Reducing Subway Wheel Flats - Line 2

Community Update

October 16, 2019

Subway noise and vibration

Subway noise and vibration (N&V) is a by-product of subway operations

Two main sources of N&V:

- Rail Infrastructure (i.e. track condition, crossovers) - confined to a short section of line
- Rolling Stock (i.e. vehicles) - along the entire line

Update for today's meeting.

Dominant factor contributing to N&V since October 2018

TTC operational practices and maintenance procedures have been developed that aim to reduce operational noise and vibrations.

TTC action to proactively reduce N&V

Inspection Activities

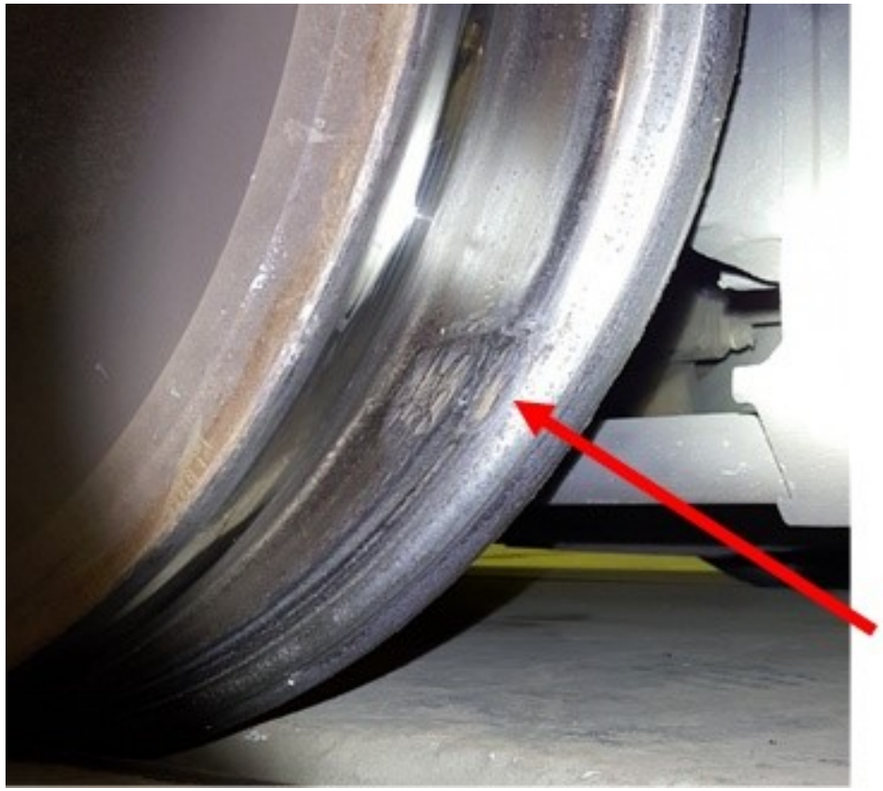
- Track Level Patrol and Riding Patrol
- Condition Based Monitoring (CBM)
- Rail Wear
- Rail Surface Corrugation Measurements (CAT and Vibration Train)
- Track Geometry
- **Wheel monitoring (AURA)**

Maintenance Activities

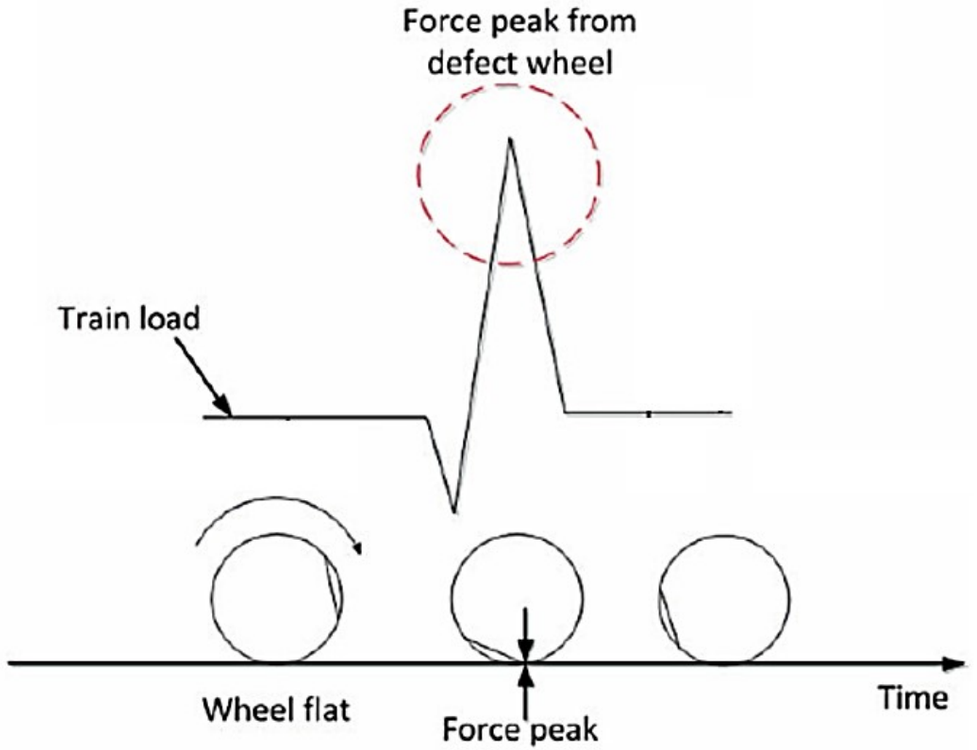
- Rail Replacement, grinding and milling
- Uneven Joint Repair/Replacement
- Rail lubrication (reduce rail wear and squeal at curves)
- **Wheel truing / replacement**

Some level of N&V is expected adjacent to subway operations – cannot be fully eliminated.

Wheel Flats



Flat spot



- Wheel Flats have a “thumping” sound and generate vibrations
- The larger the flat, the louder the thumping sound and the greater the vibrations

Wheel Flats - Background

- Expected in rail industry
- Average Backlog
  - 15 cars or 2.5 trains (4% of total fleet)

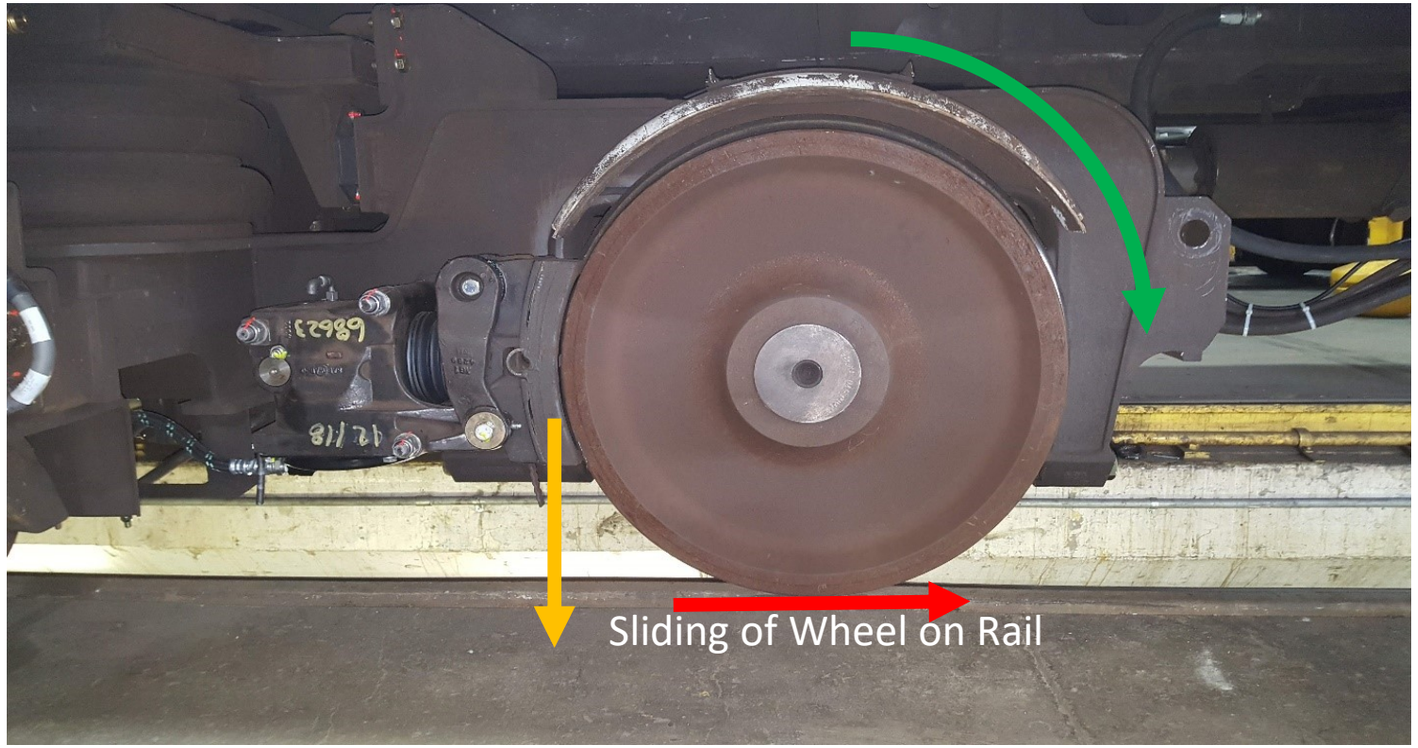
- More common in autumn (seasonal trend)
- Increase in backlog
  - 30 cars or 5 trains (8% of total fleet)

LINE 2 SERVICE REQUIREMENTS

- 45 Trains – Required for Service
- October 2018 – 90% of Fleet had Moderate to Severe Flats
- Impact to service and community along subway alignment

Wheel Flats – Causes

- Metal on metal sliding action:
  - *Low traction* rail conditions and
  - *Emergency Brake (EB) application*



Loss of traction and no wheel rotation (EB Brake) will results in wheel sliding along the track to create flat spots

Causes of Low Traction

- Wet rail, leaves, snow, and over-lubrication can cause areas of low traction.

Causes of Emergency Brake (EB) Applications

- **Operator Induced**
- **Speed Control System (SCS) Induced:**
  - Spin/Slide (Similar to traction control in automobiles)
  - Over Speed (Similar to speed governor in automobiles)
  - Signal Violation (Similar to collision avoidance system in automobiles)

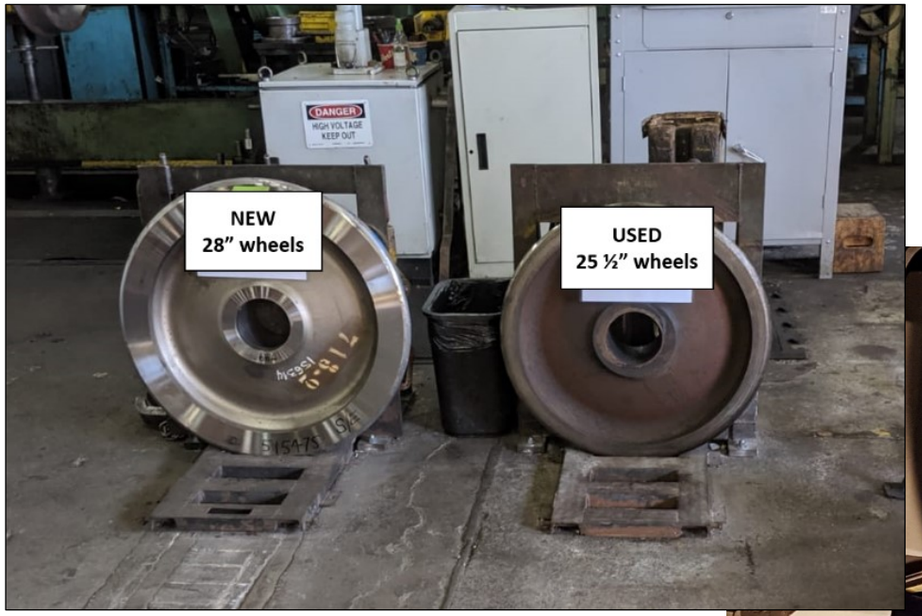
Wheel Flats - Monitoring System

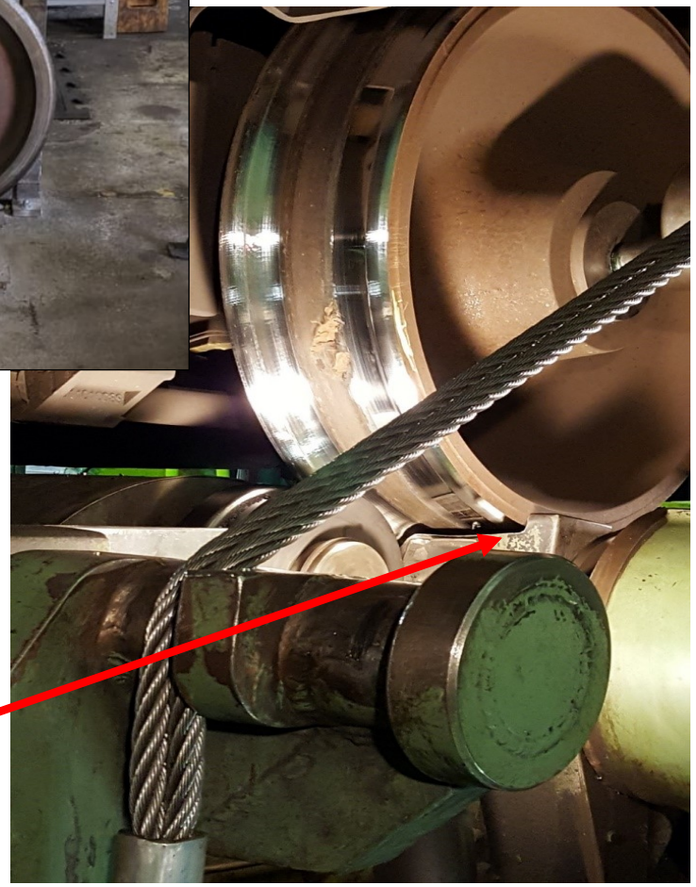
AURA Wheel Flat Detection System

- Installed on Line 2 in 2012 and Line 1 in 2015
- Early warning detection system
- AURA identifies axles and color codes according to severity of wheel flat (RED = Most Severe)
- Trains with red flats are the most severe and are removed from service as soon as possible

Repairs for Wheel Flats

- Wheels are ‘machined true’ to remove flat spots and return wheel to round
- Maximum of 6 axles (12 wheels) can be machined per 8 hr shift
- New wheel diameter = 28”
- Condemnation diameter = 25.375”
- Average Life = 4 Years (T1 Fleet)
- TTC has 2 wheel turning machines for subway vehicles located at Greenwood Carhouse and Wilson Carhouse





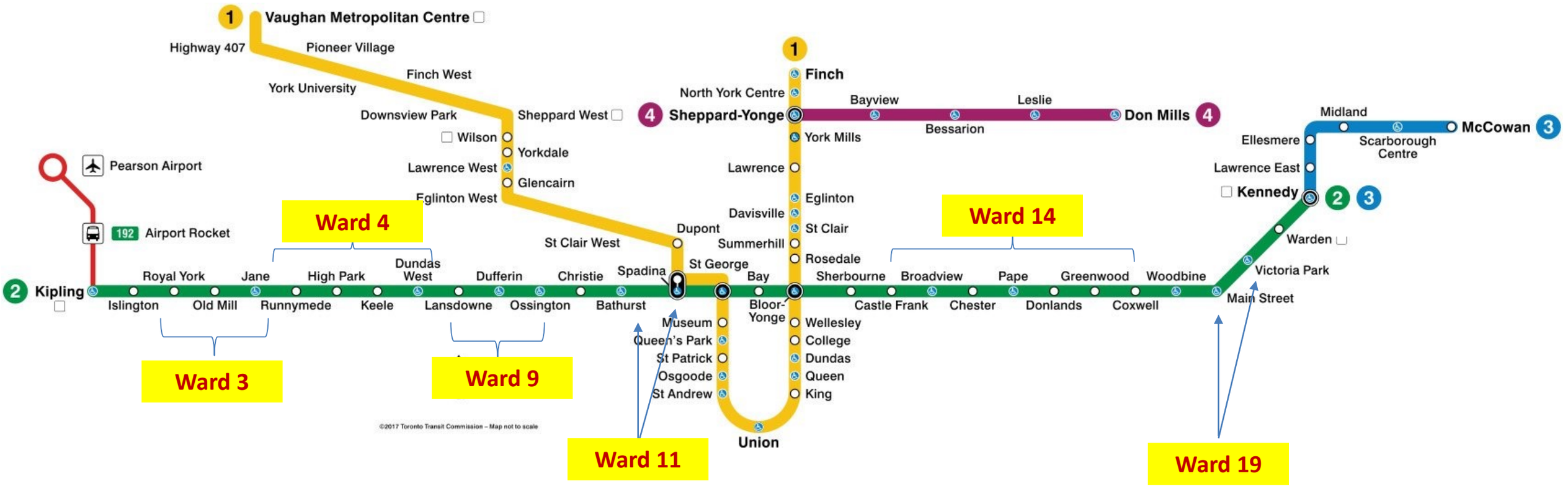
Wheel cutting machine

Impact To Community

- Starting in October 2018, an extraordinary increase in subway noise and vibration complaints were received across Line 2.
- Reports from area residents of increased N&V; frequency and levels.
- This situation was not limited to one specific section of the subway network.
- Wheel flats were not a prominent source of complaints prior to October 2018.
- No “smoking gun” found during TTC investigation into root causes of wheel flats.

Impact To Community

6 wards affected by noise & vibration



Wheel Flat - Investigation

Vehicles:

- *Inspection of wheels*
- *Inspection of brake pads*
- *Testing of acceleration & brake rates*
- *Review of data for propulsion faults*
- *Review of data for EB applications*

Track:

- *Inspection of rail*
- *Inspection of wayside lubricators*
- *Inspection of speed control system*

Action Items from Investigation

Vehicles:

- *Investigation – re-design of master controller*
- *Replacement of brake pads*
- *Installation of vibration sensors on bogies/trucks*

Operators:

- *Supervisor audits*
- *Reminder campaigns*

Track:

- *Cleaning of rail*
- *Turning off of lubricators – to eliminate grease as significant contributor*
- *Testing of top of rail friction modifier*
- *Added SCS and Un-Equipped Mode (UEM) tags*
- *Implement restricted speed zones*

Other:

- *Consulted with peer agencies*
- *Hired Network Rail to assist with investigation*

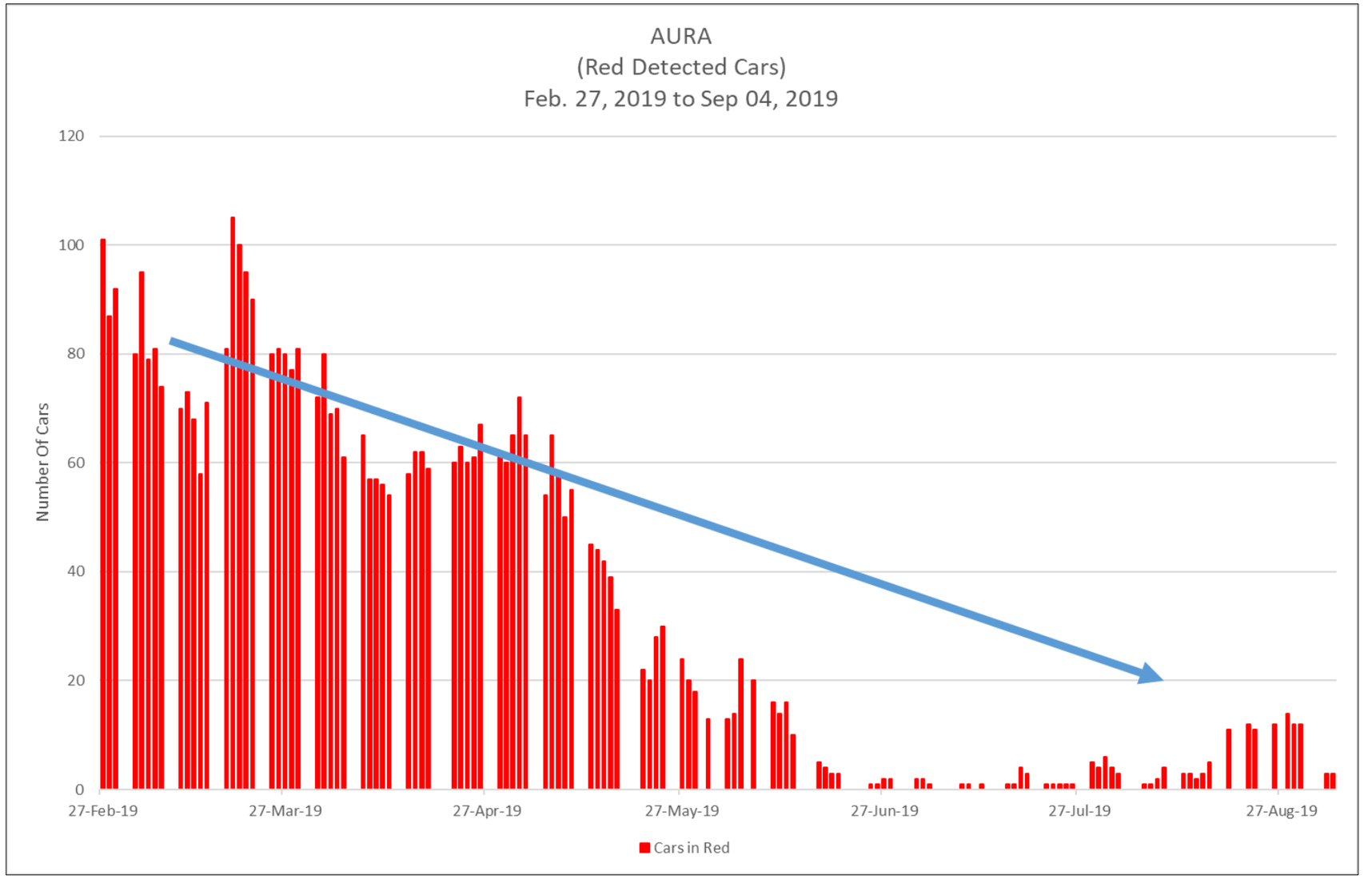
Action Plan

- Continue with action items already implemented
  - Testing of brake pad materials
  - Installation of mobile sensors on bogies/trucks for additional data collection
  - Cleaning of rail
  - Replacement of lubricators and testing of top of rail friction modifiers
  - Operate in accordance with weather conditions
  - Add additional SCS tags
- Continue investigating potential design improvements to:
  - Master Controller
  - Speed Control System

Where we are now with wheel flats

- Since mid-March 2019 the rate of new wheel flat occurrences and the total number of flats has trended downward.
- As of July 2019 TTC had been operating trains on Line 2 without severe or moderate wheel flats.
- TTC continues to monitor subway wheel flats daily and has noticed a slight increase in recent weeks (August). Moving into the fall season, it is common in the rail industry to see an increase in wheel flats.

Observations & Results - Wheel Flats



- Downward trend in wheel flats
- No trains in service with moderate or severe flats
- Wheel truing machines under maintenance for two weeks in August.
- Minor increase in flats expected in Autumn

Next Steps - Wheel Flats

- TTC will continue collaborating with other reputable N&V consultants.
- Continue regular inspections and monitoring of vehicles.
- Efforts made to avoid placing vehicles with RED flats into service.
- Expect small increase in wheel flats during Autumn season.

Questions

- Do you have any questions related to Wheel Flats or the presentation?

- Other subway N&V concerns, kindly email diego.sinagoga@ttc.ca or paul.tran@ttc.ca or call TTC Customer Service 416-393-3030.
    - If possible, please provide a description of any sound pattern you hear when subway train pass your home, as well as your address and contact information so that we can contact you to discuss further.