DRAFT TECHNICAL MEMORANDUM

DATE: March 31, 2017
TO: Kendall Square Mobility Task Force
FROM: Bruce Kaplan
RE: Kendall Square Mobility Task Force Modeling

Local and regional mobility challenges have arisen from the massive recent and planned development associated with Cambridge's Kendall Square. As part of the Kendall Square Mobility Task Force project, the Central Transportation Planning Staff (CTPS) was tasked with providing modeling support to the project team in the examination of existing roadway and transit conditions and future-year forecasts and scenarios. This memo describes the work done towards this effort.

1 METHODOLOGY AND CALIBRATION

Travel forecasting for this project used the Boston Region MPO Regional Travel Forecasting Model (the travel model). The travel model is based on the standard 4-step modeling process and is described in The 2017 memorandum titled "METHODOLOGY AND ASSUMPTIONS OF CENTRAL TRANSPORTATION PLANNING STAFF REGIONAL TRAVEL DEMAND MODELING". In order to make these forecasts as reliable as possible, the model's estimates of base year (2012) travel patterns were compared to the best available estimates of base year travel data and characteristics by mode. CTPS established benchmarks, seen below in parentheses, for these data sources that were strived to be matched by the model results. These standards, which were mostly met, focused on both system-wide transit measures and study area transit and highway measures.

The system-wide transit measures consist of:

- Daily unlinked transit trips (+/-10%), achieved -0.2%
- Daily commuter rail boardings (+/-10%), achieved -0.4%
- Daily rapid transit boardings (+/-10%), achieved -7.33%

The study area specific measures consist of:

- Total daily boardings at key rapid transit stations (+/-20%), achieved +12.5%
- Total daily boardings at key Red Line stations (+/-20%), achieved +7.9%
- Daily boardings at Kendall Station (+/-20%), achieved +8.9%
    - AM Peak boardings, -9.8%

    - PM Peak boardings, -13.4%
- Total daily boardings at key rapid transit stations and on bus routes (+/-20%), achieved -7.0%
    - AM Peak boardings, +5.9%
    - PM Peak boardings, -18.7%
- Total daily assigned highway volumes at study area locations (+/-10%), achieved -11.0%
    - AM Peak, +12.4%
    - PM Peak, -16.1%

2 FUTURE-YEAR MODELING ASSUMPTIONS

In general, the project's 2040 future-year No-Build scenario is identical to the 2040 No-Build scenario in Boston Region MPO's most recently adopted Long Range Transportation Plan (LRTP). Slight deviations in future highway and transit projects and in land-use exist due to a desire for greater investigation of development in the study area as well as due to amendments to the LRTP.

2.1 Future Transit Assumptions

New future transit projects assumed for this project are:

- Green Line Extension to Route 16 – extension of Green Line D branch service from Government Center via a new Lechmere station along the Lowell Commuter Rail right-of-way, with new stations at Washington St., Gilman Square, Lowell Street, Ball Square, College Ave/Medford-Hillside, and Mystic Valley Parkway. Extension of Green Line E branch service from a new Lechmere station to Union Square along the Fitchburg Commuter Rail right-of-way.
- Somerville Community Path – parallel to the Green Line extension, connecting Lechmere Station area to the existing multi-use path near the new Lowell St. station area
- Silver Line Gateway (extension to Chelsea) – new Silver Line BRT service connecting South Station and Chelsea via South Boston and East Boston with intermediate stops at Courthouse, World Trade Center, Silver Line way, Airport station, Eastern Avenue, Box District, and Bellingham Square.
- Commuter Rail
    - Fairmount Line improvements, with all new stations (4) operational
    - Fitchburg Line Improvements, resulting in faster travel times
    - Increased service at Yawkey Station
    - New Boston Landing Commuter Rail station
    - Increased Framingham Line service
- Inner Harbor Ferry Service: East Boston-South Boston

- Wynn Casino transit mitigation measures, such as ferries and shuttlebuses

2.2 Future Land-Use Assumptions

In general, the future land-use in Kendall Square conforms to the Year 2040 demographics adopted by the Boston Region MPO for the most recently adopted LRTP. However, in the summer of 2015, the project team decided that it would best to use a "full build-out" development scenario, so as to gauge the impact of a more aggressive pace of development on the transportation network and the ability of proposed measures to mitigate that impact. In order to reflect this projected situation, 424 additional service jobs, 1,147 additional households, and 2,650 additional people were distributed over 9 study area TAZs.

3 MODELED RESULTS

CTPS modeled a future year no-build scenario in addition to the two scenarios (constrained bus and unconstrained bus) described in Appendix 1 for both the AM Peak period (6-9AM) and PM Peak period (3-6PM).

As expected, the share of peak period auto trips to and from the study area drops in the two bus scenarios while the transit share increases; these are displayed in Tables 1 and 2. Tables 3 and 4 display the associated changes in peak period trips by mode; the unconstrained bus scenario exhibits greater changes than the constrained bus scenario when compared with the no-build scenario.

TABLE 1
Mode Shares in Peak Periods: From Study Area

Future Year Scenario	SOV	HOV	Transit	Walk
No Build	21.6%	10.2%	23.7%	44.6%
Constrained Bus	21.4%	10.2%	23.9%	44.5%
Unconstrained Bus	20.4%	9.9%	26.1%	43.6%

TABLE 2
Mode Shares in Peak Periods: To Study Area

Future Year Scenario	SOV	HOV	Transit	Walk
No Build	17.8%	7.3%	25.0%	49.9%
Constrained Bus	17.7%	7.2%	25.3%	49.8%

Unconstrained Bus	17.2%	7.0%	27.2%	48.6%

TABLE 3
Change in Peak Period Trips from Future Year No-Build: From Study Area

Modal Trips	Constrained Bus	Unconstrained Bus
SOV	-0.6%	-5.1%
HOV	-0.3%	-3.7%
Transit	1.1%	10.3%
Walk	-0.2%	-2.1%

TABLE 4
Change in Peak Period Trips from Future Year No-Build: To Study Area

Modal Trips	Constrained Bus	Unconstrained Bus
SOV	-0.7%	-3.5%
HOV	-0.4%	-3.0%
Transit	1.1%	8.4%
Walk	-0.2%	-2.5%

Similarly, Table 5 showcases that the unconstrained bus scenario has a greater effect than the constrained bus scenario on reducing average transit travel times associated with the study area. Tables 6 and 7 display that this phenomenon repeats itself in the realm of peak period Vehicle Miles Traveled (VMT) to and from the study area.

TABLE 5
Change in Peak Period Transit Travel Times from Future Year No-Build

	Constrained Bus	Unconstrained Bus
From Study Area	-0.6%	-5.5%
To Study Area	-0.6%	-4.3%

TABLE 6
Vehicle Miles Traveled – AM Peak Period

	2012	2040 No Build	2040 Constrained	2040 Unconstrained
From Study Area	21,912	27,240	27,147	26,779
To Study Area	141,937	165,641	165,074	162,457

TABLE 7
Vehicle Miles Traveled – PM Peak Period

	2012	2040 No Build	2040 Constrained	2040 Unconstrained
From Study Area	124,751	139,838	139,755	134,827
To Study Area	42,198	44,995	44,975	44,194

Table 8 displays the scenario results at key rapid transit stations. The slight increase in AM boardings at Kendall in the constrained scenario is partly due to increased ridership on the extended Routes 64 and 70; transferring to the Red Line occurs at Kendall instead of Central. Increased ridership on Route 85 also results in greater transfers at Kendall. The rise in boardings in the unconstrained scenario result from increased transfers resulting from the increased frequency of buses (EZ Ride), increased service reliability due to the dedicated bus lanes in East Cambridge, faster run times on the CT2, and the new bus routes (CT4, 92A, Lechmere-Kendall Shuttle) serving Kendall and East Cambridge.

Table 10 displays peak period boardings on existing bus routes in the future no-build scenario and the constrained bus and unconstrained bus scenarios, as well as on the new bus routes in the unconstrained scenario. Not surprisingly, the enhanced service on Route 85 due to stop consolidation, TSP, and frequency results in higher ridership. The improved service also had a spillover effect, lead to increased ridership on other routes sharing the Union Square-Kendall corridor, namely the CT2 and at times, the rerouted 87 and 88. Ridership on the 87 and 88 decreased in the unconstrained scenario in the AM peak due to longer run times resulting from their realignments. The PM peak case was slightly different as much of Route 87's ridership loss was actually shifted over to Route 88, causing an apparent ridership increase. The increased service frequencies, run times, and increased service on Route 85 in the Unconstrained did produce slightly more ridership on these 2 routes. As expected, the extension of Routes 64 and 70 from Central to Kendall does translate to increased ridership as riders

from Waltham, Watertown, and Allston/Brighton are provided with a single seat ride to and from East Cambridge.

Ridership on the unconstrained scenario's new bus routes can be seen in Table 9. All of these 3 routes use the new dedicated East Cambridge bus lanes. Ridership would be higher on these routes if they were not competing with the frequent (every 4 minutes) employer-sponsored EZ Ride shuttle.

TABLE 8
No Build Boardings and Associated Percentage Differences at Key Rapid Transit Stations

RTL Station	AM Peak				PM Peak			
	2012	2040 No Build	Difference from No Build 2040 Constrained	Difference from No Build 2040 Unconstrained	2012	2040 No Build	Difference from No Build 2040 Constrained	Difference from No Build 2040 Unconstrained
Kendall	1,100	2,200	200	300	6,300	8,300	0	-100
Charles	1,200	1,900	0	0	4,400	5,200	0	0
Central	3,400	4,700	0	-100	3,800	5,000	0	0
Sullivan	2,700	3,100	0	-100	2,100	3,200	0	-100
Lechmere	700	800	-100	0	1,100	1,900	0	700
Total	**9,100**	**12,700**	**100**	**100**	**17,700**	**23,600**	**0**	**500**

TABLE 9
Boardings on the Unconstrained Scenario's New Bus Routes

Routes	AM Peak	PM Peak
92A	300	420
CT4	1,010	1,300
Lechmere-Kendall Shuttle	330	520

TABLE 9
No Build Boardings and Associated Percentage Differences on Study Area Bus Routes

Bus Route	AM Peak			PM Peak		
	2040 No Build	2040 Constrained	2040 Unconstrained	2040 No Build	2040 Constrained	2040 Unconstrained
1	2,550	-1%	2%	4,340	-10%	-11%
47	1,420	1%	1%	1,480	1%	1%
64	740	32%	31%	540	161%	163%
68	180	-100%	-44%	180	-100%	-17%
69	490	6%	6%	510	-8%	12%
70/70A	2,700	43%	43%	2,890	23%	23%
80	270	-7%	-11%	290	3%	7%
83	530	-8%	-9%	360	-11%	-6%
85	80	188%	388%	100	100%	210%
87	800	-1%	3%	880	-16%	7%
88	700	-27%	-1%	600	50%	33%
EZ Ride	1,130	0%	18%	710	0%	21%
CT1	520	0%	0%	860	-12%	-12%
CT2	1,020	25%	25%	780	-12%	-15%
Total	**13,130**	**11%**	**29%**	**14,520**	**6%**	**26%**

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Appendix 1: Description of Bus Scenarios

Improvement Type	Route	Proposed Scenario - Constrained	Proposed Scenario - Unconstrained
Description		*Assume GLX is in place. These could be implemented in the shorter term, but will be modeled in 2040 for comparison purposes.*	*Assume GLX is in place. These could be implemented whenever funding or resources are identified, but will be modeled in 2040.*
Connections to Charlestown	92	N/A	Create a "92A" (similar to 92, but different service entirely): Add 22 weekday peak trips in each direction between Assembly (serve station) and Kendall via EZRide routing (headway ~ 15 min).
Connections to Somerville/Medford	88	Reroute all trips each way to/from Kendall instead of Lechmere via Columbia and Windsor, similar to CT2, and only making stops that the CT2 makes south of McGrath. Frequency would be reduced (about 30%) to adjust for increased cycle time (from about every 16 minutes in the peak to every 21 minutes). Off-peak headways would remain the same.	Reroute all trips each way to/from Kendall instead of Lechmere via Columbia and Windsor, similar to CT2, and only making stops that the CT2 makes south of McGrath. Frequencies would match the present service (about every 16 minutes in the peak).
Connections to Somerville/Medford	87	Reroute all trips each way to/from Kendall instead of Lechmere via Columbia and Windsor, similar to CT2, and only making stops that the CT2 makes south of Union Square. Frequency would be reduced (about 15%) to adjust for increased cycle time (from about every 21 minutes to every 25 minutes in the peak). Off-peak headways would increase by 5 minutes.	Reroute all trips each way to/from Kendall instead of Lechmere via Columbia and Windsor, similar to CT2, and only making stops that the CT2 makes south of Union Square. Frequencies would match the present service (about every 21 minutes in the peak).
Operational improvements	85	Stop consolidation and TSP at key intersections	Stop consolidation and TSP per 'constrained' scenario. Decrease peak period headway from 25 to 15 minutes, and off-peak frequency from 30 to 20 minutes.
Connections to Cambridgeport/ Allston/Brighton	70/ 70A	Extend 13 trips per direction per weekday peak period trips to Kendall, via Mass Ave, Main St, and Portland, returning via Portland, Albany, Mass Ave, Lansdowne, Franklin, Sidney, and Green. This is allowed in the constrained scenario by the elimination of 68 service.	Extend all trips to Kendall, following the same routing and stops as the constrained scenario from Central. Combined, the 64 and 70/70A provide 8 buses per hour between Central and Kendall (7.5 min headways) during the peak.

Improvement Type	Route	Proposed Scenario - Constrained	Proposed Scenario - Unconstrained
Re-allocate service	68	Eliminate service (in favor of extending the 70/70A). Please note that the City does not endorse removal of this service, which is being done for the purposes of modeling tradeoffs in the constrained scenario.	Same as current service.
Connections to Cambridgeport/ Allston/Brighton	64	Reroute 16 peak period trips ONLY each way between Kendall and Central (~ every 15 min) via Mass Ave, Main St, and Portland, returning via Portland, Albany, Mass Ave, Lansdowne, Franklin, Sidney, and Green. These trips are presently scheduled via Broadway.	Operate all 37 weekday trips to Kendall, following the same routing and stops as the constrained scenario from Central. Combined, the 64 and 70/70A provide 8 buses per hour between Central and Kendall (7.5 min headways) during the peak.
Connections Sullivan-Back Bay or Longwood	CT4	N/A	This route will connect Sullivan and Kenmore via Lechmere and Kendall from Sullivan across a future connection from Inner Belt Road to McGrath Highway, First Street, Binney, Third, Main, Vassar, and Mass Ave towards Kenmore. Headways: 15 minutes from 5:20 AM – 6:30 AM, 10 minutes from 6:30 AM – 8:00 PM, and 20 minutes from 8:00 PM – 12:40 AM.
Connections Lechmere-Kendall	Lechmere-Kendall Shuttle	N/A	This route will connect Lechmere and Kendall in the peak only, via First Street, Binney, and Third, looping via Main and Broadway. Headways: 15 minutes in the AM peak, with the first trip departing at 6:30 AM and the last at 9:00 AM, and 15 minutes in the PM peak, with the first trip leaving at 3:30PM and the last at 6:00 PM.
Connections North Station-Kendall	EZ Ride	N/A	Decrease peak period headway from the current 7 minutes to 4 minutes. Decrease midday headway from the current 20 minutes to 15 minutes. Assumes a reduction in travel time due to possible transit priority treatments on First and Binney.