BENCHMARKING GROUP OF
NORTH AMERICAN LIGHT RAIL SYSTEMS

The Impact of Operational Characteristics on Light Rail Performance

2019 APTA/TRB Light Rail Conference Presentation

April 2019

Imperial College
London

Presentation Agenda

- **Who are we**
- **How KPI data can be used to improve operational performance (LRV Maintenance Example)**
- **How KPI data can be used to evaluate proposed capital projects (BQX Example)**

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International Benchmarking: Eight Public Transit Groups – Benefits Drive Continued Participation

Imperial College London

Railway and Transport Strategy Centre

Community of Metros CoMET

Founded 1994

18 Members

Nova Group of metros

Founded 1998

20 Members

IBBG

Founded 2004

16 Members

GOAL

Founded 2016

12 Members, including
(Bf) Buffalo NFTA
(Ch) Charlotte CATS
(Ca) Calgary Transit
(Da) Dallas DART
(Ed) Edmonton ETS
(HR) Hampton Roads Transit
(Pg) Pittsburgh PAAC
(Po) Portland TriMet
(SD) San Diego MTS
(ST) Seattle Sound Transit
(To) Toronto TTC
(UT) Salt Lake City UTA

IMRBG (Mainline Rail)

Founded 2016

7 Members

Railway Infrastructure

Founded 2016

4 members

ISBeRG

Founded 2010

14 Members

ABG (Airports)

Founded 2017

9 Members

FLIRT User Group

Founded 2019

6 Members

ABBG

Founded 2011

21 Members

Benchmarking is the Search for Best Practices That Lead to Superior Performance

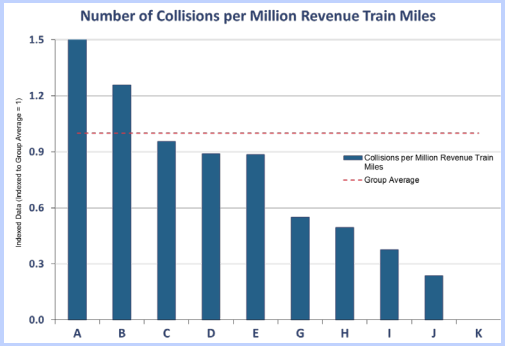
Benchmarking Is:

A systematic process of *continuously* measuring, comparing and *understanding* performance and *changes* in performance

Of a diversity of key business processes

Against comparable peers

To help the participants improve their performance



(Adapted from the definition by Lema and Price)

Benchmarking Provides:

- **Perspective through Data:**
  - How do we **compare** to our peers?
  - What are our **strengths**?
  - What are our **weaknesses**?
  - Quantitative Backing for "rules of thumb"
- **Best Practices through Discussion:**
  - What are others doing to **improve**?
  - What **works**/what doesn't?
  - How to **implement best practices**.

"Rarely is there a challenge that someone else hasn't faced…"

GOAL Key Performance Indicator System

Growth & Learning

G1 **Passenger Boardings, Car Miles & Hours** *(5-yr % change)*
G2 **Passengers per Revenue Mile & Hour** *(car & train)*
G3 **Staff Training** *(by staff category)*

Use in NY/NJ Light Rail Example

Customer

C1 **On-Time Performance** *(% of departures, 0 <> +5 min)*
C2 **Headway Regularity (to come)**
C3 **Delay Minutes** *(passenger & train)*
C4 **Passenger Miles per Revenue Capacity Mile** *(seat & planning)*
C5 **Capacity Miles per Route Mile**
C6 **Percent of Trips Operated**

Internal Processes

P1 **Peak Fleet Availability & Utilization** *(not used by cause)*
P2 **Staff Productivity** *(train or car miles or hours / labor hr)*
P3 **Staff Absenteeism Rate** *(by staff category)*
P4 **Mean Distance Between Technical Failures**
P5 **Mean Distance Between Incidents** *(>5 min delay)*
P6 **Lost Vehicle Miles** *(internal & external causes)*
P7 **Percent On-Time Pull-outs** *(% of departures, later than 4:59)*

Use in Fleet Maintenance Example

F6 **Operating Cost Recovery** *(fare & other commercial revenue per operating cost)*
F7 **Revenue per Passenger Boarding & Mile** *(categories)*
F8 **Investment Rate** *(5yr rolling avg per operating cost)*

Safety & Security

S1 **Train Collisions per Train Mile & Hour** *(preventable, non-preventable)*
S2 **Staff Injuries per Staff Work Hours**
S3 **Staff Lost Time from Accidents per Staff Work Hours**

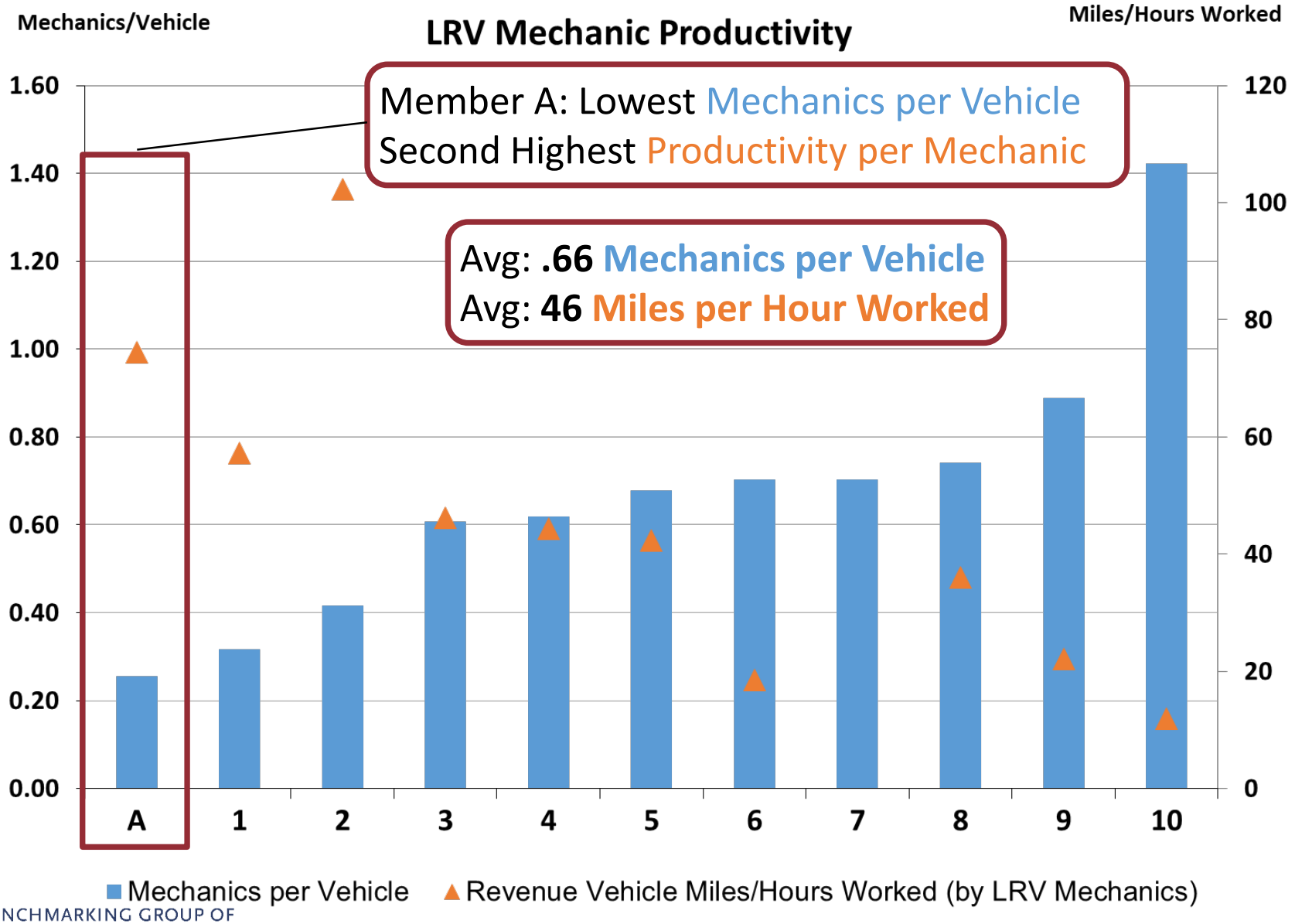
Environmental

E1 **Energy Consumption (Traction and Non-Traction)** *(per total car mile, pax mile, and capacity mile)*
E2 **CO2 Emissions per Total Car Mile & Pax Mile**

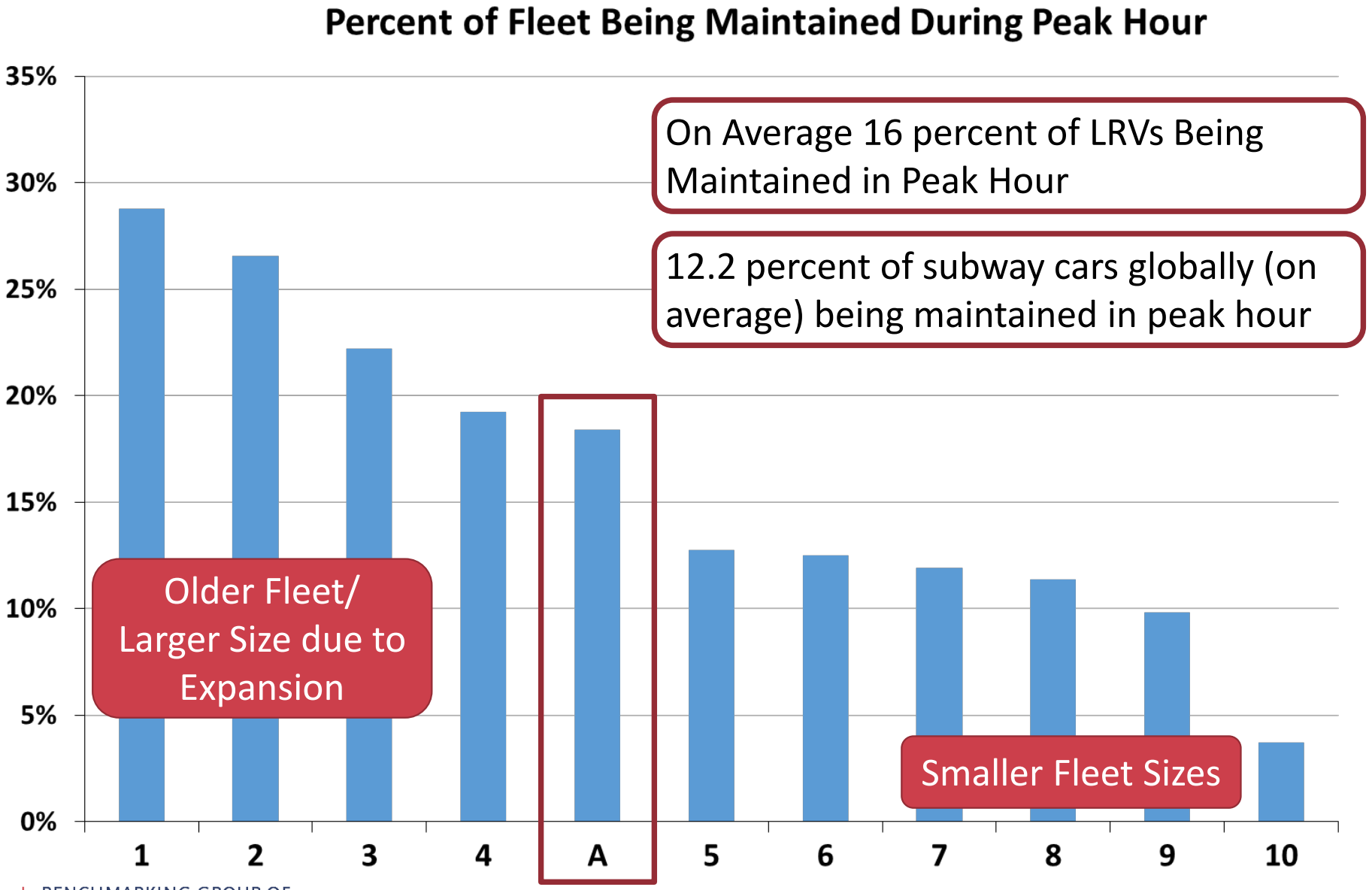
Use of Benchmarking Data to Identify Best Practices in Fleet Maintenance (Using anonymized data)

How Low is Too Low?

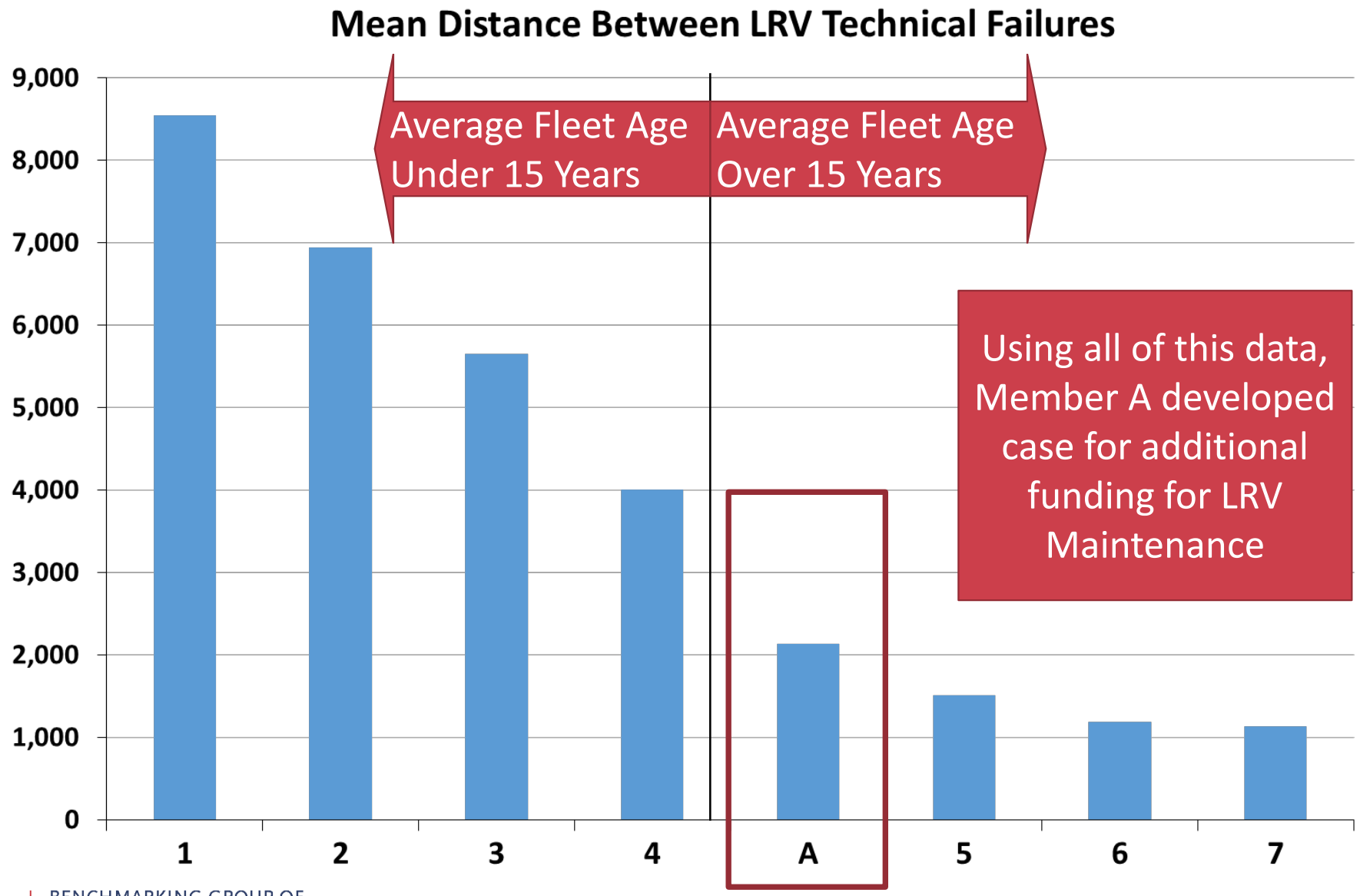
Member A: KPI Data Shows Very High Productivity for Each Mechanic – But is This Ideal Location to be In?



Fleet Available for Maintenance: Additional Capacity Available for Maintenance with Existing Fleet Numbers



Mean Distance Between Incidents – Highly Correlated with Age, Member A Has Four Lowest Reliability for Fleet



Conclusions: LRV Maintenance

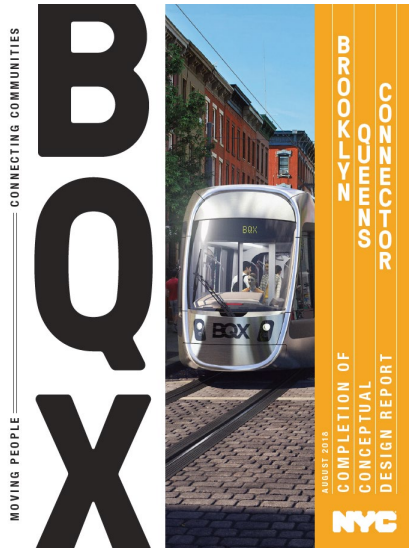
- Being high/low in a performance metric not always the **best place** to be (sometimes you want to be in the middle)

- Need to consider **multiple aspects** related to performance (MDBF, headcount, labor hours)

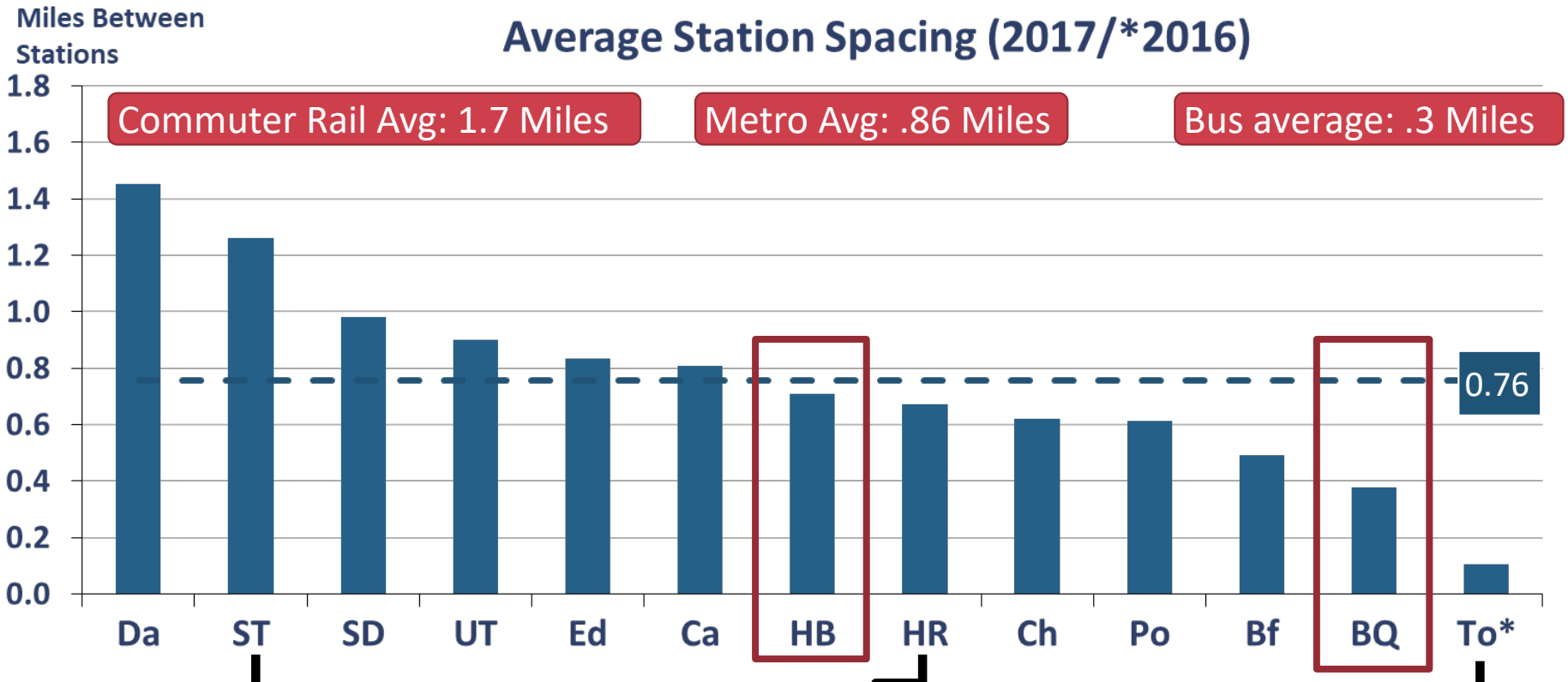
- **Unique characteristics** of LRV operations might impact vehicle availability/maintenance approaches

The Impact of Light Rail Characteristics on Operations: NY/NJ's Light Rail(s) (Using un-anonymized data)

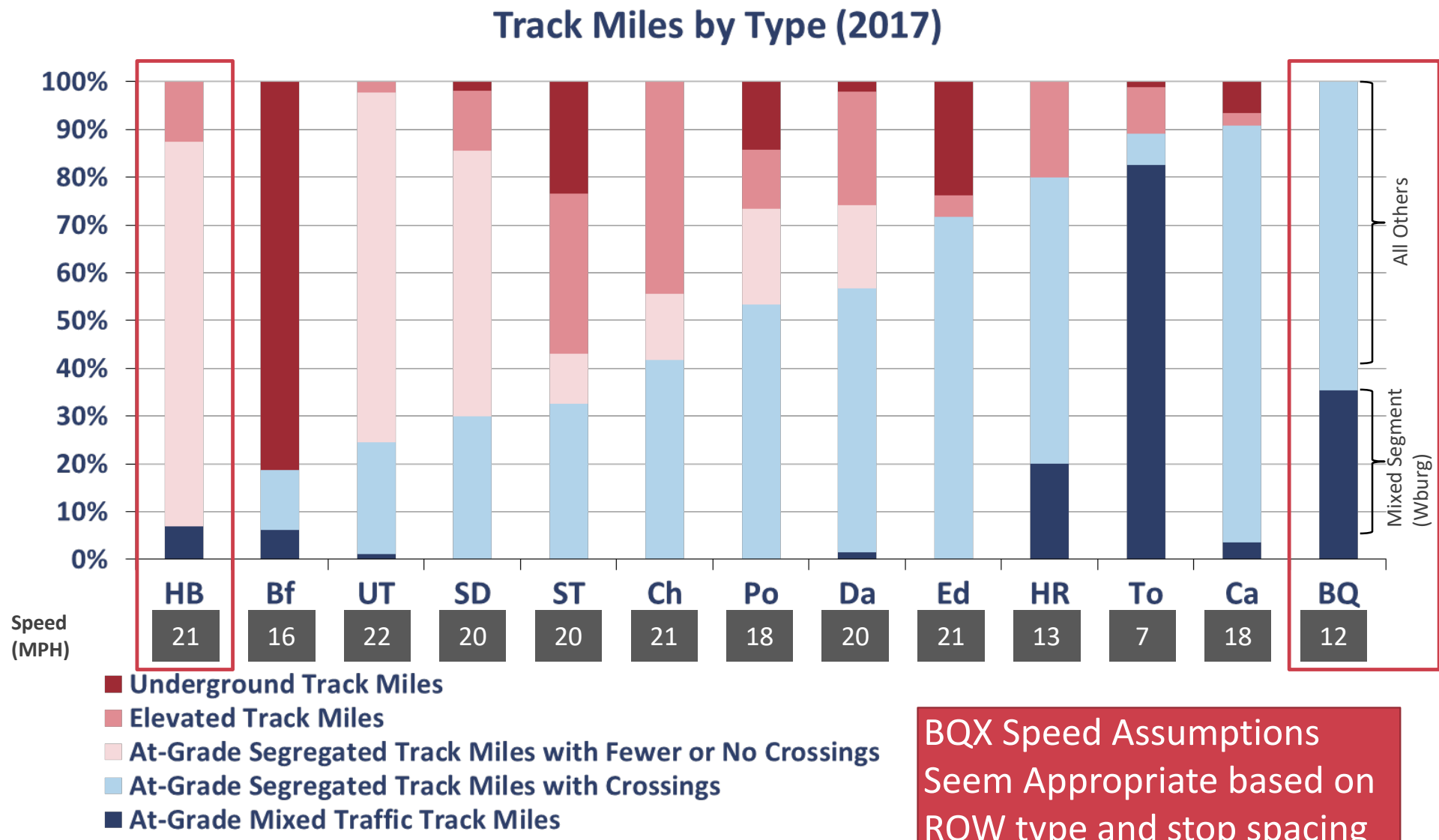
HUDSON BERGEN LIGHT RAIL



Speed: Station Spacing is a Contributory Factor, BQX Would be at Low End of Group, Higher Ridership and Lower Speed

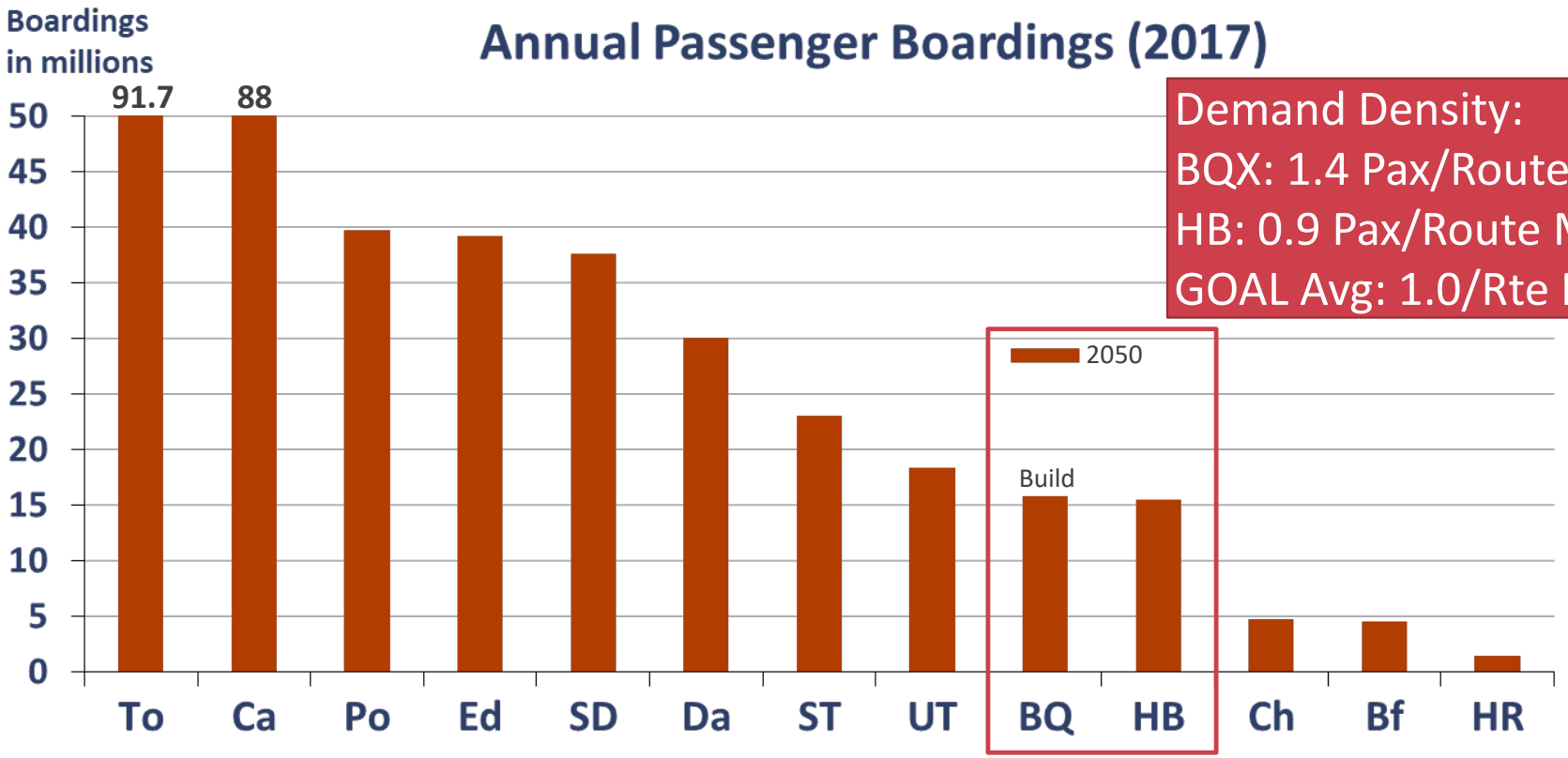


ROW Type Contributes Heavily to Speed – Very Significant Differences in BQX and HBLR ROW Types and Speeds



BQX Speed Assumptions Seem Appropriate based on ROW type and stop spacing

Annual Passenger Boardings: HBLR Has Similar Ridership, Lower Total Demand Density than BQX



Demand Density:
BQX: 1.4 Pax/Route Mile
HB: 0.9 Pax/Route Mile
GOAL Avg: 1.0/Rte Mile

What would BQX trip length/characteristic be? Short trips? Long Trips?

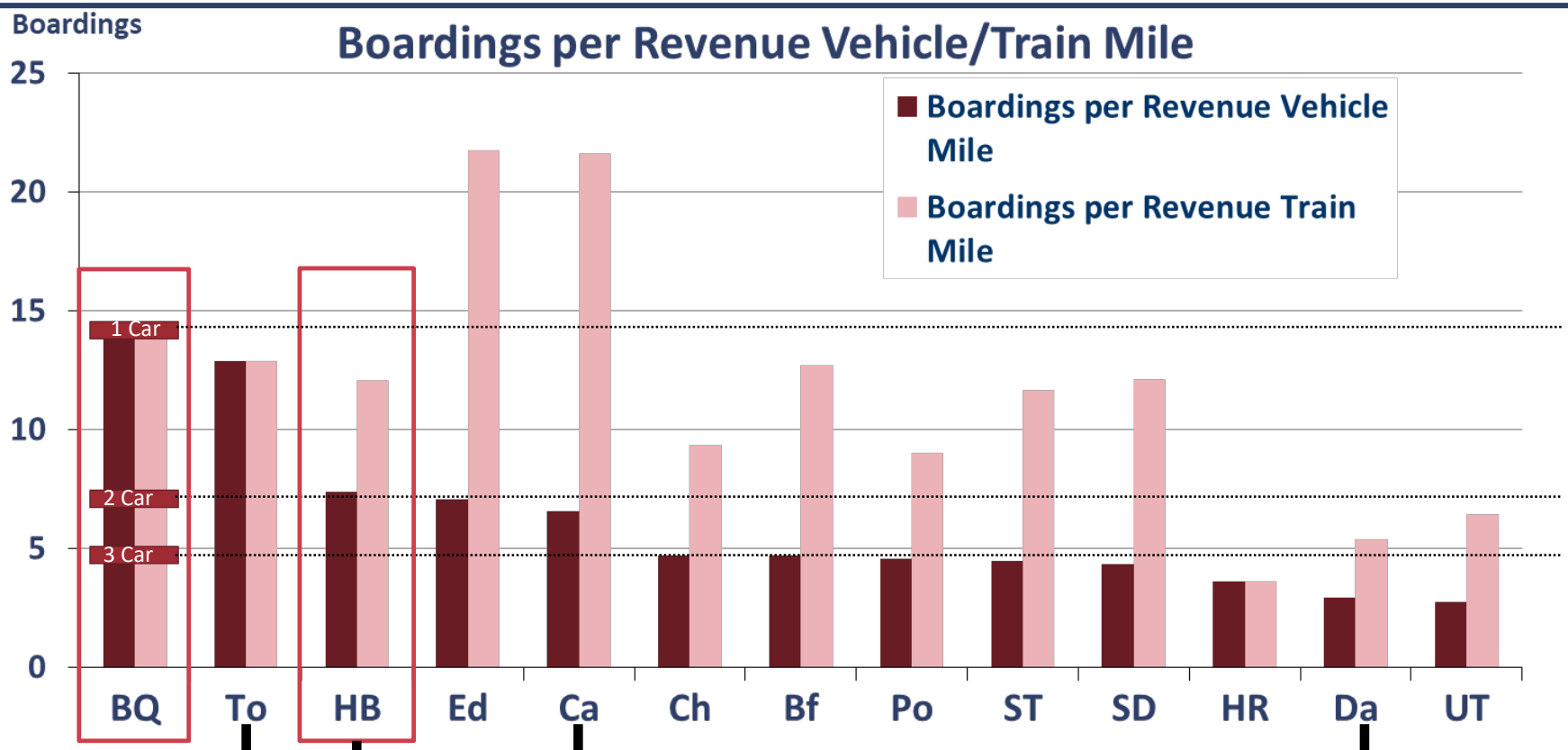
Consist Length, Service Level Impact Supply Density on Route – Would BQX be More H. Roads, Seattle or Calgary/Edmonton?

HBLR headway limited by downtown capacity

Downtown Block lengths impact 2 GOAL members

Less than 5 Minute Peak Headway on Toronto Routes (BQX proposes 5 min)

Comparing Ridership to Service Levels: On a Per Train Level BQX Would be Denser than Toronto, What Impact of Consist Length?



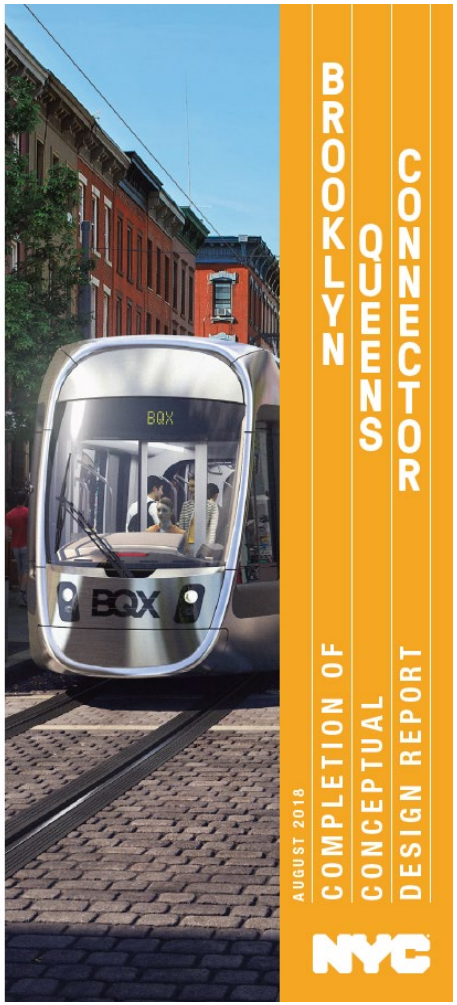
Conclusions – Capacity Constraints in NY/NJ Light Rail

- Capacity key factor in developing new systems/operating existing systems
- Impacted by design characteristics/existing conditions/trip characteristics
- Can be addressed using additional frequency, longer consists, longer trains or alternative configuration
- BQX Project will be very dense, need to look at capacity solutions

Extra Slides

Light Rail Key Performance Indicators: BQX

MOVING PEOPLE | CONNECTING COMMUNITIES



Key Statistic	BQX Report	Notes
Total Annual Boardings	15,800,000	316X Wd to Annual
Actual Vehicle/ Train Miles	1,115,004	Number of trips
Actual Vehicle/ Train Hours	92,917	
Total Route Miles	11	Google Maps
Total Track Miles	22	2X route Miles
Mixed Traffic	4	Assumed in Williamsburg Segment (Shared Use)
Segregated with Crossings	7	Assumed Rest of System
Total Number of Stations	29	