Railway Crossing Information System (RCIS)

Amy Hunter, P.Eng., PTOE
Transportation Lead
Senior Design Engineer

2023 CEA Transportation Conference

PBX ENGINEERING

AGENDA

1. Project Scope/Background
2. Design
   - Concept Operations
   - Detection
   - Messaging
   - Central System
3. Post Analysis

BACK-GROUND

- Location
- Objectives
- System Overview

+ FOCUSED.
RELIABLE.
INNOVATIVE.

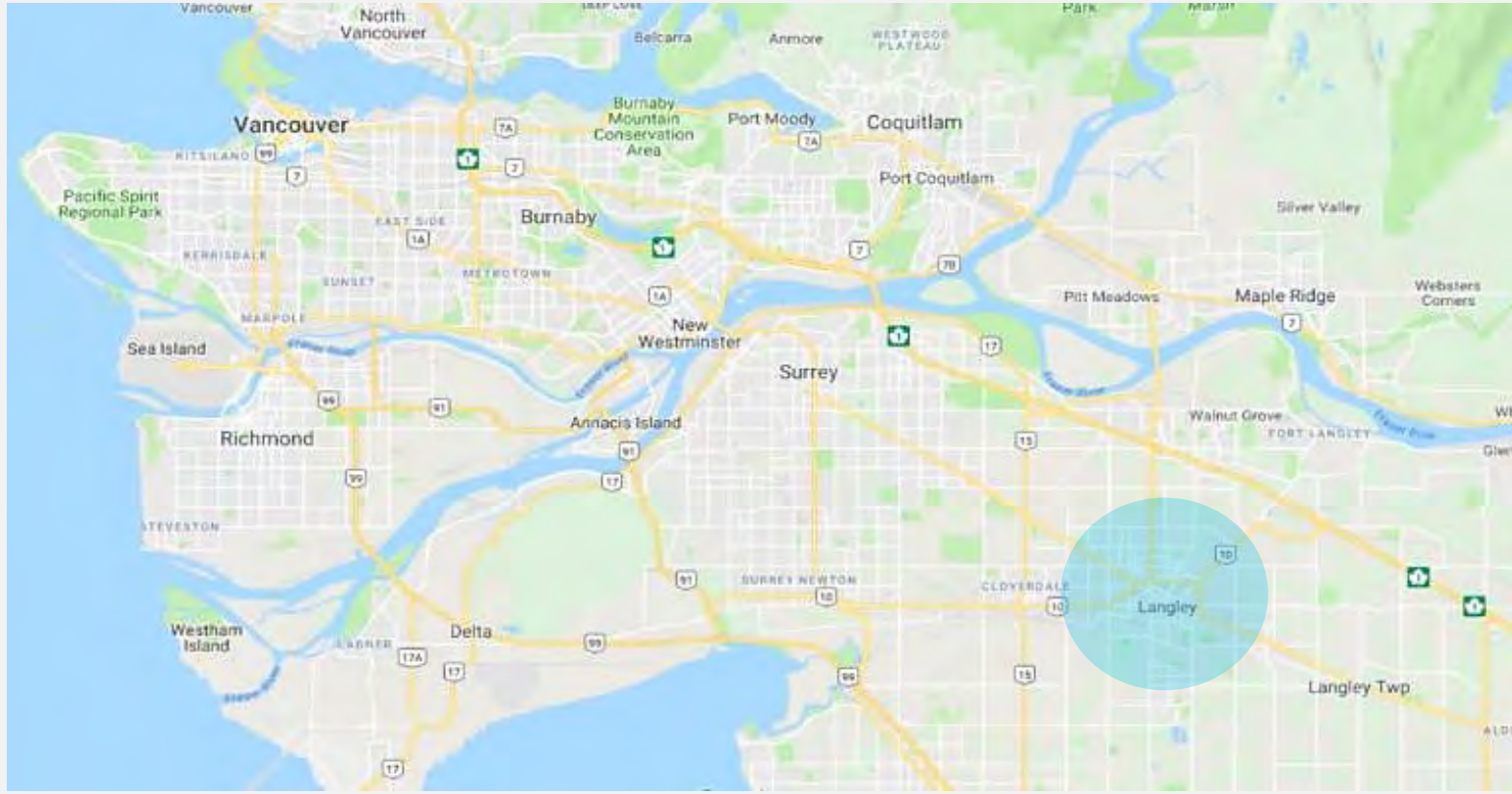
PBX ENGINEERING

Project Scope

Located along Roberts Bank Rail Corridor (RBRC) - City of Langley, BC

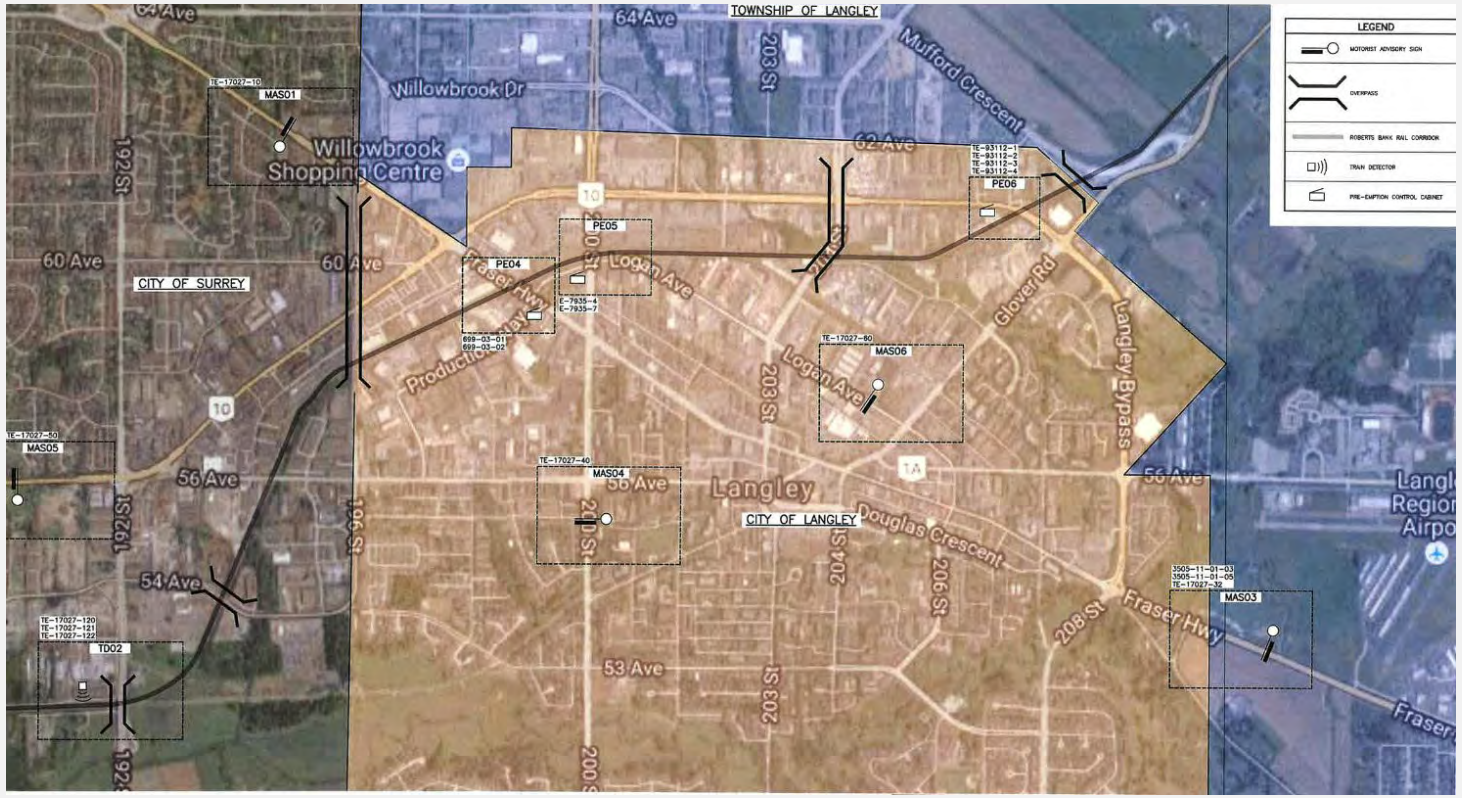
Four major at-grade crossings affecting:

- City of Langley
- Township of Langley
- City of Surrey



Rail Operations on RBRC

- Average train length = 2200m (7200’)
- Max train speed = 56 km/h (35 mph) [16m/s]
- Corridor length = 4.4 km / 11 km
- Average rail transits through corridor = 22 / day
- Train length predicted to increase by apx. 10%
- Number of transits predicted to increase by 40%



DESIGN

- Concept of Operations
- Detection
- Messaging
- Central Control System

CONCEPT OF OPERATIONS

Detect Train

- Detect train
- Track the train through the rail corridor
- Identify length of train
- Predict the time and duration of intersection blockages for each train

Activate Signs

- Activate motorist advisory signs to provide advance notice to drivers who are approaching the at-grade rail crossings
- Activate temporary turn restriction signs as part of applicable rail event timing plans

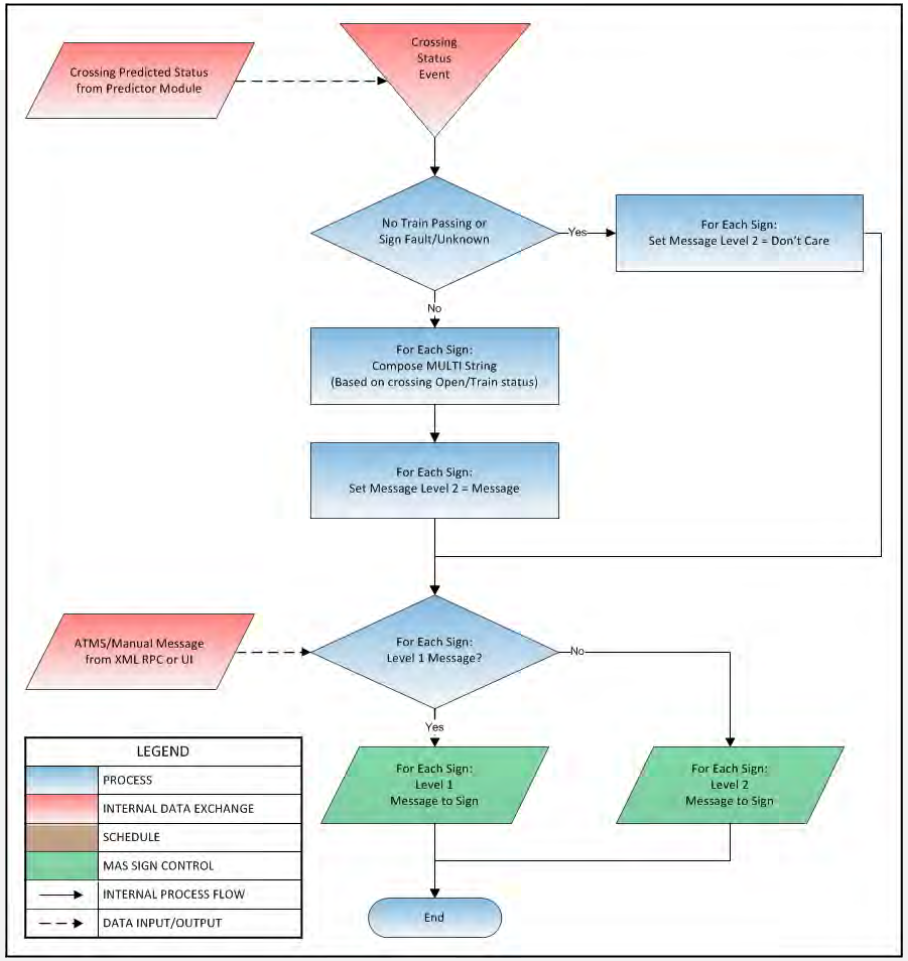
De-Activate Signs

- Confirm when the train has cleared the at-grade crossings
- Capability to keep the motorist advisory signs active for a configurable period of time to advise drivers of any residual traffic congestion

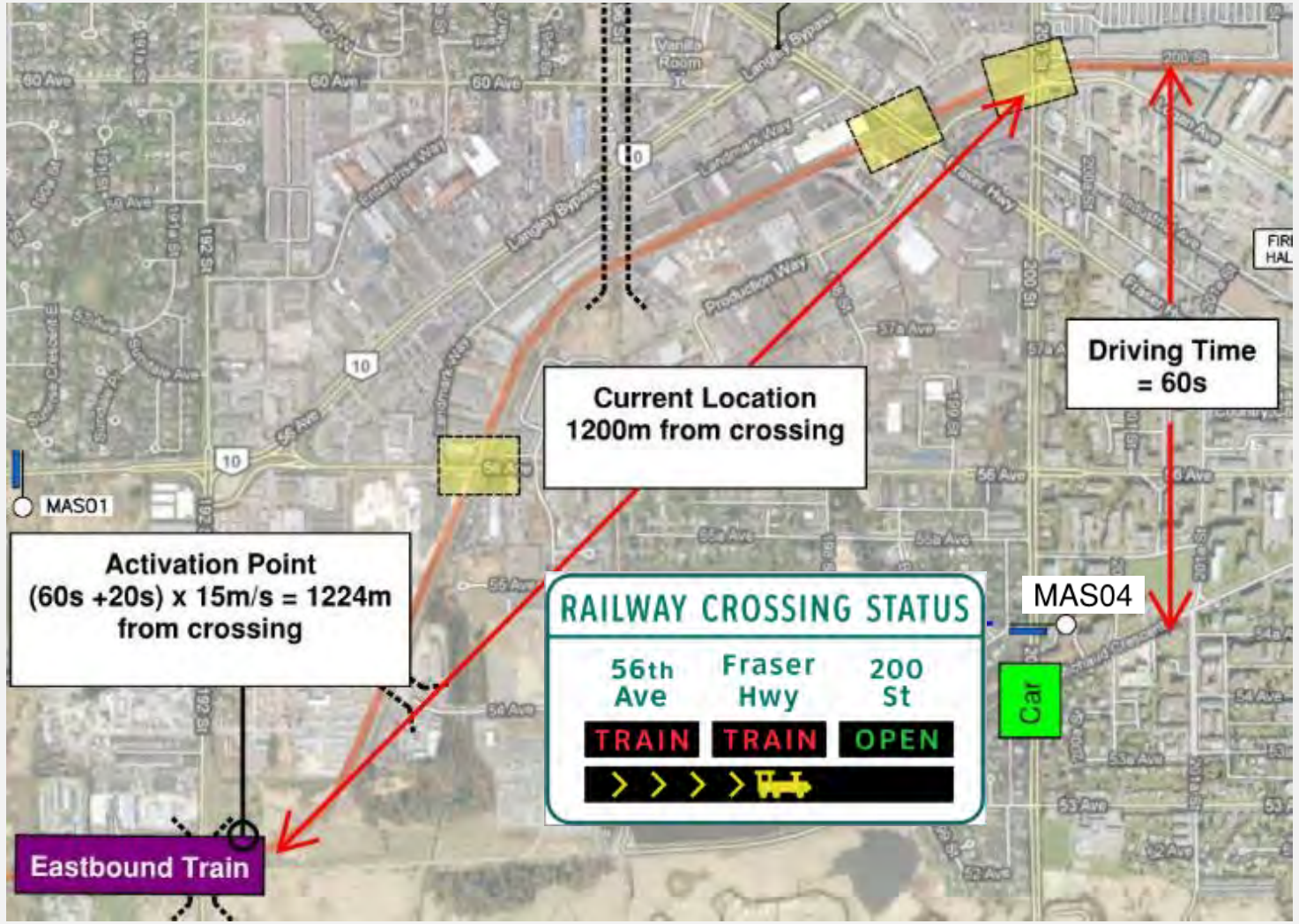
Concept of Operations

Prediction Algorithm

- Train movement tracked along corridor
- Based on train speed, direction, and length data, the following are calculated:
  - Train arrival time at each crossing
  - Estimated crossing blockage duration
- Train position confirmed using:
  - Mid-corridor train detectors
  - Crossing pre-emption signals, where available



CONCEPT OF OPERATIONS



DETECTION

Detection Technology Testing

- Pilot project conducted to test various detectors
- Complex sensors did not perform well in pilot project
- Radar detector and beam sensor configuration has proven to reliably and accurately detect train characteristics
- Integrated suite of sensors at each TD to provide resiliency
- Highly accurate detection:
  - Presence: near 100%
  - Speed: +/- 2-5%
  - Direction: near 100%
  - Length: +/- 3-9%

Rail Operations

Most **trains** were long intermodal trains but there were also occasionally short trains that were only a few locomotives long

Identifies the need to detect shorter trains and treat them differently in system design

Significant **variation** in rail car types

Chosen detection technology must be capable of detecting all car configurations

Trains do not maintain a constant speed during their travel and may accelerate or decelerate significantly

Regular monitoring of train velocity required

Exception Processing

System had to effectively address complicated scenarios

Wide variation in train configurations

- Length
- Speed
- Car type and configuration

Large number of possible exceptions

- Short trains
- Maintenance vehicles
- More maintenance vehicles
- Siding tracks
- Varying train operations
- Varying train speeds while transiting corridor

MESSAGING SIGN DESIGN

Motorist Advisory Sign Design

- Message purpose:
  - Notify drivers of rail crossing status to make informed route choice decisions
  - Appropriate messaging content is critical to guiding driver behavior
- Info needed by motorists:
  - Which crossings are blocked? ▶ OPEN - TRAIN
  - How long will they be blocked? ▶ TRAIN LOCATION INDICATOR
  - Which route should I divert to? ▶ TRAIN DIRECTION INDICATOR

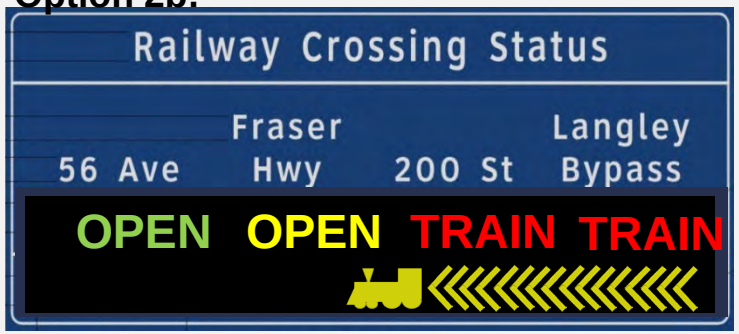
Motorist Advisory Sign Design

Survey Summary:

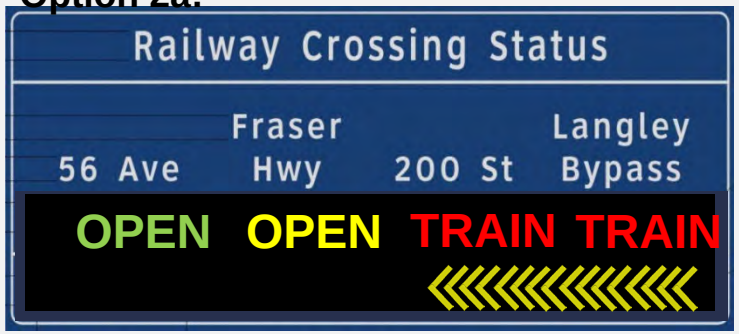
- 544 valid participants for a completion rate of 39%
- All signs scored relatively high with over three-quarters rating the signs as “somewhat” or “very effective”.
- Option 2b had both the highest combined effectiveness score as well as the highest % of ‘very effective’.

Option 1:

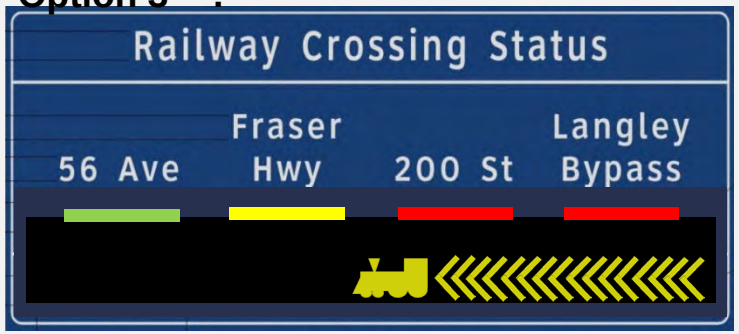
Option 2b:



Option 2a:



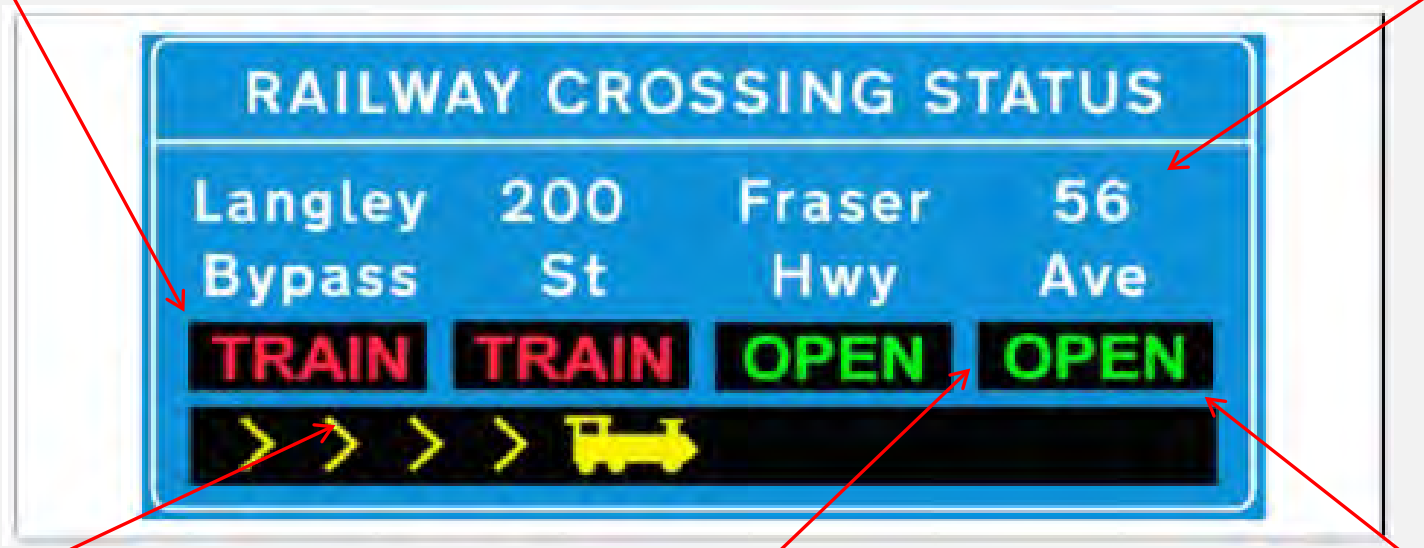
Option 3*:**



Human Factor Analysis Results

Crossing names centered above status

Vertically stacked crossing names

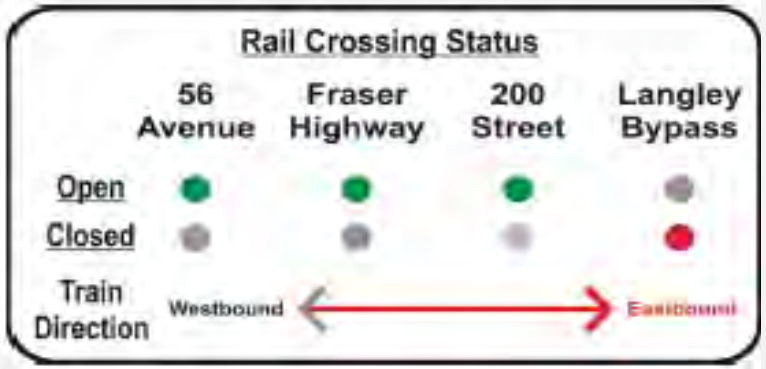


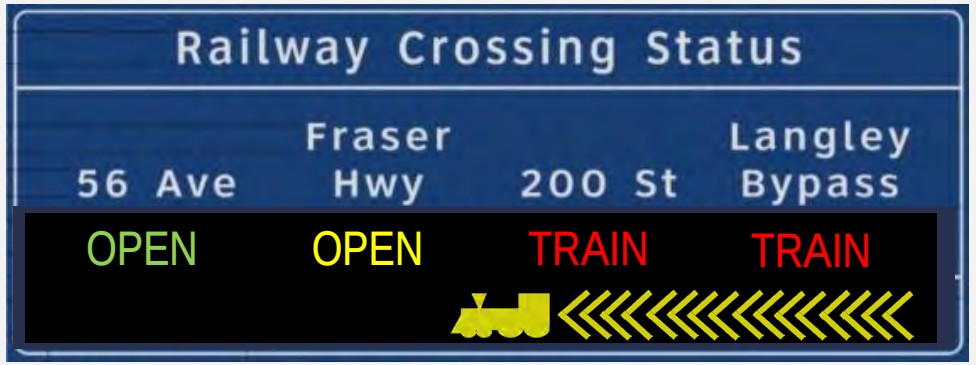
50% reduction in the number of chevrons

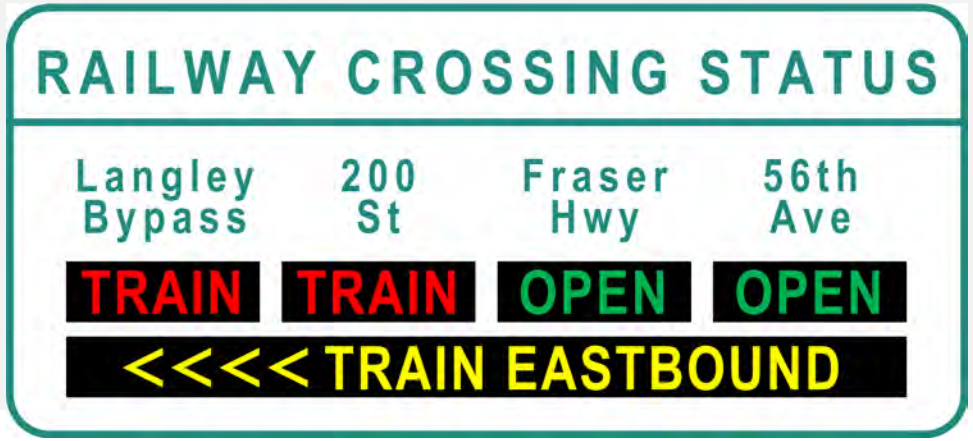
Vertical dividers between status readings

Horizontal divider between status readings and train

Motorist Advisory Sign Design





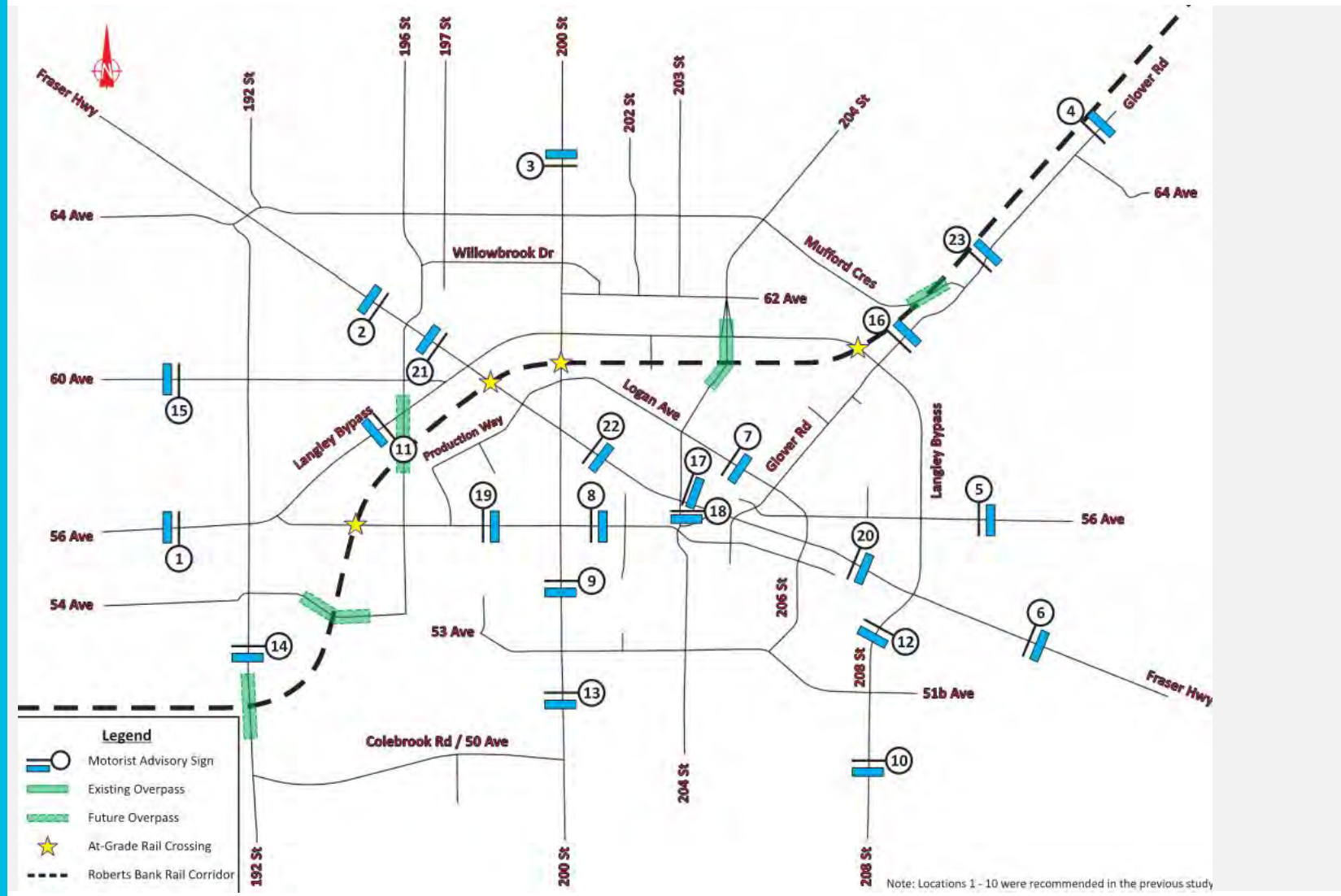


SIGN DESIGN EVOLUTION

- Human factors analysis undertaken
- Public survey conducted to test comprehension
- Sign design refined during detailed design

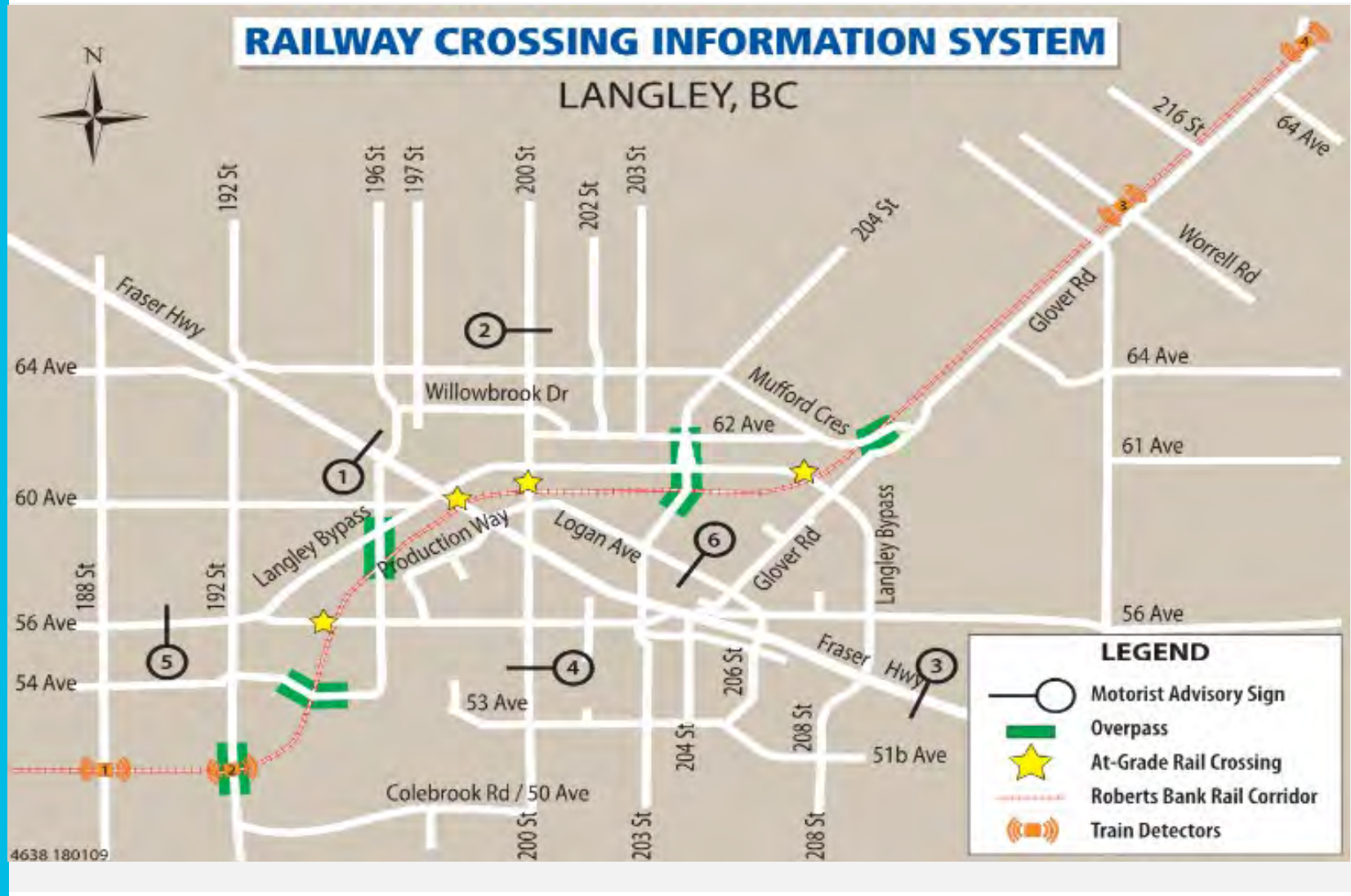
Sign Location Analysis

- Conceptual design report looked at travel times and route diversions
- 21 Motorist Advisory Sign locations considered

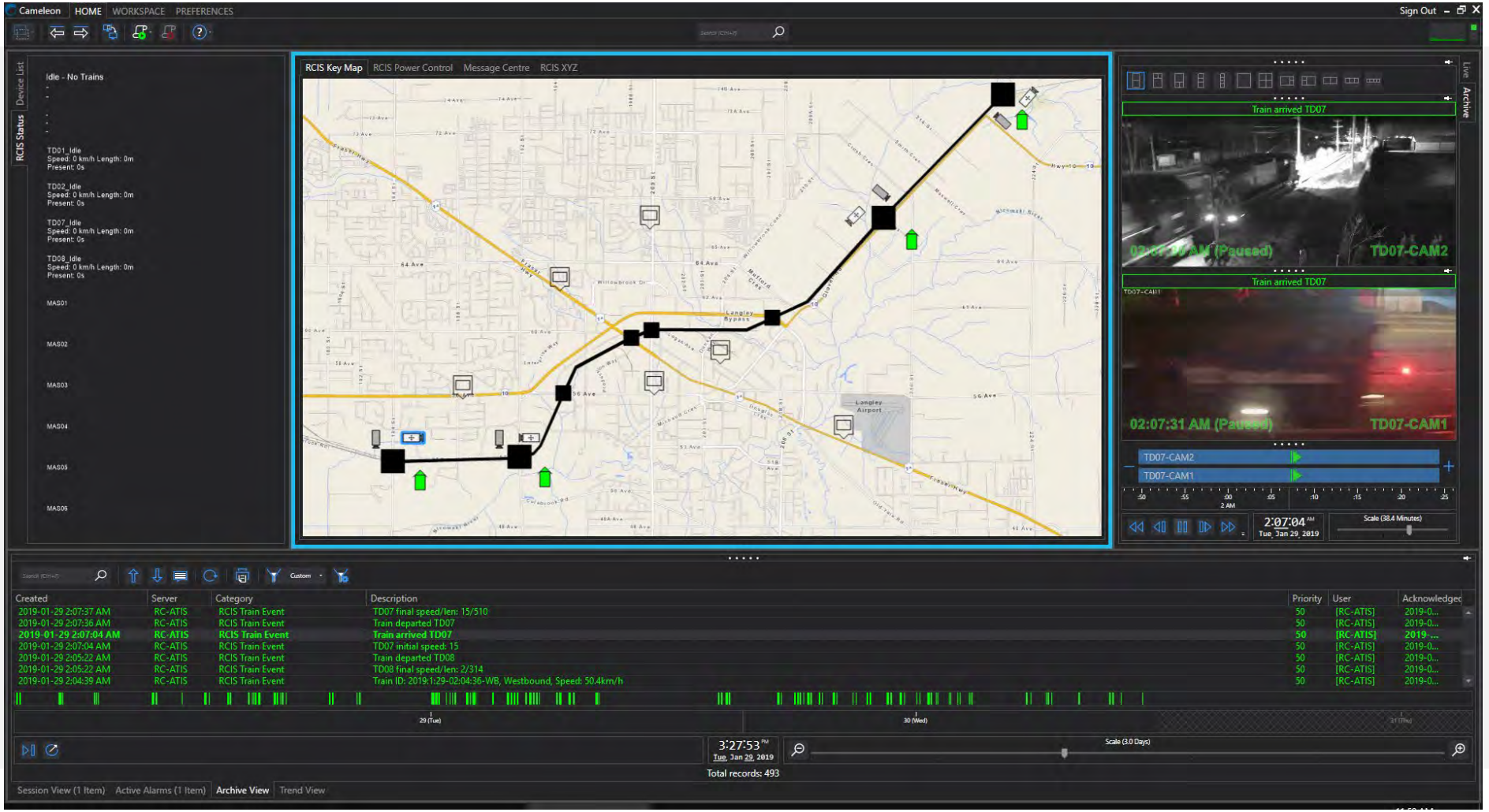


Sign Location Analysis

- VISSIM macro-simulation model to assess diversion potential and number of cars served for each sign
- Short list to 6 high priority signs that serve the most drivers



RCIS Workstation Display



Implementation Status

- Rigorous testing methodology followed
- System is live – Early March 2020
- Performance metrics
  - Pre- and post-implementation data gathered to assess diversion rate effectiveness
  - Travel time/O-D data collection – Bluetooth Sensors
- Significant support and excitement from local municipalities

Amy Hunter, P.Eng., PTOE
Transportation Lead And Senior Design Engineer
PBX Engineering Ltd.

2023 CEA Alberta Transportation Conference

Thank you.

QUESTIONS?

pbxeng.com

PBX ENGINEERING