Eglinton Station - Subway Support
Metrolinx Board Presentation

October 22nd, 2018

Overview

- CTS has secured TTC approval of plans for the construction of two LRT stations underneath Eglinton and Eglinton West Line 1 subway stations.
- Project Agreement sets extremely stringent performance criteria for this work.
- CTS undertook rigorous design, validation and checking.
- Comprehensive risk management plan developed, including 24/7 real time monitoring
- Led by tier 1 design and construction team – recognized leaders in their respective fields.
- Tight coordination between CTS, TTC and Metrolinx.
- No interruption to subway service.

Subway Support Leadership

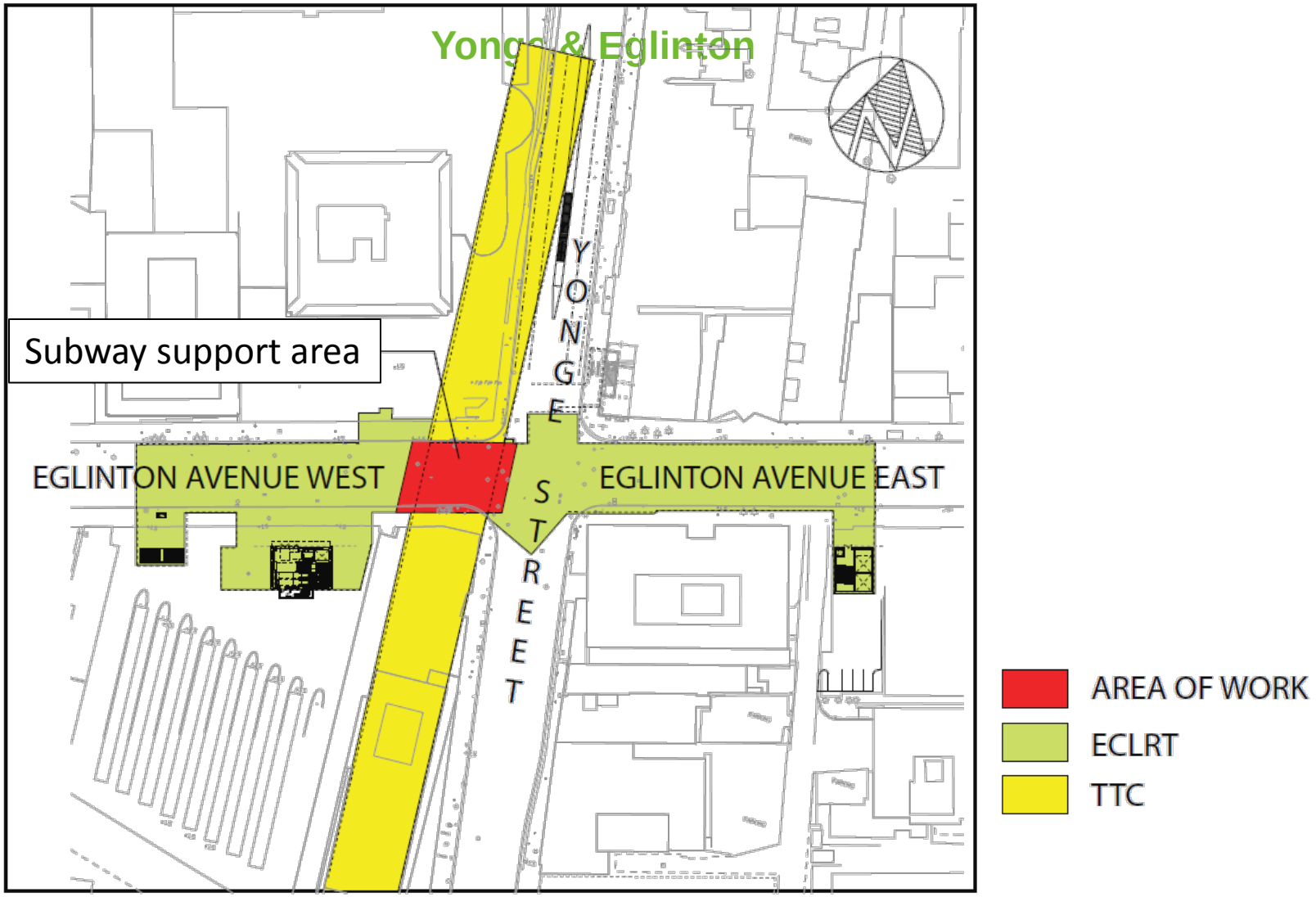
Peter Ojala – Lead Structural Engineer

- Company: LEA Consulting Ltd.
- Experience: 30+ years
- Expertise: Extensive station design work on TTC stations and large structures
- Reference Projects:
  - Keele Trestle (TTC Bloor Subway Subway Support);
  - Finch-West Subway Station, (Line 1 Spadina Extension aka TYSSE);
  - Load Factor Calibrations (3) of TTC Structural Manual;
  - Many large TTC rehabilitation jobs, including items such as roof replacement on Bloor Line tunnel under the Park Hyatt Hotel and many Triennial work assignments;
  - Numerous large structural steel and concrete bridge structures, Provincial , Federal and International; and
  - LEA Consulting Ltd. current projects: 2 stations on DRL (Downtown Relief Line - Pape and Gerrard) Yonge Station at Highway 7 (Line 1 extension).

Steve Plyler – West Stations Director

- Company: CTS
- Experience: 40+ years
- Expertise: Major Railways, Subways
- Reference Projects:
  - Crossrail Reading, United Kingdom;
  - West Coast Route Modernization, United Kingdom; and
  - Major Rail works around the world.
  - MIRO - Member Institute of Railway Operators (UK)
  - Past President Nth Texas Railway Institute

Subway Support of Line 1 at Eglinton Station



Goal - Fully Integrated Interchange Station

Subway Support Design – Performance Criteria

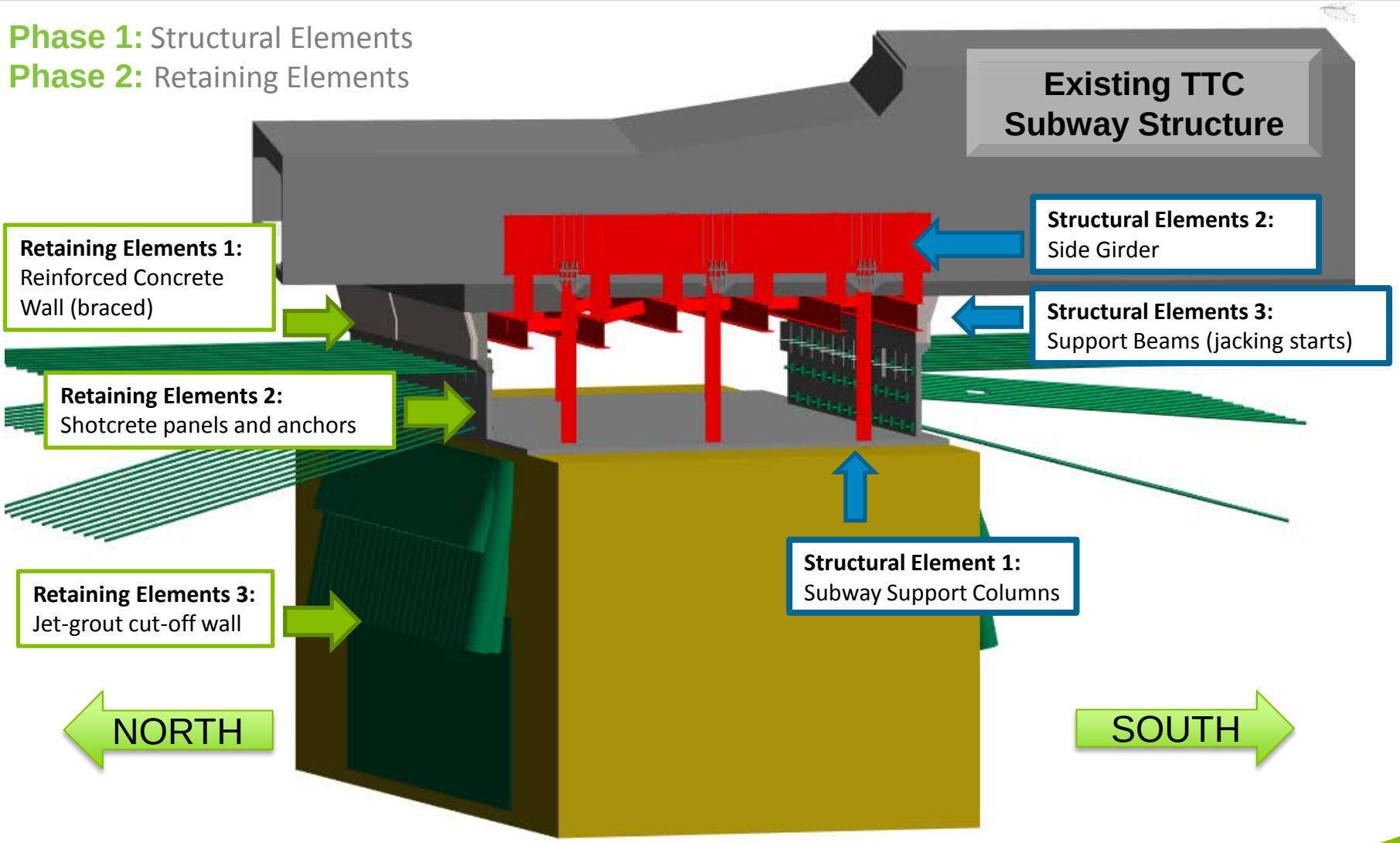
- The subway support has been designed to limit differential settlement of existing TTC structure to a maximum of:

3 millimeters

Rice Grain = 1.5 mm

Subway Support Components

Phase 1: Structural Elements
Phase 2: Retaining Elements



Similar Subway Support Operation - TTC Line 2

TTC Structure Jacking

- Conventional technology.
- Successfully used in Toronto on TTC subway Line 2 at Keele Trestle.
- Similar concept - very small movement (less than 1mm) during jacking of the TTC structure.

Expertise Jacking Heavy Structures

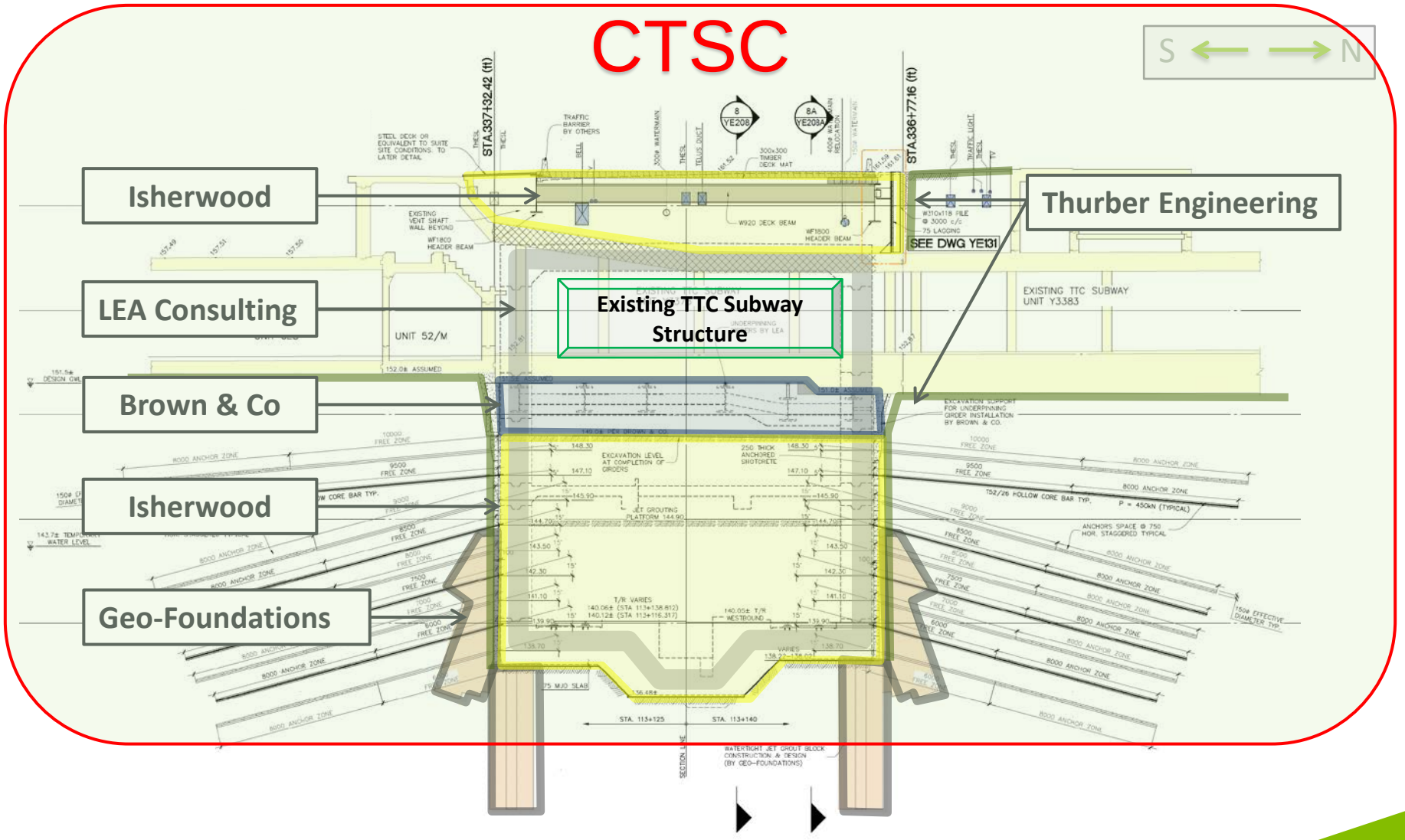
- CTS retained Western Mechanical to fabricate and operate the subway support jacks.
- Western Mechanical experience includes:

Jacking & Rolling Concrete Structure – Central Ave Bridge, Fort Erie

Lifting & Moving of Kodak Building, Crosstown Mt Dennis Station

Tier 1 Design Team -

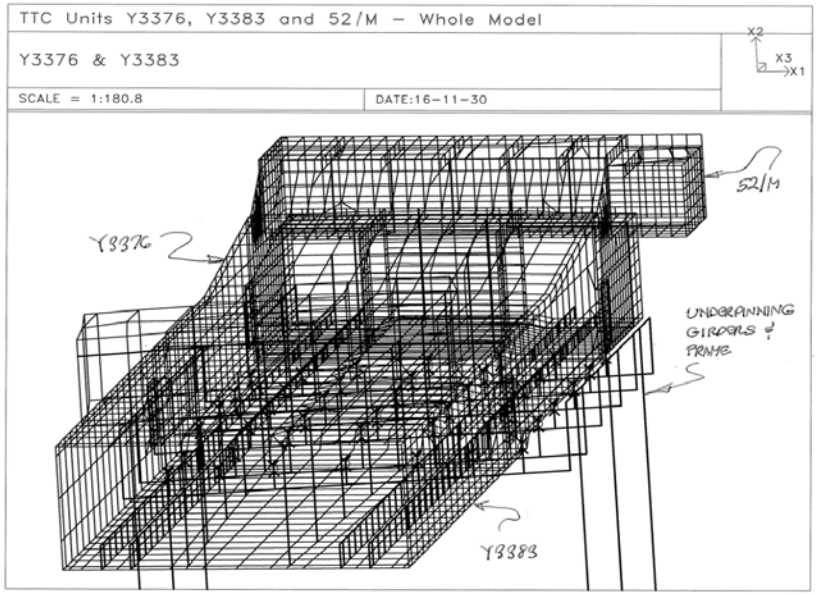
Recognized leaders in their respective fields



Rigorous Validation of Design

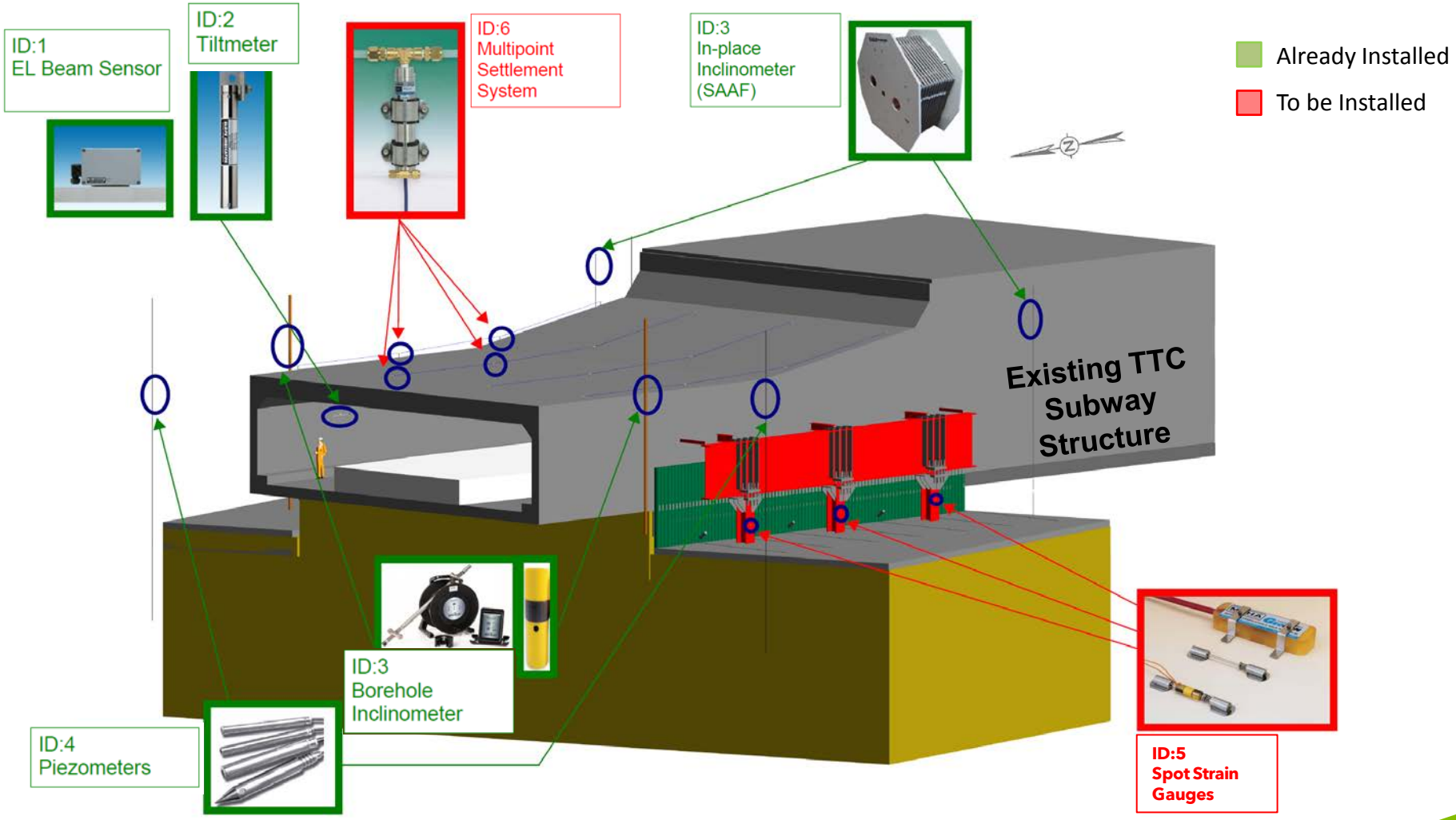
Engineering, Modeling and Design Checks:

1. Construction Impact Assessment Level (CIAR) Level 1
2. CIAR Level 2
3. Soil-Structure Interaction Modelling for CIAR Level 3
4. Modulus of Subgrade Reaction – Support Beams Installation
5. Global Stability Analysis of multiple excavation stages
6. Joint movement and structure evaluation at underpinned and adjacent TTC Structures (Finite Element Modelling)
7. Dewatering Modelling
8. Independent Structural Design Checks
9. TTC Technical Review
10. TTC 3rd Party Review



Instrumentation & Monitoring

- Monitoring of the TTC Subway Box throughout Construction



Operations Room

- ✓ 24/7 Roster in place
- ✓ Communication Plan in place
- ✓ 10:00am Daily Engineering Meeting for all parties
- ✓ Status Reports issued twice daily
- ✓ List of contingency equipment available including; back-up power supply
- ✓ Escalation Protocol
- ✓ Shift Handover Plan

Video

Risk Management

Phase of Operation

- Installation of subway support beams
- Installation of subway support beams below subway joints
- Excavation below the subway support beams

Risks

- Failure of Jacks
- Above Limits Differential Settlement of Subway Units
- Settlement of caissons
- Settlement of soil mass
- Destabilization of face of excavation due to:
  - Runoff Water
  - Groundwater
  - Damaged water mains, storm or sanitary sewers
- Construction damage to subway support structure

Response Action Plan (Risk Contingencies)

Response to Alert Level = 3 mm (differential movement)

1. Stop the works at the area that imposes impact to the structure
2. Conduct a structure inspection
3. If there are no signs of distress actions will be taken to adjust the levels and construction will resume
4. If the structure shows signs of distress, mitigation measures shall be implemented

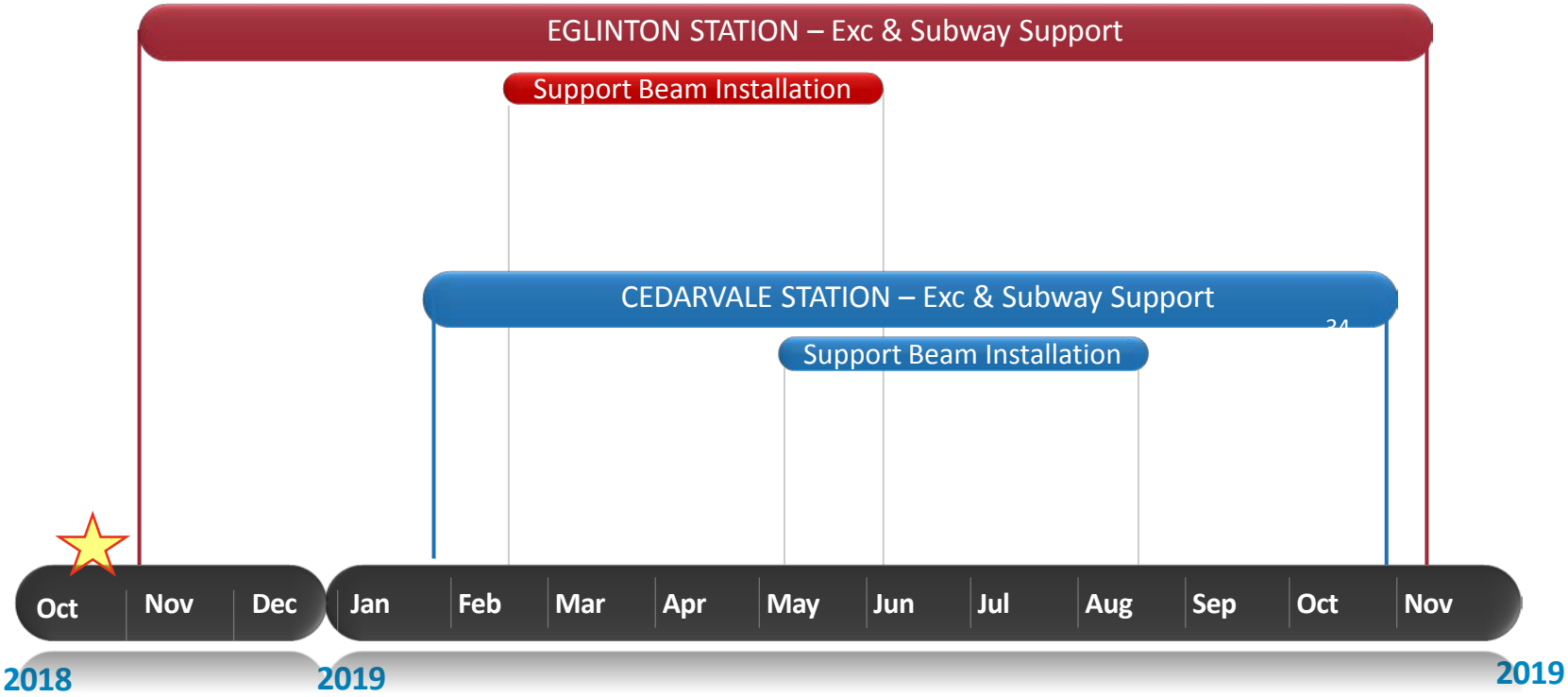
Operational Response to be developed jointly with TTC

5. Developing the process to include; TTC Engineering, Construction and Operations
6. Operational Alert Levels to be set

In Case of Emergency

- ✓ Follow TTC Subway Book Section 2 - “Responding to Emergencies”
- ✓ Call TTC Transit Control immediately at 416-393-3555
- ✓ Follow directions from TTC Transit Control

Subway Support High Level Schedule

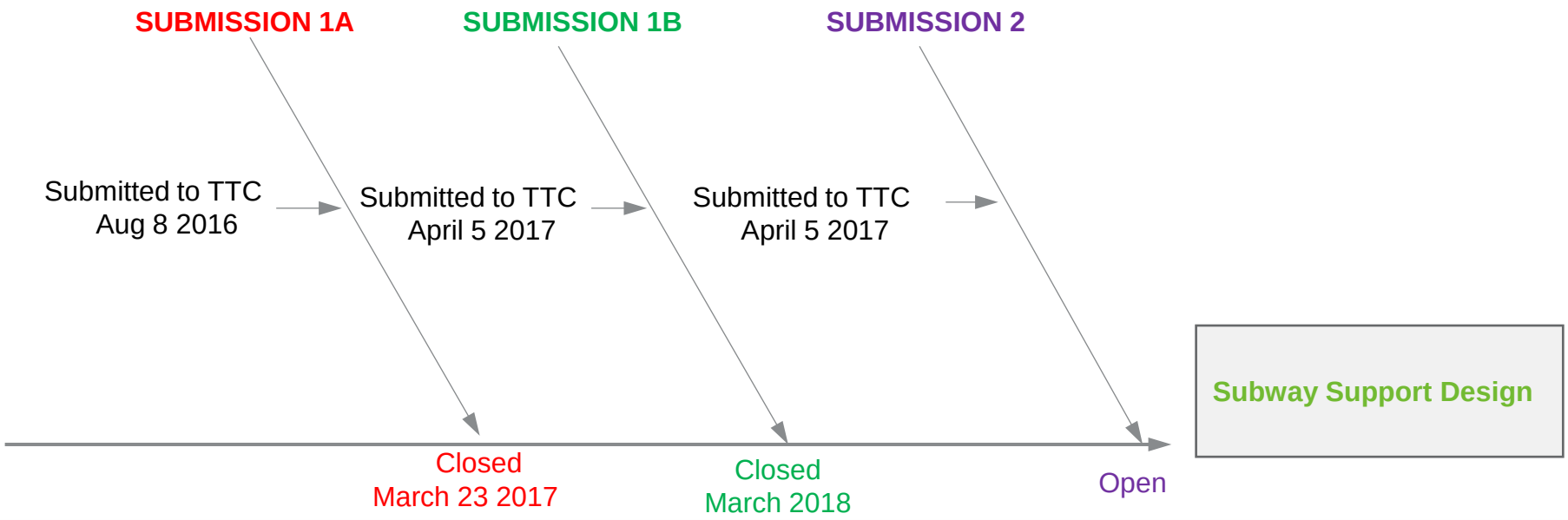


Thank you!

For more information about the Eglinton Crosstown LRT please visit:
www.thecrosstown.ca

Appendix

Subway Support Submittals Pathway



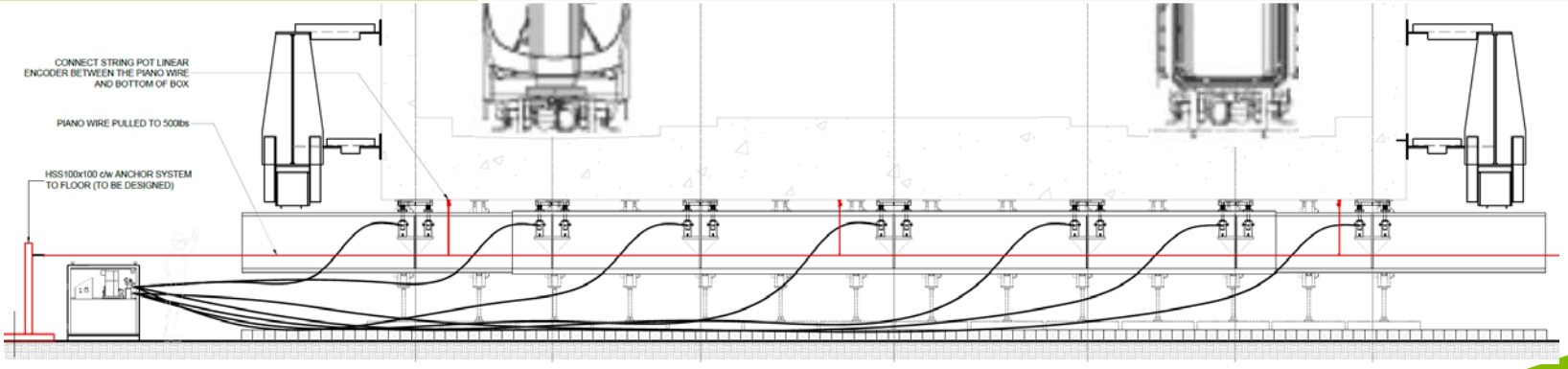
Subway Support Coordination with TTC	
Focus Group Meetings	11
TTC Comments Received	189
TTC Rebuttals Received	48
Submitted Eng. Calculation Sheets	4500
Outstanding Issues with CTS	3
CRRs to be Transmitted to TTC	28

Risk Management

Phase of Operation	• Installation of subway support beams
Risk Item	• Failure of jacks
Potential Impact	• Stop construction work, service continues
Mitigation	• Jacking system has fail-safe features • Pistons lock in place and can be manually adjusted
Response	• Replace jacks, test system and repeat operation
Impact to Subway Operations	• Probability: low • Severity: negligible

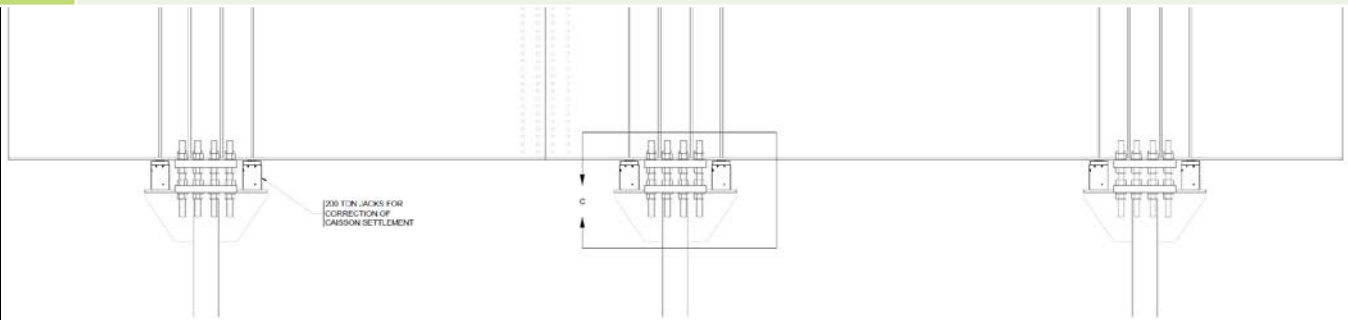
Risk Management

Phase of Operation	• Installation of subway support beams - below subway joints
Risk Item	• 3mm differential settlement between subway units
Potential Impact	• Stop construction work, service continues
Mitigation	• Engineered for 2mm movement • Extensive settlement and load monitoring
Response	• Engineering assessment, inspect track and other infrastructure • Modify jacking forces, back-grout soil gap at edge of excavation • Remedial work if required
Impact to Subway Operations	• Probability: low • Severity: very low



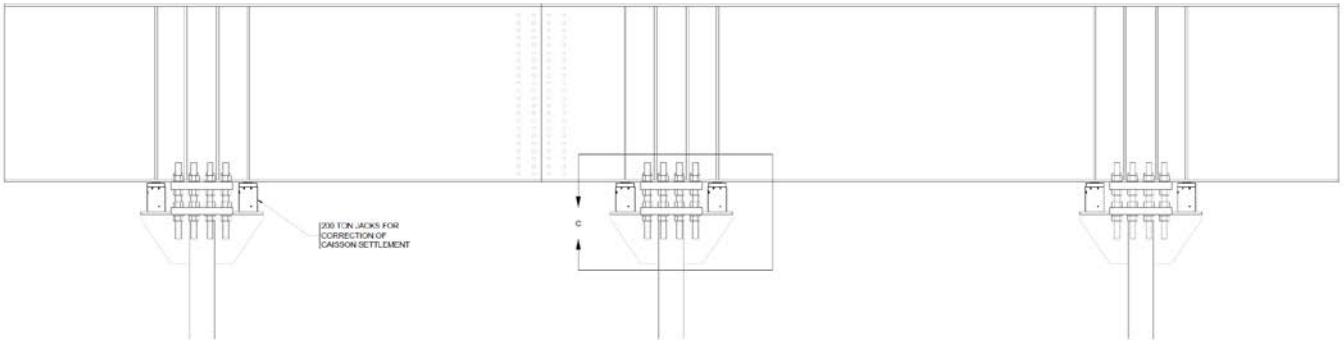
Risk Management

Phase of Operation	• Excavation below subway support beams
Risk Item	• Settlement of caissons causes 3mm differential settlement
Potential Impact	• Stop construction work, service continues
Mitigation	• Pile load testing to predict maximum settlement (10mm) • We have the capability to raise/lower subway by 75mm • Extensive monitoring of settlement and loads
Response	• Compensate settlement by adjusting elevation of the subway by controlled jacking of subway support girders prior to 3mm
Impact to Subway Operations	• Probability: very low • Severity: very low



Risk Management

Phase of Operation	• Excavation below subway support beams
Risk Item	• Settlement of **soil mass** causes 3mm differential settlement
Potential Impact	• Stop construction work, service continues
Mitigation	• **Engineered for 2mm settlement** • Extensive monitoring of settlement and loads
Response	• Compensate settlement by adjusting elevation of the subway by controlled jacking of subway support girders prior to 3mm
Impact to Subway Operations	• Probability: very low • Severity: very low



Risk Management

Phase of Operation	• Excavation below subway
Risk Item	• Storm water run-off water flows into excavation
Potential Impact	• Destabilization of face of excavation, construction and service continues
Mitigation	• City catch-basins inspected, cleared and maintained • Drainage and un-watering system installed to divert and remove water
Response	• Additional pumps to be deployed
Impact to Subway Operations	• Probability: very low • Severity: very low

Risk Management

Phase of Operation	• Excavation below subway
Risk Item	• Unplanned rise in ground water level
Potential Impact	• Construction stopped, service continues
Mitigation	• Full scale testing of dewatering performance • Engineered dewatering plan and contingency plan • System redundancy (power, equipment and pump lines) • Monitoring
Response	• Install additional pumps • Worst case: back-fill (concrete or soil) to make excavation safe
Impact to Subway Operations	• Probability: very low • Severity: very low

Risk Management

Phase of Operation	• Excavation below subway
Risk Item	• City water, storm or sewers break and flood excavation
Potential Impact	• Construction stopped, service continues
Mitigation	• All City infrastructure replaced with new pipes and valves • Monitoring • Note: all THESL relocated outside of excavation - all Telcos secured and protected
Response	• Install additional pumps • Worst case: back-fill (concrete or soil) to make excavation safe
Impact to Subway Operations	• Probability: very low • Severity: very low