

Aiming for a State of Good Repair: Moving from Reactive to Preventative Rail Maintenance



Peeter Vesik – Asset Integration Project Manager
Guideway(Track), Equipment, and Maintenance Infrastructure

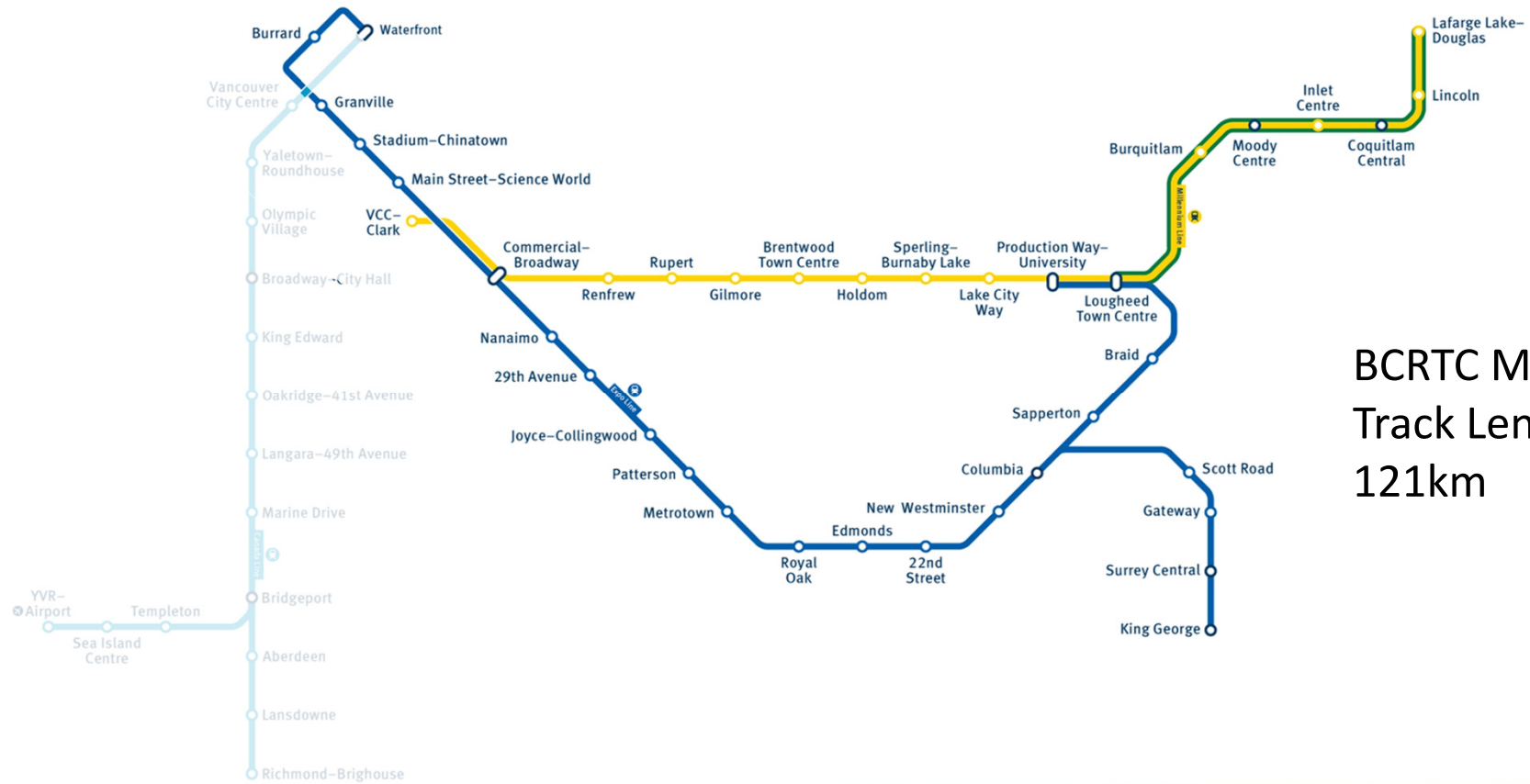


RAIL TRANSIT SEMINAR • JUNE 21



WRI 2022

Vancouver SkyTrain (not incl. Canada Line)



BCRTC Mainline
Track Length =
121km



RAIL TRANSIT SEMINAR • JUNE 21



WRI 2022

Expo/Millennium Line Fleet

Mark I: 2-car units
UTDC
150 cars
12.7 m long

Mark II: 2-car units
Bombardier
108 cars
16.7 m long

Mark III: 4-car units
Bombardier
84 cars
17 m long (avg.)

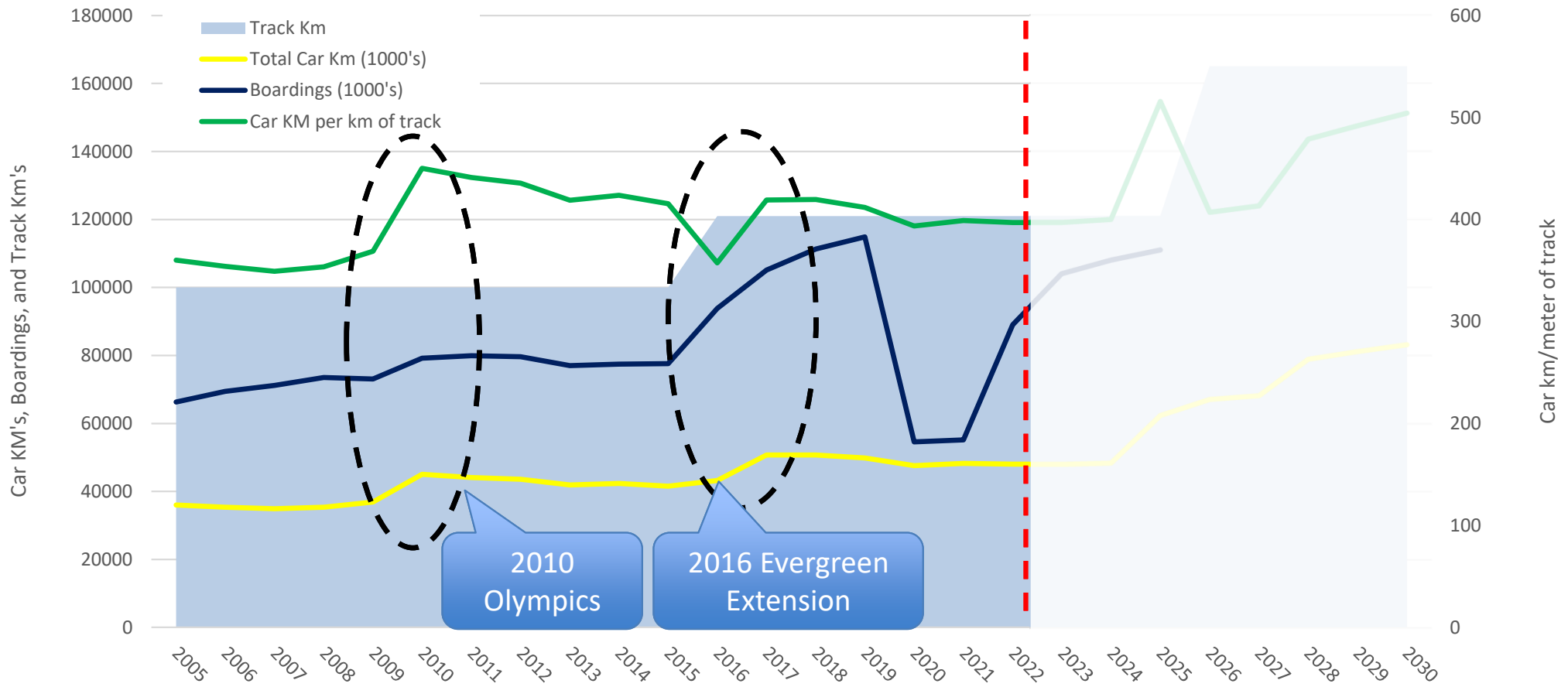
Mark IV: 5-car units
Alstom
205 cars
17 m long (avg.)



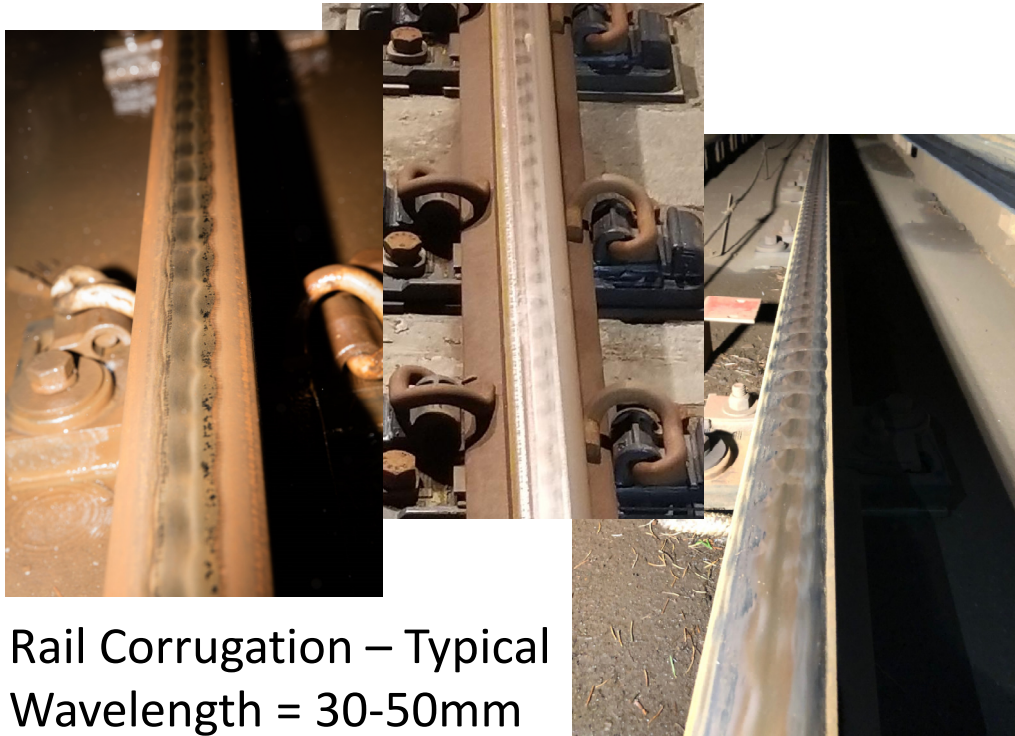
- LIM propulsion
- Steerable bogies
- Fully automated train control (driverless)



System Size, Service Levels, and Demand on Assets



Rail Defect Types



Rail Corrugation – Typical Wavelength = 30-50mm

- Removed by Rail Grinding



Mild RCF, Surface Cracking, and Spalls/Squats

- Repaired via rail plug or weld
- Maintained by regular grinding and monitoring



Track Maintenance History: 2010-2015

- Increased service levels from 2010 Olympics not aligned with maintenance practices
- BCRTC track maintenance department stretched thin
 - Keeping system safe and operable
 - Not setup for long-term sustainability
 - In-house rail grinder working, but at limited capacity
- NRC report in 2015 contained 557 defects
- If no intervention, significant re-railing would be required immediately (est. \$50M+)



Track Maintenance History: 2016 to Current

7

2015:

- Rail replacements and plugs as required
- Contractor performed Aggressive Corrective Grinding, defect removal, and re-profiling to target
- Wheel-Rail profile compatibility assessment was completed

2016:

- Contractor Re-grinds Entire System, focusing on profile and surface defects
- Introduction of 27 month grinding program by ARM (later changed to 24 month)

2017-2022:

- BCRTC revives Harsco TG-8 in house grinder → ~60km/yr to hit hot spots
- Contractor returns annually for ~40 shifts to grind system to compliment BCRTC in-house efforts, and do some of the heavy lifting
- ~3km (track) of Annual re-railing



RAIL TRANSIT SEMINAR • JUNE 21



WRI 2022

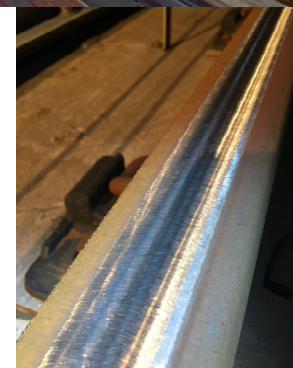
Today's Grinding Strategy

Key focus of Grinding at SkyTrain:

- Transitioning from Corrective to Preventative Grinding
- Focus on minor damage, corrugation, and profile
- Make use of in-house and contract grinding equipment
- Other maintenance inputs and projects such as rail replacements, ultrasonic/geometry results used to constantly inform grinding program
- Grinding Schedule currently on 24-month cycle
 - Highest Frequency is Quarterly
 - Lowest Frequency is Bi-annual
 - 125km ground per year (Average)



Photo: Jack Lindquist



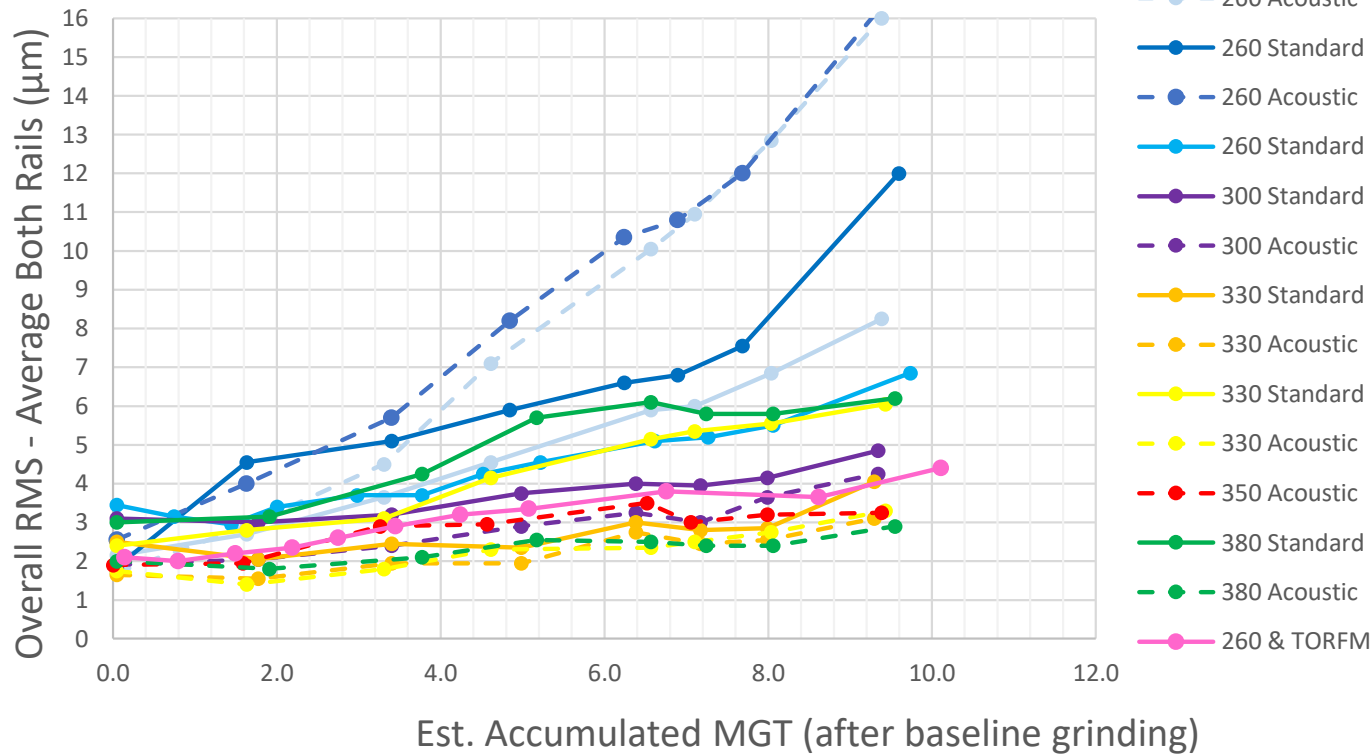
RAIL TRANSIT SEMINAR • JUNE 21



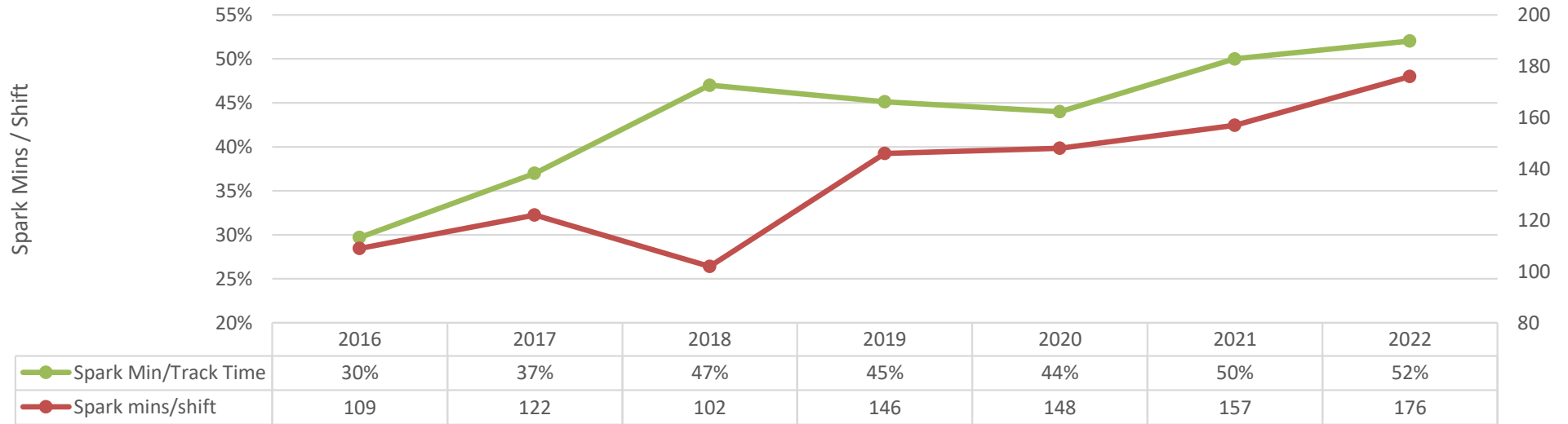
WRI 2022

What Can we Control?

Rail Roughness Growth - Rail Hardness vs. Accumulated MGT (post-grind)



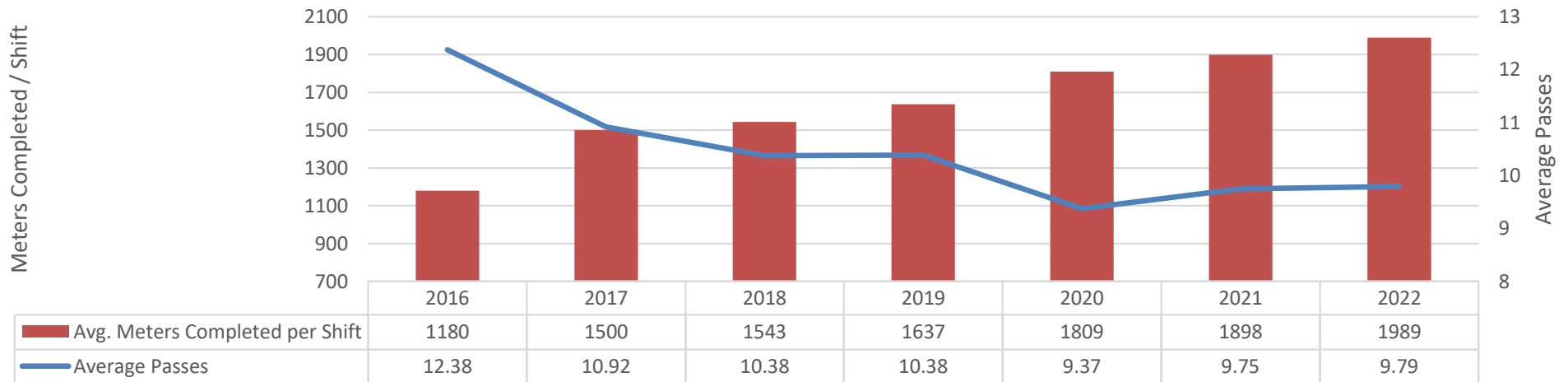
Tracking & Quantifying Grinding Effectiveness



- Increased usage of single tracking (reduces % of time on travel)
- Strategically staging and tying-up equipment in locations which maximize track time (use pockets and sidings to limit travel time)
- Ensuring stone changes and re-fueling is completed during maintenance hours as often as possible



Tracking & Quantifying Grinding Effectiveness

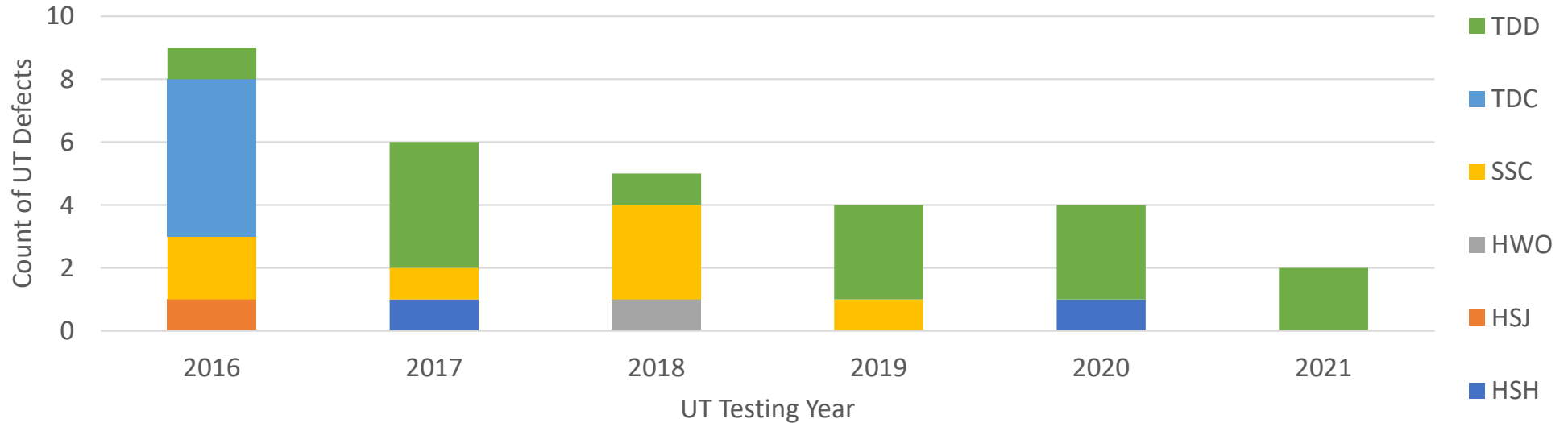


- Each year is requiring less passes than the year before
 - This is a testament to performing regular preventative grinding
- Less passes, combined with increased track time efficiency, means more track meters are being completed per shift
- Due to fixed annual grinding budget, improving conditions and increasing spark time means more track can be covered under the same amount of shifts



Quantifying Preventative Rail Maintenance

UT Defect Occurrence History - Mainline Track

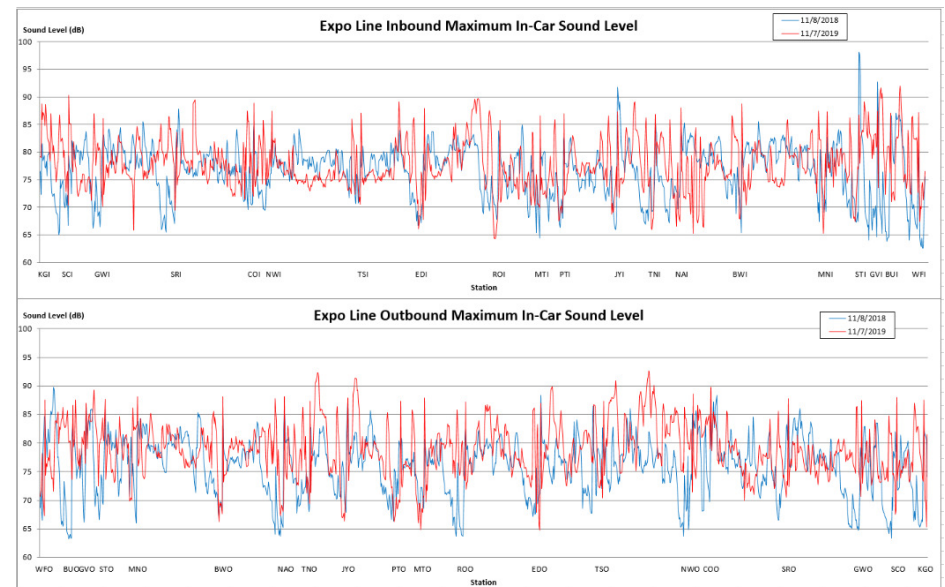


- Removing defects via grinding and rail replacements reduces impacts and vibration
- UT defect reduction aligns very well with moving to Preventative Rail maint. strategy
- More “severe” types of Defects no longer appearing
- Clearer reporting: Reduction in SSC defects for example

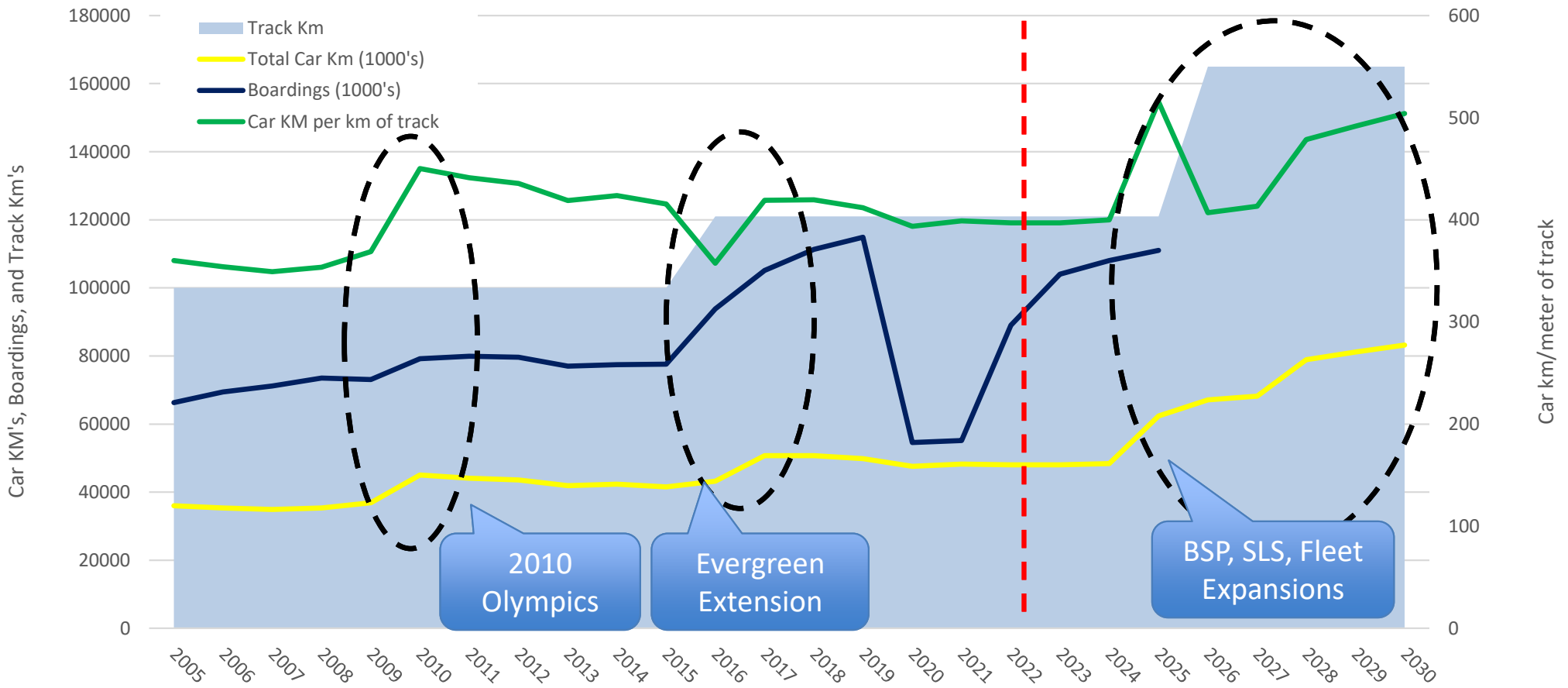


Other Metrics for Quantifying Preventative Rail Maintenance

- Maintenance work orders from visual track inspections
- Contact band width/position
- Noise complaint data
- Test train noise and impact data
- Geometry, profile, and Rail Wear Data

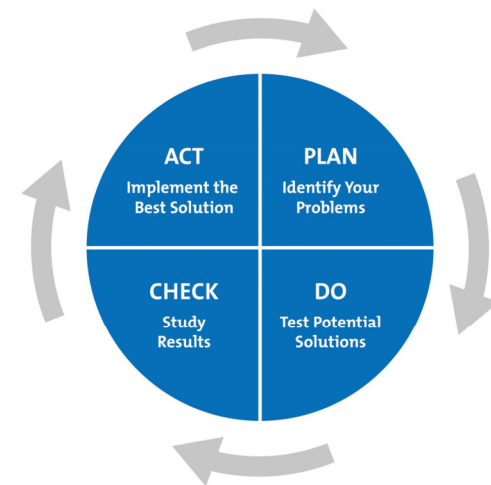


Looking into Future Demand on the System



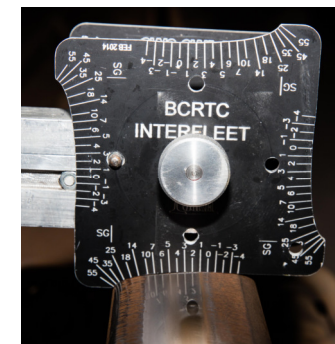
Lessons Learned

- Ensure maintenance voice is heard when planning extensions, increasing service or considering budgets
- A Good track maintenance program is about constant input, feedback, and adjustment
- Need champions to take a lead on rail condition and maintenance management
- Effectively communicate importance of rail maintenance, capital planning, and methods of measuring success to senior management regularly
- Ensure consultant recommendations are realistic and actionable from both a technical and business perspective



What's Next?

- New Rail profiles being designed to work with existing wheels
 - Phasing out of Mark 1 trains, incoming mark 5 trains
 - 2-3 tangent profiles distributed to pummel wheels
 - New Curve high and low rail profiles
- Skytrain Noise Study Complete
 - Recommended systemwide TORFM (Currently in approval stages)
 - 3.2km of Rail Dampers currently in Implementation
 - Acoustic Rail grinding found to reduce corrugation growth in harder steels
 - Harder Rail demonstrated better resistance to corrugation growth, and no signs of RCF or other defect rates increasing



What's Next?

17

- Procurement of 2x (16) stone rail grinders to have optimized/distributed annual grinding capacity, and keeping capacity on hand for upcoming extensions
- Continue Running Rail and Fastener Replacement Program
 - 2.5-3km of track per year, replacing 260HB rail with 350-370HB



RAIL TRANSIT SEMINAR • JUNE 21



WRI 2022

QUESTIONS AND DISCUSSION



Photo: Jack Lindquist

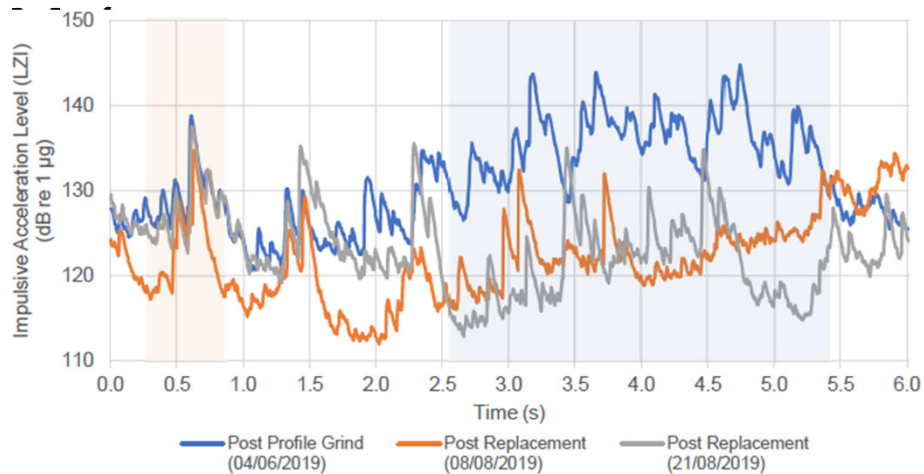


RAIL TRANSIT SEMINAR • JUNE 21



WRI 2022

Turnouts: Noise/Vibration Monitoring to Drive



- Old/Damaged switches difficult to remediate
- Replacing worn switch can result in up to 10dBA wayside noise reduction
- Must replace old/worn switches, but key is to preventatively maintain with switch grinding program

Switch (Typical Train Speed)	Condition	Broadband Wayside Sound Level [dBA]	Broadband Equivalent Vibration Level [dB re 10 ⁻⁶ g]	Reduction ¹	
				Sound Level	Vibration Level
DC09 (50 km/h)	Post Replacement	82	135	-	-
	Post Profile Grind	82	129	0	5
DC10 (48 km/h)	Post Profile Grind ²	90	137	-	-
	Post Replacement	80	123	10	14
DC11 (49 km/h)	Post Profile Grind	86	133	-	-
DC12 (46 km/h)	As-Found	85	134	-	-
	Post Profile Grind	86	135	0	-3
	Post Replacement	78	125	7	7
DC30 (75 km/h)	As-Found	90	128	-	-
	Post Profile Grind	90	131	0	-3
DC40 (75 km/h)	As-Found	88	135	-	-
	Post Profile and Rotary Grind	84	129	4	6

¹ Negative reduction values correspond to an increase in the vibration level.

