



Customer Service, Operations and Security Committee

Information Item III-B

November 3, 2016

Overnight Maintenance Window

Washington Metropolitan Area Transit Authority

Board Action/Information Summary

☐ Action ☒ Information

MEAD Number:
201811

Resolution:
☐ Yes ☒ No

TITLE:

Overnight Maintenance Window

PRESENTATION SUMMARY:

The Board's Customer Service, Operations and Security Committee will receive a briefing on Metro's new aggressive Preventative Maintenance (PM) plan that requires a change to hours of operation in rail service.

PURPOSE:

To provide a comprehensive overview of Metro's first industry grade preventive maintenance program. Rebalancing non-passenger service and maintenance windows will drive sustained improvements in reliability to train service.

DESCRIPTION:

Each of the four "Hours of Service" scenarios proposed at the September 8, 2016 Customer Service, Operations and Security meeting would increase the work window for overnight rail system maintenance. This presentation explains what programs will be implemented with this additional time and the anticipated impact on reliability.

Key Highlights:

Five preventative maintenance programs that will be predominately carried out during non-passenger service hours overnight.

- Preventive maintenance program will reduce service disruptions due to track failures such as insulator fires, cable fires, broken rail, and broken fasteners.
- Overnight maintenance will create opportunities to identify and repair track problems before they disrupt daytime rail service.
- Many maintenance tasks require a train free environment with no power to the rails in order to be safely performed.
- Current programs are inefficient because the work windows are too short and crews are underutilized.
- Multiple reviews by oversight and peer agencies have all reached the same conclusion that Metro needs more maintenance time.

Background and History:

Metro's current work window Sunday through Thursday provides five hours of non-

passenger service that allows for a 2-3 hour productive work window, once the last train is off the line and the work areas have been safely established. Prior to SafeTrack, there was a four hour non-passenger train window on Friday and Saturday nights with the system closing at 3am and opening at 7am. This yielded a one-hour work window which was unproductive for preventative maintenance and therefore only used for emergency work.

Discussion:

The additional time would allow for new and expanded programs consisting of new preventative maintenance programs, quality control and quality assurance, basic maintenance tasks prescribed by our standards and industry best practices, as well as benefiting capital programs like the radio project.

New Preventive Maintenance Programs (PM): At the conclusion of SafeTrack, Metro will commence industry standard PM programs. Prior to SafeTrack, these critical programs had either been inadequately implemented or not carried out to a degree sufficient to deliver meaningful results. The five PM programs that Metro will initiate after SafeTrack are:

- Systemwide Tamping and Surfacing (T&S)
- Interlocking Component Maintenance
- Mechanical Joint Maintenance
- Traction Power Cable Meggering
- Earth to Ground Stray Current Testing

These PM programs will be predominantly carried out during non-passenger service hours overnight. This recognizes that weekend single tracking operations, weekend shutdowns and weeknight early outs on line segments are primarily focused on capital work that involves the replacement or rehabilitation of wayside components and infrastructure. A robust and well-resourced PM program is critical to ensure the long-term safety and reliability of Metro's aging infrastructure.

Details for each new PM program are noted below.

Tamping and Surfacing (T&S): Metro intends to commence a T&S program in which all ballasted mainline track would be tamped and surfaced once every two years. Depending on many variables, to include but not limited to substructure condition and gross tonnage, these T&S cycles may be less or more than once every two years. T&S is the most fundamental and critical PM activity for ballasted track. T&S entails using a piece of computerized track equipment to adjust the vertical (profile) and horizontal (alignment) geometry of the track to restore the track to its' as built geometry. The tamping equipment lifts the track and vibrates ballast under the tie to ensure adequate tie support. Sound tie support extends the life of the tie and further reduces rail breaks as the rail is less prone to severe bending stress. While using the tamping equipment, ballast is often added to the track to attain the proper vertical (profile) geometry and to ensure the tie is properly supported on all sides. Metro maintains 99 miles of ballasted track. On an annual basis, Metro must T&S 50 miles, or 264,000 linear feet (LF), of ballasted track.

In addition all ballasted switches in mainline track would be tamped and surfaced once every year. T&S of ballasted switches is critical to ensure proper support of the switch area to allow the safe passage of trains in this segment of track. A primary cause of track circuit failures in ballasted switches is poor ballast support. If the switch is not properly supported (from the insulated joint leading up to the point of switch through the crossing) it is probable that the track circuit will fail because the track circuit is reliant on the proper alignment of the many components of a railroad switch. Metro maintains 314 mainline switches. Of those, approximately 200 are in ballasted track.

Interlocking Component Maintenance: This PM program primarily consists of switch point grinding and frog grinding and welding. This PM program is critical to ensure these high impact track components remain in a state of good repair. Over the past three to four years, Metro has experienced a significantly high failure rate of in service frog points. As pointed out by external consultants, Metro does not carry out a routine frog grinding and welding maintenance program to properly maintain these high impact track components that is critical to ensure proper wheel and rail interface.

Mechanical Joint Maintenance: This PM program primarily consists of spot tamping and adding ballast, tightening and replacing bolts and nuts, and spot tie replacement. Similar to interlockings and switches, mechanical joints represent a high risk area that require special PM programs. Metro experiences numerous service delays due to broken joint bars and broken joint bar bolts because they are not properly maintained. Due to the excessive dynamic loading at mechanical joints, the fastening systems (ties, fasteners, grout pads, stud bolts) that support the joints, and the underlying substructure, experience accelerated deterioration as compared to track segments with no joints. The time and frequency to properly maintain a mechanical joint varies significantly due to a multitude of variables. Currently, Metro has approximately 1,200 open joints in the mainline track system and at a minimum, each joint must be maintained on an annual basis.

Traction Power Cable Meggering: This PM program is intended to identify high voltage cables that no longer maintain the ability to adequately insulate electrical current. A majority of traction power cables are not visible as they are carried in conduit. As such, defective cables cannot be identified through visual inspection. Meggering a traction power cable is a time-intensive effort, as it requires manually disabling all of the breakers which provide power to the cable being tested, and then disconnecting the cable from the breaker housing and its point of connection along the wayside. Degraded traction power cables are a significant risk and the program is designed to identify those cables prior to failure.

Earth to Ground Stray Current Testing: This PM program is intended to identify defective components within the negative side (return circuit which carries the electrical current from the running rails back to the negative switch board in the traction power substation) of the traction power circuit. Particularly in wet areas of the tunnel system, stray current is the root cause of many defects that negatively impact safe and reliable service. Stray current significantly accelerates the degradation of track components to include direct fixation fasteners, the rail clips which secure the rail to the direct fixation fastener and the anchor bolts which secure the direct fixation fastener to the tunnel floor. Stray current is also a primary cause of track circuit failures and direct fixation fastener fires. Similar to meggering a traction power cable, this time-intensive PM

program entails manually disabling all power in the area and further disassembling rail joints within the track so test voltage can be inducted **into the circuit in order to identify where the current is not following its intended path.**

Quality Control and Quality Assurance: In order to ensure these new PM programs deliver the intended results, Metro will take advantage of the additional eight hours of non-passenger service to carry out a robust Quality Control (QC) and Quality Assurance (QA) program. Metro's Track and Structures (TRST) department is currently building a Compliance Office, which will be responsible for performing quality control functions over work performed in the field. In addition, as demonstrated during SafeTrack, Metro will continue to carry out QA sampling of work performed in the field. During SafeTrack, Metro built a robust QA function that reports directly to the General Manager. The QA function, carried out by the Quality and Internal Compliance Office (QICO), currently sends weekly field audit reports directly to the General Manager. Under this proposal, extending non-passenger hours will enable Metro to continue QA activities over track work after SafeTrack.

Basic Maintenance Tasks: Beyond the aforementioned PM programs and QC/QA functions, there are several fundamental tasks that require additional non-passenger hours. Over the past year, several third parties have identified the following tasks that require greater emphasis, all which require access to the tracks:

1. Inspection, maintenance and repair of Emergency Trip Station {ETS) boxes (emergency power shut off and emergency phones).
2. Improvement of tunnel lighting through execution of a multi-year program to replace all tunnel lights in the tunnels (already underway).
3. Inspection, maintenance and clearing of tunnel drains.
4. Removal of mud, debris and water, particularly focused in the tunnels.
5. Inspection, compliance checks and repair of fire extinguishers located in the tunnels.
6. Clearing debris and material from all emergency egress routes.

Radio Project: In order to deliver cellular service in the tunnels and completely replace Metro's aging radio system to improve communications reliability and comply with Federal law, Metro commenced field activities in support of the Radio Project in January of 2016. This highly visible and critical project requires extensive track access in order to conduct design and survey activities and install hundreds of miles of cables throughout Metro's 100-mile tunnel network. Currently, Metro deploys field crews to the tunnels on a nightly basis to perform this work. Over the past nine months, Metro has learned that performing this work with other work crews in the same work zone is not safe or efficient. The Radio Project needs to use heavy track-bound vehicles to install the cable components to the tunnel wall. As the installation progresses, the heavy vehicles are continuously moving along the track, thereby prohibiting the use of other vehicles in the same work zone. As such, the Radio Project requires exclusive track access with no other crews in the area. Increasing the weekly duration of non-passenger hours will enable Metro to more safely and effectively complete the Radio Project.

Non-passenger hours and work efficiency

There are opportunities to increase work efficiencies during the non-passenger work windows with several parallel initiatives to gain more productive work time. However, there is a limit to the potential efficiency gains that will additionally take 2-3 years to materialize. Our current work rules are a direct result of past experience and the need to protect workers in the roadway. Any changes to these rules will take time and technology to safely implement.

FUNDING IMPACT:

No additional budget required.	
Project Manager:	Joseph Leader, Chief Operating Officer
Project Department/Office:	Operations

TIMELINE:

Previous Actions	September 2016 - Presentation to Customer Service, Operations and Security Committee on Hours of Service
Anticipated actions after presentation	December 2016 - Presentation to Customer Service, Operations and Security Committee on Public Hearing Staff Report

RECOMMENDATION:

Information only.



Washington Metropolitan Area Transit Authority

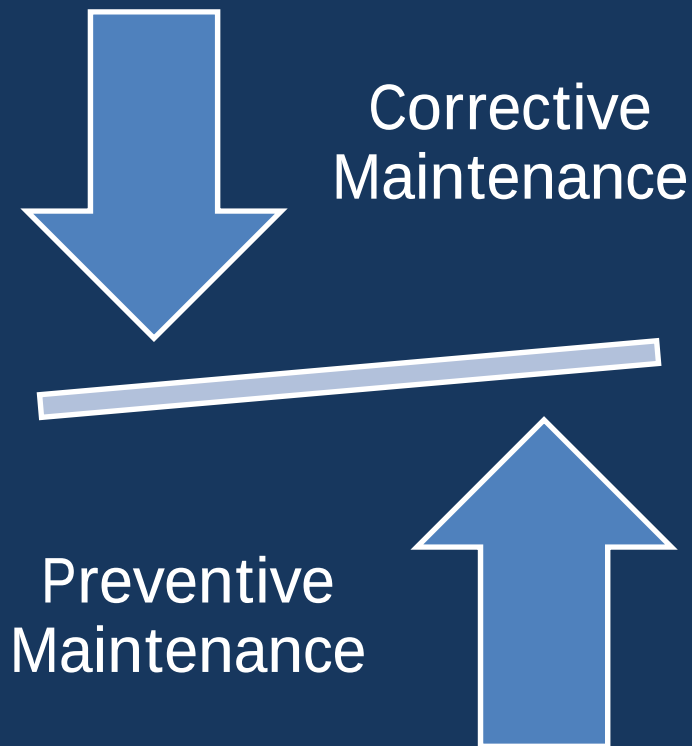


**Preventive
Maintenance:
Why more
time is required
to deliver
reliable service**

Customer Service, Operations and Security Committee
November 3, 2016



Why is more time needed?



- To avoid SafeTrack 2.0
- Shift balance from reactive to proactive
 - Corrective vs Preventive
- Multiple programs to target specific safety & reliability issues

Preventive Maintenance is the Anti-SafeTrack



How will the time be used?

- New Programs targeting specific safety & reliability issues
 1. Traction Power Cable Meggering
 2. Stray Current Testing
 3. Tamping & Surfacing
 4. Interlocking Component Maintenance
 5. Mechanical Joint Maintenance
- Inspections, Testing & Maintenance highlighted by:
 - WMATA Engineering Standards
 - NTSB Recommendations (4)
 - FTA Corrective Action Plans (8)
 - 2016 APTA Peer Reviews (3)
 - Network Rail Track Time Study



1) Cable Meggering

- **Benefits**

- Prevent fire or smoke incidents (L'Enfant Plaza, McPherson Square, & Metro Center)

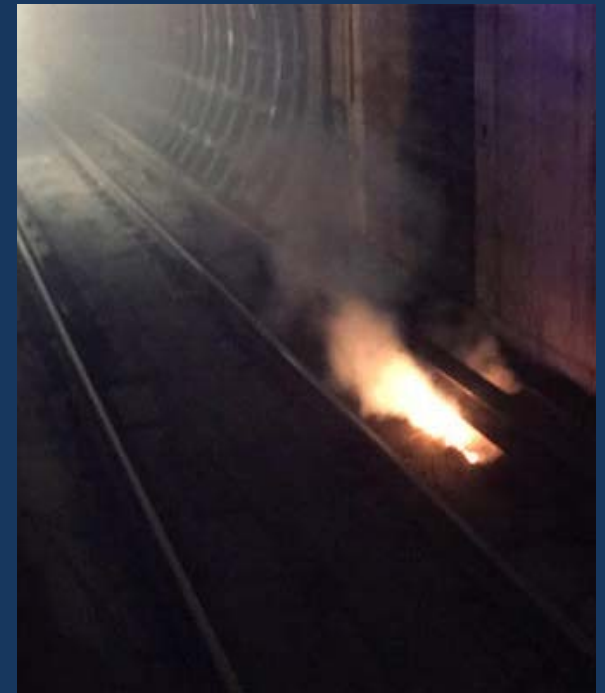
- **Program Description**

- Long duration, systemic program to test cables that can't be visually inspected
- Test the insulation of high voltage cables to monitor & trend condition of cable and replace cables with poor insulation (FTA SMI R-5-35-d)
- 13,529 cables to be tested every four years

- **Requirements**

- Two crews to disconnect every cable from the breaker to megger individually
- Requires 19 work hours per week

5 related incidents
2016 year to date





2) Stray Current Testing

- **Benefits**

- Prolong life expectancy of rail, track and structures
- Reduce risk of fires
- Improves track circuit stability (smoother and faster ride)

- **Program Description**

- Shut down all power and send a test voltage into the tracks to find where there are weaknesses in the electrical insulation
- Test every 4-5 years

- **Requirements**

- Four 3+ hour work windows per area to set-up, test and investigate results

83 related incidents
2016 year to date





3) Tamping & Surfacing

- **Benefits**

- Improves ride quality, minimizing bumps
- Preserves the track by eliminating excessive strain on the rails & ties and stability of track circuits

117 related incidents
2016 year to date

- **Program Description**

- Maintenance program to correct the alignment of rails and improve track stability
- Mainline biannually; switches annually

- **Requirements**

- Computerized track equipment that lifts track & vibrates ballast to ensure adequate tie support and add ballast where needed
- Requires 20 work hours per week



4) Switch Welding & Grinding

- **Benefits**

- Reduce noise and vibration
- Improve service by keeping all interlocking operable to mitigate other delays
- Reduce length of single-tracking events

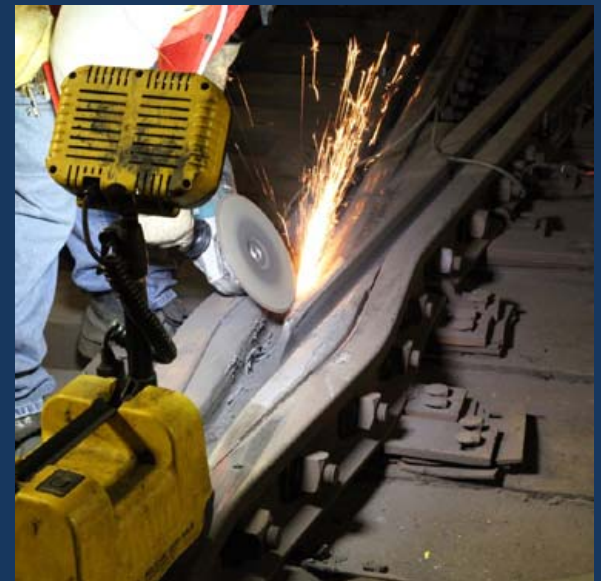
- **Program Description**

- Switch point grinding and frog grinding & welding to ensure proper wheel/rail interface
- ATC Component cleaning

- **Requirements**

- Longer windows (4+ hours)

80 related incidents
2016 year to date



5) Mech. Joint Maintenance

- **Benefits**

- Reduces excessive dynamic loading at joint which accelerate deterioration of track & structure
- Reduce speed restrictions

28 related incidents
2016 year to date

- **Program Description**

- Inspect, tighten mechanical joints and spot-tie replacements to ensure alignment



- **Requirements**

- Requires 18 work hours per week



6) Other Preventive Maintenance

1. Inspection, maintenance and repair of Emergency Trip Stations (ETS)
2. Tunnel lighting replacement
3. Tunnel drains
4. Removal of mud, debris and water
5. Fire extinguishers compliance checks and repair
6. Maintaining emergency egress routes.
7. Torquing
8. Ultrasonic testing of running rails

FTA CAP R-3-23a: Insufficient time for maintenance



How do we use the time we have?

5 hour window is really 2 hour work window

1 hour

All last trains
move to final
destination

½ - 1 hour

Turn off
power/safely
establish work
zone

2 hours
Productive Work Window

½ hour

Restore
power

½ hour

Trains
move to
begin
service

Today's Maintenance Window
Sunday-Thursday

4 hour window is really 1 hour work window

1 hour

All last trains
move to final
destination

½ - 1 hour

Turn off
power/safely
establish work
zone

1 hour
Unproductive
Work Window

½ hour

Restore
power

½ hour

Trains
move to
begin
service

Pre-SafeTrack Maintenance Window
Friday & Saturday

*Could not be used for preventative
maintenance*



Efficiency Is Not Enough

- Parallel initiatives
 - Reduce train moves → Max gain 15 min
 - Reduce work area set-up → Max gain 15 min
- Safety trumps Service
 - Current rules are direct result of past experience
 - Changes will take 2-3 years to ensure we stay safe
 - o Technology investments
 - o Time to implement procedural changes



How do we get the time needed?

4 hour window is really 1 hour work window



Pre-SafeTrack Maintenance Window
Friday & Saturday

Could not be used for preventative maintenance

Adjusted Maintenance Window/Current SafeTrack Maintenance Window
Closing Metrolink 3 hours earlier

Reducing weekend late night service creates additional productive nights to work

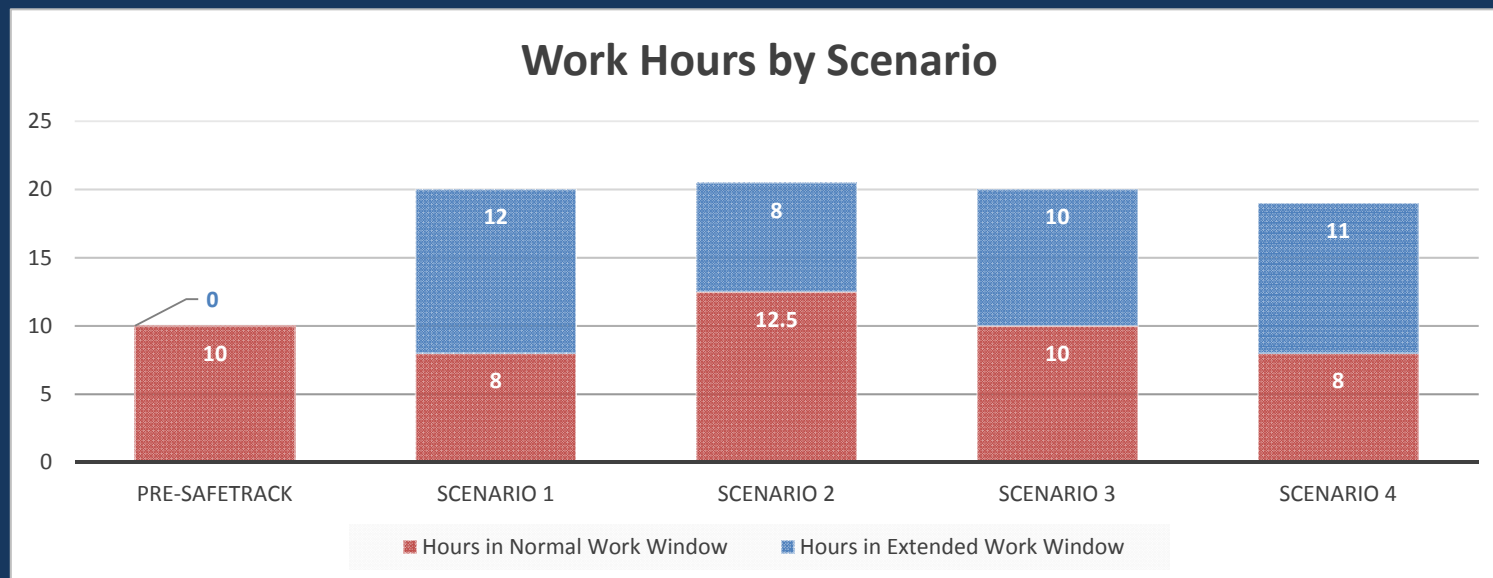


Weekends need to be part of the solution



What are the options?

- Four scenarios have been proposed that:
 - Decrease passenger service by 8 hours (5%)
 - Impacts <1% of ridership
 - Double productive work time, from 10 hours to 20 hours per week
 - Create expanded work windows (>3 hours) for time-intensive work





What does everyone else do?

- Different properties are different
 - Type of components
 - How they are used
 - Environmental conditions
- Atlanta >> Concrete ties vs wood
- Chicago >> Rebuild vs Maintenance
 - Dan Ryan Line Rebuild closed 10 miles for 5 months
 - o Similar to closing Vienna to Clarendon
 - o Four miles of 10mph speed restriction prior to closure

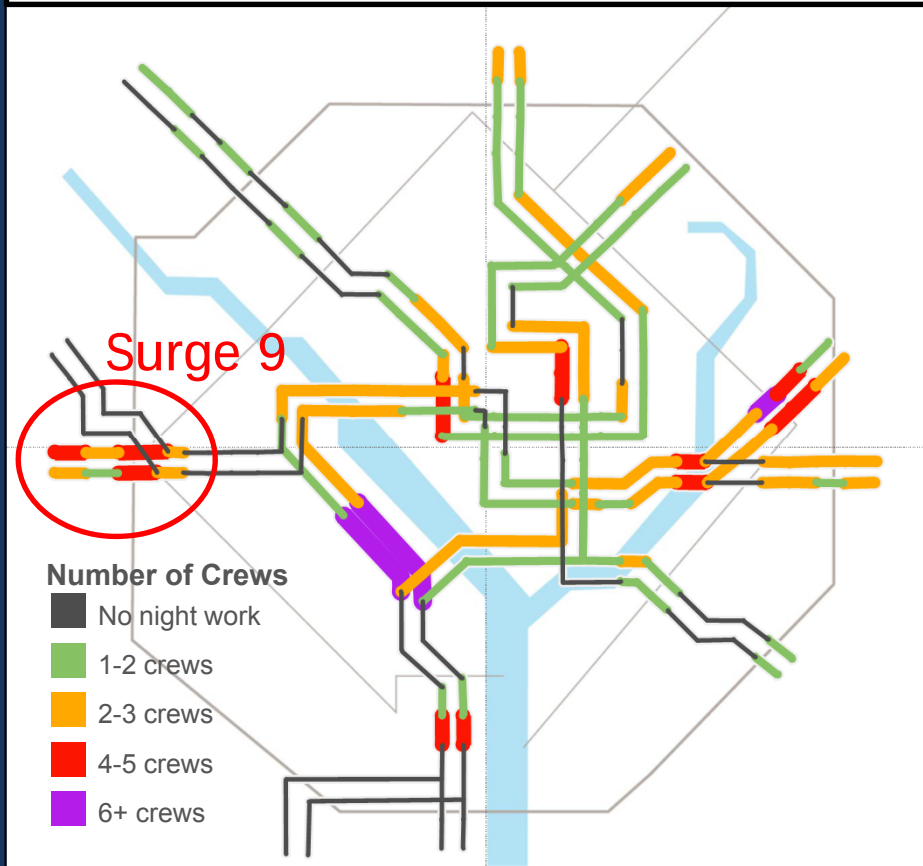


Why can't we surge instead?

- Volume of work overnight exceeds a surge
 - Avg. night → 57 work crews
 - Surge + Early Outs → 15
- Different needs for access, power and frequency of work

Night of Sept 7, 2016

- Work on 164 of 234 track miles
- Most outside Surge, after hours

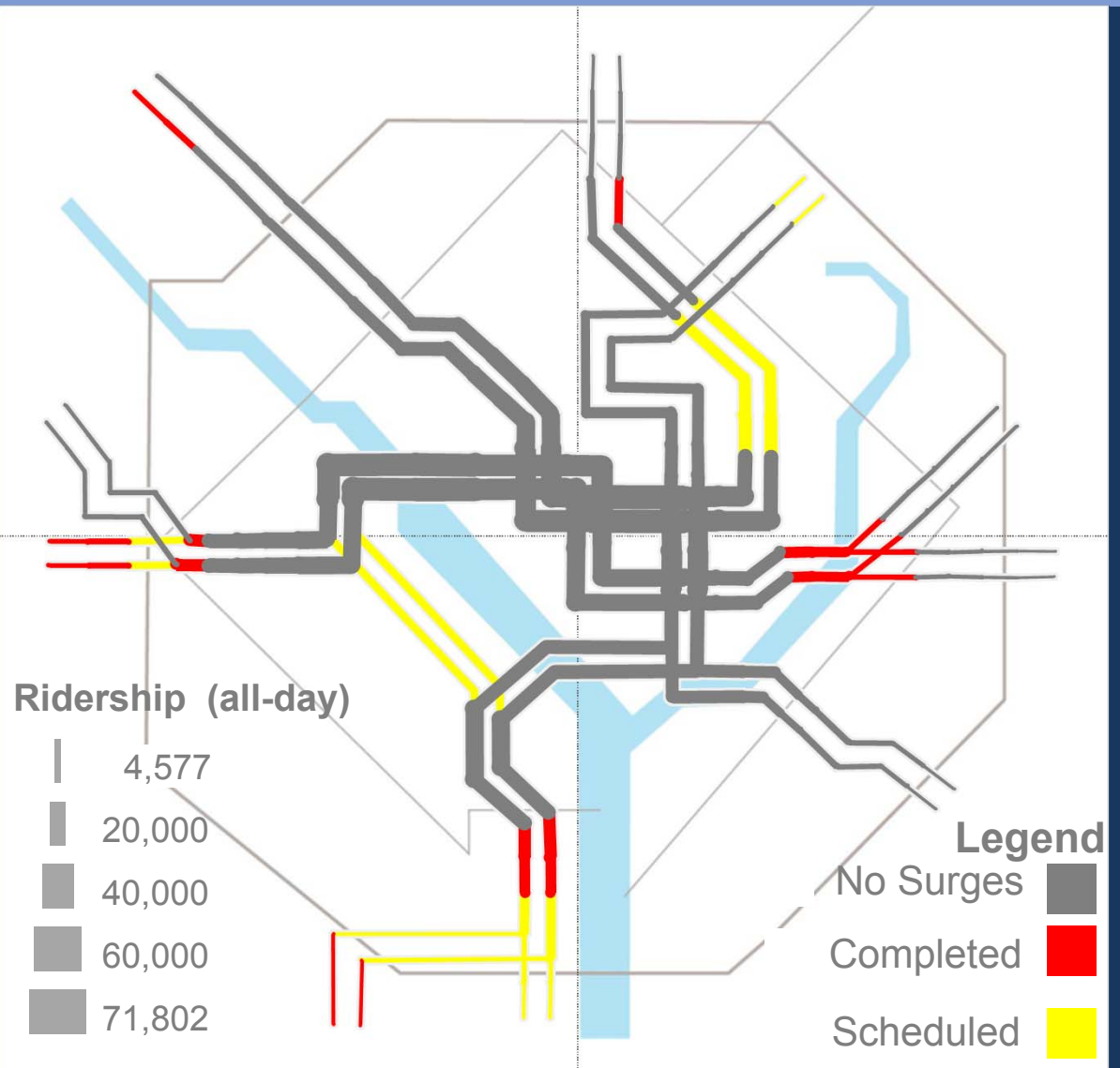




SafeTrack has not touched Core

Surges in the core would have a much greater impact on the system:

- 20+ min headways
- 85% reduction in service through core





What would PM surging be like?

- 55 surges, two years, to complete one pass
 - 415 days of surging
 - \$42m of additional support costs
 - Plus additional weekend and late-night single tracking for higher frequency programs
- Ineffective for work crews
- Inefficient for riders
 - Surges reduce capacity beyond the work area
 - Surges in core would dramatically impact the whole system



How will we know it is working?

- New metric: Infrastructure Availability
 - Miles of track impacted
 - Severity of impact
 - Root cause of delay
 - Trends by location
 - Supplements current OTP metric in Vital Signs
- Riders will experience more reliable service
- Measureable immediately; re-evaluate in two years



And what if we don't?

- SafeTrack 2.0 will be a matter of time
- Reliability degrades:
 - Significant unplanned service disruptions
- Other urgent safety programs suffer in competition for track time
 - Tunnel Lighting
 - Radio Project



Pivotal Decision for WMATA

- “Safety trumps Service” led to SafeTrack
- The question now is Service vs. Reliability:
 - Reduce infrastructure-related delays by HALF (10% overall)
 - Impact <1% of trips

Preventive Maintenance, and the time to execute it, is the only way to deliver safe & reliable service and every peer and regulatory review has come to the same conclusion.