

Date: September 2, 2021
To: Jonathan Kapust, Deputy Chair, Brookline Transportation Board
cc: Todd Kirrane, Transportation Administrator
From: David Trevvett, Chair, Pedestrian Advisory Committee
Re: Walk Signal Timing Recommendations for Beacon Street Intersections

The recommendations in this memo are triggered by and based on pre-pandemic observations and subsequent analysis performed by a Northeastern University (NU) graduate student, Felix Lao, working with his faculty advisor, Professor Peter Furth, focusing on two Beacon Street intersections, at St Paul and Kent/Powell. Their report¹ is very consistent with observations and recommendations that the Pedestrian Advisory Committee (PedAC) has submitted to the Transportation Board over the past two years, but goes even further. The NU authors make major new recommendations for the structure and timing of traffic and walk signals, provide substantial data and analysis to support them, and conclude that the changes they propose could shorten the average daily delay for pedestrians crossing Beacon Street at these intersections from roughly 100 secs to about 35 secs, a dramatic improvement.

Several of the NU recommendations represent substantial departures from the Town's past practice along Beacon Street; it is their carefully collected data that demonstrates not only the feasibility but also the desirability of such major departures. The report explains that the recommended changes would have little if any impact on vehicle traffic, with the major "sacrifice" being the loss of flexibility from widely varying left-turn signal durations. The Pedestrian Advisory Committee endorses the recommendations as summarized in this memo.

Disclaimer

The NU report is an engineering document, and some PedAC members felt that they did not have sufficient technical understanding of either the analysis itself or the underlying concepts to make specific recommendations. Nevertheless, the Committee as a whole felt that the Committee Chair, David Trevvett, was the most knowledgeable Committee member concerning traffic and walk signal timing issues, underscored by the fact that he was the primary author of the Committee's 2019 Walk Signal Study report and associated memos and data collections, and had had detailed discussions with the Transportation Administrator and Engineer on walk signal programming. The Committee therefore asked the Chair to prepare a set of recommendations to the Transportation Board based on the Northeastern University analysis and report. This memo is the result; it was reviewed at the Committee's September 1, 2021 meeting and approved for submission by unanimous roll call vote.

Summary of Key Recommendations

The following recommendations focus primarily on the Beacon-St Paul intersection, where the greatest benefit is to be realized because of the skewed intersection and resulting long crosswalks, but could in principle be applied to other Beacon Street intersections as well:

¹ "Improving Pedestrian Service and Safety on Beacon Street (Brookline, MA) Using Pedestrian – Left Turn Overlaps," Felix Yik Kun Lao and Peter G. Furth, Northeastern University

- Change left turn signal timing to a fixed minimum length. This is to provide sufficient time for a walk signal.
- Put the left turn signals on recall, so that they come on automatically every cycle.
- Allow pedestrians to cross the Beacon Street traffic lanes (inbound or outbound, respectively) that are stopped for a Beacon Street left turn signal phase; this requires a walk signal that overlaps left turn and through traffic phases.
- Provide a Lead Pedestrian Interval for pedestrians crossing St Paul Street on either the north or especially the south side of Beacon Street, thereby removing a dangerous situation that currently exists on the south side.
- Change the walk signal phases across the intersecting streets (i.e., crosswalks parallel to Beacon Street traffic) to tie to the green lights for through Beacon traffic instead of to the MBTA Green Line green; this change substantially lengthens the time available to pedestrians without changing the times given to vehicles or to the MBTA Green Line on Beacon.
- Extend the “WALK” (walking person icon) portions of walk signals for those Beacon Street lane crossings that are shorter than necessary (all currently 7 sec irrespective of crosswalk length, which varies greatly), notably on the south (inbound) side of Beacon.
- Increase the minimum green durations for the side streets to better match vehicular demand.
- Increase maximum green for some left turn phases that often get too little time to clear their queues

The remainder of this memo provides a bit of background, some examples to illustrate how pedestrians are poorly served by the current signal programming, and additional explanation for the recommendations above.

Background

Peter Furth, Northeastern University Professor in Civil and Environmental Engineering, had contacted the Pedestrian Advisory Committee in February 2020 to let us know about this student’s Master’s project. We arranged for him and his student, Felix Lao, to attend our March 11, 2020 meeting to present their observations and initial recommendations. Prior to that meeting we had shared with Professor Furth our Committee’s 2019 Walk Signal Study Report, so we were able to discuss both sets of recommendations together. Our own observations about the dangerous St Paul crossing on the south side of Beacon prompted their including this situation in their study. Unfortunately, the day after that March meeting, the pandemic shut down many activities in the region, including some of Mr. Lao’s work, so it was not until February 5, 2021 that Professor Furth was able to send us the final report based on this project. He also sent that report to Chris Dempsey and Todd Kirrane, and Chair Dempsey invited the Pedestrian Advisory Committee to review the report and submit to the Transportation Board any recommendations it wished to make based on that work.

Overview Assessment of NU Study

The data collection and analysis seem to have been done carefully and well. Even when the pandemic interfered with data collection because of greatly reduced traffic volumes, the authors found ways to estimate data using other sources and simulations. As a result, the data and analyses underlying the report’s conclusions seem accurate and reliable.

More importantly for our Committee, the report's observations expand and add substantial data backing to the observations and recommendations that the PedAC itself had presented in its October 2019 Walk Signal Study report and in subsequent memos to the Transportation Board.

NU Report's Observations on How Pedestrians Are Poorly Served²

- At cross streets such as St Paul, the walk signal timing for crossing Beacon Street typically provides too little time for the average pedestrian to cross the entire street in one signal cycle. Rather, the assumption seems to be that pedestrians will wait in the median for the next cycle. As a result, the “average pedestrian delay for those crossing Beacon Street is 100 sec, far beyond the 60 sec threshold for ‘Level of Service F’ (the worst level of service, as defined by the *Highway Capacity Manual*). Many pedestrians walk against the light rather than wait this long, making this a safety issue as well as a matter of convenience.”
- For street crossings parallel to Beacon Street, pedestrians are given substantially less time to do so than the vehicles moving in parallel along Beacon Street through the same intersection. Pedestrians wanting to cross St Paul on the south (inbound) side of Beacon are given only 24 sec³ to do so, while the adjacent eastbound Beacon vehicles have 47 sec, about twice as long. Similarly on the north (outbound) side, vehicles get 39 sec but pedestrians only 24 sec. The walk signals for crossing St Paul St on both north and south sides of Beacon Street are currently tied to the MBTA Green Line phase, which has a 25 sec duration. If the St Paul crossing on the north side of Beacon were tied to the outbound traffic green, the total walk time (including clearance interval) could be extended to the full 39 sec. Similarly, on the south side of Beacon, tying the St Paul crossing to the inbound traffic green could increase the walk signal duration to about 45 sec. These seemingly simple changes produce 56% and 80% pedestrian improvements, respectively.
 - The above changes would remove what is currently a hazardous situation: As the NU report explains, the current “odd arrangement . . . creates an unnecessary danger for pedestrians walking along the south side of Beacon Street, because it means the Walk signal comes up after the through traffic stream has had the green for 22 s, allowing that stream – which includes cars turning right onto St. Paul Street – to reach full speed and for drivers in that stream to become accustomed to making right turns without pedestrian interference. When the Walk signal finally comes on, pedestrians are then expected to step into a moving stream of traffic. Right turning motorists get no indication that the regime has changed and that they must now begin yielding to pedestrians.”
- The crosswalks across the various Beacon Street inbound and outbound travel lanes at St Paul are not of equal length, ranging from 25' to 58', yet the “Walk” sub-phases (walking person icon) are exactly the same for all of these crossings, at 7 sec. In particular, the crossings between the south side of Beacon and the median are only given about half as much time (15 sec total, including clearance) as the parallel St Paul through traffic (29 sec).
- NU observations showed that St. Paul traffic runs to its maximum allowed green duration 70% of the time in the a.m. and p.m. peak periods. Therefore, the minimum green time for St Paul could be increased at these periods to the current maximum (making it fixed-length) with minimal impact on vehicles, but regularly providing an important additional 5 sec of walk time for pedestrians.

Note that all of the above situations could be addressed without having to deal with left turn overlaps, which require more complex changes, discussed below. The NU report makes this statement: “A little-

² Timings cited are based on pre-Covid observations, traffic levels, and signal programming

³ Unless stated otherwise, the pedestrian crossing times cited are the sum of the “Walk” and “Finish Walking” intervals, i.e. the walking person icon time plus the Flashing Don't Walk time (FDW - the clearance interval).

known and unfortunate aspect of standard traffic engineering practice is that when traffic studies are done and signal timing plans are developed, pedestrian delay is neither measured nor reported.” Whether this is true or not in terms of general practice in Brookline, we don’t know, but it certainly seems that providing pedestrians with a fair share of traffic signal cycle time has not been a high enough priority at the Beacon-St Paul and potentially other intersections.

Additional Pedestrian Benefits Possible if Left Turn Overlaps are Implemented

- Left turn signals at the St Paul and Kent/Power intersections with Beacon Street are currently triggered by ground loop detection, are variable in duration up to a set maximum, and allow for very short turn signals, under the apparent assumption that there may be only 1 or two cars – or even none – waiting to turn. Such short turn signals preclude allowing walk signals concurrently – there isn’t enough time for a pedestrian to safely cross the stopped traffic lanes (inbound or outbound, as the case may be) if the left turn signal is short. However, actual NU observations at several different times of day during this study showed that most of the time, there are actually multiple cars waiting to turn, so increasing the minimum left turn duration sufficiently to allow a concurrent walk signal would actually have little if any impact on vehicular traffic. In fact, since only rarely are no cars waiting to turn, putting left turn signals on recall – which facilitates walk signals – would also have little impact on vehicular traffic.
- Allowing inbound (eastbound) Beacon traffic at St Paul Street to get up to speed for a full 20 sec before pedestrians receive a walk signal to cross St Paul on the south side of Beacon Street, with no warning to drivers that they can no longer make unimpeded right turns into southbound St Paul, is downright dangerous. This “lead vehicle interval” situation was already cited as an issue in the PedAC 2019 Walk Signal report, but as far as we know nothing has been done to remove this hazard. This dangerous situation should be corrected immediately. In fact, it is the pedestrians who should receive a lead walk signal before vehicles receive a green light.

Another proposed Improvement for Vehicles

In addition to increasing the minimum green for St Paul traffic, which helps clear the queue of St Paul vehicles, the NU report identified another change that could benefit vehicle traffic:

- The Beacon westbound left turn phase (WBL) currently has a fixed duration. The NU report recommends making the end of this phase actuated, so that if additional cars are detected waiting to turn, the phase can be extended a few more seconds. This would reduce delays for the westbound left direction.

This change is separate from those recommended earlier to improve pedestrian service.

A Potential Issue

During the PedAC development of its 2019 Walk Signal report, we were told by the Transportation Department that having a walk signal phase that overlapped both a left turn phase and a through traffic phase was not within the capabilities of Brookline’s current traffic signal control cabinets. And while Transportation later confirmed that the distributor used by the Town can provide controllers that do support such overlapped phases, we were told that there’s a substantial cost to acquiring and installing those controllers, with no budget to support it.

At the PedAC’s March 11, 2020 meeting, Professor Furth expressed disbelief about this, and insisted that any modern controller, such as those installed along Beacon Street around 2004, should be able to support such overlapping phases. This issue therefore requires further exploration.

Additional Information and Specific Signal Plans

This memo has not attempted to reflect the very detailed data and analyses contained in the NU report, nor has it reproduced all the explanations in the NU document for why vehicle traffic would not be impacted; that report itself should serve as the reference document for this information.⁴

In particular, the NU report proposes specific traffic and walk signal timing plans for a.m. peak, mid-day, and p.m. peak periods for each of the Beacon/St Paul and Beacon/Kent-Powell intersections. Brookline's transportation engineers should study these plans and determine how best to implement them.

Conclusion

The Pedestrian Advisory Committee has repeatedly observed to the Board that pedestrians are frequently underserved by traffic and walk signal programming in Brookline, which seems to have historically focused on keeping vehicles moving as efficiently and flexibly as possible. This has left pedestrians without a fair share of intersection cycle time. As the NU report states, "it is surprising that a dense, walkable community like Brookline should have traffic signal control that delivers such poor pedestrian service. . . .these poor designs, which were implemented when Beacon Street got its new signal control system around 2004, have gone unchanged for more than 15 years."

We urge the Transportation Board, the Transportation Division, and the Department of Public Works in general to begin immediately taking steps to improve pedestrian safety and facilitation along Beacon Street, as laid out in the specific recommendations of the NU report and this memo. Some changes could be made quickly, others may take additional time and potentially resources.

More specifically, we recommend that the Transportation Board ask the Transportation Division to assess the recommendations presented here, determine what would be required to enable Brookline to implement the recommendations, and provide a report back to the Board, preferably with an implementation plan.

Postscript

The detailed analyses, trade-off considerations, and signal plan proposals presented in the NU report serve as a useful and forceful reminder of the complex challenges that face transportation engineers in attempting to balance the varying flows of many different traffic types and directions, especially along a major, multi-modal route like Beacon Street. As pedestrian advocates, we wish to make it clear that we greatly appreciate the work of Brookline's transportation staff in managing such complicated situations.

⁴ As of the date of this memo, the NU report does not yet appear to be posted at Professor Furth's web site for "local projects", but can be found from the Pedestrian Advisory Committee's document repository at this link: https://drive.google.com/file/d/1vhuDhOSQiq2_Ng1p5ISFgstG-TZXEVsD/view?usp=sharing