

**CITY OF BOULDER  
TRANSPORTATION ADVISORY BOARD  
AGENDA ITEM**

**MEETING DATE:** December 14, 2015

**AGENDA TITLE:** Public hearing and consideration of a recommendation regarding Living Lab Phase I pilot projects

**PRESENTERS:** Michael Gardner-Sweeney, Interim Director of Public Works for Transportation  
Bill Cowern, Transportation Operations Engineer  
Kathleen Bracke, GO Boulder Manager  
Marni Ratzel, Senior Transportation Planner  
Dave “DK” Kemp, Senior Transportation Planner

**EXECUTIVE SUMMARY**

The purpose of this item is to provide a Living Lab Phase I update and recommendations for consideration to the Transportation Advisory Board (TAB). Staff last briefed TAB on the Phase I pilot projects at the Sept. 15, 2015 meeting. Based on TAB feedback, staff conducted additional outreach and hosted an open house to seek additional feedback. This update includes the community feedback from the open house, project evaluation highlights, and staff recommendations for the Phase I projects.

Phase I of the Living Lab program provides a forum for testing new, innovative facilities and contemporary treatments to improve Boulder’s existing bicycle infrastructure. Phase I projects began in 2013 as part of the community engagement process for the Transportation Master Plan (TMP) update and have been opportunistic and primarily bicycle related. User feedback is an integral element of the evaluation process coupled with technical data and field “before and after” behavior observations. The Phase I analysis process is also being informed by the lessons learned from the Living Lab Phase II experience related to Folsom Street.

**STAFF RECOMMENDATION**

Staff has prepared recommendations for the initial set of the Living Lab Phase I projects, including the buffered bike lanes on Spruce Street, back-in angled parking on University Avenue, and protected bike lanes on University Avenue and on Baseline Road. These recommendations were prepared based on the review of the technical data, observed behavior, and user feedback. More detailed information regarding the staff recommendation can be found in the staff analysis section. Below is a summary of the recommendations:

1. Buffered bike lanes - Spruce Street (15<sup>th</sup> to Folsom streets) – Maintain as-is. Refine buffered bike lane design when Spruce is re-stripped.
2. Protected bike lanes - Baseline Road (30<sup>th</sup> to 37<sup>th</sup> streets) – Extend modified treatment to Mohawk Drive removing concrete parking stops.
3. Parking Protected bike lanes - University Avenue (9<sup>th</sup> Street to Broadway) – Convert back to buffered bike lane configuration.
4. Back-in angle parking - University Avenue (Broadway to 17th Street) – Keep as-is and continue to monitor.

### **TAB ACTION**

Staff requests TAB consideration of the staff recommendation and a TAB recommendation regarding this set of Phase I projects and next steps.

### **BACKGROUND**

The vision of the Transportation Master Plan (TMP) is to create and maintain a safe and efficient multimodal transportation system that meets the sustainability goals of the community. A focus area of the TMP is to provide “Complete Streets”, which are streets for everyone. Complete Streets enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities.

The Living Lab program is a Complete Streets action item that installs pilot projects to test new street designs and community engagement processes, and inform the street design guide. All projects are considered experimental and allow the city to gather technical, observational and community feedback as part of an ongoing evaluation to assess whether the pilot project treatments achieve the intended benefits of complete streets.

[This link](#) provides a map to Phase I projects below:

1. Buffered bike lanes
  - o Spruce Street (15<sup>th</sup> to Folsom streets)
  - o University Avenue (9<sup>th</sup> Street to Broadway)
2. Protected bike lanes
  - o Baseline Road (30<sup>th</sup> to 37<sup>th</sup> streets)
  - o University Avenue (9<sup>th</sup> Street to Broadway)
3. Back-in angle parking adjacent to a bike lane
  - o University Avenue (Broadway to 17th Street)
4. Dashed (advisory) bike lanes
  - o Harvard Lane (Dartmouth Avenue to the Broadway path at Table Mesa Drive)
5. Bike Box
  - o Folsom Street at Arapahoe Avenue
6. Multiway Boulevard
  - o Pearl Parkway (30<sup>th</sup> to the BNSF Railroad tracks)
7. Shared Street
  - o Junction Place (Pearl Parkway to Goose Creek greenway path)

The Phase I projects have been primarily opportunistic and bicycle focused. Installed in August 2013, the first wave of projects tested buffered bike lanes along both corridors, protected bike lanes along Baseline Road, and back in angle parking adjacent to a bike lane treatments. The second wave of Phase I projects, installed in November 2014, converted the buffered bike lanes along University Avenue to protected bike lanes and installed dashed (advisory) bike lanes along Harvard Lane. The remaining Phase I projects were installed this summer.

At the Sept. 15, 2015 TAB meeting, the Transportation Division presented key findings for the first and second wave of Phase I pilot project treatments and proposed additional outreach to gather more community feedback on whether these pilot projects should continue in their locations, be refined or removed.

### Community Engagement

On Nov. 17, 2015, staff hosted a public open house to present key findings of the on-going evaluation for the first and second wave of Phase I pilot projects. In response to TAB input, staff increased outreach efforts to promote the open house meeting. A post card was distributed by direct mail to all property owners within a geographic boundary of each pilot project treatment. Posters were displayed at retail businesses in the vicinity of each pilot project area as well as at CU-Boulder and Naropa. The city and our community partners, including homeowner and business associations also publicized the open house through social media channels and e-blasts.

A total of 48 community members attended the open house. Informational boards with background information on the TMP, Complete Streets and the Living Lab program along with pilot project specific boards with key findings were presented. To view the open house materials, please visit [this link](#).

An online survey also was published on the BoulderLivingLab.net project web page to gather feedback from community members unable to attend the open house. A summary of the November 2015 open house comments, online survey responses and e-mail correspondence can be found in [this link](#).

For each project, community members were asked to provide comments under three topic headings: continue it, refine it, or remove it. A summary of the general community sentiment expressed for each project is outlined below.

*Buffered Bike Lanes - Spruce Street (15<sup>th</sup> to Folsom streets)* – Most comments expressed support for continuing and maintaining the buffered bike lanes. Some refinements were suggested to further enhance the bike lane separation from adjacent lanes including physical barriers. There were no comments in support of removal of the treatment.

*Buffered Bike Lanes - University Avenue (9<sup>th</sup> Street to Broadway)* – Outreach materials did not request feedback on whether to continue, refine or remove the buffered bike lanes because this treatment was replaced with protected bike lanes in fall 2014. However, some feedback received during the additional public engagement process supported re-installing the buffered bike lanes along this stretch of University Avenue.

*Protected Bike Lanes - Baseline Road (30<sup>th</sup> to 37<sup>th</sup> streets)* – Most comments expressed support for continuing the barrier protected bike lanes with some refinements. Refinements included removing some or all of the concrete blocks, delineating the lane with green pavement markings, and improving aesthetics of the barriers to include plantings or raised bike lanes. Some people supported removing the protected bike lanes along Baseline, expressing that the buffered bike lane was sufficient.

*Parking Protected Bike Lanes - University Avenue (9<sup>th</sup> Street to Broadway)* – Most comments supported removing the parking protected bike lanes. Continued concern for winter maintenance practices, visibility and sight lines between cyclists and drivers along or intersecting with the corridor, and impacts to delivery vehicles were expressed as safety issues. Several comments suggested refinements to the aesthetics and improving winter maintenance practices. Some suggested refining it by returning it to the buffered bike lanes piloted during the first wave of Phase I Living Lab projects.

*Back-in Angle Parking University Avenue (Broadway to 17th Street)* – Comments ranged across all three categories from continuing to refining or removing the back-in angle parking treatment. Safety was a primary theme expressed by all. Those in support of continuing the treatment expressed that it seems safer. Yet, several comments stated that backing into the angle parking as well as illegal maneuvers by westbound drivers crossing the vehicle lanes to access parking spaces front-in are safety concerns that justify removal.

*Dashed Bike Lanes - Harvard Lane (Dartmouth Avenue to the Broadway path at Table Mesa Drive)* – Most comments expressed support for continuing or refining the dashed bike lanes by widening the bike lanes. There were no comments in support of removal of the treatment.

This community input has helped inform staff recommendations whether or not to keep the existing pilot projects in place and to determine if these type(s) of treatments should be considered for future projects in other areas of the community and included in the city's upcoming street facility design guidelines.

#### STAFF ANALYSIS

Evaluation of the Living Lab Phase I pilot projects includes community feedback, field observations, and “before” and “after” comparison for both quantitative and qualitative measures.

The Fox Tuttle Hernandez Transportation Group (FTH) has been assisting city staff with field observations and data analysis for all projects implemented to date. [This link](#) provides a detailed analysis of each of the Phase I facilities.

Technical and observational “after” data was collected in April 2015 to coincide with the start of the peak cycling season and to ensure University of Colorado (CU) travel patterns are reflected. The qualitative analysis focuses on public input and informs an iterative review and response process to address community comments and concerns.

In July 2015, a bike box was installed at the intersection of Folsom Street and Arapahoe as part of the Living Lab Phase II pilot project along the Folsom corridor. This treatment and the dashed bike lane pilot project on Harvard are currently not national standard street markings; however, these treatments are being utilized in other U.S. cities. The City of Boulder has been granted a Request to Experiment (RTE) approved by the Federal Highway Administration (FHWA) to evaluate these two treatments. The federal approval evaluation process is continuing into mid- 2016.

The section below describes the Living Lab Phase I project treatment, the date of installation and project status, key findings, and a staff recommendation for next steps.

### Buffered bike lanes

#### *Overview*

Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane. In Aug. 2013, the City installed buffered bike lanes along Spruce Street from 15<sup>th</sup> Street to Folsom and along University Avenue from 9<sup>th</sup> Street to Broadway. In Oct. 2014, the University Avenue buffered bike lanes were removed and replaced with parking protected bike lanes. A before/after analysis of vehicle volume and speed was performed for the buffered bike lanes along University Avenue but there were issues with the before and after data collected on Spruce Street and consequently those analyses were not performed.

- Spruce Street
  - The number of bicycles observed was higher during the summer observation period than during the fall observation period, likely due to seasonal conditions. However, 18% more bicyclists were observed riding the corridor during August (2015) ‘after installed’ when compared to the August (2013) ‘before installed’ period.
  - Only 2 to 3% of the motor vehicles encroached into the buffer area in the after condition. Prior to the installation of the buffered bike lanes, no bicycle facilities existed on this corridor.
  - In the three years prior to the installation of the buffered bike lanes, two bicyclists were involved in a “dooring” type of collision. Since the installation, this type of collision has not occurred.
  - Community feedback expresses support for the buffered bike lane treatment.
- University Avenue
  - During the buffered bike lane pilot project, 93% of motor vehicles were observed traveling within the travel lane while 6% encroached into the bike buffer and 1% traveled with a wheel across the centerline.
  - Observations during a winter storm event indicated that motor vehicle drivers stay within the travel lane. Snow plow practices windrow the snow toward the middle

of University Avenue, which may result in drivers encroaching into the buffered bike lane area.

- Vehicle speeds remained approximately the same in the before and after condition with the buffered bike lanes, which was to be expected as the buffering had limited effect of narrowing the perceived motor vehicle travel lane.
- In the two years prior to the installation of buffered bike lanes, the most common collisions were u-turn related, parking-related, and right angle collisions. These collision trends continued after the installation of buffered bike lanes, though fewer collisions per year occurred in the after period.
- Community feedback expresses support for the buffered bike lane treatment.

*Recommendation:*

Staff recommends keeping the buffered bike lanes in place along Spruce Street and re-installation of buffered bike lanes along University Avenue. In both of the tested areas, buffered bike lanes worked successfully to provide separation for bicyclists between the bike lane and the travel lane, or the parking lane (door zone). Buffered bike lanes can also have the added effect of narrowing wider travel lanes and increasing comfort level for cyclists as well as providing social queues for both motor vehicle drivers and cyclists as to where each user should be traveling along the corridor. When and where appropriate, staff will consider this tool for future projects and for inclusion in the street facility design guide.

Protected bike lanes

*Overview*

A protected bike lane is an on-street buffered bicycle lane that is physically separated from vehicle traffic by flexible posts, parked vehicles, planters, or a curb. In August 2013, the city installed protected bike lanes along Baseline Road from 30<sup>th</sup> to 37<sup>th</sup> Street. This treatment tests the use of flexible bollards and concrete blocks to physically separate the bike lanes from the adjacent travel lane. Vehicle speed and volume were not measured in the before/after condition. In Oct. 2014, parking protected bike lanes were installed along University Avenue from 9<sup>th</sup> Street to Broadway.

- Many cyclists have shared that they feel safer traveling in bike lanes that are physically separated from travel lanes.
- Baseline Road
  - Some public concern has been expressed regarding the use of concrete blocks due to aesthetic reasons and the inability for bicyclists to move from the protected bike lane when executing left turns near the intersection.
  - An average of 42% of vehicles accessing Baseline from side streets roll through the stop bars. The visibility and sight lines at intersections within the study area are generally good, and may contribute to this level of stop bar non-compliance
  - Speed data was not collected on Baseline prior to implementation. Comparative speed data is being collected in sections of Baseline with and without the

protected bike lanes. However, the adjacent travel lanes are 13 feet wide so there is little expectation of speed reduction from this treatment.

- Observations during a winter storm event indicated that existing snowplow vehicles used along the corridor are able to effectively remove snow.
- Community feedback expresses support for continuing or refining the protected bike lane treatment.
- University Avenue
  - Bicyclists traveling in the wrong direction in the protected bike lanes accounted for approximately 6% of the bike lane users. Skateboarders accounted for another 6% of the users in the protected bike lanes. This activity was not observed on Baseline Rd. protected bike lanes.
  - The 85<sup>th</sup> percentile speed was reduced from 29 (mph) to 26 (mph) with the installation of the protected bike lanes and the narrowing of the travel lanes, which effectively moved parking closer to the moving traffic. The speed limit on this section of University Avenue is 30 mph.
  - 22% of the motorists approaching University Avenue on a stop sign controlled side-street stopped before entering the protected bike lane. Another 26% of the motorists stopped within the bike lane. 27% of the motorists stopped in the parking lane or vehicular travel lane, and 25% of the side street vehicles rolled through the intersection without stopping at all.
  - Parking-related and left-turn collisions were more common with the parking protected bike lane configuration, compared to the buffered and standard bike lanes. The total number of reported collisions per year also increased after the protected bike lanes were installed.
  - Winter maintenance practices are extremely challenging despite the city's efforts to improve parking enforcement and increase attention to snow and ice removal. The on-going freeze/thaw cycles, drainage, vehicles parked incorrectly, and low angle sun are major factors working against the parking protected bike lane installation.
  - User feedback expresses support for the removing the protected bike lane treatment. Community members have shared observations of cyclists riding within the travel lanes, particularly during and after winter storm events.
  - Comments also have expressed concern for the narrow street design, winter maintenance challenges, and inappropriate use of the bike lane by pedestrians, skateboarders and wrong way cyclists. Drivers have expressed concerns with lack of visibility of bicyclists, pedestrians, and cars when entering University from a side street. Feedback in support of the University Avenue protected bike lanes includes design encourages new and diverse riders, people feel more safe and comfortable to ride separated from auto traffic, and slower vehicle speed.

*Recommendation:*

**Baseline Road** – Staff recommends keeping the protected bike lanes in place, but removing the concrete blocks. The removal of the concrete blocks will improve maintenance access and address some of the aesthetic concerns while also improving cyclists turning maneuverability at intersections. Staff also recommends extending the refined design of the protected bike lanes to Mohawk Drive. The extension of the protected bike lanes to Mohawk Drive will improve connectivity to an existing north/south bike route. Staff proposes to distribute a post card by direct mail to inform property owners in the geographic area of the project limits of the planned installation. Comments and concerns would be addressed prior to installation.

**University Avenue** – Staff recommends converting the parking protected bike lanes between Broadway and 9<sup>th</sup> Street back to the buffered bike lane configuration. Safety concerns resulting from lack of sight distance from side streets and the encroachment of vehicles into the crosswalk and protected bike lanes are the primary reasons behind this recommendation. Year round maintenance of the parking protected bike lanes is challenging, particularly during the winter months due to a high crown in the roadway and the geographic position of the street in relation to the angle of the sun. The slope of the road nearest the curb within the protected bike lanes is greater than normal causing adverse conditions during freeze/thaw periods. Additionally, the north side of the street is shaded by the adjacent homes letting very little sunlight to naturally melt snow and ice. Finally, parking irregularities by drivers of private and commercial vehicles continue to exist, which have presented additional safety and maintenance issues along the corridor.

Staff believes that the parking protected bike lane treatment is generally a good tool when applied in the right context. University Avenue is not the right street for this type of treatment due to the concerns mentioned above. Staff will consider this treatment for future projects, and include it in the street facility design guidelines for future potential applications.

Back in Angle Parking

*Overview*

This treatment changes front-in angled parking to back-in angled parking adjacent to a bike lane in an effort to reduce the potential for conflict and documented collisions between cyclists or motor vehicles on the street and vehicles backing out blindly into their path. In August 2013, back-in angle parking was installed along University Avenue between Broadway and Macky Drive.

- Citations related to back in angle parking have decreased from year one (Aug. 2013-Aug. 2014) to year two (Aug. 2014-Aug. 2015) by approximately 48%.
- Between 5 and 10% of the parked vehicles continue to park across the stall lines, but the latest after data (Aug. 2015) shows that no parked vehicles encroached into the bike lane.
- Observations during a snow event indicated that some vehicles did not back all the way to the curb, and some were parked encroaching into the bike lane area.

- Based on observations, vehicles exiting the parking stall yielded to bicyclists before pulling out into traffic on University Avenue.
- In the three years before the back-in angled parking, there were four parking related crashes, two of these involving bikes. In the two years following the installation, there have been three parking related crashes, none of these involving bikes.
- User feedback ranges from continuing to refining or removing the back-in angle parking treatment.

*Recommendation:*

Staff recommends keeping the back-in angle parking in place to further evaluate the installation. The reduction of crashes that are more prone to injury, including bicycle related crashes is the primary reasons for keeping the demonstration in place. Conclusions about crash data will not be truly useful without additional years of data.

On-going Living Lab Phase I Projects

The section below describes Phase I projects that are recently completed and are currently undergoing evaluation efforts.

Dashed Bike Lanes

*Overview*

Used on low volume streets that are too narrow for traditional bike lanes, this treatment is marked with a skip stripe pattern (not a solid stripe) between the travel lane and bike lane. No centerline is striped on the two-way street. The vehicle travel lanes are narrowed to accommodate a minimum standard width of five feet for each bike lane. This bike lane treatment prioritizes space for bicyclists while allowing motorists to encroach into the bike lane if needed to pass oncoming motor vehicles. In Oct. 2014, dashed bike lanes were installed along Harvard Lane between Bates Lane and the Broadway multi-use path north of Table Mesa Drive. The experiment is part of a FHWA “request to experiment” and will be evaluated over one year and reported to FHWA in 1<sup>st</sup> quarter 2016.

- User feedback thus far expresses support for continuing or refining the dashed bike lanes by widening the bike lanes.

Bike Box

*Overview*

A bike box is a designated area in front of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible place to wait during the red signal phase. Bike boxes help prevent ‘right-hook’ conflicts with turning vehicles at the start of the green signal phase. Bike boxes also group bicyclists together to clear an intersection quickly, minimizing delay to other traffic. Motor vehicles are prohibited from making right turns during red signal phase and must yield to bicyclists within the bike box.

The bike box was installed in the southbound lane on Folsom Street at Arapahoe Avenue in July 2015. The experiment is part of a FHWA “request to experiment” and will be evaluated over one year with a final report to FHWA in the summer of 2016.

### Multi-way Boulevard

#### *Overview*

A multi-way boulevard provides center through lanes and parallel local access lanes separated from one another with tree-landscaped medians. The purpose is to provide buffered pedestrian spaces, bicycle access, and parking areas that are separated from through traffic and create a more attractive and inviting boulevard environment. As part of the Boulder Junction area, the city completed construction of a multi-way Boulevard along Pearl Parkway from 30<sup>th</sup> Street to the BNSF railroad tracks in July 2015. Evaluation of the project began in fall 2015 and will continue through 2016. Evaluation criteria will include measuring potential conflicts among all road users, vehicle speeds and volume, collisions, snow removal, and parking space utilization.

### Shared Street

#### *Overview*

A shared street allows pedestrians and bicyclists to utilize roadway space along with motor vehicles, which are required to yield the right of way to these slower street users. Shared street design techniques remove curbs, roadway markings and traffic signs. It is designed with distinctive streetscape features that minimize separation among transportation users. As part of the Boulder Junction area improvements, the city completed construction of a shared street along Junction Place from north of the transit station at Depot Square to Goose Creek. Evaluation of the project began in fall 2015 and will continue through 2016. Evaluation criteria will include measuring potential conflicts among all road users, vehicle speeds and volume, and snow removal.

### Summary of Recommendations

1. Buffered bike lanes - Spruce Street (15<sup>th</sup> to Folsom streets) – Keep as-is. Refine buffered bike lane design when Spruce is re-stripped.
2. Protected bike lanes - Baseline Road (30<sup>th</sup> to 37<sup>th</sup> streets) – Extend to Mohawk Dr. and remove concrete parking stops.
3. Protected bike lanes - University Avenue (9<sup>th</sup> Street to Broadway) – Convert back to buffered bike lane configuration.
4. Back-in angle parking - University Avenue (Broadway to 17th Street) – Keep as-is and continue to monitor.
5. Continue monitoring and evaluating the remaining Phase I projects.

### NEXT STEPS

Following the December TAB meeting, staff will present the Living Lab Phase I update and recommendations to the City Council (public hearing) on January 19, 2016. Based upon

feedback from City Council, staff is prepared to implement modifications to Living Lab – Phase I projects, as weather permits.

Staff will continue the evaluation process for the remaining Phase I projects and will report the results at a future TAB meeting.