Route 47 Routing

MBTA presentation to Cambridge Transit Advisory Committee

July 7, 2021
Overview of project and results

Developing data
Routing options
Customer experience measures

Subtitle

- Walking time
  - Changes affect those who transfer between the 47 and other transit at Central Square.
  - Estimated at 1,205 people on a typical 2019 weekday.

- Travel time
  - Changes affect those who travel to or from Central Square.
  - Estimated at 2,020 people on a typical 2019 weekday.

- Waiting time
  - Changes affect those who ride the 47.
  - Estimated at 5,565 people on a typical 2019 weekday.
Customers who are travelling to and transferring at Central Square benefit using the Mass Ave alternative

<table>
<thead>
<tr>
<th></th>
<th>Walking Time</th>
<th>Travel Time</th>
<th>Additional Waiting Time</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>59 feet per minute</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Ave</td>
<td>0:02:21</td>
<td>0:03:30</td>
<td>0:00:26 (+0:00:16)</td>
<td>0:06:17</td>
</tr>
<tr>
<td>Green St</td>
<td>0:06:06 (+0:03:45)</td>
<td>0:03:14</td>
<td>0</td>
<td>0:09:20 (+0:03:03)</td>
</tr>
<tr>
<td>264 feet per minute</td>
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<td></td>
</tr>
<tr>
<td>Mass Ave</td>
<td>0:00:46</td>
<td>0:03:30 (+0:00:16)</td>
<td>0:00:26 (+0:00:26)</td>
<td>0:04:42</td>
</tr>
<tr>
<td>Green St</td>
<td>0:01:44 (+0:00:58)</td>
<td>0:03:14</td>
<td>0</td>
<td>0:04:58 (+0:00:16)</td>
</tr>
</tbody>
</table>

- NACTO: “people who walk with assistance—in form of canes, walkers, or other devices — are limited to speeds of 0.3 m/s–0.5 m/s”* or 59 feet per minute to 98 feet per minute.
- Five-minute quarter mile: 264 feet minute.

*<https://globaldesigningcities.org/publication/global-street-design-guide/designing-streets-people/designing-for-pedestrians/overview/>
Customers overall benefit using the Green St alternative

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Passengers</strong></td>
<td>1,205</td>
<td>2,020</td>
<td>5,565</td>
<td></td>
</tr>
<tr>
<td><strong>Time per</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Passenger</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Ave</td>
<td>0:00:57</td>
<td>0:03:30 (+0:00:16)</td>
<td>0:00:26 (+0:00:26)</td>
<td>0:00:26 (+0:00:26)</td>
</tr>
<tr>
<td>Green St</td>
<td>0:02:14 (+0:01:17)</td>
<td>0:03:14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Time Total</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Green St</td>
<td>44:58:06 (+25:54:30)</td>
<td>108:35:21</td>
<td>0</td>
<td>153:33:28</td>
</tr>
</tbody>
</table>
• Walking and waiting for a bus is perceived as taking more time than riding a bus.

• As part of the Bus Network Redesign, our colleagues at OTP are using a multiplier of 2 for this, so we did as well.

• This is referred to below as “weighted delay”.

This Photo by Unknown Author is licensed under CC BY-ND
Customers overall benefit using the Green St alternative

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<td>1,205</td>
<td>2,020</td>
<td>5,565</td>
<td></td>
</tr>
<tr>
<td><strong>Time per Passenger</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Ave</td>
<td>0:00:57</td>
<td>0:03:30 (+0:00:16)</td>
<td>0:00:26 (+0:00:26)</td>
<td></td>
</tr>
<tr>
<td>Green St</td>
<td>0:02:14 (+0:01:17)</td>
<td>0:03:14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Time Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green St</td>
<td>44:58:06 (+25:54:30)</td>
<td>108:35:21</td>
<td>0</td>
<td>153:33:28</td>
</tr>
<tr>
<td><strong>Time per Passenger (weighted)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Ave</td>
<td>0:01:54 (+0:00:16)</td>
<td>0:03:30 (+0:00:16)</td>
<td>0:00:52 (+0:00:52)</td>
<td></td>
</tr>
<tr>
<td>Green St</td>
<td>0:04:29 (+0:02:35)</td>
<td>0:03:14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Time Total (weighted)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green St</td>
<td>89:56:13 (+51:49:00)</td>
<td>108:35:21</td>
<td>0</td>
<td>198:31:34</td>
</tr>
</tbody>
</table>
• We compared the total time impact of the Mass Ave and Green St alternatives.
• The Mass Ave alternative created time savings only for those alighting/boarding at Central Square.
• The Green Street alternative created much larger time savings when all riders are considered, including the majority of route 47 riders who do not go to Central Square.
• These conclusions are true if a 2x weight is added to walking and waiting time.
• Therefore, the MBTA Service Planning recommendation is to pursue the Green Street alternative.
Developing Data
Developing data: Overview
For each alternate routing (Massachusetts Avenue and Green Street) we calculated:

### Walk Time

**WHAT:** Time to walk between each proposed stop and nearest Red Line entrance at various walking speeds

**SOURCES (distance/time):**
- Google Maps measuring tool
- Average waiting time to cross Mass Ave from the City
- NACTO walking speeds

**SOURCES (customers):**
- MBTA Ridership (2019) and Transfer (2017) data

**CALCULATE:** (Distance x walking speed) + Applicable Waiting Time to Cross

### Travel Time

**WHAT:** Time it would take the bus to travel the proposed route

**SOURCE (travel time):**
- Streetlight Data, a service that compiles travel time information using cell phone, vehicle data

**SOURCE (customers):**
- MBTA Ridership (2019) data

**CALCULATE:**
- Measure the average time it takes to travel the road segments in a motor vehicle at different times of the day.

### Wait Time

**WHAT:** Additional wait time passengers experience with longer headways due to longer route travel time

**SOURCE (travel time):**
- Streetlight Data

**SOURCE (customers):**
- MBTA Ridership (2019) data

**CALCULATE:** (Additional travel time)/2
- We divide by 2 assuming passengers arrive at stops at a continuous basis.

### Total

\[(\text{Walk Time}) \times (\text{Number of impacted passengers}) + (\text{Travel Time}) \times (\text{Number of impacted passengers}) + (\text{Wait Time}) \times (\text{Number of impacted passengers})\]
Developing data: Walking Time
Distance, speed, and time

Walk distance to nearest Red Line entrance

Average waiting time to cross Mass Ave

Speed
It is important to look at range of experiences

- Five-minute quarter mile: 264 ft/min
- NACTO: “People who walk with assistance—in form of canes, walkers, or other devices—are limited to speeds of 0.3 m/s–0.5 m/s”* or 59 ft/min to 98 ft/min.

37.5 seconds

7/7/2021
Developing data: Walking Time
Distance, speed, and time

Crossing Mass Ave adds on average 37.5 seconds.

About 77% of transfers were 47 Outbound to Redline Outbound or Redline Inbound to 47 Inbound, which favors the Mass Ave proposal.

<table>
<thead>
<tr>
<th>Transfer</th>
<th>Cross Mass Ave?</th>
<th>Transfer</th>
<th>Cross Mass Ave?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Ave</td>
<td>N</td>
<td>RL IB to 47 IB</td>
<td>N</td>
</tr>
<tr>
<td>Mass Ave</td>
<td>Y</td>
<td>RL OB to 47 IB</td>
<td>Y</td>
</tr>
<tr>
<td>Green St</td>
<td>Y</td>
<td>RL IB to 47 IB</td>
<td>N</td>
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Developing data: Walking Time
Passengers Affected

2,020 Route 47 passengers impacted at the three existing stops on the map →

Data source: MBTA Ridership by Stop data from Fall 2019

Walk Time
Developing data: Walking Time

Passengers Affected

2,020 Route 47 passengers impacted at the three existing stops on the map →
Data source: MBTA Ridership by Stop data from Fall 2019

60% transfer to transit (78% of those transfer to/from the Red Line)
Data source: MBTA Origin-Destination-Transfer model (ODX) data from 2017 (latest)
Developing data: Walking Time

Passengers Affected

2,020 Route 47 passengers impacted at the three existing stops on the map →

Data source: MBTA Ridership by Stop data from Fall 2019

60% transfer to transit (78% of those transfer to/from the Red Line)

Data source: MBTA Origin-Destination-Transfer model (ODX) data from 2017 (latest)

Therefore, 1,205 Route 47 passengers are affected by Walking Time.

# of Ons

# of Offs

Existing stops
Developing data: Walking Time

Passengers Affected

2,020 Route 47 passengers impacted at the three existing stops on the map →
Data source: MBTA Ridership by Stop data from Fall 2019

60% transfer to transit (78% of those transfer to/from the Red Line)
Data source: MBTA Origin-Destination-Transfer model (ODX) data from 2017 (latest)

Therefore, 1,205 Route 47 passengers are affected by Walking Time.

Total Walking Time = (Walk time per passenger) x (# of affected passengers)
Developing data: Travel Time

Sources and Methodology
Developing data: Travel Time

Sources and Methodology

This does not account for buses running slower than cars, and does not account for the time to turn, therefore minimizing the impact of travel time, favoring Mass Ave proposal.
Developing data: Travel Time

Passengers Affected

2,020 Route 47 passengers impacted at the three stops on the map →

Data source: MBTA Ridership by Stop data from Fall 2019, broken down by time of day.

Therefore, 2,200 Route 47 passengers are affected by Travel Time

Total Travel Time = (Additional Travel Time per passenger) x (# of affected passengers)
Developing data: Waiting Time

Sources and Methodology

- If you have the same number of buses, and it takes longer to run the route, the buses come less frequently.

- Streetlight data was used to understand the full run time, including deadhead, for each proposal at different times of day.

- Customers arrive at stop at different times, so we do not assign entire waiting period to each. Rather averaged to half the waiting time per passenger.
Developing data: Waiting Time

Passengers Affected

On average, 5,565 passengers ride the Route 47 daily.

Data source: MBTA Ridership by Stop data from Fall 2019, broken down by time of day.

Assumes 100% of Route 47 passengers are impacted by longer travel times.

Therefore, 5,565 Route 47 passengers are affected by Travel Time.

Total Waiting Time = (Wait time per passenger) x (# of affected passengers)

Wait time
Thank you