures are necessary.
<p>Training material indicates 30 to 32 MPH speed:</p> <ul style="list-style-type: none"> • Instructing train operator not to go slower than a certain speed could create unsafe condition. 	Agree	<ul style="list-style-type: none"> • LADOT explained that an operating speed of 30 to 32 MPH is necessary for trains to take advantage of the traffic signals synchronization feature, which allows trains to operate without stopping at each intersection. • If a train operates at a speed that is less than the desired 30 to 32 MPH, then it is likely that it will be stopped at an intersection, and will be penalized to the extent of one traffic cycle. • Train operators should be clearly instructed to operate slower than 30 to 32 MPH if it is necessary to ensure safety of operation, and during adverse weather conditions.
<p>Blue Line operating speed should be consistent between Metro and LADOT.</p>	Partially Agree	<ul style="list-style-type: none"> • While the operating speed on the Blue Line should be consistent with LADOT speed to take advantage of traffic signals synchronization feature, the main priority and focus should be safety of operation. Train Operators should be instructed to operate slower than the LADOT speed if necessary to ensure safety of operation.



APTA Observation/Recommendation	TWG's Evaluation	TWG's Comments
General		
<p>Observed operation does not comply with training documents (training documents vs operating rules and procedures).</p>	Agree	<ul style="list-style-type: none"> The APTA Peer Review appeared to have the understanding that Operators were being trained to observe the pedestrian count down timers in anticipation of the signal clearing to proceed and noted that there were no procedures written to support this training for field application. As noted above, Metro representatives indicated that Train Operators should follow all signal indications at an intersection and should not be focusing only on the cross walk countdown timer, therefore no written procedures are necessary. There were no other examples provided in the APTA Peer Review report to assess this finding. In speaking to Operators on the Blue Line in the field, some have developed their own techniques to support "situational awareness" in managing the many types of possible distractions while operating the Light Rail vehicle that may not be completely detailed in the training program or in procedures. In addition, Blue Line Operating procedure BSOP-04 states: "Stop and Proceed mode is the normal mode of operation in the yard and requires authorization by Control or schedule for use on the mainline". The train movement in and out of Blue Line 7th and Metro/Center station was the only exception noted to this procedural provision. Stop and proceed mode was observed to be used on the mainline at station stops as a means to move the vehicle to the designated station berthing stop location. It is recommended that Metro assess its line training program to ensure consistency with rules, procedures, classroom training on the operating techniques being applied and solicit input from the operators to identify good practices to incorporate and standardize within the rules, procedures, and training program.
<p>Train operators should be instructed to mitigate hazards by "Situation Control".</p>	Agree	<ul style="list-style-type: none"> The current Operator training program includes information on anticipating events while in operations that could impact safety. The Light Rail lines pose the greatest opportunity to be distracted by pedestrians, motorist, traffic conditions, and passengers. These factors are not in control of the Operators and they need to be continually alert of their situation at all times to react to unanticipated events. Some Operators have developed their own techniques to support their "situational awareness" in managing the many types of possible distractions while operating the Light Rail vehicle that may not be completely detailed in the training program. It is recommended that Metro assess its desired Operator "situational awareness" techniques and ensure good practices are incorporated within the Operator new hire and refresher training programs as well as the Metro rules and procedures as applicable. Metro should assess the in-service application of the "situational awareness" techniques as part of its Operators Line evaluation program and through efficiency testing.
<p>Supervisors should be trained and encouraged to enforce train handling skills: Smooth train operation.</p>	Agree	<p>In discussions with staff, it was stated that the level of experience with field supervision and controllers is less than in previous years. It is important for all supervisors to have a thorough understanding of the Operators responsibilities and desired operation of the vehicle in adherence rules, procedures and the training program techniques as a means to reinforce desired operating practices and mitigate any "practical drift" from their application in the field. Practical drift is defined as: "The slow and inconspicuous, yet steady, uncoupling between written procedures and actual practices during provision of service". It is recommended that Metro assess its training programs for both the field supervisors and controllers to ensure it provides a thorough understanding of the Operators tasks for which they are responsible for overseeing, interacting, and reinforcing on a daily basis. Any deviation in actual operating practices from the current rules and procedures should be identified, addressed and evaluated to assess if the rules and procedures may need to be modified or additional training and oversight of the existing provisions need to be applied.</p>
<p>Supervisors should be trained to detect operator "Hi-Spotting" the signals to get over the road.</p>	Agree	<p>Supervisors should be trained to identify any exceptions to the desired Operator practices as stated above.</p>



APTA Observation/Recommendation	TWG's Evaluation	TWG's Comments
General		
Correct signage for motorists.	Agree	Metro representatives indicated that they brought this issue to LADOT, and that the signage was corrected.
Metro's Rules & Procedures		
No exception taken to current rules & procedures.	Disagree	Suggestions were made by the project team related to clarifying the rules applying to Manual Block procedures that included interlocking(s) locations within the Manual Block limits. In addition, it is proposed to simplify the Operator Metro Rail operating rules and procedures scope (Separate Light Rail Rule Book) to more effectively support Operators' understanding, compliance and operating requirements of the Line to which they will initially be assigned.
No reference to use of countdown timers.	Agree	Metro representatives indicated that train operators will not be trained on the use of pedestrian countdown timers.
Inconsistency between classroom training and field applications.	Agree	As stated previously, it is proposed that Metro assess its line training program to ensure consistency with classroom training on the operating techniques being applied and solicit input from the Operator workforce to identify good practices to incorporate and standardizes within the training program. Metro should assess possible gaps between training provided and the application in the field through its Operator Line evaluations and Efficiency Testing program.
Need real life rail simulator to supplement training.	Agree	A number of Metro representatives indicated that a simulator with capabilities to simulate real life incident scenarios will be useful for training train operators and controllers. We understand that there is a staff recommendation to implement such a program.
Metro's Program of Rules Compliance and Efficiency Training		
Improve program with additional oversight activities.	Agree	The intent of this APTA Peer Review recommendation was designed to not just apply the efficiency testing program for disciplinary reasons but also to reinforce good practices observed. The use of the Smart Cam system was one tool mentioned to apply this positive reinforcement.
Efficiency testing needs to be more robust.	Agree	<p>The current Metro Rail Efficiency Testing program application does not effectively support Operator rule compliance objectives. Metro has recognized the need to develop more robust rules compliance program and is in the process of initiating changes to the program that are expected to be implemented by the end of 2016.</p> <p>It is recommended that the updated program includes the scope of requirements similar to the FRA mandated program under 49 CFR Part 217 and at a minimum complies with the APTA Rules Compliance Standard RT-S-OP-011-10. The new program should include clear accountability within Operations for the management of the efficiency testing program, training for the supervisory personnel responsible for implementing the program and documenting the findings, and management oversight of the program application, focus, and results. Corporate Safety should continue to be responsible for quality assurance oversight and conduct a designated number of internal audits to verify the desired level and quality of program implementation.</p>
Revise Mystery Rider program to include driver observations.	Disagree	The Mystery Rider program was primarily focused on ADA compliance activities and qualitative aspects of customer service. Additional eyes in the field to provide feedback on performance would only be helpful if staff were adequately trained and may be more effectively addressed through the revised efficiency testing program and on-going supervisory observations.



APTA Observation/Recommendation	TWG's Evaluation	TWG's Comments
Metro's Disciplinary Policies		
<p>APTA team considers the disciplinary program to be at the level of best industry practice.</p>	<p>Partially Agree</p>	<p>The APTA Peer Review appeared to be basing its disciplinary program on the severity of the discipline being imposed for stop signal violations. Metro has changed its discipline for such violations with the most recently executed contract. While clear and high levels of accountability need to remain for safety violations, Metro also needs to consider the pathway to promoting a proactive safety culture that should be perceived as just and fair. The application of the stop signal discipline takes limited consideration of employee prior records. Only those violations that are the result of accountable accidents and or not accounting for passenger fares after a one year period. With a limited focus on all violations does not support a perception of a fair and just process. In addition, other contributory related factors that may have influenced the rules violations do not appear to be factored into the level of discipline issued.</p> <p>The FTA Map-21 Safety Management System (SMS) program as well as the FRA Confidential Close Call Reporting System is promoting the industry to look towards enhancing existing disciplinary procedures with consideration of distinguishing unintentional errors/mistakes from deliberate/gross violations as a means to promote employee hazard reporting communications.</p>
Metro's Train Control Signal System		
<p>Good line of sight operation for interlocking signals (normal and reverse).</p>	<p>Partially agree</p>	<p>While most of the normal and reverse interlocking signals have good line of sight operation, there are a number of locations where it is difficult for a train operator to clearly see the signals. These locations are identified in site specific reports.</p>
<p>The lack of approach signal to the interlocking does not prepare the operator as to the home signal aspect.</p>	<p>Partially Agree</p>	<p><i>See Attachment "A".</i></p>
<p>Interlocking signals are not uniformly placed (due to space restrictions).</p>	<p>Agree</p>	<p><i>See Attachment "B".</i></p>
<p>Consistency of locations and adding approach signals would be helpful.</p>	<p>Partially Agree</p>	<p><i>See Attachment "A".</i></p>
<p>Train operators operate with the assumption that a signal would be clear or would change to a clear position.</p>	<p>Agree</p>	<ul style="list-style-type: none"> • Need better coordination between train operators and controllers. • This could also be mitigated through consistent operation for automatic route setting, as well as the implementation of automatic dispatching systems.
<p>Provide training to operators to expect a restricted signal.</p>	<p>Agree</p>	<ul style="list-style-type: none"> • Need better coordination between train operators and controllers. • This could also be mitigated through the implementation of consistent automatic route setting and automatic dispatching systems. • Further stress this focus through training programs and Operator ride evaluations.
<p>Hot spot indication should be aimed for the operator's vision at stations.</p>	<p>Agree</p>	<p>Metro has assessed priority signal locations where signal visibility can be restricted and has made adjustments to improve the signal display at a few locations. Further, Metro installed "temporary Identifiers" at priority signal locations to draw the attention of train operators when approaching the signal.</p>
<p>Separate normal (G/R) and reverse (R/G) signal heads.</p>	<p>Agree</p>	<p><i>See Attachment "B".</i></p>
<p>Make reverse running signals approach lit, or use program view heads.</p>	<p>Disagree</p>	<p><i>See Attachment "D".</i></p>



APTA Observation/Recommendation	TWG's Evaluation	TWG's Comments
Metro's Train Control Signal System		
It is a poor practice to simultaneously display a stop and a proceed signal (proceed interlocking signal and a stop bar signal).	Agree	<ul style="list-style-type: none"> • LADOT is not willing to modify its traffic light installation to coordinate the clearing of an interlocking signal and a bar signal at an intersection. • It is possible to precondition the clearing of and interlocking signal at an intersection through a SCADA interface with the bar signals. • Preconditioning interlocking signals to clear based on the clearing of bar signals could decrease the reliability of interlocking signals and could introduce delays in the movement of trains through intersections. • Metro should consider modifying interlocking signals at intersections by implementing automatic routing based on train occupancy of approach track circuit. An "Approach Clearing" function automatically establishes a route for a train as it approaches an interlocking signal. • <i>See Attachment "C".</i>
Audible warnings for grade crossings are not consistent with operating rules.	Agree	It is assumed the APTA Peer Review observed inconsistencies as to what was in the Rule Book to what was actually practiced in the field relevant to the Operator utilizing the vehicle audible alarm upon entering a grade crossing. Compliance to these rules has been a focus in the efficiency testing documentation reviewed with few violations noted. These safety critical rules should be continued to be emphasized in the training program, ride evaluations, and efficiency tests.
Confidential Close Call Rail Program		
Structure needs to be put in place to support the program.	Partially Agree	Metro has established a process for employees to report an unsafe condition, hazard or near miss called SAFE-7. These reports can be submitted by the employee to their supervisor, the Safety Committee, and/or Corporate Safety. Based upon employee feedback and corporate safety, the SAFE-7 form is not being used for this purpose, however, a significant percentage of employees responded that they are reporting "near misses". It appears that they are using informal channels to report such events. In discussing this program with Metro management, they believed improvement can be made to streamline this safety reporting process to make it easier to report and respond to employee concerns.





Attachment A

Attachment “A”

Issue:

Assessment of APTA Peer Review recommendation to add approach signals at various locations.

Discussion:

The APTA Peer Review Panel observed that because of space restrictions, interlocking signals are not uniformly spaced. As a result, normal and reverse running signals are installed side by side, which could cause confusion on the part of train operators and contribute to red signal violations. The Peer Review Panel then recommended a number of alternative signal modifications to mitigate this condition.

Finding A7.1:

One of the recommendations is to add approach signals to prepare train operators as to what is the home signal aspect they should be approaching. We are advised that in street running territory, a “stop” aspect is not enforced.

While the installation of approach signals will provide train operators with advance notice as to the aspect displayed at the associated home signal, there are other considerations that should be taken into consideration when implementing approach signals. In transit applications, one of the functions of an approach signal is to provide trailing point protection. If the trailing point switch is close to the home signal, this function preconditions the clearing of an approach signal on the trailing point switch being locked in the normal position. Other factors include the sighting distance of the home signal.

As such, the decision of whether to add approach signals should be made in the context of enhancing the safety of operation in non-Automatic Train Protection (ATP), street running territory. It should be noted that the addition of approach signals to an existing interlocking requires extensive modifications to the interlocking control logic. If the control line for the approach signal runs through its associated trailing point switch, then it must be interlocked with that switch.

It should also be noted that at locations where the home signal is located far away from the trailing point switch (no need for trailing point protection), and where the sighting distance for the home signal is adequate with good visibility, the addition of an approach signal will provide minimum benefits to operational safety. In addition, it should be recognized that in the absence of enforcement of “stop” signal, operational safety is fully dependent on compliance by train operators with operating rules and procedures.



Finding A7.2:

Further, on the Gold Line, interlocking signals are approach clearing, which means that in the absence of a train in the approach track circuit, the signal will normally display a “Red” aspect. Under such existing design, the addition of an approach signal will not add any benefit in terms of providing advance notice to train operators. However, this limitation can be rectified by extending the approach clearing limit.

Recommendations:

A-1: Blue/Expo Line - Metro should consider the installation of approach signals on a case by case basis in the approach to home signals in street running territory. The criteria for the addition of an approach signal should be based on:

- The need for trailing point protection (when for example the home signal is located close to the trailing point switch),
- Inadequate sighting distance, or
- Poor visibility of the home signal aspects.

A-2: Gold Line – Metro should consider the installation of approach signals on a case by case basis in the approach to home signals in street running territory, only if the approach clearing limit is extended beyond the approach signal location. The criteria for the addition of an approach signal is the same as above.





Attachment B

Attachment “B”

Issue:

Assessment of APTA Peer Review recommendation to relocate reverse running home signals.

Discussion:

Finding A7.3:

The APTA Peer Review Panel observed that because of space restrictions, interlocking signals are not uniformly spaced. As a result, normal and reverse running signals are installed side by side, which could cause confusion on the part of train operators and contribute to red signal violations. The Peer Review Panel then recommended a number of alternative signal modifications to mitigate this condition. One of the recommendations is to relocate reverse running home signals away from normal running signals to eliminate any confusion on the part of train operators.

While relocating reverse running signals will theoretically eliminate a contributing factor to red signal violations, it may not be sufficient to address other safety risks inherent in street running operation. Further, there may exist physical constraints that will preclude relocating a reverse running home signal at a specific location.

It should be noted that relocating a reverse running interlocking signal to the left side of the track should not present a problem to vehicle drivers as the signal will not be facing traffic direction.

As will be discussed in Section C on “Automatic Train Protection” of the main report, there are safety risks associated with not implementing ATP in street running territories.

Accordingly, the decision to relocate reverse running signals should be considered in the context of a comprehensive design approach to enhance operational safety in street running territory. Such design approach could be based on ATP overlay, or site specific modifications using approach signals and/or relocating reverse running home signals.

Recommendation:

A-3: Metro should consider relocating reverse running home signals as part of a comprehensive design approach to upgrade the safety of operation in street running territory. The decision to relocate reverse running home signals should be coordinated with other measures such as the installation of approach signals.





Attachment C

Attachment “C”

Issue:

Assessment of APTA Peer Review recommendation to integrate interlocking signals with bar signals.

Discussion:

A number of street intersections on the Blue, Expo and Gold Lines include interlocking signals that are controlled by Metro’s signal system, as well as bar signals controlled by local municipalities. Since the interlocking signals and the bar signals operate independent of each other, it is possible for a train operator to observe a proceed interlocking signal indication with a stop semaphore bar signal. The APTA Peer Review Panel concluded that it is a poor practice to display a stop signal and display a proceed signal at the same location, and recommended integrating interlocking signals with bar signals to mitigate this condition.

There are two operational scenarios related to the divergence between an interlocking signal and a bar signal located at the same intersection:

1. The interlocking signal displays a “stop” indication, while the semaphore bar signal displays a “proceed” indication, and
2. The interlocking signal displays a “proceed” indication, while the semaphore bar signal displays a “stop” indication.



Finding A7.4:

During discussions with Metro representatives, it was indicated that LADOT is not willing to modify its control logic for the bar signals to pre-condition the clearing of a bar signal on the clearing of an interlocking signal at the same location. This was confirmed in a telephone interview with a principal transportation engineer from LADOT. However, this representative indicated that LADOT is willing to provide an input to the SCADA system to precondition the clearing of the interlocking signal on a clear bar signal. This will only address operating Scenario # 2, and will not mitigate a potential contributing factor for a train operator violating an interlocking signal (Scenario # 1). Further, interfacing the bar signal with the SCADA system for the purpose of pre-conditioning the clearing of the interlocking signal could impact the operational reliability of the interlocking signal, and introduce delays in the operation of a train through the intersection. However, this interface should be further investigated by Metro to determine its feasibility



and the safety benefits derived from its implementation. During the telephone discussion with a LADOT representative, the representative explained that the clearing of bar signals is triggered by a train detector loop located in the approach to the intersection.

Finding A7. 5:

In view of the need to minimize the occurrence of operating Scenario # 1, Metro should consider implementing automatic route setting of the interlocking signal on the Blue/Expo Line. Automatic route setting is already implemented on the Gold Line through the approach clearing feature, wherein route initiation is triggered by the train occupying the approach track circuit. Automatic route setting can help achieve the objective to have the interlocking signal clear when the bar signal clears. The bar signal was observed to operate at a number of intersections as follows:

- The bar signal changes from “vertical” (proceed) to “diagonal” as soon as the train reaches half way through the intersection,
- The bar signal changes from “diagonal” to “horizontal” (stop) when the train reaches the far end of the intersection.

Metro’s representatives indicated that this typical operation of bar signals presents a problem if a train operator makes a hard stop to avoid a pedestrian or a vehicle, then continues to move through the intersection. It is our understanding that under this scenario, the operator has a bar signal violation at the LADOT traffic signal. In the event of such a occurrence a train operator is instructed to contact the ROC and request permission to violate the bar signal.

Recommendations:

A-4: Metro should investigate the feasibility and practicality of preconditioning the clearing of an interlocking signal at an intersection based on the clearing of the bar signal at the intersection.

A-5: Metro should consider modifying interlocking signals at intersections within the Blue/Expo Line by implementing automatic route setting based on a train occupying the approach track circuit. This approach clearing feature is already implemented on the Gold Line.

A-6: Metro should discuss with LADOT the feasibility of modifying the algorithm that detects bar signal violations in order to reduce false violation alarms.





Attachment D

Attachment “D”

Issue:

Assessment of APTA Peer Review recommendation to modify reverse running signals to approach lit signals.

Discussion:

Finding A7.6:

The APTA Peer Review Panel observed that because of space restrictions, interlocking signals are not uniformly spaced. As a result, normal and reverse running signals are installed side by side, which could cause confusion on the part of train operators and contribute to red signal violations. The Peer Review Panel then recommended a number of alternative signal modifications to mitigate this condition. One of the recommendations is to modify the reverse running signals to approach lit signals, such that these signals remains dark until a train is present on the approach track circuit.

Approach lit signals were used in the past on Class A Railroad Installations for the purpose of extending the life of signal bulbs. However, the practice of implementing approach lit signals is rarely used in modern transit signaling installations. One disadvantage of approach lit signals is that it can create a culture where dark signals are tolerated. Currently, Metro’s operating rules and procedures require train operators to report a dark signal.

Recommendation:

A-7: Metro should not employ approach lit signals as a measure to minimize red signal violations.





Appendix 8

Appendix 8




Industry Best Practices for Signage, Street Markings and Traffic Equipment: Check List to Evaluate Rail/Vehicle Intersections

As part of this review, TWG researched APTA and public databases to determine industry best practices for lighting, gating, and signage that will discourage public unsafe behavior. Specifically, TWG reviewed the following documents:







- FHWA – Railroad Highway Grade Crossing Handbook,
- Best Practices in Rapid Transit System Design - A Rapid Transit System design guide for residents, advocates, and policymakers in Montgomery County, MD,
- Recommended Practice for Rail Transit Grade Crossing Public Education and Rail Trespass Prevention - Volume 3 - Rail Grade Crossings - APTA RT-RP-RGC-002-02,
- Recommended Practice for Rail Transit System Highway Rail Grade Crossing Safety Assessment - Volume 3 - Rail Grade Crossings - APTA RT-RGC-RP-003-03,
- Standard for Rail Transit System Highway Rail Grade Crossing Warning Device Inspection, Testing and Maintenance - Volume 3 - Rail Grade Crossings - APTA RT-RGC-S-001-02,
- Standard for Rail Transit Grade Crossing Warning System Design Criteria, Installation and Operation - Volume 3 - Rail Grade Crossings - APTA RT-RGC-S-004-03,
- Manual on Uniform Traffic Control Devices for Streets & Highways - Part 10, Traffic Controls for Highway-Light Rail Transit Grade Crossings,
- CALTRAIN Design Criteria - Chapter 7, Grade Crossings
- California MUTCD – Chapter 8B, Signs & Markings,
- METROLINK – SCRRRA Highway Rail Grade Crossings – Recommended Design Practices and Standards Manual,
- California MUTCD – Part 3, Markings,
- California MUTCD – Part 8, Traffic Control for Railroad and Light Rail Transit Grade Crossings,
- Transit Corporate Research Program (TCRP) – Report 137, Improving Pedestrian and Motorist Safety Along Light Rail Alignments, and
- Pedestrian Safety Guide for Transit Agencies – Chapter 3, Actions to Increase the Safety of Pedestrians Accessing Transit.








Below is the check list of basic requirements for signage, street markings, pedestrian barriers, channelization design, traffic equipment, lighting and traffic enforcement that we developed after a review of industry best practices.

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations		
Mounted signs at crossing comply with MUTCD standards		
Mounted signs at crossing are maintained in good condition		
Use of retro reflectorized or illuminated signs		
No sign or signal shall be located in the center of an undivided highway, except in a raised island		
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD		
Presence of a "STOP" sign 		
Presence of "YIELD" sign 		
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 		



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)		
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)		
Presence of illuminated No Left Turn sign  R3-2		
Presence of illuminated No Right Turn sign  R3-1		
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8		
Presence of “Stop Here on Red” sign  R10-6		



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) <div style="text-align: center;">  </div>		
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) <div style="text-align: center;">  </div>		
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) <div style="text-align: center;">  </div>		
Skewed Crossing Sign (W10-12) <div style="text-align: center;">  </div>		
Presence of “No Vehicle on Track” sign <div style="text-align: center;">  </div>		



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 		
Emergency Notification Sign (I-13 or I-13a) 		
Presence of "Suicide Crisis Line" sign 		
Cross buck sign installed on the right side of the road		
No train horn sign 		
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings		
Pavement markings in advance of a high-way-light rail transit grade crossing shall consist of an X, the letters RR		
Dynamic Envelope Markings		
Continuous network of accessible pathways to pedestrians		
Presence of 6' median refuges, high visibility crosswalks		
Continuous network of low-stress facilities to connect to stations for bikers		



Presence of swing gates		
Contrasting pavement color or texture for pedestrian crossings		
Use of pedestrian barriers		
Channelization design to guide pedestrians		
Is guard railing installed at the approaches to the crossing		
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate		
Presence of a safety buffer zone to provide accommodation for the slower moving individual		
Presence of illuminated active in-pavement marking (IPM) systems		
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals		
Four-Quadrant Gate Systems		
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings		
Pedestrian activated crossing signals		
Automatic pedestrian signal traffic phase		
Adequacy of time provided to pedestrian to cross		
Presence of flashing warning lights		
Presence of bells and other audible devices		
Presence of gates for vehicles		
Presence of gates for pedestrians		
Presence of signal indicator for train operators		
Cab-signaling (ATP) protection		
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)		
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices		
Adequate sighting distance (no obstructions)		
Visibility of sign to rail vehicle operator		
Adequacy of illumination at crossing (street lighting)		
Visibility of bar signals to rail vehicle operators		
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras		



It should be noted that certain items in the above check list are applicable to only one type of intersection. It should also be noted that the intent of the above check list is to include the basic items that need to be assessed at train/vehicle intersections based on Metro's operating environment and in the context of being relevant to a safety assessment.

There are additional items that are included in the various standards, which are not part of this check list because they are either not applicable or are not relevant to the safety assessment at intersections.





Appendix 9



Appendix 9

Assessment of Signage, Street Markings and Traffic Control Devices







Intersection # 1

18th Street & Flower Street







Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	Few signs are present at this intersection.
Mounted signs at crossing are maintained in good condition	Yes	Few signs are present at this intersection.
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	No	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	





Requirement	Compliance	Comments
SIGNAGE		
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	N/A	
Presence of “number of tracks” sign  W48 (CA)	No	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	No	
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop Here on Red” sign 	Yes	
Presence of “Stop here when Flashing” sign (R8-10 sign) 	N/A	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	No	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	Yes	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	Yes	
Emergency Notification Sign (I-13 or I-13a) 	N/A	
Presence of "Suicide Crisis Line" sign 	No	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Fair	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	N/A	
Dynamic Envelope Markings	N/A	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6' median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	N/A	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	Partial	Only on one side.
Channelization design to guide pedestrians	No	Presence of sign to guide pedestrian to the other side of the street to cross.
Is guard railing installed at the approaches to the crossing	N/A	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	No	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	No	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	N/A	
Four-Quadrant Gate Systems	N/A	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	Yes	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	No	
Adequacy of time provided to pedestrian to cross	N/A	
Presence of flashing warning lights	N/A	
Presence of bells and other audible devices	N/A	
Presence of gates for vehicles	N/A	
Presence of gates for pedestrians	N/A	
Presence of signal indicator for train operators	N/A	
Cab-signaling (ATP) protection	No	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	No	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	N/A	
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Fair	
Visibility of signs to pedestrians	Fair	
Visibility of signs to rail vehicle operator	Fair	
Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	Fair	



TRAFFIC ENFORCEMENT MECHANISM

Traffic enforcement mechanisms, such as cameras

No

Finding A9.1: Intersection # 1:

Intersection of 18th Street & Flower Street– 16 accidents and one fatality between 2005 & 2014

Discussion:

The intersection of South Flower Street and 18th Street is located within the Blue Line street running territory, and this intersection provides access to the Freeway Entrance for southbound traffic on Flower Street. Records provided by Metro indicate that 16 accidents occurred at this intersection between 2005 and 2014, resulting in injuries and one fatality.



Signage



There are a number of pedestrian and vehicle signs that are missing at this intersection. They include:

- Advance warning signs
- Look signs
- No vehicle on track sign
- Suicide crisis line sign



Street Markings

The street markings for pedestrians and vehicles at this intersection provide basic guidance for pedestrians, and are in fair condition.



Traffic Equipment



Traffic signals are provided at the intersection to control the movements of vehicles, trains and pedestrians. A multi-phased traffic controller controls traffic signal aspects as well as the bar signals for trains. Pedestrian signals are activated manually via push buttons.

Factors Contributing to Prior Accidents

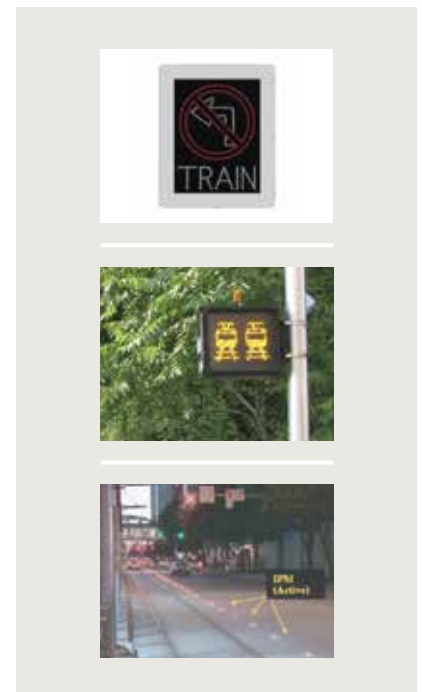
Out of 16 accidents at this intersection, there were 15 train/vehicle accidents and one train/pedestrian accident that resulted in a fatality. The main contributing factor in the train/vehicle accidents is a vehicle violating the traffic signal and enters the track way from the left turn lane. The indicated contributing factor for the pedestrian accident is attributed to two trains passing through the intersection.

Recommendations:

A8: Needed Safety Enhancements

As indicated above the main factor that contributed to prior accidents is the unsafe behavior by the public in violating traffic signals. To enhance the safety of operation at this intersection, it is essential to undertake measures that will discourage unsafe public behavior. Therefore, in order to improve the safety of operation at the intersection, there is a need to focus on improving the signage and dynamic information provided to the public, as well as the implementation of traffic enforcement measures. We recommend the installation of the following measures to encourage public safe behavior:




- Installation of blank out no left turn sign,
- Installation of a second train signal to advise motorists and pedestrians that two trains are approaching an intersection,
- Installation of illuminated active in-pavement marking (IPM) systems, and
- Installation of traffic enforcement devices.









Intersection # 2

Pico Boulevard & Flower Street






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	Yes	
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	No	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	No	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	No	
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	Yes	
Presence of “Stop Here on Red” sign  R10-6	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	N/A	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	No	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	Yes	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	Yes	
Emergency Notification Sign (I-13 or I-13a) 	N/A	
Presence of "Suicide Crisis Line" sign 	Yes	At Pico Station.
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Good	
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	No	
Dynamic Envelope Markings	Partial	On one side of the tracks.
Continuous network of accessible pathways to pedestrians	Yes	At Pico Station.
Presence of 6' median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	Yes	At Pico Station.
Presence of swing gates	Yes	At Pico Station.
Contrasting pavement color or texture for pedestrian crossings	Yes	
Use of pedestrian barriers	Partial	Pedestrian barriers are present at Pico Station except in front of driveway.
Channelization design to guide pedestrians	Yes	At Pico Station.
Is guard railing installed at the approaches to the crossing	Yes	At Pico Station.
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	Yes	At Pico Station.
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	No	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	N/A	
Four-Quadrant Gate Systems	N/A	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	Yes	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	No	Count down timer is adequate for brisk walking. A slow moving individual is not able to cross the intersection within time provided.
Adequacy of time provided to pedestrian to cross	Yes	For pedestrians at Pico Station.
Presence of flashing warning lights	Yes	For pedestrians at Pico Station.
Presence of bells and other audible devices	N/A	
Presence of gates for vehicles	N/A	
Presence of gates for pedestrians	N/A	
Presence of signal indicator for train operators	N/A	
Cab-signaling (ATP) protection	No	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	No	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	Good	
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Fair	One sign is installed at a bus stop, and is obstructed by buses making a station stop.
Visibility of signs to pedestrians	Good	
Visibility of signs to rail vehicle operator	Fair	



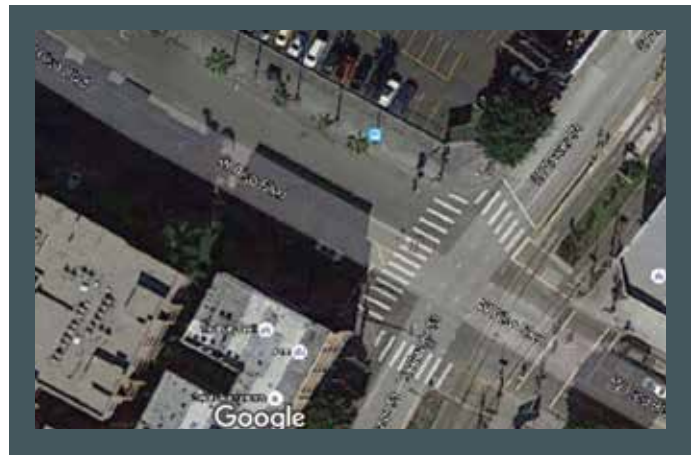
Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	Fair	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	No	

Finding A9.2: Intersection # 2:

Intersection at Pico Blvd. & Flower Street – Four accidents during 2013-2014

Discussion:

The intersection of Pico Blvd. and Flower Street is located within the Blue Line street running territory, and is adjacent to Pico Station. Records provided by Metro indicate that four accidents occurred at this intersection between 2013 & 2014, resulting in injuries to the public.



Signage

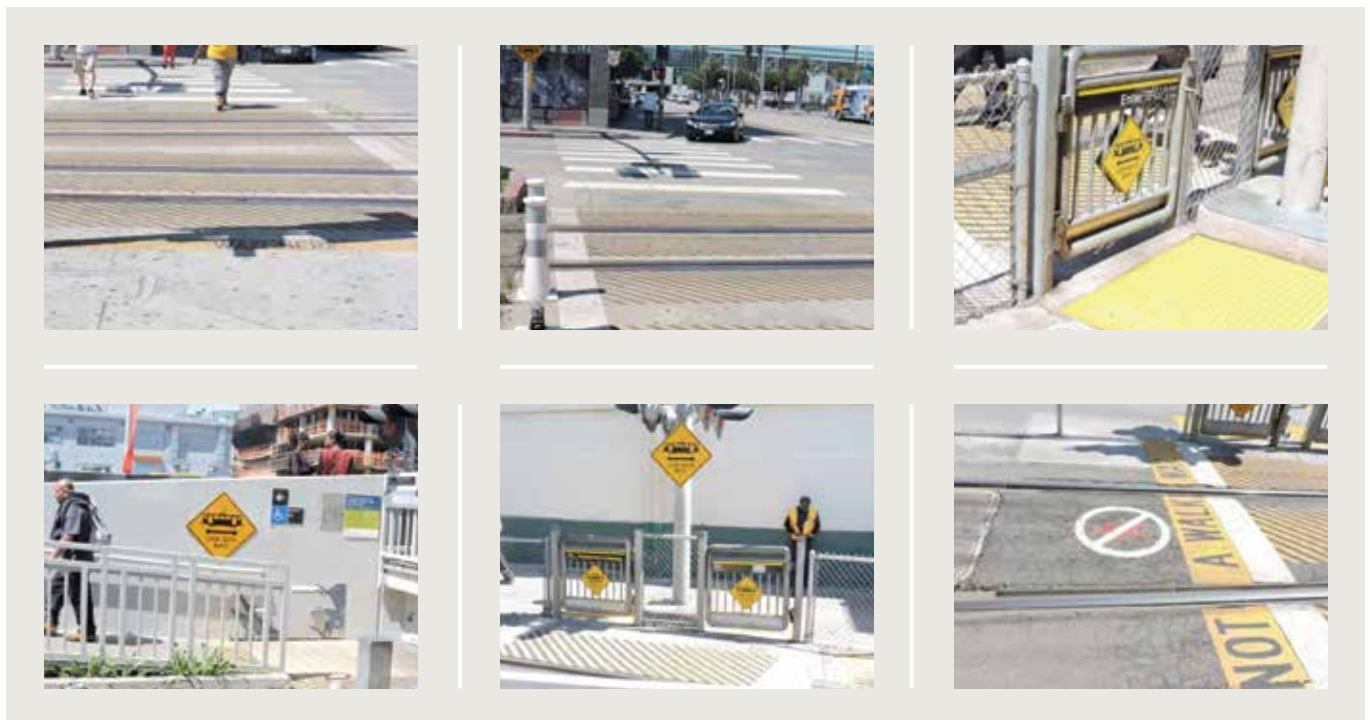




There are a number of pedestrian and vehicle signs that are missing at this intersection including:

- Advance warning signs, and
- No vehicle on track sign.

Street Markings



This intersection has good street markings to guide pedestrians through the crossing. Contrasting pavement color is provided to designate track areas. Pico Station also has pedestrian channelization with a barrier installed to guide pedestrians exiting from the station.



Traffic Equipment



Traffic signals are provided at the intersection to control the movements of vehicles, trains and pedestrians. A multi-phased traffic controller controls traffic signal aspects as well as the bar signals for trains. Pedestrian signals are activated manually via push buttons. Pedestrian flashing warning lights and bells are installed at Pico Station.

Other Issues



One of the “Look” signs is installed at a bus stop. When a bus makes a station stop, the sign is not visible.





An unprotected private driveway exists at the south end of Pico Station. Based on the accident records provided by Metro, 12 accidents including one fatality occurred at driveways along Flower Street. The issue of unprotected private driveways was brought to the attention of Metro’s Corporate Safety to ascertain if Metro took actions to mitigate the risks associated with these driveways.

Corporate Safety indicated that it has taken a number of measures to address the risks associated with private driveways, and advised TWG of the following:

- Metro was successful in closing two driveways.
- Metro installed active “No Left Turn” signs at all the driveways as well as passive signs.

Metro explained that there is not much that can be done with the driveways since private businesses must remain active and provide access for their customers and vendors. Metro further indicated that it discussed closing the driveway at Pico with the owner some time ago, but it had to stay open since employees’ park in the below ground parking garage and that is the only access to it. While TWG understands the challenges associated with private driveways, the fact is that the driveway at Pico remains unprotected.

Recommendation:




A-9: Metro should implement appropriate measures to ensure safety at the private driveway at the south end of Pico Station.









Intersection # 3

Long Beach Avenue & 20th Street






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	Partial	Some signs are covered with graffiti.
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	Yes	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	Yes	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	Yes	
Presence of illuminated No Left Turn sign  R3-2	N/A	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	No	
Presence of “Stop Here on Red” sign  R10-6	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	No	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	Yes	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	N/A	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “No Pedestrian” sign 	Yes	
Emergency Notification Sign (I-13 or I-13a) 	Yes	
Presence of “Suicide Crisis Line” sign 	Yes	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Poor	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	No	
Dynamic Envelope Markings	N/A	
Continuous network of accessible pathways to pedestrians	Partial	Only in the approach to station.
Presence of 6’ median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	No	
Contrasting pavement color or texture for pedestrian crossings	Partial	North side of Washington Station.
Use of pedestrian barriers	Yes	
Channelization design to guide pedestrians	Yes	North side of Washington Station.
Is guard railing installed at the approaches to the crossing	No	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	N/A	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	N/A	
Presence of illuminated active in-pavement marking (IPM) systems	N/A	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	Yes	
Four-Quadrant Gate Systems	No	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	N/A	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	N/A	
Adequacy of time provided to pedestrian to cross	N/A	
Presence of flashing warning lights	Yes	
Presence of bells and other audible devices	Yes	
Presence of gates for vehicles	Yes	
Presence of gates for pedestrians	No	
Presence of signal indicator for train operators	Yes	
Cab-signaling (ATP) protection	Yes	Only at crossing. No ATP in the approach to the station.
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	N/A	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	Good	
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Fair	
Visibility of signs to pedestrians	Fair	
Visibility of signs to rail vehicle operator	Fair	



Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	N/A	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	Yes	

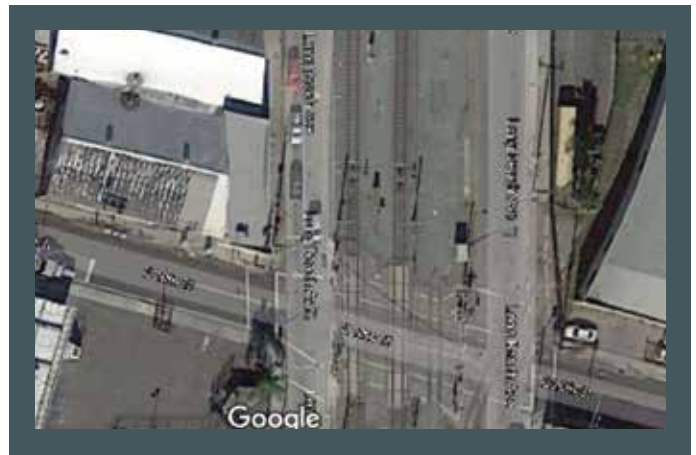
Finding A9: Intersection # 3:

Blue Line, Intersection of Long Beach Ave. & 20th Street (Washington Station).

Discussion:

This intersection is located at the south end of Washington station within dedicated right-of-way on the Blue Line. There are no recorded accidents at this intersection.

Signage





This intersection includes most of the basic vehicle and pedestrian signs, with the exception of the “No Vehicle on Track” sign and “Do not Stop on Track” sign.



Street Markings



The 20th Street intersection (south end of Washington Station) does not have street markings or channelization to guide pedestrians through the crossing. Further, there is no street marking or treatment to mark the edge of the crossing. However, the north end of the station has channelization to guide pedestrians to exit the station. Further, street markings north of the station employ contrasting pavement color or texture for pedestrian crossings.

Traffic Equipment



The 20th Street intersection is equipped with basic crossing gates, flashing lights and bells for vehicles. There are no pedestrian flashing lights, gates or bells at this intersection. The only pedestrian crossing lights at this intersection are countdown lights that are manually activated by pedestrians.

Other than a sign for pedestrian to “Watch for Trains”, there is no other protection provided. Pedestrians are provided with a zone to wait for the clearing of the countdown crossing signals to clear. However, there are no provisions provided for pedestrians waiting between the tracks to activate the crossing signals.



Traffic Enforcement

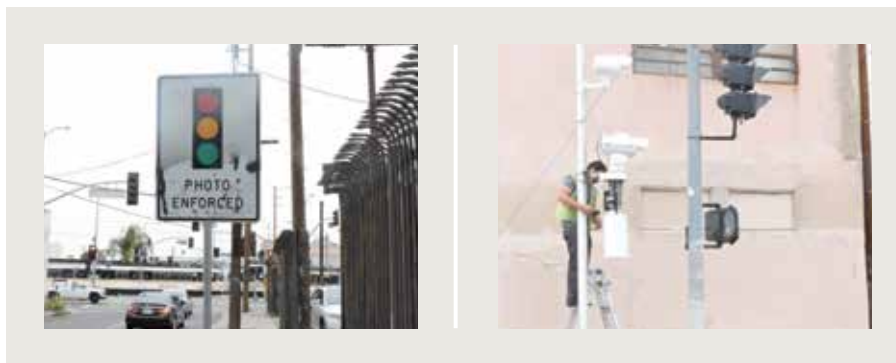


Photo enforcement is provided for traffic signals at the south end of Washington Station.

Recommendations:

A10: Needed Safety Enhancements

Although there is no recorded history of prior accidents at this intersection, the safety of operations at this location will benefit from the implementation of the following measures:




- Install additional signs, street markings & traffic equipment.
- Implement a channelization scheme to guide pedestrians through the 20th Street crossing.
- Implement dynamic information related to approaching trains to inform the public when more than one train is approaching the intersection.
- Provide a pedestrian traffic button for activation of countdown crossing signals north of Washington Station.









Intersection # 4

Long Beach Avenue & 24th Street






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	No	Some signs have graffiti.
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	Yes	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	Yes	Covered with graffiti.
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	Yes	Covered with graffiti.
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	No	
Presence of “Stop Here on Red” sign  R10-6	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	No	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	Yes	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	N/A	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “No Pedestrian” sign 	No	
Emergency Notification Sign (I-13 or I-13a) 	Yes	
Presence of “Suicide Crisis Line” sign 	Yes	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Poor	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	No	
Dynamic Envelope Markings	No	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6’ median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	No	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	No	
Channelization design to guide pedestrians	No	
Is guard railing installed at the approaches to the crossing	No	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	N/A	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	N/A	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	Yes	
Four-Quadrant Gate Systems	No	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	N/A	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	N/A	
Adequacy of time provided to pedestrian to cross	Fair	
Presence of flashing warning lights	Yes	
Presence of bells and other audible devices	Yes	
Presence of gates for vehicles	Yes	
Presence of gates for pedestrians	No	
Presence of signal indicator for train operators	Yes	
Cab-signaling (ATP) protection	Yes	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	N/A	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	Good	Some devices are obstructed by trees and other structures.
Visibility of traffic signals at intersection	N/A	
Adequate sighting distance (no obstructions)	Fair	
Visibility of signs to pedestrians	Fair	
Visibility of signs to rail vehicle operator	Poor	Some signs are obstructed.



Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	N/A	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	No	

Finding A9: Intersection # 4:

Intersection of Long Beach Ave. & 24th Street – One accident resulting in a fatality in 2015.

Discussion:

This intersection is located within the dedicated right-of-way on the Blue Line. In January 2015, a train fatally struck a pedestrian at the intersection.



Signage

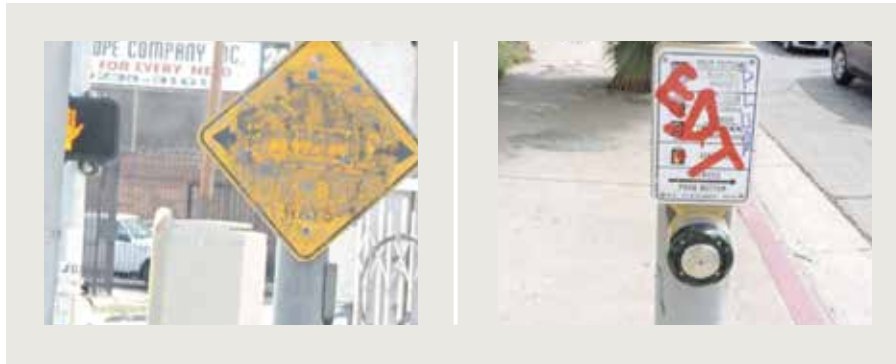


There are a number of pedestrian and vehicle signs that are not provided at this intersection. These includes:

- No vehicle on track sign,
- No pedestrian sign, and
- “Stop here when flashing” sign.

Further, a number of signs at this intersection are covered with graffiti.





Street Markings



There are no street markings or channelization to guide pedestrians through the crossing. Further, there is no street markings or treatment to mark the edge of the crossing.

Crossing Equipment



This intersection is equipped with basic crossing gates, flashing lights and bells for vehicles. There are no pedestrian flashing lights, gates or bells at this intersection. The only pedestrian crossing lights at this intersection are countdown lights that are manually activated by pedestrians.



Other Observations



During our site visit at this location, we observed that the temporary identifier used to identify priority signal locations is placed on the right of way in an attempt to create a pedestrian barrier. It is not a good practice to use this temporary identifier in a different application that is not associated with a priority signal location. Such practice dilutes the safety intent of this temporary identifier.

Factors Contributing to Prior Accidents

Documents provided by Metro reveal that in January 2015, a train pedestrian accident resulted in a fatality at this intersection.

Recommendations:

A11: Needed Safety Enhancements




To enhance the safety of operation at this location, it is essential to undertake measures that will discourage unsafe public behavior. This can be achieved through the installation of additional signs, street markings and traffic equipment, and by implementing a channelization scheme to guide pedestrians through the crossing. Further, the implementation of dynamic information related to approaching trains will inform the public when more than one train is approaching the intersection. *See appendix 8* for check list of a number of industry best practices to improve the safety at rail/vehicle intersections. It is believed that the implementation of a number of these measures at this location will help achieve an environment that will encourage safe public behavior.









Intersection # 5

Gage Avenue






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	Yes	
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	Yes	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	Yes	





Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	Yes	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	No	
Presence of illuminated No Left Turn sign  R3-2	N/A	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	No	
Presence of “Stop Here on Red” sign  R10-6	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) <div style="text-align: center;">  </div>	No	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) <div style="text-align: center;">  </div>	Yes	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) <div style="text-align: center;">  </div>	N/A	
Skewed Crossing Sign (W10-12) <div style="text-align: center;">  </div>	N/A	
Presence of “No Vehicle on Track” sign <div style="text-align: center;">  </div>	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	No	
Emergency Notification Sign (I-13 or I-13a) 	No	
Presence of "Suicide Crisis Line" sign 	Yes	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Poor	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	No	
Dynamic Envelope Markings	No	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6' median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	No	
Contrasting pavement color or texture for pedestrian crossings	Yes	
Use of pedestrian barriers	No	
Channelization design to guide pedestrians	No	
Is guard railing installed at the approaches to the crossing	No	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	N/A	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	N/A	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	Yes	
Four-Quadrant Gate Systems	No	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	N/A	
Pedestrian activated crossing signals	N/A	
Automatic pedestrian signal traffic phase	N/A	
Adequacy of time provided to pedestrian to cross	N/A	
Presence of flashing warning lights	Yes	
Presence of bells and other audible devices	Yes	
Presence of gates for vehicles	Yes	
Presence of gates for pedestrians	Yes	Only at one side of the intersection.
Presence of signal indicator for train operators	Yes	
Cab-signaling (ATP) protection	Yes	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	N/A	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	Good	Some devices are obstructed by trees and other structures.
Visibility of traffic signals at intersection	N/A	
Adequate sighting distance (no obstructions)	Fair	
Visibility of signs to pedestrians	Fair	
Visibility of signs to rail vehicle operator	Poor	Some signs are difficult to notice.



Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	N/A	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	No	

Finding A9.5: Intersection # 5:

Gage Ave. Intersection – Seven accidents & four fatalities between 2005 & 2014.

Discussion:

The Gage Avenue intersection is located within dedicated right-of-way on the Blue Line. Gage Ave. intersects two Blue line tracks, as well as two tracks operated by Union Pacific Railroad. This requires pedestrians to cross four active tracks at this intersection. The intersection is adjacent to a park that is heavily used,



which increases the number of pedestrians crossing at this location. Records provided by Metro indicate that seven accidents occurred at this intersection between 2005 & 2014 resulting in injuries and four fatalities.

Signage



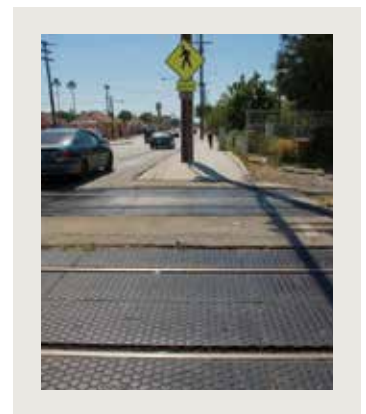
There are a number of pedestrian and vehicle signs that are not provided at this intersection. These include:

- Look signs,
- No vehicle on track sign,
- Emergency notification sign,
- No pedestrian sign, and
- “Stop here when flashing” sign.

Further the location of the “Suicide Crisis Line” sign does not provide clear visibility to the public.

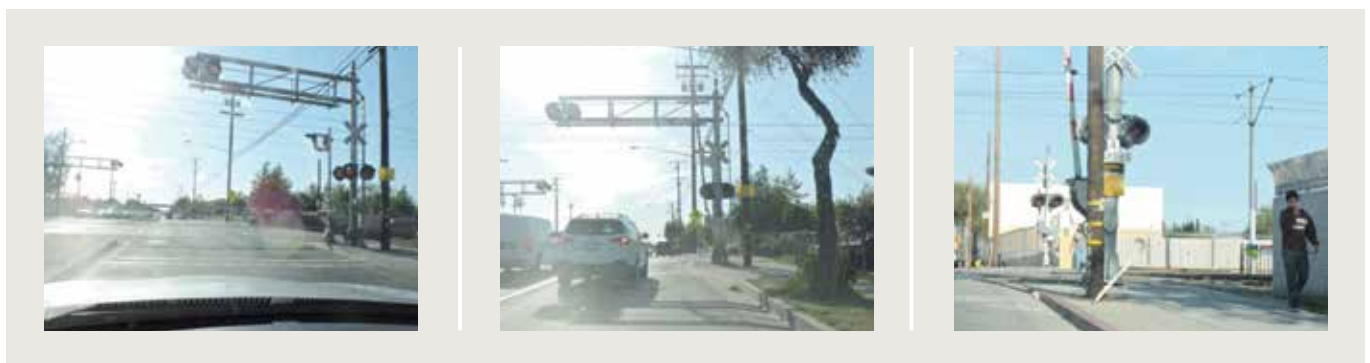
Street Markings

Crossing protection to pedestrians is only provided at one side of the intersection. There are no street markings or channelization to guide pedestrians through the crossing. Further, there is no street marking or treatment to mark the edge of the crossing.



Traffic Equipment

This intersection is equipped with basic crossing gates, flashing lights and bells for vehicles. Pedestrian flashing lights, gates and bells are provided only at one side of the intersection.



Factors Contributing to Prior Accidents

Out of seven prior accidents at this intersection, there were one train/vehicle accident and six train/pedestrian accidents that resulted in four fatalities. The main cause for train/pedestrian accidents is a pedestrian running around a lowered gate or trespassing on the right-of-way. Similarly, the train/vehicle



accident was caused by the vehicle moving around a lowered gate. As such, the main contributing factor to the accidents is unsafe behavior on the part of the public.

Recommendation:

A12: Needed Safety Enhancements




To enhance the safety of operation at this location, it is essential to undertake measures that will discourage public unsafe behavior. This can be achieved through the installation of additional signs, street markings & traffic equipment, and by implementing a channelization scheme to guide pedestrians through the crossing. Further, the implementation of dynamic information related to approaching trains will inform the public when more than one train is approaching the intersection. A contributing factor to one fatality at this intersection is related to a second train that struck a pedestrian. Appendix 8 identifies a number of industry best practices to improve the safety at rail/vehicle intersections. The implementation of a number of these measures at this location will help achieve an environment that will encourage safe public behavior.









Intersection # 6

Washington Boulevard & Hooper Avenue






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	Very few signs at this intersection.
Mounted signs at crossing are maintained in good condition	Yes	Very few signs at this intersection.
Use of retro reflectorized or illuminated signs	Yes	Very few signs at this intersection.
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	Yes	
Presence of a "STOP" sign  R1-1	N/A	
Presence of "YIELD" sign  R1-2	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign)  R15-1	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	Yes	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	No	
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	No	
Presence of “Stop Here on Red” sign  R10-6		



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) <div style="text-align: center;">  </div>	N/A	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) <div style="text-align: center;">  </div>	Yes	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) <div style="text-align: center;">  </div>	Yes	
Skewed Crossing Sign (W10-12) <div style="text-align: center;">  </div>	N/A	
Presence of “No Vehicle on Track” sign <div style="text-align: center;">  </div>	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	No	
Emergency Notification Sign (I-13 or I-13a) 	N/A	
Presence of "Suicide Crisis Line" sign 	No	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Poor	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	No	
Dynamic Envelope Markings	No	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6' median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	No	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	No	
Channelization design to guide pedestrians	No	
Is guard railing installed at the approaches to the crossing	No	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	N/A	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	N/A	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	No	
Four-Quadrant Gate Systems	No	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	Yes	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	N/A	
Adequacy of time provided to pedestrian to cross	Fair	
Presence of flashing warning lights	No	
Presence of bells and other audible devices	No	
Presence of gates for vehicles	No	
Presence of gates for pedestrians	No	
Presence of signal indicator for train operators	No	
Cab-signaling (ATP) protection	No	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	No	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	N/A	
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Fair	
Visibility of signs to pedestrians	Fair	
Visibility of signs to rail vehicle operator	N/A	Very few signs at this intersections.

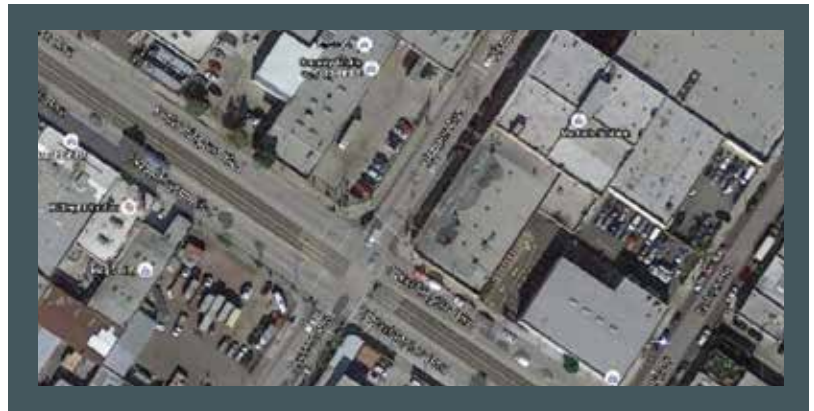


Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	Fair	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	No	

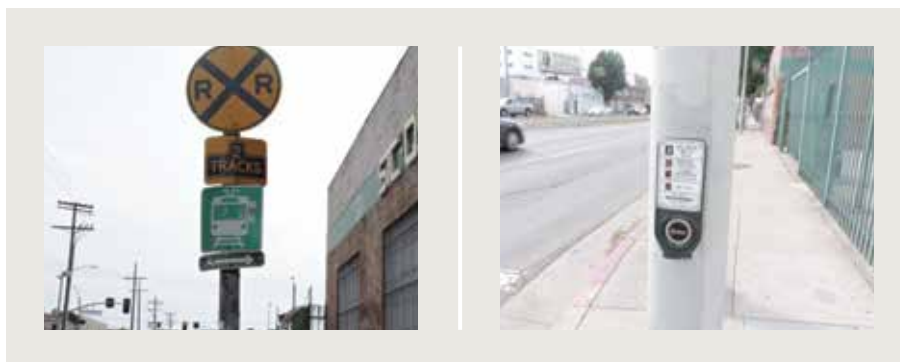
**Finding A9.6: Intersection # 6:
Blue Line - Intersection of Washington Blvd & Hooper Avenue – Three accidents
(2006 – 2015)**

Discussion:

This intersection is located within the street running territory on the Blue Line. Documents provided by Metro indicate that three train/vehicle collisions occurred at this intersection between 2006 & 2015.



Signage



There are a number of pedestrian and vehicle signs that are not provided at this intersection. They include:

- Look sign,
- No vehicle on track sign,
- Stop here on red sign,
- “Suicide Crisis Line” sign,
- No pedestrian sign, and
- “Stop here when flashing” sign.



Street Marking



There are no street markings or channelization to guide pedestrians to cross the tracks, and pedestrian street markings are fading and need to be repainted.

Traffic Equipment



Traffic signals are provided at the intersection to control the movements of vehicles, trains and pedestrians. A multi-phased traffic controller controls traffic signal aspects as well as the bar signals for trains. Pedestrian signals are activated manually via push buttons.

Factors Contributing to Prior Accidents

All three accidents at this intersection are train/vehicle collisions. The description of one accident indicates that a contributing factor to the accident is related to two trains passing through the intersection.



Recommendation:

A13: Needed Safety Enhancements




The main factor that contributed to prior accidents is unsafe behavior by the public in violating traffic signals. To enhance the safety of operations at this intersection, it is essential to undertake measures that will discourage unsafe public behavior. There is a need to focus on improving the signage and dynamic information provided to the public, as well as the implementation of traffic enforcement measures. Appendix 8 identifies a number of industry best practices to improve the safety at rail/vehicle intersections. Implementing a number of the identified measures will help achieve an environment that encourages safe public behavior.









Intersection # 7

Long Beach Boulevard & Burnett Street






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	Few signs are present at this intersection.
Mounted signs at crossing are maintained in good condition	Yes	Few signs are present at this intersection.
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	No	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	No	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	No	
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	No	
Presence of “Stop Here on Red” sign  R10-6	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	N/A	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	No	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	Yes	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	No	
Emergency Notification Sign (I-13 or I-13a) 	N/A	
Presence of "Suicide Crisis Line" sign 	No	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Poor	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	N/A	
Dynamic Envelope Markings	N/A	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6' median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	N/A	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	No	
Channelization design to guide pedestrians	No	
Is guard railing installed at the approaches to the crossing	N/A	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	No	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	No	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	N/A	
Four-Quadrant Gate Systems	N/A	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	Yes	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	No	
Adequacy of time provided to pedestrian to cross	Fair	Count down timer is adequate for a brisk walking individual. However, a slow moving individual is not able to cross the intersection within time provided.
Presence of flashing warning lights	N/A	
Presence of bells and other audible devices	N/A	
Presence of gates for vehicles	N/A	
Presence of gates for pedestrians	N/A	
Presence of signal indicator for train operators	N/A	
Cab-signaling (ATP) protection	No	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	No	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	N/A	
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Fair	
Visibility of signs to pedestrians	N/A	No signs are provided.
Visibility of signs to rail vehicle operator	N/A	No signs are provided.



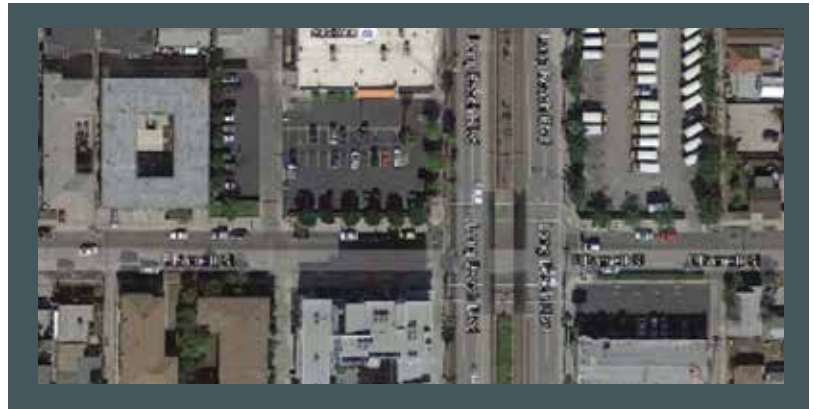
Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	Poor	Bar signal aspects are dim and barely visible.
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	No	

Finding A9.7: Intersection # 7:

Intersection Long Beach Boulevard & Burnett Street – Three accidents and one fatality between 2010 & 2014

Discussion:

The intersection of Long Beach Blvd. and Burnett Street is located within the Blue Line street running territory. This intersection is located within the municipality of Long Beach. Records provided by Metro indicate that three



accidents occurred at this intersection between 2010 and 2014, resulting in injuries and one fatality.

Signage

There are a number of pedestrian and vehicle signs that are missing at this intersection. They include:

- Advance warning signs,
- Look signs,
- No vehicle on track sign,
- No pedestrian sign,
- Do not stop on track sign,
- Stop here on red sign, and
- Suicide crisis line sign.



Street Markings



There are no street markings or channelization to guide pedestrians through the crossing. Further, there is no street marking or treatment to mark the edge of the crossing.

Traffic Equipment

Traffic signals are provided at the intersection to control the movements of vehicles, trains and pedestrians. A multi-phased traffic controller controls traffic signal aspects as well as the bar signals for trains. Pedestrian signals are activated manually via push buttons.



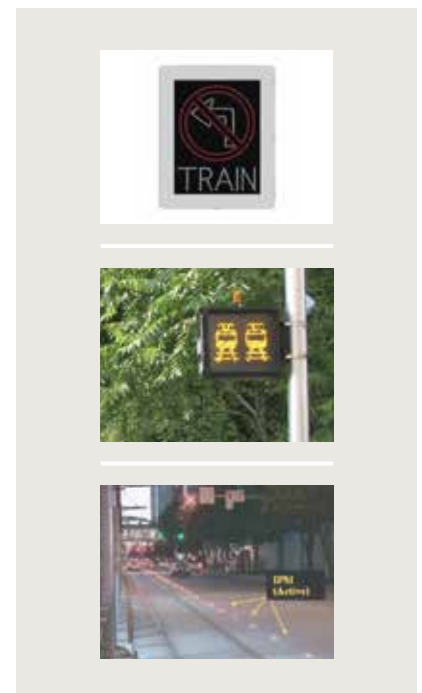
Factors Contributing to Prior Accidents

All three accidents occurring at this intersection are due to a vehicle making an illegal left turn with a train approaching the intersection.

A14: Needed Safety Enhancements

As indicated above the main factor that contributed to prior accidents is the unsafe behavior by drivers violating traffic signals. To enhance the safety of operations at this intersection, it is essential to undertake measures that will discourage unsafe public behavior. In order to improve the safety of operations at the intersection there is a need to focus on improving the signage, street markings and dynamic information provided to the public. It is also desirable to implement traffic enforcement measures. Appendix 8 identifies a number of industry best practices to improve the safety at rail/vehicle intersections. It is believed that the following measures will help achieve an environment that will encourage public safe behavior:




- Installation of blank out no left turn sign,
- Installation of a second train signal to advise motorists and pedestrians that two trains are approaching an intersection,
- Installation of illuminated active in-pavement marking (IPM) systems, and
- Installation of traffic enforcement devices.









Intersection # 8

Exposition Boulevard & Raymond Avenue






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	Yes	
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	Yes	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	Yes	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	Yes	Covered with graffiti.
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	Yes	
Presence of “Stop Here on Red” sign  R10-6	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	N/A	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	Yes	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	Yes	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	Yes	
Emergency Notification Sign (I-13 or I-13a) 	N/A	
Presence of "Suicide Crisis Line" sign 	Yes	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Good	
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	Yes	
Dynamic Envelope Markings	No	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6' median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	No	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	No	
Channelization design to guide pedestrians	No	
Is guard railing installed at the approaches to the crossing	No	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	N/A	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	N/A	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	No	
Four-Quadrant Gate Systems	No	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	Yes	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	N/A	
Adequacy of time provided to pedestrian to cross	Fair	Count down timer is adequate for a brisk walking individual. However, a slow moving individual is not able to cross the intersection within time provided.
Presence of flashing warning lights	No	
Presence of bells and other audible devices	No	
Presence of gates for vehicles	No	
Presence of gates for pedestrians	No	
Presence of signal indicator for train operators	No	
Cab-signaling (ATP) protection	No	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	No	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	N/A	Some devices are obstructed by trees and other structures.
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Good	
Visibility of signs to pedestrians	Good	
Visibility of signs to rail vehicle operator	Good	

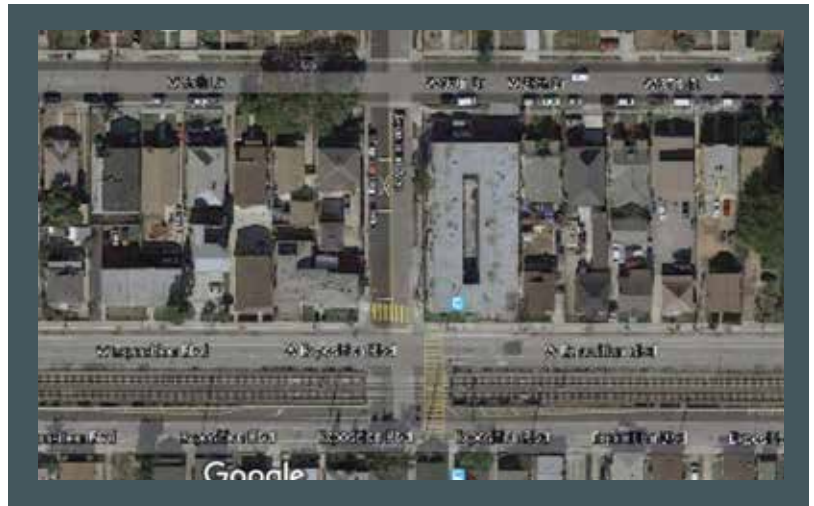


Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	Fair	Some of the bar signal aspects are dim.
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	Yes	

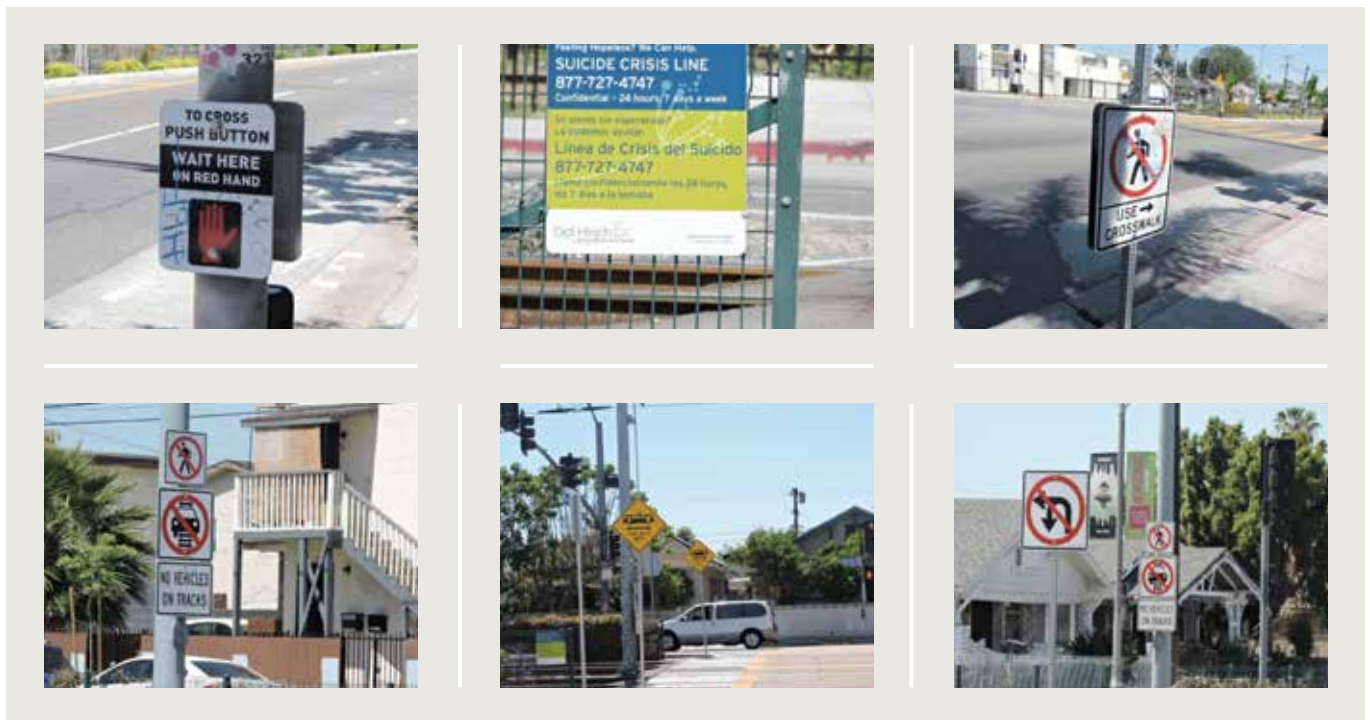
**Finding A9.8: Intersection # 8:
Intersection of Raymond Ave. & Exposition Blvd. – Six accidents between 2013-2014**

Discussion:

The intersection of Raymond Ave. and Exposition Blvd. is located within the Exposition Line street running territory. Records provided by Metro indicate that six accidents occurred at this intersection between 2013 and 2014, resulting in one injury.



Signage





This intersection has all the basic pedestrian and vehicle signs.

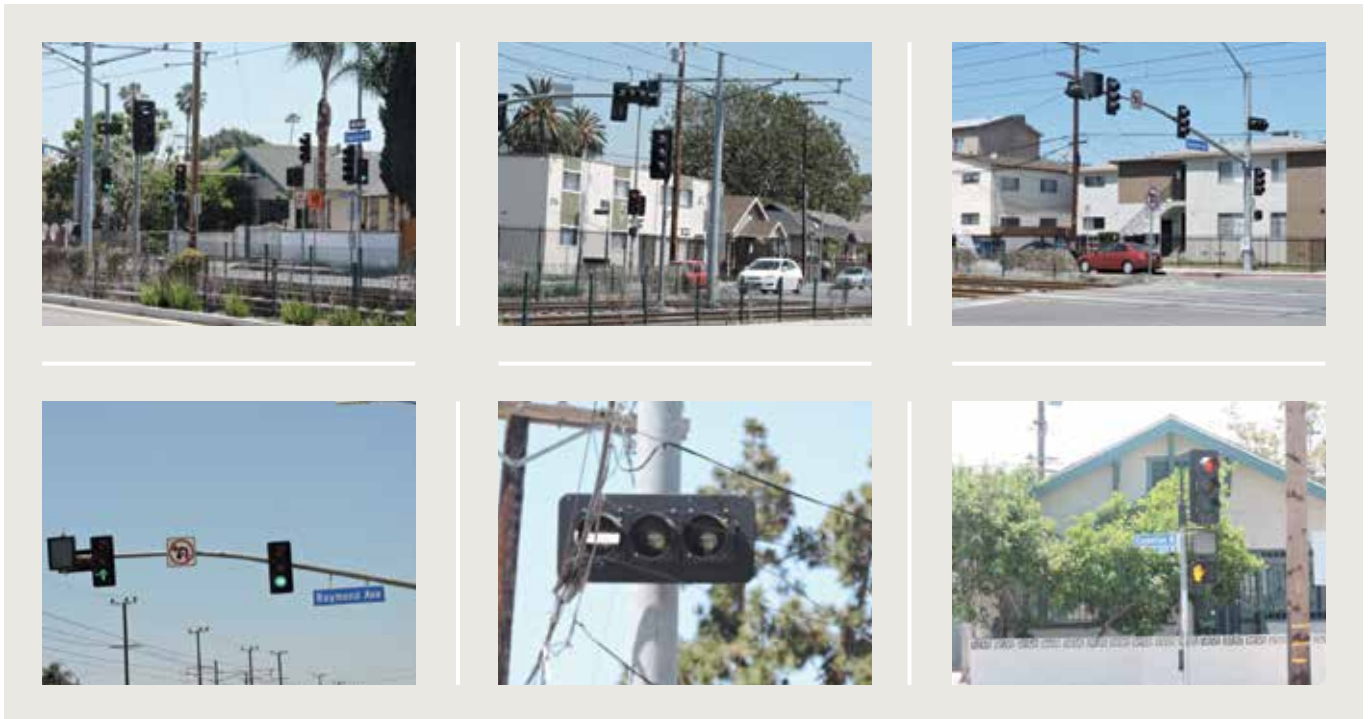
Street Markings



The street markings for pedestrians and vehicles at this intersection provide basic guidance for pedestrians to cross the tracks, and are in fair condition.



Traffic Equipment



Traffic signals are provided at the intersection to control the movements of vehicles, trains and pedestrians. A multi-phased traffic controller controls traffic signal aspects as well as the bar signals for trains. Pedestrian signals are activated manually via push buttons.

Traffic Monitoring Equipment



Traffic signals at this intersection are photo enforced.

Factors Contributing to Prior Accidents

All six accidents occurring at this intersection are due to a vehicle making an illegal left turn with a train approaching the intersection.

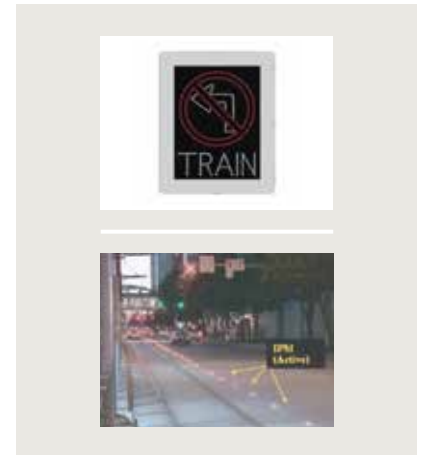


Recommendation:

A15: Needed Safety Enhancements

As indicated above the main factor that contributed to prior accidents is the unsafe behavior by the public in violating traffic signals. Although there is photo enforcement at this intersection, some drivers continue to violate traffic regulations. It is believed that the following measures will help achieve an environment that will encourage public safe behavior:




- Installation of blank out no left turn sign,
- Installation of illuminated active in-pavement marking (IPM) systems.









Intersection # 9

Exposition Boulevard & Watt Way






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	Yes	Some signs are covered with graffiti.
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	No	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	N/A	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	No	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	No	
Presence of illuminated No Left Turn sign  R3-2	No	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	Yes	
Presence of “Stop Here on Red” sign  R10-6	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	N/A	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	No	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	Yes	
Skewed Crossing Sign (W10-12) 	N/A	
Presence of “No Vehicle on Track” sign 	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of "No Pedestrian" sign 	Yes	
Emergency Notification Sign (I-13 or I-13a) 	N/A	
Presence of "Suicide Crisis Line" sign 	Yes	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Fair	LADOT responsibility.
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	N/A	
Dynamic Envelope Markings	N/A	
Continuous network of accessible pathways to pedestrians	No	
Presence of 6' median refuges, high visibility crosswalks	No	



Continuous network of low-stress facilities to connect to stations for bikers	No	
Presence of swing gates	No	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	Yes	
Channelization design to guide pedestrians	No	
Is guard railing installed at the approaches to the crossing	No	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	N/A	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	No	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	N/A	
Four-Quadrant Gate Systems	N/A	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	Yes	
Pedestrian activated crossing signals	Yes	
Automatic pedestrian signal traffic phase	No	
Adequacy of time provided to pedestrian to cross	Fair	Count down timer is adequate for a brisk walking individual. However, a slow moving individual is not able to cross the intersection within time provided.
Presence of flashing warning lights	N/A	
Presence of bells and other audible devices	N/A	
Presence of gates for vehicles	N/A	
Presence of gates for pedestrians	N/A	
Presence of signal indicator for train operators	N/A	
Cab-signaling (ATP) protection	No	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	No	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	N/A	Some devices are obstructed by trees and other structures.
Visibility of traffic signals at intersection	Good	
Adequate sighting distance (no obstructions)	Good	
Visibility of signs to pedestrians	Good	
Visibility of signs to rail vehicle operator	Good	

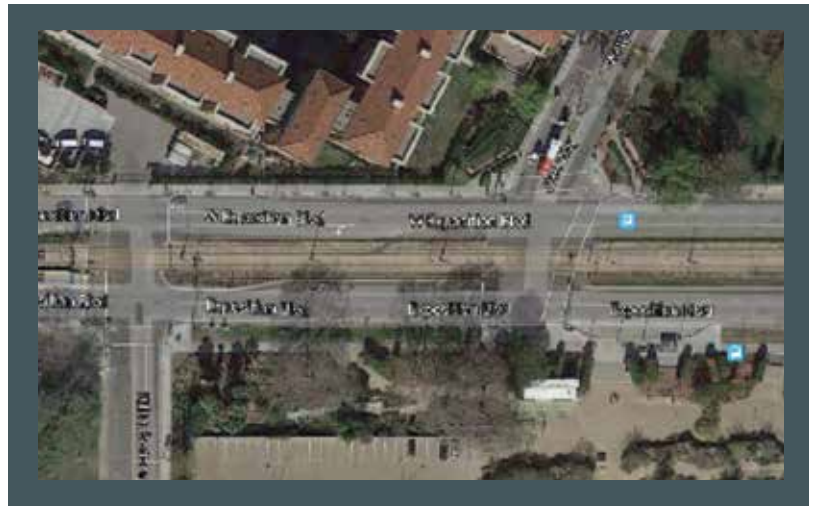


Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	Fair	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	Yes	

**Finding A9.9: Intersection # 9:
Exposition Blvd. & USC Watt Way Intersection – Three (3) accidents during 2014-2015**

Discussion:

The intersection of Exposition Blvd. and Watt Way is located within the Exposition Line street running territory. Records provided by Metro indicate that three accidents occurred at this intersection between 2014 and 2015. One of these accidents resulted in 21 injuries.



Signage



There are a number of pedestrian and vehicle signs that are missing at this intersection. They include:

- Advance warning signs, and
- Look signs.

Street Markings



There are only fading white lines to mark the pedestrian crossing. There is no channelization to guide pedestrians through the crossing.

Traffic Equipment

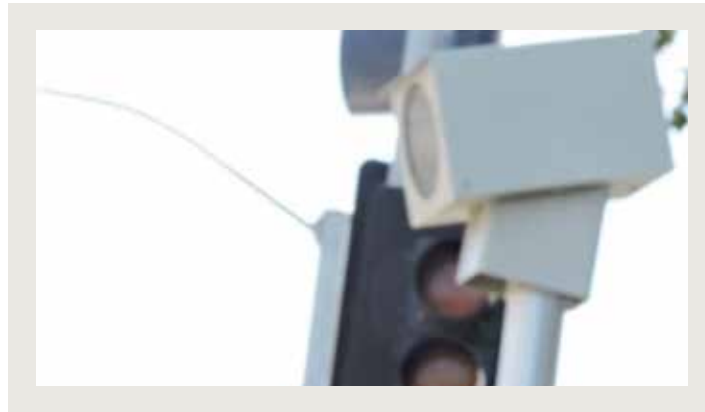
Traffic signals are provided at the intersection to control the movements of vehicles, trains and pedestrians. A multi-phased traffic controller controls traffic signal aspects as well as the bar signals for trains. Pedestrian signals are activated manually via push buttons.





Monitoring Equipment

Photo enforced monitoring of traffic signals is provided.



Factors Contributing to Prior Accidents

All three prior accidents at this intersection were caused by drivers violating no left turn signals, and making an illegal left turn with a train approaching the intersection.

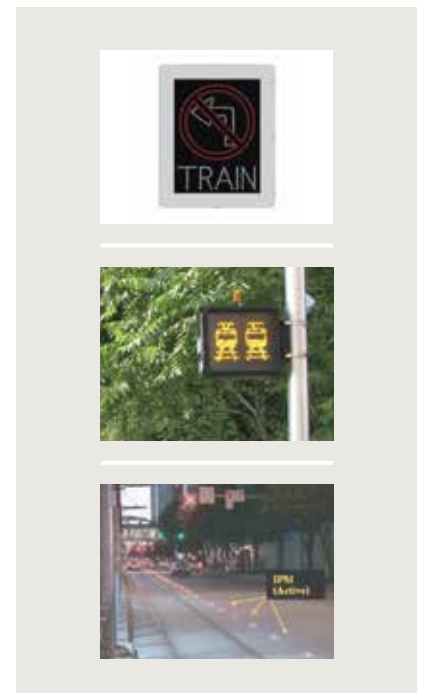


Recommendation:

A16: Needed Safety Enhancements

As indicated above the main factor that contributed to the prior accidents was the unsafe behavior by drivers violating traffic signals. In order to improve the safety of operations at the intersection there is a need to focus on improving the signage and dynamic information provided to the public. Appendix 8 identifies a number of industry best practices to improve the safety at rail/vehicle intersections. It is believed that the following measures will help achieve an environment that will encourage public safe behavior:




- Installation of blank out no left turn sign,
- Installation of a second train signal to advise motorists and pedestrians that two trains are approaching an intersection and
- Installation of illuminated active in-pavement marking (IPM) systems.









Intersection # 10

Pasadena Avenue & Monterey Road






Assessment of Signage, Street Markings and Traffic Control Devices

Requirement	Compliance	Comments
SIGNAGE		
Clear signs to guide passengers at transfer stations	N/A	
Mounted signs at crossing comply with MUTCD standards	Yes	
Mounted signs at crossing are maintained in good condition	Yes	
Use of retro reflectorized or illuminated signs	Yes	
No sign or signal shall be located in the center of an undivided highway, except in a raised island	Yes	
Advance Warning Signs shall be installed on each approach to a highway-rail grade crossing in accordance with the requirements of the MUTCD	Yes	
Presence of a "STOP" sign 	N/A	
Presence of "YIELD" sign 	N/A	
Presence of Cross buck sign, using retro reflectorized white with the words RAILROAD CROSSING in black lettering (R15-1 sign) 	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “number of tracks” sign  W48 (CA)	Yes	
Presence of “LOOK BOTH WAYS” sign  W82-1 (CA)	Yes	
Presence of illuminated No Left Turn sign  R3-2	N/A	
Presence of illuminated No Right Turn sign  R3-1	N/A	
Presence of “Do not Stop on Track” sign (R8-8 sign)  R8-8	Yes	
Presence of “Stop Here on Red” sign  R10-6	Yes	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “Stop here when Flashing” sign (R8-10 sign) 	No	
Highway-Rail Grade Crossing Advance Warning Signs (W10-1) 	Yes	
Light Rail Transit Approaching-Activated Blank-Out Warning Sign (W10-7) 	N/A	
Skewed Crossing Sign (W10-12) 	No	
Presence of “No Vehicle on Track” sign 	No	



Requirement	Compliance	Comments
SIGNAGE		
Presence of “No Pedestrian” sign 	Yes	
Emergency Notification Sign (I-13 or I-13a) 	Yes	
Presence of “Suicide Crisis Line” sign 	Yes	
Cross buck sign installed on the right side of the road	N/A	
No train horn sign 	N/A	
STREET MARKINGS & PEDESTRIAN BARRIERS		
Pavement Markings	Fair	
Pavement markings in advance of a highway-light rail transit grade crossing shall consist of an X, the letters RR	Partial	
Dynamic Envelope Markings	Yes	
Continuous network of accessible pathways to pedestrians	Partial	
Presence of 6’ median refuges, high visibility crosswalks	N/A	



Continuous network of low-stress facilities to connect to stations for bikers	N/A	
Presence of swing gates	Yes	
Contrasting pavement color or texture for pedestrian crossings	No	
Use of pedestrian barriers	Yes	
Channelization design to guide pedestrians	Partial	
Is guard railing installed at the approaches to the crossing	Yes	
Presence of a pedestrian safety buffer zone on the level area between the clear point and the gate arms and swing gate	Yes	
Presence of a safety buffer zone to provide accommodation for the slower moving individual	No	
Presence of illuminated active in-pavement marking (IPM) systems	N/A	
TRAFFIC CONTROL DEVICES		
Flashing-Light Signals	Yes	
Four-Quadrant Gate Systems	Yes	
Use of Traffic Control Signals for Control of Light Rail Transit Vehicles at Grade Crossings	N/A	
Pedestrian activated crossing signals	N/A	
Automatic pedestrian signal traffic phase	N/A	
Adequacy of time provided to pedestrian to cross	N/A	
Presence of flashing warning lights	Yes	
Presence of bells and other audible devices	Yes	
Presence of gates for vehicles	Yes	
Presence of gates for pedestrians	Yes	
Presence of signal indicator for train operators	Yes	
Cab-signaling (ATP) protection	Yes	
Presence of Light Rail Transit-Activated Blank-Out Turn Prohibition Signs (R3-1a – R3-2a)	N/A	
VISIBILITY & LIGHTING CONDITIONS		
Visibility of warning devices	Good	Some devices are obstructed by trees and other structures.
Visibility of traffic signals at intersection	N/A	
Adequate sighting distance (no obstructions)	Fair	Some signs are obstructed by tree branches.
Visibility of signs to pedestrians	Fair	Some signs are obstructed by tree branches.
Visibility of signs to rail vehicle operator	Good	

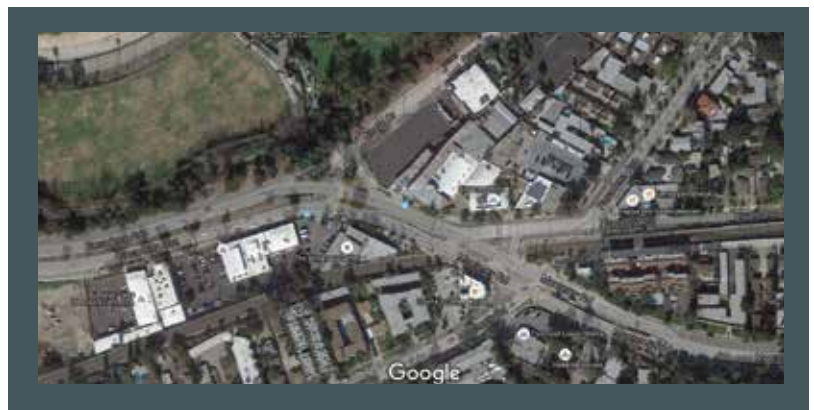


Adequacy of illumination at crossing	Fair	Only street lighting is provided.
Visibility of bar signals to rail vehicle operators	N/A	
TRAFFIC ENFORCEMENT MECHANISM		
Traffic enforcement mechanisms, such as cameras	No	

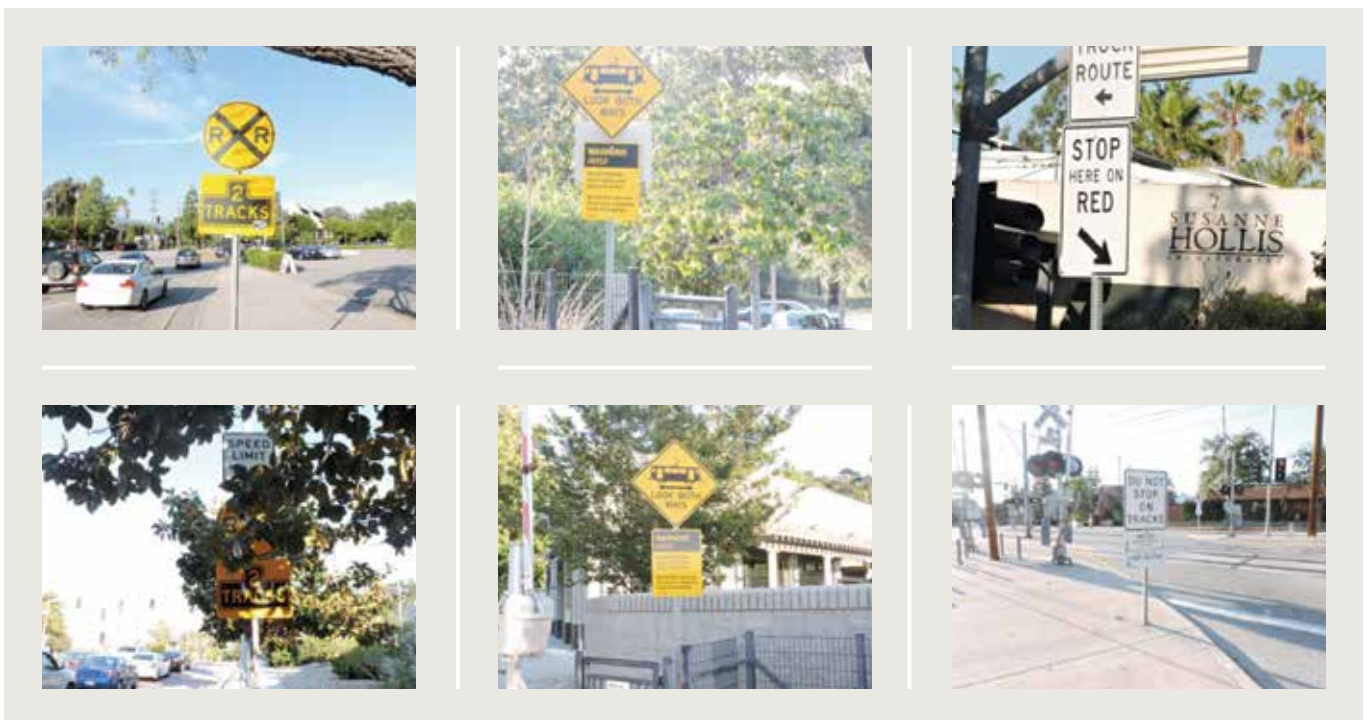
**Finding A9.10: Intersection # 10:
Gold Line - Intersection of Pasadena and Monterey Road – Two accidents during 2013-2014, including one fatality**

Discussion:

The intersection of Pasadena & Monterey Road is located within the dedicated right-of-way on the Gold Line. Records provided by Metro indicate that two train/pedestrian accidents occurred at this intersection between 2013 and 2014, resulting in one injury and one fatality.



Signage





This intersection includes most of the basic vehicle and pedestrian signs, with the exception of the skewed crossing sign.

Street Markings



Adequate crossing protection is provided to pedestrians, including channelization to guide pedestrians through the crossing and swing gates. However, street markings within the intersection are fading away.



Traffic Equipment



This intersection is equipped with a Four-Quadrant gate system, including crossing gates, flashing lights and bells for vehicles. Pedestrian flashing lights, gates and bells are also provided.

Factors Contributing to Prior Accidents

The two prior accidents at this intersection are attributed to trespassing by pedestrians. As such, the main contributing factor to the accidents is unsafe behavior on the part of the public.

Recommendation:

A17: Needed Safety Enhancements

This intersection employs a full set of signs to advise pedestrians to stay off the track, as well as channelization and guard railing in the approach to the crossing. The intersection will benefit from clearer street markings that designate the track area where pedestrian should be crossing. Although it was not indicated as a factor, the safety at this intersection will also benefit from the implementation of a second train signal to advise motorists and pedestrians that two trains are approaching the intersection.





Appendix 10

Appendix 10

High Priority Locations: Analysis of the Configurations and Equipment at the Signal Locations

The pattern of red signal violations indicates that there is a high probability of significant contributing factors at a number of “priority locations”. The TWG team has evaluated each of the eleven following locations and developed recommendations for reducing the number of violations at each. It should be noted that Metro did form a “Stop Signal Working Group” that performed a similar analysis, and identified the same signal locations as “High Priority Locations”. Multiple violations occurred during our review period by locations:

- Six red signal violations at Wilshire/Western – Signal 8 from 2011-2015
- Fourteen red signal violations at 7th & Metro Center – Signals 3N, 2S & 4S from 2011-2015
- Nine red signal violations at Pico – Signal 5N from 2012-2015
- Five red signal violations at Maple Interlocking – Signal 2S from 2012-2015
- Eleven red signal violations at Washington & Flower Interlocking – Signals 8N & 2S from 2011-2015
- Six red signal violations at Washington Station – Signals 5N & 2S from 2011-2014
- Three red signal violations at 22nd Street Interlocking – Signal 2S from 2013-2014
- Three red signal violations at 30th Street Interlocking – Signal 2S from 2012-2-14
- Nine (9) red signal violations at Atlantic Station – Signals 2N & 4N from 2010-2015
- Four (4) red signal violations at Pico Aliso Station – Signals 2S & 4S from 2013-2016
- Nine (9) red signal violations at Ditman Interlocking – Signal 2N from 2010-2015

These eleven locations are identified within the Metro’s organization as “Priority Signal Locations”. It should be noted that the context of the TWG analysis is to identify specific signal configurations, operating practices, and other site specific factors that has contributed or could contribute to red signal violations. It should also be noted that it is not the intent of this review to perform a comprehensive assessment or analysis of the design and safety of the existing signal installations. However, where appropriate our team made a number of safety observations and reflected these observations in the report.

Our general approach to review, analyze and assess the priority signal locations includes the following elements:

- Conduct interviews with Metro’s operating, safety and maintenance representatives,



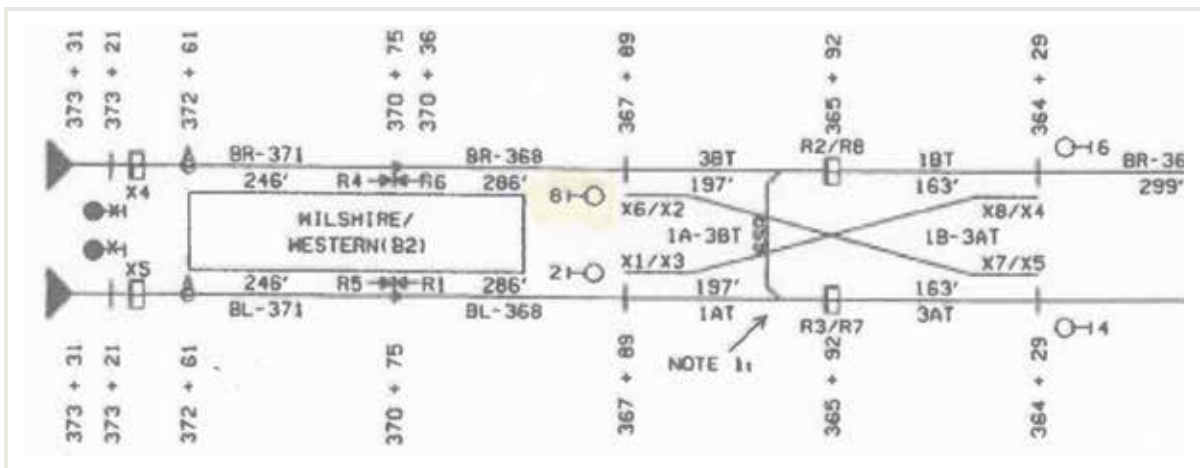
- Conduct interview with LADOT representative,
- Review signal configuration drawings,
- Conduct site visits to priority signal locations,
- Review Operating Rules & Procedures and SOPs,
- Review the findings of the APTA Peer Review Report,
- Review the Stop Signal Working Group documents, and
- Review the technical Provisions for Metro’s Contract to modernize existing SCADA/CTC system.

The results of our review and analysis are summarized in the following site specific reports:

Finding A10.1: Red Line, Wilshire/Western at Signal 8

During the years 2011 through 2015 six (6) red signal violations occurred at Signal 8, Wilshire/Western Station. Metro investigated these violation incidents and concluded that the root cause for each incident is attributed to “Operator Inattention”. No contributing factors were reflected in the reports.

In view of the high number of violations at this signal location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal configuration to determine if there are other factors that contributed to the violations.



Operating Characteristics

Wilshire/Western is a terminal station on the Red Line with operating characteristics similar to other terminal stations in the Metro network. This analysis focuses on establishing routes at interlocking signals and dispatching of trains.



A review of the Standard Operating Procedures (SOPs) for Controllers and Train Operators indicates that there are two ways to establish a route at Signal 8:

- Train operators can establish a route by activating a push Button at the signal location, or
- The Controller at the ROC can establish the route.

Our discussions with Metro’s Operations personnel provided insights about the operating history of this signal location. We found that for a long durations of time, train operators did establish the route at Signal 8. However, for undisclosed reasons, and during other periods of time, the ROC controller assumed the responsibility for establishing the route. This division in responsibility requires proper coordination between train operators and controllers. It is believed that one contributing factor to red signal violation at this location is the uncertainty as to who is responsible for route setting. This uncertainty can result in a false expectation by a train operator that the signal would clear. Also, a false expectation could be driven in part by lack of communication or misunderstanding in communication between train operators and controllers.

It should be noted that one of findings of the APTA Peer Review Panel is that “Train operators operate with the assumption that a signal would be clear or would change to a clear position”. This APTA finding supports our conclusion related to one of the contributing factors at this priority location.

With respect to train dispatching, the current operating procedures delegate the responsibility of dispatching trains at this terminal station to train operators. Pursuant to these procedures, a train operator uses his or her watch to determine when to close train doors, and depart the terminal station upon the establishment of the route for the leaving signal. This dispatching procedure requires close coordination between route setting and dispatching is required. When there is uncertainty as to who is responsible for route setting, it could result in false expectation that the leaving signal would clear.

Site Visit Observations:

Our site visit and inspection of the signal configuration at this location revealed the following:

- Although Metro signal standards require signals to be installed on the left of the track, Signal 8 is a right hand signal,



- The motorman pushbutton at the location does not include an indicator to inform the train operator if it is necessary to establish the route at the signal, and



- When the train operator's cab is aligned with the motorman pushbutton location, Signal 8 is not visible from the train operator's position. The train operator needs to lean to the right side of the cab to see the signal.



Factors that Can Contribute to Red Signal Violations:

Based on the above, it is believed that the following factors may contribute to red signal violations at signal 8:

- Lack of coordination between train operators and ROC controllers with respect to route setting,
- Lack of indication on the motorman pushbutton to inform train operator that it is necessary to establish the route at the signal location, and
- Poor visibility of signal 8 aspect from the train operator's position.



Recommendations:

A18: Metro should consider modifying the design of the motorman pushbutton to include an indicator. The indicator would be activated from the ROC to instruct the train operator to establish a route at Signal 8 when required.

A19: Metro should investigate the installation of a repeater signal for signal 8, which would be visible from the train operator's position in the cab.

A20: Metro should investigate the implementation of an ATD. Typically, an ADT system is driven by the operating schedule, and activates an indicator at the terminal station to instruct the train operator when to close the doors and depart the terminal. A current Metro Contract No. OP39603035 will provide the main tools necessary to implement ATD.

Finding A10.2: Blue Line – 7th Street & Metro Center - Signals 3N, 2S & 4S

A review of the red signal violation reports during the years 2011 through 2015 indicates that fourteen (14) red signal violations took place at 7th & Metro Center (7th Street & Flower Street) Terminal Station on the Blue Line. The violations occurred at the following signal locations:

- 3 violations at Signal 3N
- 4 violations at Signal 2S
- 7 violations at Signal 4S

Metro investigated these violation incidents and concluded that the root cause for each incident is attributed to "Operator Inattention". No contributing factors were reflected in the reports.

In view of the high number of violations at this terminal station, our team conducted a number of interviews with Metro's Operations personnel, and inspected the physical signal configuration at the station to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro's Stop Signal Working Group, as well as the ROC Controller SOPs and the Blue/Expo Train Operator SOPs.

Operational Characteristics of Terminal Station

The operation of the terminal station and associated tail tracks is governed by Standard Operating Procedures for ROC observers and Train Operators, as well as an Automatic Route Setting SCADA system as follows:



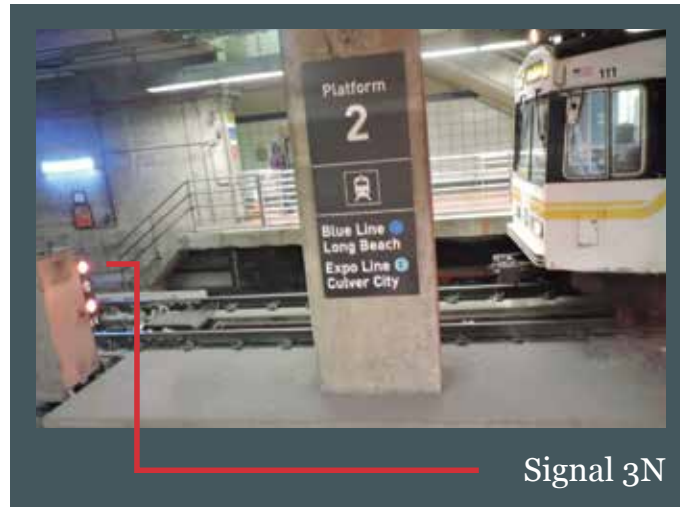
- There are two settings at the ROC for the terminal operation at 7th Street & Flower Street:
 - Central: Controller is responsible for establishing routes at the terminal, and
 - Auto: Train Operators are responsible for establishing routes at individual signal locations by activating a cab switch when the train is at a Train to Wayside Communication (TWC) location.
- If the terminal setting is “Auto”, there are two modes of operation (described only in the ROC Controller SOPs):
 - Mode 1 - Signal 3N displays a STOP indication after train berths on platform 1. Manual routing is required to route trains into the tail track, and
 - Mode 2 – Signal 3N will automatically route trains into the trail track for fallback procedure.
- The ROC Controller SOPs do not provide any other specific instructions related to the terminal operation at 7th Street & Flower Street.
- The Train Operator SOP is silent with respect to manually establishing a route at Signal 3N to the tail tracks.
- The TO SOP instructs Train Operators to activate the TWC to request routing from the tail track (either Signal 3S or 4S) to the designated platform.
- The TO SOP authorizes Train Operators to use “stop and Proceed” for scheduled move into and out of platforms and tail tracks.
- The TO SOP implies that the routes at leaving signals 1S & 2S will be established by the ROC controllers, and instructs Train Operators to contact the ROC if the departure route is not aligned and the proper indication is not displayed two (2) minutes prior to the scheduled departure time.
- The TO SOP instructs Train Operators to select a destination route at signals 1S & 2S, by entering a code on the cab thumbwheel. The TWC code will be transmitted to wayside signal equipment to establish the appropriate route at the Flower/Washington Junction.



- The TO SOPs indicate that there are differences in the mechanism to update the destination sign between P-865 vehicle and the P-2000 vehicle.



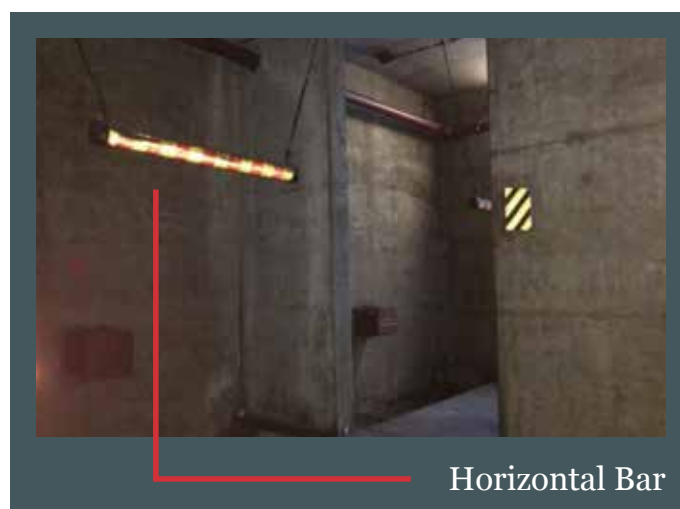
- The TO SOPs note that moves into occupied platform or tail track are prohibited without ROC authorization.

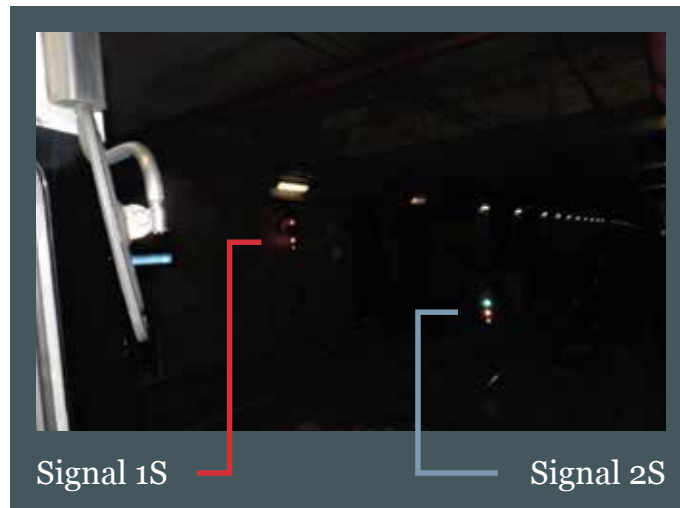


Site Visit Observations:

The following is a summary of our site visit observations, as well as observations from the site visit conducted by the Stop Signal Working Group:

- Good visibility of signal 3N,
- There is a horizontal bar at the end of the tail track. Train operators are reluctant to stop the train at the horizontal bar, and some train operators stop a few feet short of the horizontal bar for fear of hitting the bump wall. This tight configuration makes it difficult for train operators to see Signal 4S, especially if the train stops a few feet from the horizontal bar, and
- Good visibility for Signals 1S & 2S.





Factors that Can Contribute to Red Signal Violations:

The following factors can contribute to red signal violations at 7th Street & Flower Street Terminal Station:

- Tight configuration at tail track 35, making it difficult for train operators to see Signal 4S when the train is stopped a few feet from the horizontal bar at the end of the track.
- It is not clear how train operators can ascertain if signal 3N will clear automatically, or will require manual route setting.
- It is not clear what governs the selection of “Central” mode vs “Automatic” mode for terminal operation.
- Terminal dispatching is fragmented between train operators and controllers. While train operators are responsible for closing the doors, the ROC controller is responsible for establishing the route at the departing signal (1S and 2S). Further, it appears that the Controller relies on train operators to remind him or her if departing signal is not clear.
- This division of responsibility between controllers and train operators, and the different modes used to establish a route at signal 3N, could result in false expectation by train operators that an interlocking signal would clear. It should be noted that this site specific operational condition supports the General APTA Peer Review finding that “Train operators operate with the assumption that a signal would be clear or would change to a clear position”.

Recommendations:

A21: Metro should investigate the feasibility of relocating Signal 4S with associated IJ and TWC. Alternatively, Metro should consider the installation of a right hand repeater for Signal 4S.

A22: Metro should clarify who is responsible for establishing routes at leaving signals 1S & 2S.



A23: Metro should investigate the implementation of an Automatic Dispatching System (ATD). Typically, an Automatic Train Dispatching System is driven by the operating schedule, and activates an indicator at the terminal station to instruct the train operator when to close the doors and depart the terminal. The ATDS should also be coordinated with the route setting of departing signals. A current Metro Contract No. OP39603035 will provide the main tools necessary to implement ATD.

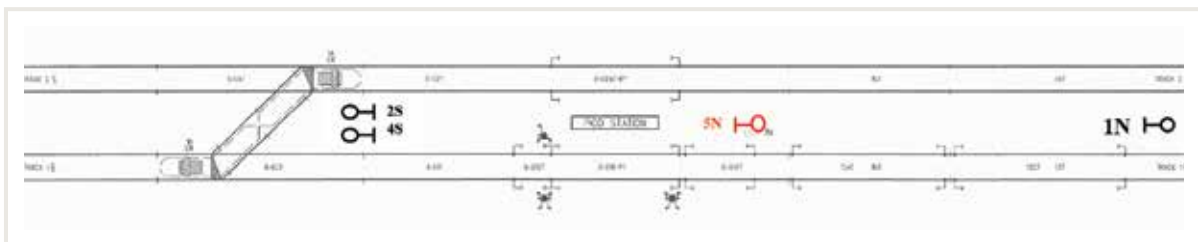
A24: Metro should review the current process for establishing a route at signal 3N, and investigate the feasibility of providing an indicator at the signal to inform the train operator when it is necessary to manually establish a route.

A25: Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central”, and wherein the normal mode of operation is “Automatic”.

A26: Metro should review the current SOPs for terminal operation at 7th & Flower, and make the necessary clarifications/changes to ensure proper coordination between ROC Controllers and Train Operators.

Finding A10.3: Blue Line – Pico Station: Signal 5N

A review of the red signal violation reports during the years 2012 through 2015 indicates that nine (9) red signal violations took place at signal 5N, Pico Station. Metro investigated these violation incidents and concluded that the root cause for eight (8) incidents is attributed to “Operator Inattention”. The ninth incident was attributed to a SCADA false indication. No contributing factors were reflected in the reports.



In view of the high number of violations at this signal location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal configuration to determine if there are other factors that contributed to the violations.





Operational Characteristics:

Signal 5N is located in Street Running territory, 300 FT North of the Pico Station, at the 12th Street intersection. The purpose of Signal 5N is to control the movement of Northbound trains into the portal, and to provide train separation for trains entering the portal. Signal 5N clears automatically if no train is present between signals 5N and 1N.

A review of the signal single line drawings shows that Signal 5N is located at least 50 feet south of the feed end for track circuit 15T. Further, the configuration of overlay track circuit 601AT does not detect a train crossing at Signal 5N. As such, it appears that Signal 5N will remain clear until the train reaches track circuit 15T, approximately for 50 FT past the signal location. Similarly, a train violating a stop aspect at 5N will not be detected for approximately 50 feet. Such operation is not desirable, and could be a contributing factor to red signal violation. The Blue/Expo Train Operator SOPs describes the procedure for operating in the approach to the portal, and specifically states that train operator will be governed by signal 5N. The SOPs then instruct the train operators to “Operate at 35 mph from Pico station until train is completely inside underground section”.

Site Visit Observations:

Signal 5N is clearly visible from the operator’s cab, and there is a sign in the approach to the signal, alerting the train operator to check the signal.

A field observation of the operation of signal 5N confirmed that the signal remains clear until the front end of a northbound train reaches the portal. Further, when the front end of the train reaches the portal, the train continues to block the 12th Street intersection.



The Stop Signal Working Group identified the following issues at Signal 5N:

- The bar signal at the intersection changes very quickly,
- The Limit Line at the signal location is barely visible, and
- The signal remains “Green” until the train crosses the intersection.



Factors that Can Contribute to Red Signal Violations:

While the Limit Line should be repainted, a violation of the limit line by itself does not register as a red signal violation because the controlling track circuit is located at least 50 feet north of the signal location. However, if the train stops past the limit line, then it will be difficult for train operator to see signal 5N. Upon the clearing of the bar signal at the intersection, and the movement of the train past the intersection, a red signal violation will register when the train passes the insulated joint for track circuit 15T.

With respect to a fast changing bar signal, this will not contribute to a violation. However, a clear bar signal at the intersection can distract train operators from paying attention to signal 5N. It should be noted that the APTA Peer Review Panel identified lack of coordination between bar signals and interlocking signals at an intersection a one of the contributing factors to violations.

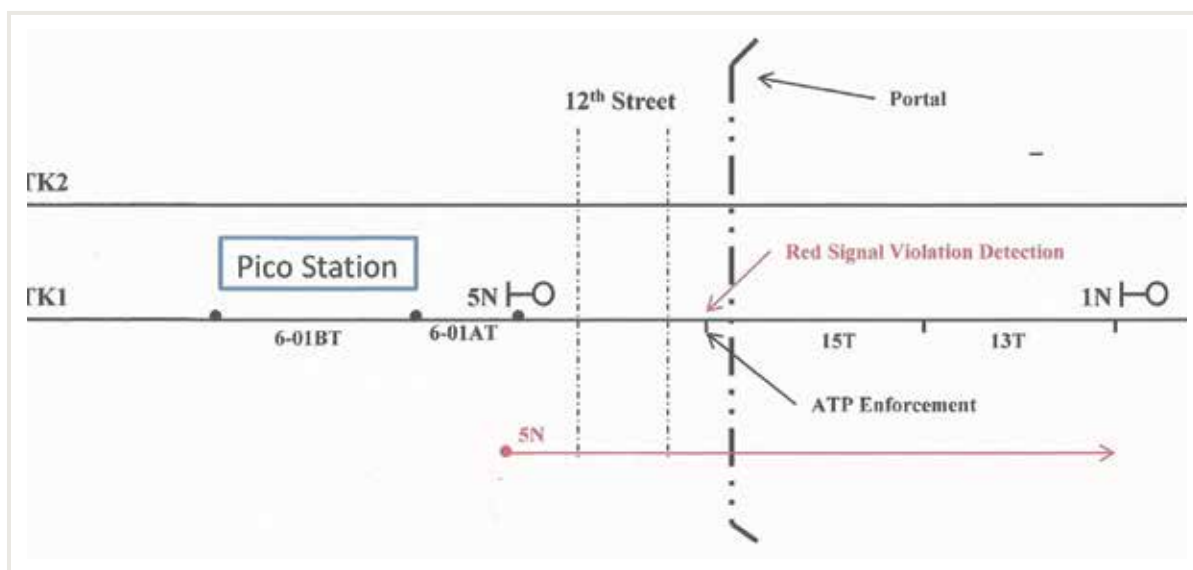
Another observation that should be noted is the text in the SOPs that instruct train operators to operate at 35 mph from Pico station until train is completely inside underground section. It is not clear why 35 mph, and this text should reference the bar signal at the intersection. It should be noted that if a train violates a red aspect at Signal 5N, and operates at 35 mph, then this can increase the risk of train to train collision. Signal 5N is a block controlled signal, and will display a red aspect if there is a train present on track circuit 15T or track circuit 13T. Depending on the position of a train ahead, the ATP enforcement at the portal may not provide sufficient braking distance to stop a train traveling at 35 mph in a downgrade area before colliding with the train ahead.



The interviews with Metro’s representatives revealed that as part of the Regional Connector project, Signal 5N will be relocated to the portal within ATP territory. However, the completion of this task will not occur until 2019. Further, by just relocating Signal 5N to the current boundary of track circuit 15 T, will result in the train blocking the 12th Street intersection when Signal 5N is displaying a “stop” aspect.

Safety Hazard at Signal 5N

As indicated above, there is a risk of train to train collision at Signal 5N. The following simplified drawing shows the main elements of the signal configuration between Pico Station and interlocking signal 1N in the approach to 7th & Metro Terminal Station:



The factors that contribute to this safety hazard are summarized as follows:

- As indicated above, Signal 5N operates as an automatic signal (block signal control) to provide train separation for trains entering the portal. Signal 5N displays a “stop” aspect if either 15T or 13T is occupied.
- There is no enforcement at Signal 5N. However, ATP enforcement starts at 15T.
- During 2012 through 2015, there were 9 red signal violations at Signal 5N.
- The signal configuration at this location is such that Signal 5N is located at least 50 feet south of the feed end for track circuit 15T. Further, the configuration of overlay track circuit 601AT does not detect a train crossing at Signal 5N. As such, Signal 5N will remain clear until the train reaches track circuit 15T, approximately for 50 FT past the signal location.
- A red signal violation at Signal 5N indicates that the violating train crossed the 12th Street intersection and reached 15T with a train still at the approach to Signal 1N.
- There is a downgrade in the approach to the portal.



- The Blue/Expo Train Operator SOP instructs train operators to maintain a speed of 35 MPH from Pico Station until the train is completely in the underground section.
- Typically, there is a visibility issue when a train approaches a portal due to the difference in lighting conditions.

While TWG acknowledges that in Street Running territories, the safety of operation depends on compliance by train operators with operating rules and procedures, there are a number of factors present at this location that increases the risk of collision. For example, if a train ahead “A” is stalled on 15T, Signal 5N will display a “stop” aspect. In the event a following train “B” violates Signal 5N, maintains a speed of 35 MPH as required by the SOP, while train “A” remains stalled on 15T, there is a risk of rear-end collision between trains “B” and “A”. Depending on the location of train “A” within 15T, the ATP enforcement may not have sufficient breaking distance to stop train “B” before colliding with train “A”.

TWG performed preliminary safety calculations to determine if sufficient breaking distance exists between the ATP enforcement point and a train stopped just inside the portal (portal location). This calculation is based on worst case condition, wherein a train is traveling at maximum attainable speed within Street Running territory (35 mph), violating a stop aspect at Signal 5N, and continuing to travel towards the portal without any further action on the part of the train operator (i.e. ATP activates the train brakes after expiration of equipment reaction time. The following data is used in the calculations:

- Drawings provided by Metro show the following location data for various elements:
 - Signal 5N: 43+20 (no enforcement and no RSV detection),
 - Track Circuit 15T: 42+00 (start of enforcement and detection of RSV), and
 - Portal: 37+80.
- Reaction time to activate train brakes: 4 seconds (provided by Metro during a conference call).
- Train deceleration rate: 2.8 Miles per Hour per Second.

The following is a summary of the calculations:

- The distance between start of ATP enforcement and portal is approximately: **420 feet** (downgrade).
- Based on a reaction time of 4 seconds, the train will continue to move for approximately 200 feet at 35 mph, before the brakes are applied.
- Braking distance to stop a train from 35 mph at level grade is approximately 320 feet for breaking rate of 2.8 m/h/s.
- Total distance to stop train is approximately **520 feet** at level track,
- The braking distance at 6% down grade is longer.



The above calculations show that under a worst case operating scenario, a train traveling at 35 mph, violating a stop aspect at Signal 5N, and moving forward towards the portal will collide with a train stopping at the portal.

In view of the finding of this safety hazard, TWG brought this issue to Metro's attention on April 10, 2016, and recommended that for Metro to issue a safety advisory instructing train operators to operate at a reduced speed in the approach to the portal. In response, Metro took immediate action to mitigate this hazard, including:

- Instructing train operators leaving Pico Station to limit train speed to not to exceed 20 mph until the train is completely in the underground section.
- Deploying Field Supervisors during peak service hours to 7th/Metro to discuss with operators the change in operational procedure entering the portal and the reason.
- Conducting speed checks from 12th Street to ensure that train operators are complying with the 20 mph speed restriction.

TWG believes that the actions taken by Metro are reasonable to address this safety hazard, and within the context of Metro's operating environment in street running territories. This conclusion is based on the following safety calculations associated with an operating speed of 20 mph:

- Based on a reaction time of 4 seconds, the train will continue to move for approximately 117 feet at 20 mph, before the brakes are applied.
- Braking distance to stop a train from 20 mph at level grade is approximately 105 feet for braking rate of 2.8 m/h/s.
- Total distance to stop train at level grade is approximately **222 feet**.
- The total distance to stop train at 6% downgrade is approximately **250 feet**, which is well below the **420 feet** between the ATP enforcement location and the portal.

TWG further recommended to Metro to conduct a braking test that verifies the initial hazard condition and the mitigation implemented by Metro. In addition, TWG recommended for Metro to install a speed sign of 20 mph in the approach to the portal.

Recommendations:

A27: Metro should repaint the Limit Line at signal 5N.

A28: Metro should conduct braking tests as discussed above.



A29: Metro should install a speed sign of 20 mph in the approach to the portal.

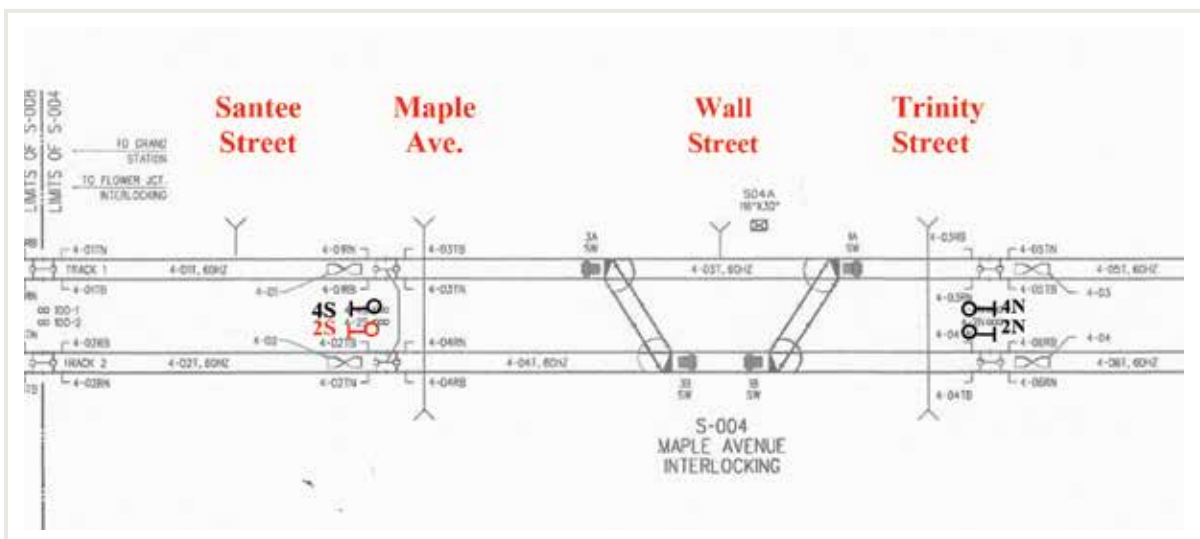
A30: Metro should advance the date of implementing modifications at Signal 5N. The modifications must ensure the safety of operation in the approach to the portal, and protecting a train stopped ahead in the approach to Signal 1N. The modification should also ensure that a train stopping at a relocated 5N will not block the intersection.

A31: Metro has revised the text in the SOPs that instruct train operators to operate at 35 mph from Pico station until train is completely inside underground section. If the results of the proposed test indicate a need to change the 20 mph speed limit, then Metro should further modify the text of the SOP as appropriate to ensure safety of operation.

A32: If Metro decides to leave Signal 5N at its current location, then Metro should add a track circuit between the current location for 5N and track circuit 15T. Metro should also investigate the feasibility of adding ATP enforcement at Signal 5N.

Finding A10.4: Blue Line – Maple Interlocking: Signal 2S

A review of the red signal violation reports during the years 2012 through 2015 indicates that five (5) red signal violations took place at signal 2S, Maple Interlocking. Metro investigated these violation incidents and concluded that the root cause for four (4) incidents is attributed to “Operator Inattention”. The root cause for the fifth violation was inconclusive. No contributing factors were reflected in the reports.



Operational Characteristics:

The Maple Avenue interlocking is located between San Pedro and Grand Stations within the Street Running territory. The ROC Controller SOPs indicate that Maple interlocking does not have an automatic mode, and that signal 2S should remain fleted during normal operation.



Site Visit Observations:

1. Signal 2S is located between Hill and Maple Streets, and is clearly visible from the operator's cab. A number of bar signals are located in the approach to, and ahead of signal 2S.
2. Reverse running signals 2N & 4S are installed on the right side of the track.

Factors that Can Contribute to Red Signal Violations:

A review of the red signal violation reports for Signal 2S show that in one of the violation incidents (# 2414720), the train operator stated that he was more concentrated on the vehicular traffic and bar signals, and was not focused on interlocking signal 2S. The Stop Signal Working Group indicated that this location has a history of “fleet dropping”, which requires re-establishment of the route by the ROC Controller. Since normally, signal 2S should be fleted, there is an expectation on the part of train operators that this signal would be clear. A memorandum from Signal Maintenance confirms the presence of glitches at this location, indicating that intermittent loss of switch indication at this interlocking is causing fleet to drop. Signal Maintenance further indicated that a recorder will be installed to help determine the root cause of the failure. Therefore, there are two contributing factors at this location:

- Since normally signal 2S is fleted, there is an expectation by train operators that it would be clear.



- The presence of bar signals in the approach to and ahead of signal 2S, wherein the bar signals are not coordinated with interlocking signal 2S, and the operating instruction to train operators to maintain a minimum speed of 32 mph in this section contribute to the violations.

Recommendations:

A33: Signal maintenance should follow up on the installation of an event recorder to determine the root cause for losing switch indication.

A34: Metro should instruct ROC Controllers to inform train operators any time the fleet feature is cancelled at an interlocking signal that is normally fledted.

A35: Metro should explore the implementation of technologies that will provide a cab alarm when a train is approaching a red signal.

A36: Metro should provide training modules to train operators that focus on site specific situations, wherein interlocking signal and bar signal could conflict.

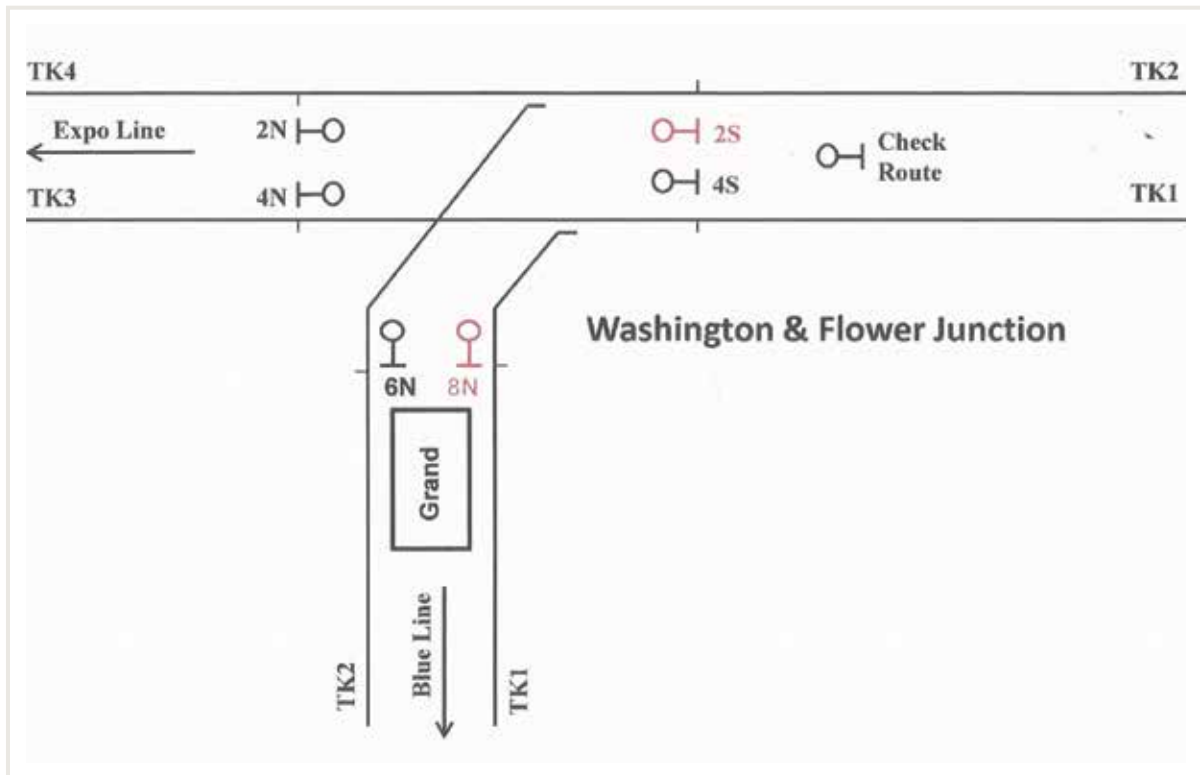
Finding A10.5: Blue Line – Washington & Flower (Junction): Signals 8N & 2S

A review of the red signal violation reports during the years 2011 through 2016 indicates that eleven (11) red signal violations took place at Washington & Flower (Junction) Interlocking. The violations occurred at the following signal locations:

- 8 violations at Signal 8N, and
- 3 violations at Signal 2S.

Metro investigated these violation incidents and concluded that the root causes for 10 incidents are attributed to “Operator Inattention”. The remaining incident is attributed to ROC error.





In view of the high number of violations at this interlocking, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Blue/Expo Train Operator SOPs.

Operational Characteristics of Washington & Flower Junction:

The ROC controller SOP indicates that the routes at the Washington & Flower Junction are established as follows:

- Southbound routes (signals 2S & 4S) for trains originating at 7th & Metro are established based on the TWC code that was imputed by train operators via thumbwheels,
- Northbound routes (signals 2N, 4N, 6N & 8N) are established based on “first come, first serve”,
- Signals are called when trains are in the approach, and
- A “Check Route” sign is provided in the approach to signals 2S and 4S to remind train operators to ensure that the proper route at these signals is established.





Site Visit Observations:

The site visit revealed that signals 2S and 4S have good visibility. However, these southbound signals are installed side-by-side, which is contradictory to basic training provided to train operators.



Similar operating conditions exist at northbound signals 2N & 4N: good visibility however, the signals are installed side-by-side.



With respect to northbound signal 8N, it is partially obstructed by automatic vending machines installed at the north end of Grand/LATTC Station.



The Stop Signal Working Group identified two main issues at Washington & Flower Junction:

- There are issues that could result in misrouting of trains at Signal 2S, and
- Signals installed on the right side of the track contradict with what was taught to train operators,

With respect to misrouting at Signal 2S, it should be noted that some of the documented violations at Signal 2S are related to a train operator taking the wrong route.

Factors that Can Contribute to Red Signal Violations:

Based on the above, it is believed that poor visibility at Signal 8N contributes to red signal violations at Washington & Flower Junction. It is not clear who is responsible for re-establishing a route at signal 2S in the event of a misrouting condition. A lack of consistency or uncertainty related to route setting could lead to false expectation that a signal would clear.

Recommendations:

A37: Metro should investigate alternatives to improve the visibility of Signal 8N.

A38: Metro should implement consistent route setting at least within the same line. Metro is currently implementing a project to modernize its SCADA/CTC system (Contract No. OP39603035). This project will provide the tools necessary to implement consistent route setting.



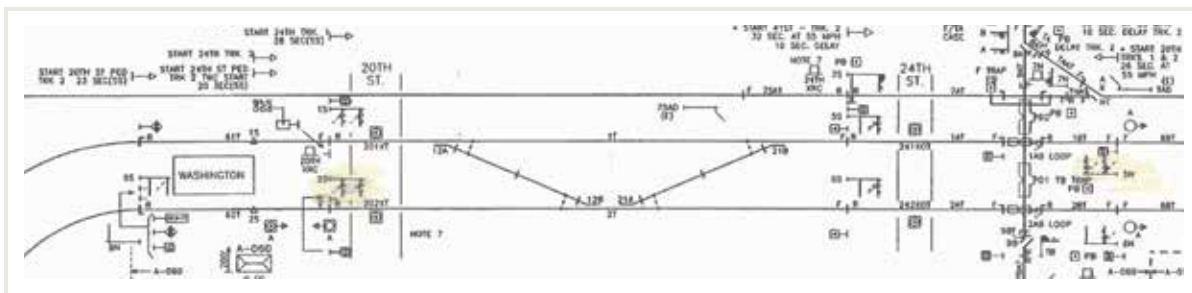
A39: Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central”, and wherein the normal mode of operation is “Central”.

Finding A10.6: Blue Line – Washington Station: Signals 5N & 2S

A review of the red signal violation reports during the years 2011 through 2014 indicates that six (6) red signal violations took place at Washington Station. The violations occurred at the following signal locations:

- 2 violations at Signal 5N, and
- 4 violations at Signal 2S.

Metro investigated these violation incidents and concluded that the root causes for all incidents are attributed to “Operator Inattention”.






In view of the high number of violations at this location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Blue/Expo Train Operator SOPs.

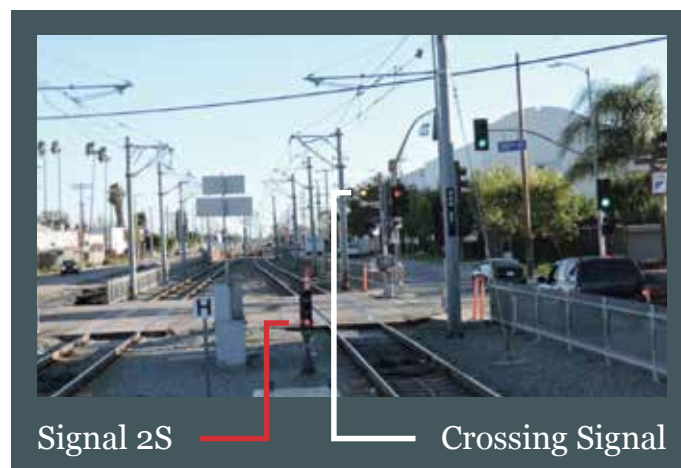
Operational Characteristics of Washington Station

Some of the operational characteristics at Washington Station are related to the presence of a gate crossing installation at 20th Street, south of the station. More specifically, the interlocking signals at the approach to the 20th Street intersection require the gates to be secure in the down position before displaying a clear aspect. Further, the crossing installation includes an independent signal that informs the train operator that it is safe to proceed through the interlocking (a flashing yellow). A summary of relevant operational features includes:

- While the interlocking signal (2S) is interlocked with the crossing gates, the crossing signal can clear even though a route has not been established at the interlocking signal.
- Signal 2S is an approach clearing signal. A train must be on track circuit 62AT before the signal clears. 62AT also activates the gates at 20th Street.
- In the event of a crossing gate failure, train operators need a clearance card to proceed through the intersection, and permission to use “Stop & Proceed” to pass the interlocking signal (2S).
- Under normal operating conditions (absence of failures), a train operator can only proceed through the 20th Street intersection upon clearing of both interlocking signal 2S and the crossing signal.
- The Operating Rules and Procedures include two rules related to crossing gate indications for the Gold Line. However, there are no corresponding rules for the Blue/Expo Line. However, the text for the flashing yellow indication does not take into consideration a configuration similar to the installation at Washington Station. It is difficult to coordinate the gate indication with an interlocking signal indication because the gate indication is provided for both directions of traffic, while an interlocking signal is related to a single traffic direction.

Gold Line Crossing Gate 		
Aspect	Indication	Signal
Yellow	Reduce speed, Prepare to STOP.	
Flashing Yellow	Resume normal speed, crossing gates are down and locked.	

The current crossing gate indications are fine provided that they are used consistently and explained in the operating rules and procedures. The issue is one of coordinating cross gate indication with interlocking signal indication.



The Stop Signal Working Group identified two main issues at Washington Station:

- There is potential for human error due to frequent occurrence of gate failure, and the need to rely on rules and procedures to operate through the crossing,
- Signal 2S is not clearly visible. The Stop Signal Working Group recommended to either raise the signal, or relocate it to the platform.

Site Visit Observations:

The following is a summary of our site visit observations:

- Signals 5N and 2S are located on the left side of the track, and are clearly visible as a train approaches the signals. However, there is a case in the approach of Signal 2S, which partially obstructs the signal from the station platform. As indicated above the Stop Signal Working Group recommended raising the signal.



- Signal 9S is installed at the entrance to the station. Its function is to control the movement of a train into the station. It normally displays a FG/R (Flashing Green over Red) if there is no train at the platform. If a train is berthed at the platform, signal 9S displays R/R (Rule 3082). Also, this signal is located at the boundary between street running and ATP (cab-signaling) territory. There is a sharp curve in the approach to the signal, which results in a short sighting distance for the signal. Further, there is no enforcement at this signal, and safety of operation depends entirely on compliance with operating rules and procedures.





- Signal 9N is a reverse running signal located at the entrance to street running territory. It normally displays a “Red” aspect, and requires authorization from the ROC to proceed (Rule 3082). This signal is at the approach to a sharp curve.

Factors that Can Contribute to Red Signal Violations:

- Conflicting indications between Signal 2S and crossing signal,
- Obstructed visibility of Signal 2S, and
- Frequent occurrence of gate failure.

In addition, the safety of operation at signals 9S & 9N relies completely on compliance with operating rules and procedures. Further, it should be noted that although Rule 3082 requires the ROC controller to authorize the movement of a reverse running train at signal 9N, there is no train detection equipment north of Signal 9N to provide train detection information at the ROC.

Recommendations:

A40: Metro should review the text of the rule associated with the crossing gate, and make appropriate modifications.

A41: Metro should survey Signal location 2S to determine if modification is warranted.

A42: Metro should conduct a risk assessment of the operation of Signal 9S, and implement signal modifications as necessary.

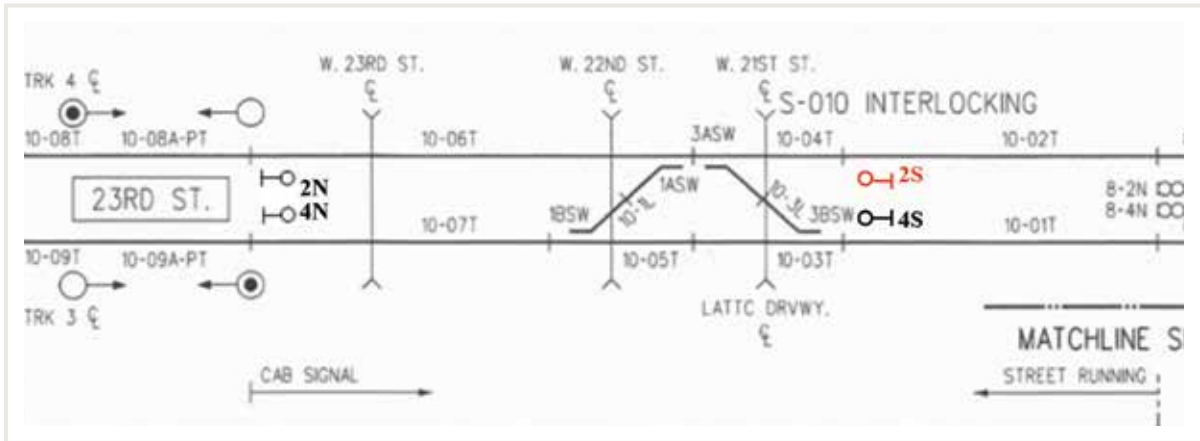
A43: Metro should install train detection equipment at the curve north of Washington Station to provide visibility of train movements to controllers at the ROC.



Finding A10.7:

Expo Line – 22nd Street Interlocking: Signal 2S

A review of the red signal violation reports during the years 2013 through 2014 indicates that three (3) red signal violations took place at signal 2S, 22nd Street Interlocking. Metro investigated these violation incidents and concluded that the root cause for one incident is attributed to “ROC error”. The remaining two incidents were attributed to “Operator Inattention”. No contributing factors were reflected in the reports.



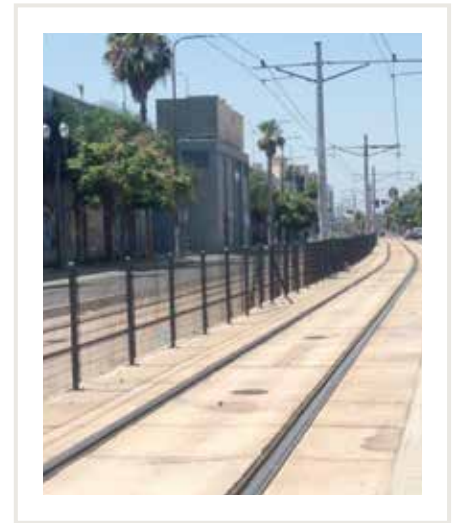
In view of multiple violations at this location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Blue/Expo Train Operator SOPs.

Operational Characteristics of 22nd Street Interlocking

With respect to the operational characteristics at 22nd Street interlocking, this location is similar to other interlocking locations within street running territory.



The normal and reverse running signals 2S & 4S are installed side-by-side, and are located in the approach to the 21st Street intersection. A traffic Bar Signal is located at the far right corner of the intersection, and operates independently of the interlocking signals. The ROC Controller SOPs indicate that this interlocking does not have an “Automatic” mode and that during normal operation, the interlocking remains in “Central” mode with signals 2S and 4N fleted.



Site Visit Observations:

The following is a summary of our site visit observations:

- Reverse running signal 4S is installed on the right side of the track,
- There is a slight curve in the approach to signal 2S, and
- A “radio” sign is partially obstructing signal 4N at the north end of the station.

The Stop Signal Working Group did identify the curve in the approach to Signal 2S as a potential contributor to red signal violation. It was indicated that it is difficult to see the signal from 500 feet. However, the signal representative indicated that there is a restricted speed approaching the station, and train operators should be slowing down.



Factors that Can Contribute to Red Signal Violations:

As indicated above, one of the three violations at Signal 2S was attributed to ROC error, and the remaining two violations to “Operator Inattention”. However, one of these two violations involved a landscaper on the right of way, which could have distracted the train operator. Other factors that could contribute to violations at this location include:

- Lack of coordination between Signal 2S and the Bar signal at the intersection,
- Lack of uniformity in the placement of interlocking signals,
- Obstructed visibility of Signal 4N, and
- The presence of a curve in the approach to Signal 2S, with potential impact on signal visibility.

Recommendations:

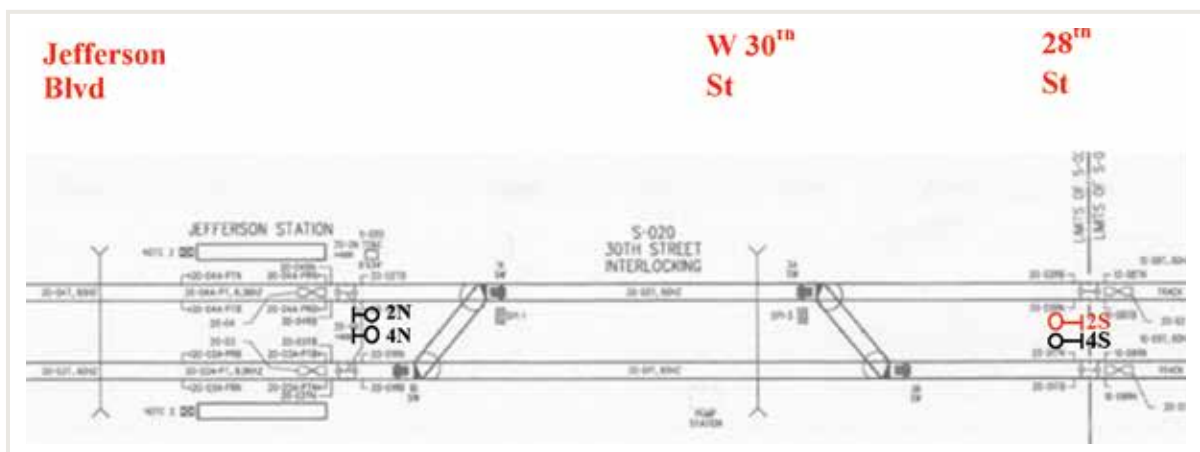
A44: Metro should relocate the radio sign that is partially obstructing Signal 4N.

A45: Metro should investigate the feasibility of implementing technologies to provide cab indication/ alarm when a train is approaching a red signal.

A46: Metro should instruct ROC Controllers to inform train operators any time the fleet feature is cancelled at an interlocking signal that is normally fleted.

Finding A10.8: Expo Line – 30th Street Interlocking: Signal 2S

A review of the red signal violation reports during the years 2012 through 2014 indicates that three (3) red signal violations took place at signal 2S, 30th Street Interlocking. Metro investigated these violation incidents and concluded that the root cause for two incidents is attributed to “Operator Inattention”. The third incident appears to be caused by Controller’s error (Incident # 2,314,918). No contributing factors were reflected in the reports.



In view of multiple violations at this location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Blue/Expo Train Operator SOPs.

Operational Characteristics at 30th Street Interlocking

With respect to the operational characteristics at 30th Street interlocking, this location has similarities to other interlocking locations within street running territory. The normal and reverse running signals 2S & 4S are installed side-by-side in the approach to 28th Street intersection. Similarly, the northbound signals 2N & 4N are installed side-by-side. The ROC Controller SOP indicates that this interlocking does not have an “Automatic” mode and that during normal operation, the interlocking remains in “Central” mode with signals 2S and 4N fleted.

Site Visit Observations:

The following is a summary of our site visit observations:

- Reverse running signals 2N & 4S are installed on the right side of the track,
- Good visibility for signals 2S & 4S. However, there is a slight curve in the approach to the signals, and
- Good visibility for signals 2N & 4N.

The Stop Signal Working Group made reference of the curve in the approach to Signals 2S & 4S. The group also observed that Signals 2N & 4N are too low and recommended raising the signals.



Factors that Can Contribute to Red Signal Violations:

There are no site specific factors that contribute to red signal violations. However, there are a number of factors that are common in many street running interlocking signal locations:

- Lack of coordination between Signal 2S and the Bar signal at the intersection,
- Lack of uniformity in the placement of interlocking signals, and
- At interlocking locations wherein signals are normally fledted, train operators expect that signals would be clear. Under certain operating conditions when the fleet is cancelled, there could be a false expectation that would contribute to violations.

Recommendations:

A47: Metro should investigate the feasibility of implementing technologies to provide cab indication/ alarm when a train is approaching a red signal.

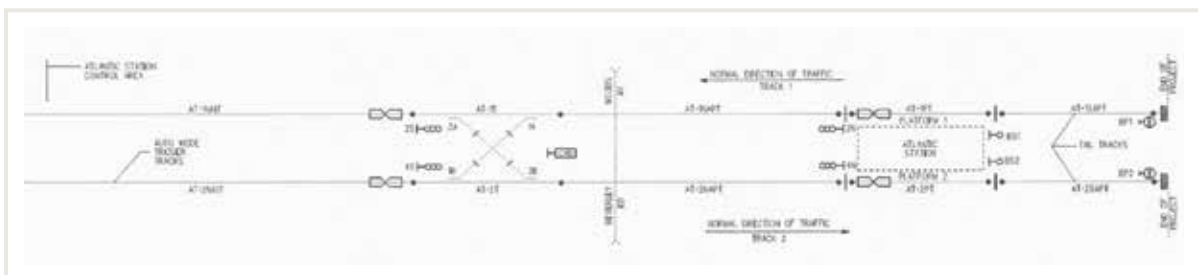
A48: Metro should instruct ROC Controllers to inform train operators any time the fleet feature is cancelled at an interlocking signal that is normally fledted.

Finding A10.9: Gold Line – Atlantic Station: Signals 2N & 4N

A review of the red signal violation reports during the years 2010 through 2015 indicates that nine (9) red signal violations took place at Atlantic Station. The violations occurred at the following signal locations:

- 4 violations at Signal 2N, and
- 5 violations at Signal 4N.

Metro investigated these violation incidents and concluded that the root causes for 8 of the 9 incidents are attributed to “Operator Inattention”. The remaining incident was not a violation, but rather a SCADA error. No contributing factors were reflected in the reports.



In view of multiple violations at this location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Gold Train Operator SOPs.

Operational Characteristics at Atlantic Station:

With respect to the operational characteristics at Atlantic Station, this location is a terminal station and has similar operating characteristics to other terminal stations in the Metro network, wherein train operators are responsible for dispatching trains based on the operating schedule. In general, the ROC Controller SOPs indicate that fleeting is not available for interlocking signals on the Gold Line. Further, route setting is provided through the following modes:

- Automatic:
 - Train Operator initiates route through TWC (Terminal Station)
 - Approach route setting (Block Clearing) – intermediate locations,
- Central: Manual route setting from ROC, and
- Local: Operation is taken over at Local Control Panel (LCP).

With respect to the operation at the Atlantic Terminal station, train operators are responsible for dispatching trains based on the operating schedule. A train operator closes the train doors, then establishes a route at signal 2N or 4N, and departs the terminal when the signal clears.

Site Visit Observations:

The following is a summary of our site visit observations:

- Reverse running signal 2S is installed on the right side of the track,
- Good visibility for signals 2N & 4N, and
- Good visibility for signals 2S & 4S.



The Stop Signal Working Group made a number of observations related to the angle/orientation at the various signals. Further, the group questioned if the 500 feet sighting distance requirement is satisfied at signals 2S & 4S.





Factors that Can Contribute to Red Signal Violations:

There are no site specific factors that contribute to red signal violations. However, similar to other terminal stations, there are operational factors that can contribute to the violations:

- It is not clear what governs the selection of “Central” mode vs “Automatic” mode for terminal operation.
- When the terminal operates in “Central” mode, train dispatching task becomes a joint effort between train operators and ROC controller. This division of responsibility could result in false expectation by train operators that the leaving signal would clear. It should be noted that this terminal operating condition supports the General APTA Peer Review finding that “Train operators operate with the assumption that a signal would be clear or would change to a clear position”.

Recommendations:

A49: Metro should investigate the implementation of an Automatic Dispatching System (ATD). Typically, an Automatic Train Dispatching System is driven by the operating schedule, and activates an indicator at the terminal station to instruct the train operator when to close the doors and depart the terminal. The ATD System should also be coordinated with the route setting of departing signals. A current Metro Contract No. OP39603035 will provide the main tools necessary to implement ATD.

A50: Metro should review the current SOPs for terminal operation at Atlantic Station, and make the necessary clarifications/changes to ensure proper coordination between ROC Controllers and Train Operators.

A51: Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central”, and wherein the normal mode of operation is “Central”.

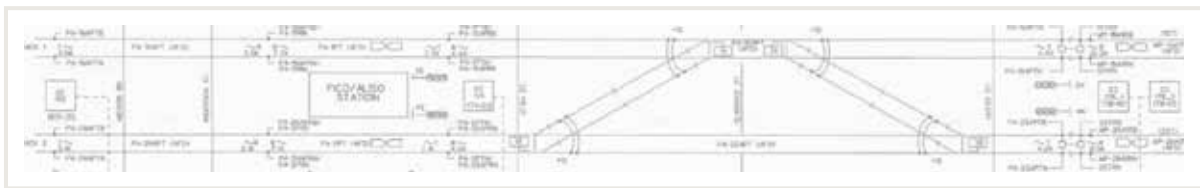


Finding A10.10: Gold Line – Pico Aliso: Signals 2S & 4S

A review of the red signal violation reports during the years 2013 through 2016 indicates that four (4) red signal violations took place at Pico Aliso Station. The violations occurred at the following signal locations:

- 2 violations at Signal 2S, and
- 2 violations at Signal 4S.

Metro investigated these violation incidents and concluded that the root causes for all four incidents are attributed to “Operator Inattention”. No contributing factors were reflected in the reports.



In view of multiple violations at this location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Gold Line Train Operator SOPs.



Operational Characteristics at Pico Aliso Station:

With respect to the operational characteristics at Pico Aliso Station, this location has similarities to other interlocking locations within street running territory. The normal and reverse running signals 2N & 4N are installed side-by-side in the interlocking and past Gless Street intersection. Based on description in



the ROC Controller SOPs, Signals 2S and 4S have approach clearing if the interlocking is operating under “Automatic” mode. However, a review of the incident reports does not reveal the mode of operation in effect at the time of the violation incidents.



Site Visit Observations:

The following is a summary of our site visit observations:

- Reverse running signal 4N is installed on the right side of the track,
- Good visibility for signals 2N & 4N, and
- Good visibility for signals 2S.
- The “Green” aspect of Signal 4S is partially obstructed by the protection barrier as a train approaches the signal.

The Stop Signal Working Group noted that the barrier is partially obstructing the view of Signal 4S.

Factors that Can Contribute to Red Signal Violations:

There are no site specific factors that contribute to red signal violations. Although Signal 4S is partially obstructed, the signal is visible when a train is stopped at the station. However, similar to other locations, there are operational factors that can contribute to the violations:

- The mode for this interlocking location is normally set to “Automatic” mode, which means that the route at an interlocking signal is normally established when the train moves to the approach track circuit. Because signal 4S is located at the leaving end of the station, the route should be established when the train enters the station. In the event the interlocking is placed in “Central” mode, the route needs to be established by the ROC Controller. Proper coordination between Train Operators and Controller is then necessary to prevent violations.



Recommendations:

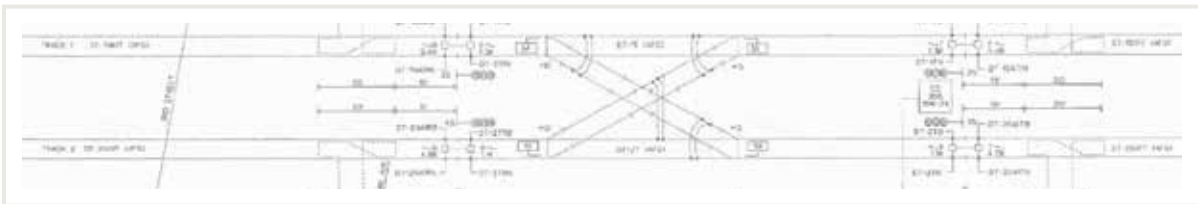
A52: Metro should implement consistent route setting at least within the same line. Metro is currently implementing a project to modernize its SCADA/CTC system (Contract No. OP39603035). This project will provide the tools necessary to implement consistent route setting.

A53: Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central”, and wherein the normal mode of operation is “Central”.

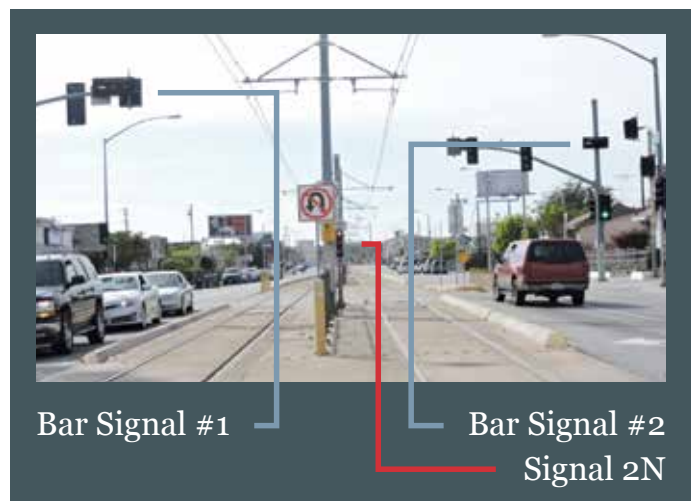
Finding A10.11: Gold Line – Ditman Interlocking: Signal 2N

A review of the red signal violation reports during the years 2010 through 2015 indicates that nine (9) red signal violations took place at Ditman Interlocking.

Metro investigated these violation incidents and concluded that the root causes for all nine incidents are attributed to “Operator Inattention”. No contributing factors were reflected in the reports.



In view of multiple violations at this location, our team conducted a number of interviews with Metro’s Operations personnel, and inspected the physical signal installation to determine if there are other factors that contributed to the violations. Further, our team reviewed the Site Visit Reports provided by the Metro’s Stop Signal Working Group, as well as the ROC Controller SOPs and the Gold Train Operator SOPs.



Operational Characteristics at Ditman Interlocking:

With respect to the operational characteristics at Ditman Interlocking, this location has similarities to other interlocking locations within street running territory. The normal and reverse running signals 2N & 4N are installed side-by-side. Based on description in the ROC Controller SOPs, Signals 2S, 4S, 2N and 4N have approach clearing if the interlocking is operating under “Automatic” mode. However, a review of the incident reports does not reveal the mode of operation in effect at the time of the violation incidents.

Signal 2N, where all the violations occurred, is located between two street intersections with Rowan Ave. There is a first Bar Signal (#1) located at the left side of the track in the approach to signal 2N, and a second Bar Signal (# 2) located at the right side of the track in front of Signal 2N. Similar to other locations, interlocking signal 2N and the Bar Signals operate independent of each other.



Site Visit Observations:

The following is a summary of our site visit observations:

- Reverse running signal 4N is installed on the right side of the track,
- There are a number of traffic signs and a case that are installed in the approach to signal 2N, and are partially obstructing the view of the signal,
- Bar Signals #1 & #2 clear concurrently, and
- A train stopping at signal 2N will obstruct vehicle traffic at the first Rowan intersection.

The Stop Signal Working Group made a number of observations, including:

- No sign present for train operators to check for signal, and
- Excessive number of signs at the location.

Factors that Can Contribute to Red Signal Violations:

- Lack of coordination between the clearing of Bar Signals and the clearing of interlocking signals 2N & 4N,
- Obstructed view of Signal 2N due to the presence of traffic signs, and
- Signal 2N is an approach clearing signal provided the interlocking is in “Automatic” mode. If the interlocking is in “Central” mode, and the route is not established, train operator’s false expectation that the signal would be clear or will change to a clear position could be a contributing factor.

Recommendations:

A54: Metro should investigate the feasibility of relocating Signals 2N and 4N to the south side of the first Rowan intersection. It should be noted that the installation of an approach signal to Signal 2N does not provide advance indication to train operators because Signal 2N is approach clearing and will normally display a “stop” aspect without a train present on the approach track circuit.

A55: Metro should instruct controllers to inform train operators any time a controller switches the mode of operation of an interlocking from “Automatic” to “Central”, and wherein the normal mode of operation is “Central”.





Metro

Interoffice Memo

Date October 21, 2016

To Karen Gorman
Inspector General

From James T. Gallagher *JTG.*
Chief Operations Officer

Subject Safety Culture Report

I have received from your office and reviewed the Safety Culture Report dated October 6, 2016.

We in Operations will begin the process of understanding and implementing the recommendations immediately. I expect to provide you in approximately a month, a separate document with a detailed matrix of the status of our agreement with an approach to the various recommendations.

I trust this meets your immediate needs in this matter.

CC:

Greg Kildare

✓ Bernard Jackson

Bob Spadafora

✓ Frank Alejandro

✓ Diane Corral-Lopez

Jon Hillmer

Bob Holland

Alex DiNuzzo