



# Bus Bridging Visualizations

**OCADU & U of T**

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# What is Bus Bridging?

“Bus Bridging involves establishing – short-term – bus routes to restore connectivity between stations affected by a disruption.” (Kepaptsoglou and Karlaftis, 2009)

## Bus Bridging Decision Support Toolkit



Major unexpected rail disruptions occur frequently



Often, a simplistic approach is followed for selecting shuttle buses



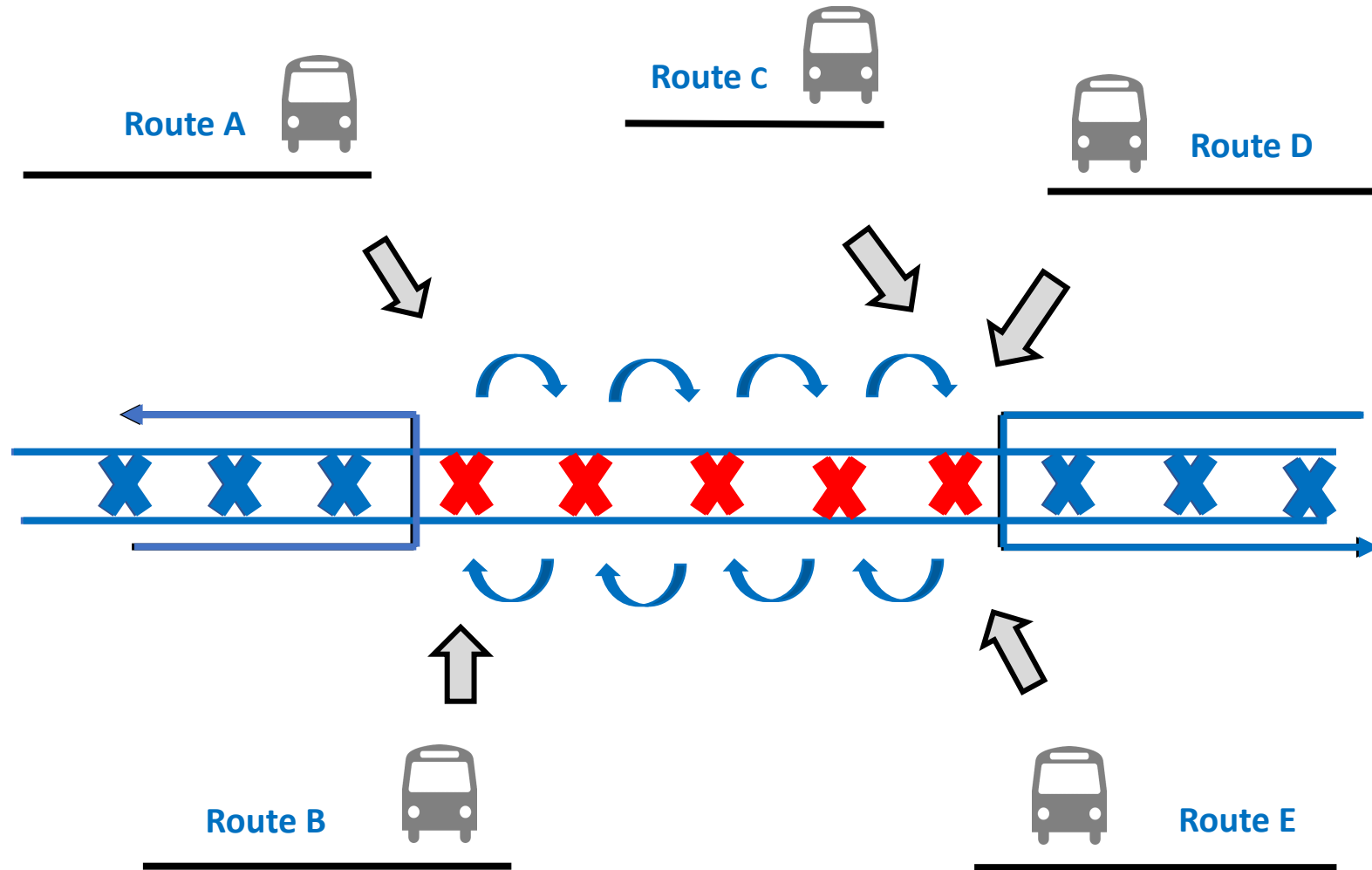
Can lead to extensive delays for passengers and buildup at stations



Result in degraded service and potential loss of loyal passengers

# Bus Bridging Assessment Tool

*A User Delay Modelling Tool (UDMT)*



Develop a tool to help agencies evaluate potential bus bridging plans



Provide measures of the impact on train and bus passengers



Provide measure of how well shuttle buses are used

# Bus Bridging Assessment Tool

## *Input and Output*

User Specified Input

 Incident location and time

 Expected duration of incident

 Dispatch time and Demand reduction

 Number & assignment of shuttle buses

Data Inputs

 Transit network characteristics

 Train and bus ridership

 Train and bus travel time

Bus Bridging  
Assessment  
Tool

 Subway Passengers' Delay

 Bus Riders' Delay

 Detailed measures at disrupted stations

 Longest queue at disrupted stations

 Detailed impact on each bus route

 Shuttle buses performance measures

 Degree of utilization of shuttle buses

 Deadhead time of shuttle buses

# Bus Bridging Web User Interface

**Trapeze™ Bus Bridging** **UTTRI**

**NAME** KiplingKeele\_Plan1 **SELECT SAVED**

**Disruption Occurred**

**DATE** Select

**START TIME** 08:00 AM

**Expected Duration**

**DURATION** 55 mins

**Affected Stations**

**FIRST** Kipling

**LAST** Keele

**Pick Shuttle**

**AGENCY** TTC

97

**Assign to Terminal**

Search Terminal #

**Kipling - Towards Keele** 12

**Available Routes**

TTC 97:Yonge	1
TTC 90:Vaughan	1
TTC 79:Scarlett Rd	1
TTC 53:Steeles East	1
TTC 199:Finch Rocket	2
TTC 85:Sheppard East	1
TTC 195:Jane Rocket	1
TTC 35:Jane	1

**NETWORK** GTHA

**SIGNUP** GTHA with HSR F2017

**SCENARIO** Demo Scenario

**Set Parameters**

Dispatch Time: 5

Demand Reduction: 0

**CALCULATE**

## Effectiveness Summary

### TOTAL DELAYS

2878.7 hours

For **Subway Riders**



99.3 hours

For **Bus Riders**



MAP VIEW

### DELAYS PER STATION

Station Name	No Riders Affected	Riders Delays (h)	Queue at End (p)	To Clear Queue (min) ^	Extra Wait
Keele Station - Westbound Platform	1,892.9	412.86	572.88	0	13.09
Kipling Station - Eastbound Platform	1,851.6	492.23	1,191.64	0	15.95
High Park Station - Westbound Platform	42.8	3.71	60.19	1.56	3
Islington Station - Eastbound Platform	1,136.1	554.07	1,115.37	4.37	25.56
Royal York Station - Eastbound Platform	793.8	425.8	774.04	8.6	25.46
Runnymede Station - Westbound Platform	103.2	8.01	5.29	9.5	4.17
Old Mill Station - Eastbound Platform	261.7	154.31	257.65	10.11	25.71
Jane Station - Eastbound Platform	507.2	303.41	491.6	11.33	25.49
Jane Station - Westbound Platform	136.9	18.16	26.75	13.26	5.37
Old Mill Station - Westbound Platform	59.8	8.03	3.67	14.86	7.14
Runnymede Station - Eastbound Platform	459.7	297.37	445.16	14.99	25.53
Royal York Station - Westbound Platform	81.4	17.18	14.4	16	9.84
High Park Station - Eastbound Platform	231.5	172.94	287.09	16.03	25.73

NETWORK GTHA

SIGNUP GTHA with HSR F2017

SCENARIO Demo Scenario

SAVE

MODIFY

### Effectiveness Summary

#### TOTAL DELAYS

2878.7 hours

For Subway Riders



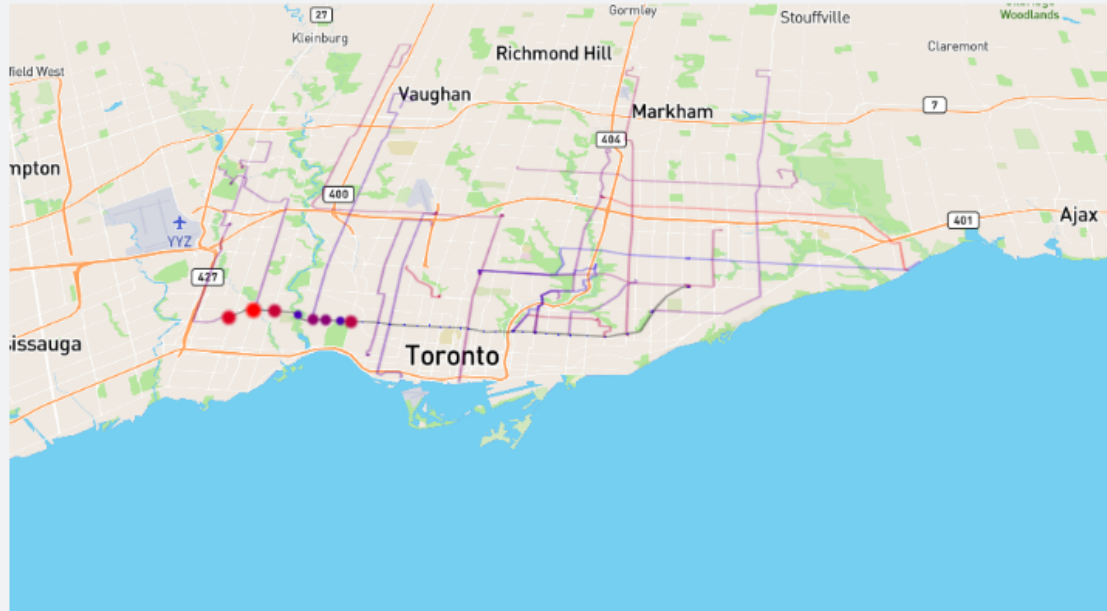
99.3 hours

For Bus Riders



TABLE VIEW

#### Map View



NETWORK GTHA

SIGNUP GTHA with HSR F2017

SCENARIO Demo Scenario

SAVE

MODIFY

# What was missing?

- Visualizations of several situations simultaneously
- Passenger count to be graphically scaled
- Visual tracking of TTC vehicles
- Delay time for arriving passengers at affected stations
- Complete overview of system
- User feedback tool
- No need for input of data in the visualization tool yet



# 1st Iteration

## Model Bus Bridging Tool

Disruption Information

Time: 11:00 AM

Date: 23 May 2020

Direct Impact of Incident

Agency:

Assign to Terminal:

Passenger Count:

Train:

Bus:

Pedestrian:

Indirect Impact of Incident

Passenger Count:

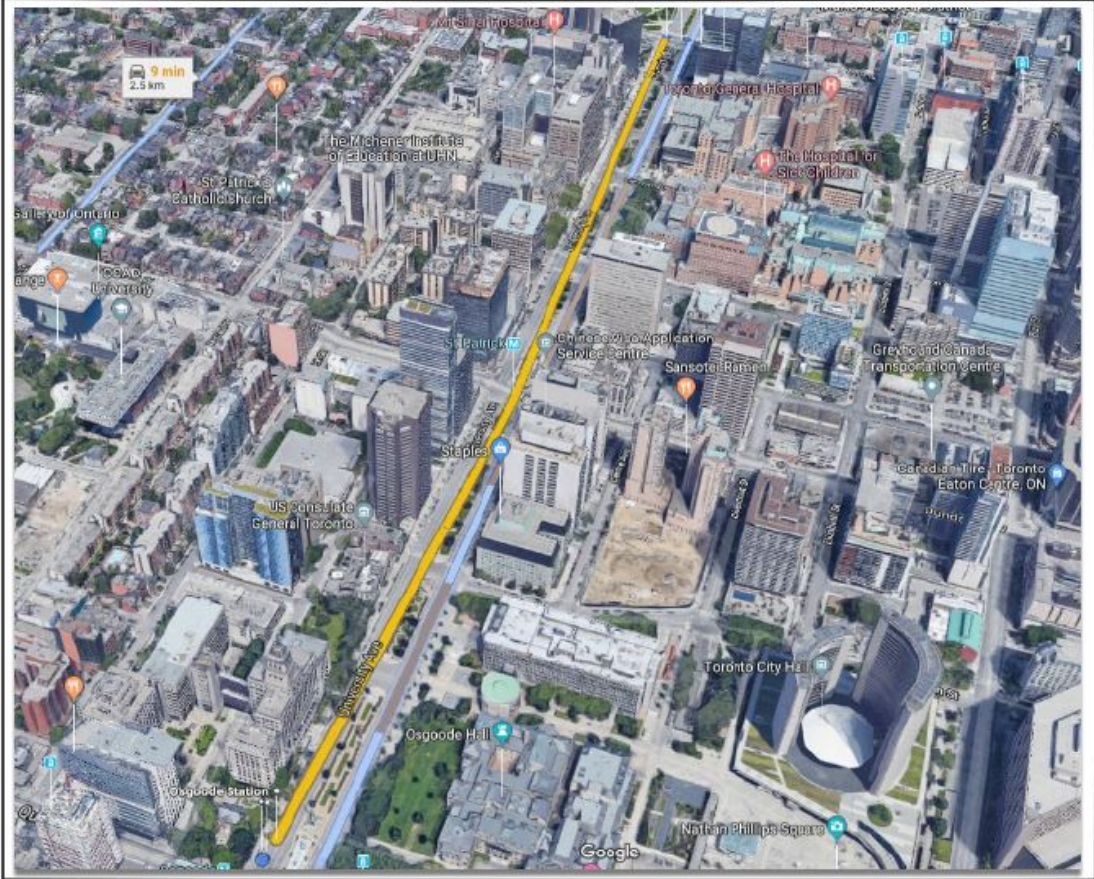
Train:

Bus:

Pedestrian:

Start

End



Selected Buses

- 501
- 502
- 6
- 6A
- 01

Shuttle Service Time:

Initial Response Time:

Dispatch Time:

Allow Consecutive Buses:

Release Periodic Public Updates:

Impact on TTC Subway System

Number of Stations:

Number of Trains:

Passenger Count:

Customer Live Feedback Ratings

☆☆☆☆☆



### Disruption Information

Time: 9:45am

Date: 21 July 2019

### Direct Impact of Incident

Passenger Count

Train:   
 Bus:   
 Pedestrrian:

Agency:

### Assign to Terminal

### Indirect Impact of Incident

Passenger Count

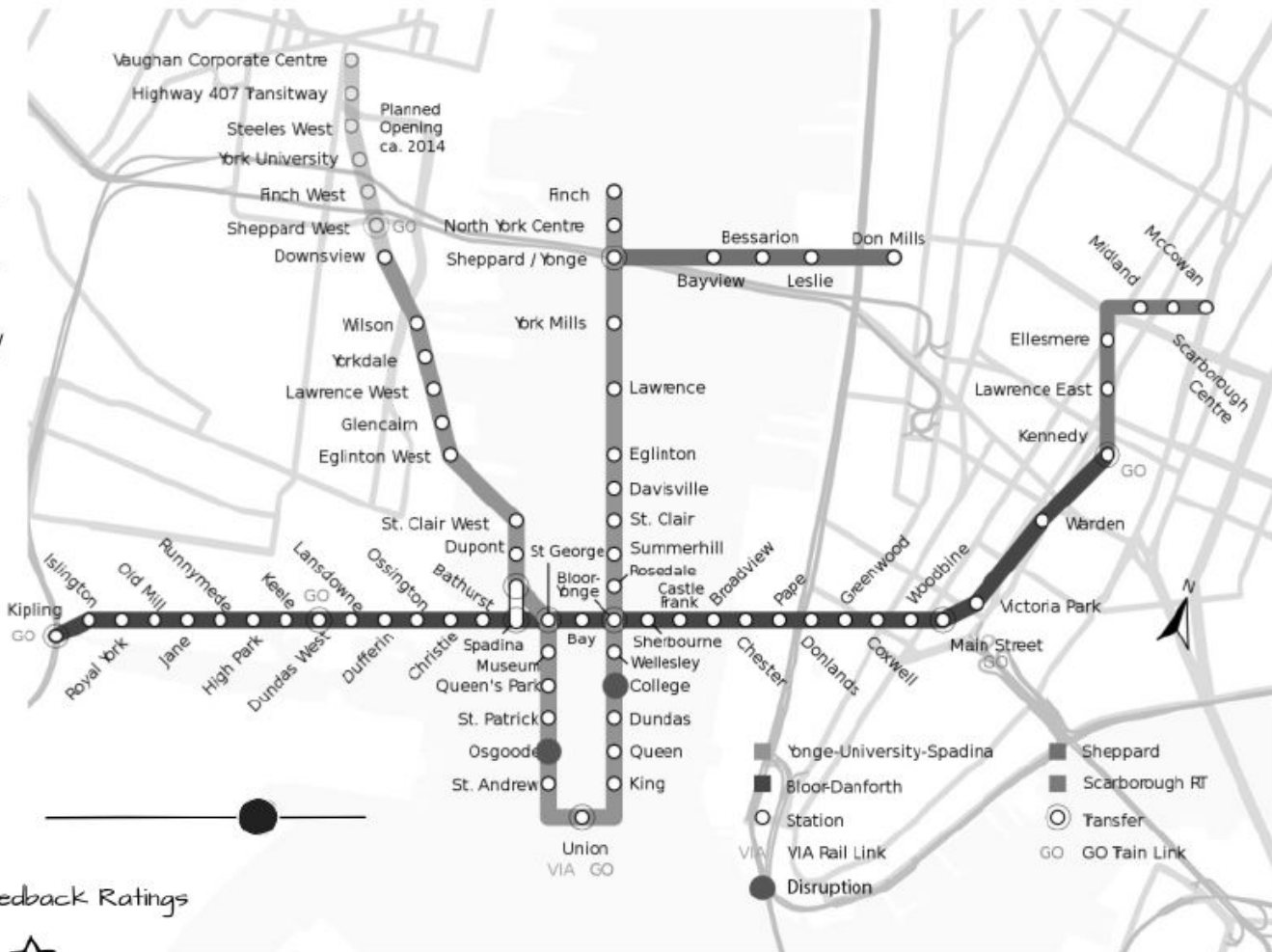
Train:   
 Bus:   
 Pedestrrian:

Start

End

### Impact on TTC Subway System

Number of Stations:   
 Number of Trains:   
 Passenger Count:



### Selected Buses

- 501
- 502
- 6
- 6A
- 101

Shuttle Service Time:

Initial Response Time:

Dispatch Time:

Allow Consecutive Buses:



Release Periodic Public Updates:



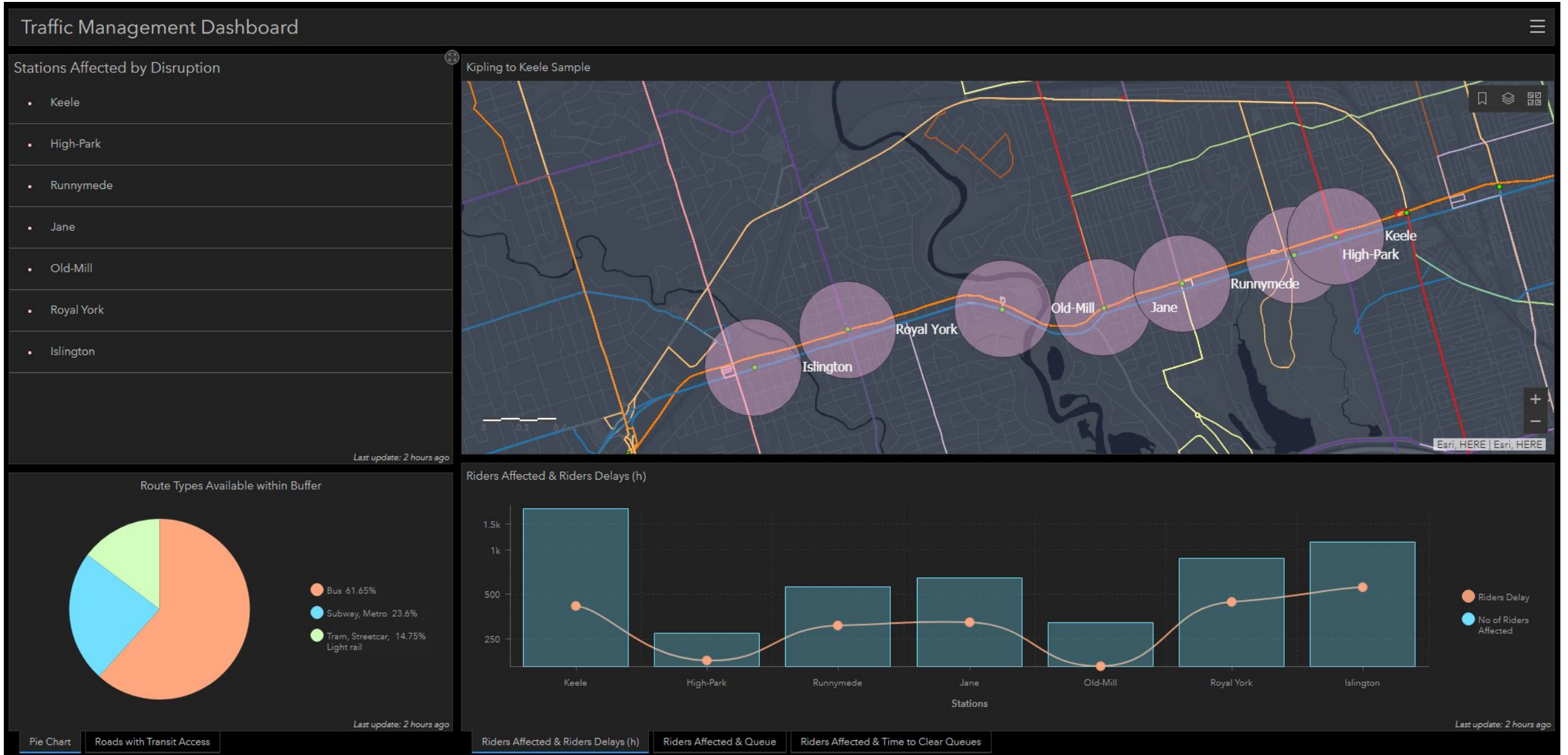
Customer Live Feedback Ratings



# Assessment

- Display delay using varying circles
- Lacking in any statistical data
- Need for more of a visualization tool
- Create two different scenarios
- Buffer surrounding bus lines
- Lacking in meaningful data
- No interactivity
- Doesn't support decision making
- Poor readability

# 2nd Iteration

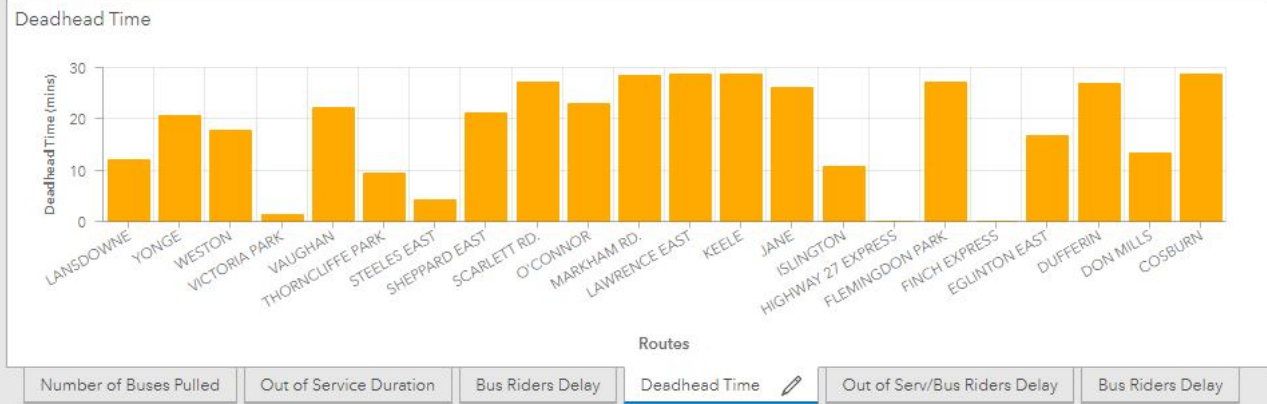
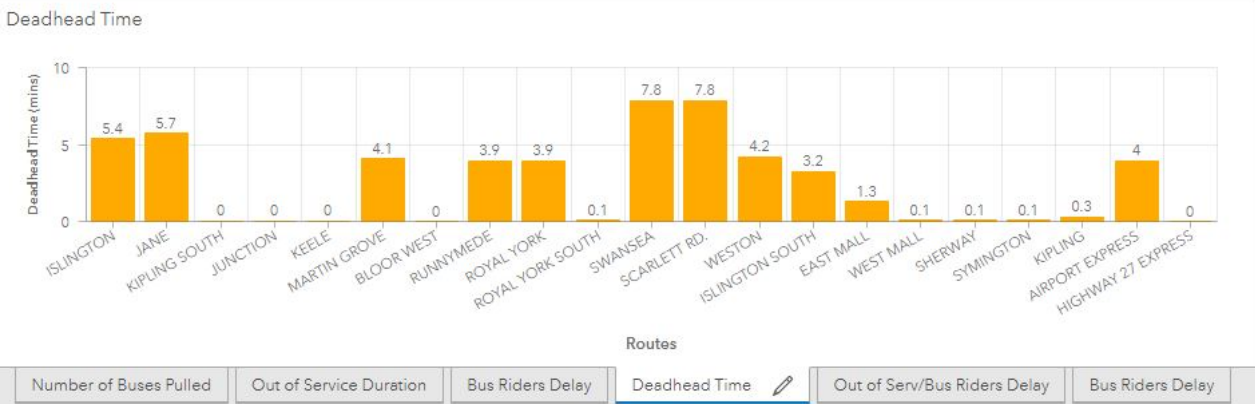
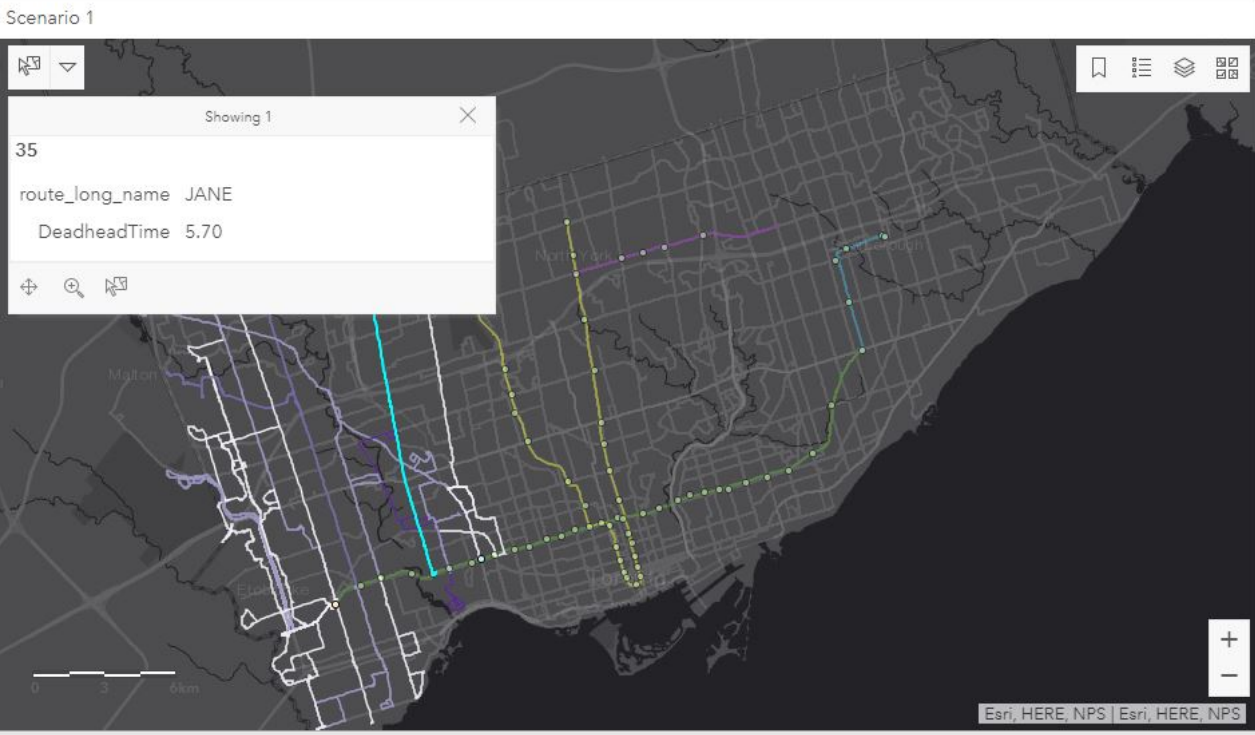


# Assessment

- No overview of entire scenario
- Total user delay for each scenario
- Insufficient data display
- Map isn't very interactive
- Dashboard should have different scenarios
- Delay times with tooltips and dialogue boxes

# 3rd Iteration







### Scenario 1



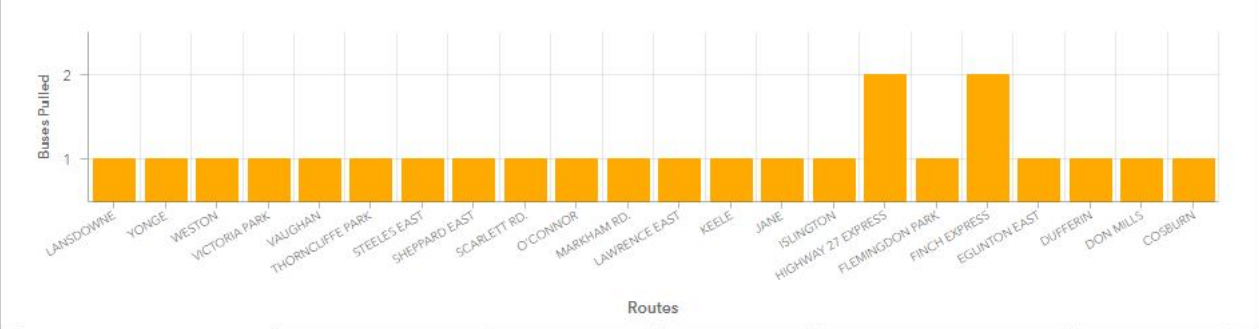
### Scenario 2



### Number of Buses Pulled from Route



### Number of Buses Pulled from Route







**Questions?**

**BAY**  
YORKVILLE

**KENNEDY**

**EXIT**