District Department of Transportation

&

Howard University Transportation Research Center

ADVISORY BICYCLE LANES TRIAL EXPERIMENT

Summary and Results

July 2024

Data Collection, Analysis & Survey Prepared by:

HUTRC Howard University Transportation Research and Data Center

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16. Abstract

DDOT requested to use the advisory bike lane treatment in 2019 in an effort to find a roadway treatment that worked better than shared lane markings, also known as "sharrows", in order to better connect the District's bicycle network using our local streets with low traffic that are generally narrow and constrained to supplement our arterial and collector street bicycle lane network. These local streets are also used by residents to store private vehicles - even small changes to that use create significant controversy. The use of standard 10-foot width travel lanes and 5-foot width bicycle lanes would require parking removal or conversion of streets to one-way operation – changes that are politically-charged on most of these streets. DDOT's initial investigation into this treatment examined domestic and European examples which have demonstrated a strong track record of safety, giving us assurance that it would work.

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EXECUTIVE SUMMARY

DDOT requested to use the advisory bike lane treatment in 2019 in an effort to find a roadway treatment that worked better than shared lane markings, also known as “sharrows”, in order to better connect the District’s bicycle network using our local streets with low traffic that are generally narrow and constrained to supplement our arterial and collector street bicycle lane network. These local streets are also used by residents to store private vehicles - even small changes to that use create significant controversy. The use of standard 10-foot width travel lanes and 5-foot width bicycle lanes would require parking removal or conversion of streets to one-way operation – changes that are politically-charged on most of these streets. DDOT’s initial investigation into this treatment examined domestic and European examples which have demonstrated a strong track record of safety, giving us assurance that it would work.

Two primary sources for the design of this treatment come from the FHWA and the Netherlands Crow Manual (Appendix C). In general, DDOT has followed the FHWA approach and chosen consistent dimensions for the bike lane of 5’, with a 14’ width for the central lane, with the exception of the 1500 – 1700 blocks of E Street SE, which approximates the CROW approach with an 11’ central lane.

Primary goals for this project were to:

- Use a pavement marking treatment that was intuitive to drivers, cyclists, and pedestrians without requiring signs and public awareness campaigns
- Improve bicycling conditions and support increased bicycling activity by creating a dedicated bicycling space
- Slow motorist speeds in support of traffic calming goals by narrowing their perceived operating space
- Preserve existing on-street parking
- Ensure safety of all users of the roadway
- Develop a design treatment that was acceptable to the agency staff and the public

The research indicates the advisory bike lane treatment achieves these goals. The results indicate the ABL treatment enhances safety for people on bikes, increases their comfort on the roadway leading to increased bicycling activity, and seems to have a noticeable affect on managing speed towards our 20 MPH speed limit. We believe this result comes from placing drivers in more direct alignment with opposing traffic, and the speed control that comes from this placement paired with the visual the narrowing of the operating space. Survey results and the absence of collisions in the review period suggest the goals for an intuitive and safe design were achieved, with large majorities of every user class describing that they felt they knew how to operate with the new treatment and supported its use as a design strategy.

In our review of this treatment, as deployed on five streets in the Capitol Hill neighborhood, the results suggest FHWA should allow broader adoption its use while providing some regulatory and design guardrails. Based on the District's experience, we recommend the advisory bike lane treatment be allowed for testing by jurisdictions, utilizing 5'-6' bike lanes, a center shared vehicular lane between 10'-15', a maximum 30 MPH speed limit, an upper threshold of 4,000 vehicles per day on the corridor, and peak hour volume thresholds (400 hourly[1]) in order to maintain a high level of comfort and not introduce so many interactions for drivers and cyclists that the lanes become stressful or drivers become frustrated.

In our judgement as planners and engineers charged with developing a citywide network of bike facilities, we believe advisory bike lanes should be used in combination with other strategies to reach this goal. In service of this, we are requesting that FHWA authorize interim approval for the advisory bike lane treatment under the MUTCD. This action will allow more jurisdictions the flexibility to use this treatment, and lead to a greater body of evidence to inform additional design guidance for this treatment.

What follows is a summary of our experiment on this treatment, with Howard University Transportation Research & Data Center providing all data collection services, analysis, and survey preparation/administration.

[1] Directionality of any volume will have a large influence on what is acceptable, a 50/50 balance of bi-directional vehicle traffic would create more interactions between bicyclists/drivers than a 90/10 balance, which would function much more smoothly at higher volumes. DDOT suggests further study in this area.

KEY AREAS OF SUCCESS AND NOTABLE OBSERVATIONS

Community familiarity: The advisory bike lane treatment builds upon a roadway configuration that is already quite common in the District's residential neighborhood; narrow two-way streets constrained by curbside parking to less-than-typical widths. Within DC, 30' streets with parking on both sides and two-way traffic are routine, leaving 14' – 18' of operating width for bi-directional traffic and no centerlines. Thus, the ABL experiment with 11' and 14' space for the vehicular travel lane draws upon familiarity with narrower-than standard street environments[2]. The ability to cross into the bike lane for vehicular passing interactions is akin to one of these narrow streets with an extra margin of flexibility for passing interactions, however, the ABL treatment does promote more cautious and slower speed driving as would occur on a legacy narrow street.

User Behavior: Almost everyone seems to have understood where to ride and drive. If we were to revisit the survey, we would ask a more direct question, such as "Did you feel like you know how to drive or ride on this roadway?". The survey may have unintentionally downplayed that area of study by asking if the configuration was easy to understand.

Effects on Speed: The vehicular speed reduction effects are notable and occurred without having to make changes to motor vehicle access or major curbside use changes.

Crashes, or Lack Thereof: There was a complete lack of reported crashes *despite an increase in interactions,* which speaks to the fact that these low-speed interactions are safe, and jurisdictions can have some level of confidence designing roads where they occur.

Vulnerable User Comfort: Both through user behavior and survey response, there was vastly improved comfort and perceived safety of the bike facility, which may be a reason for the

[2] DDOT's Design & Engineering Manual specifies minimum 10' lane widths for vehicles, though there are thousands of bi-directional roadway segments, chiefly in neighborhoods, which do not meet that minimum.

increased bicycle volume and the decreased sidewalk riding, two important policy achievements.

Lane Width Considerations: The ABL treatment is still under development in the US, and draws on examples and guidance from abroad. One area of interest is whether the central lane should be wide enough to allow smaller vehicles to pass each other within that lane (14’-18’ wide) or if the central lane should be narrower (10’-12’) and always require passing vehicles to merge into the bike lane. Our experiment has examples of both designs, and we did not draw a strong conclusion either way on this question.

Applicability of the ABL Treatment: The number of roadways where this treatment could be applied is significant, and comprise much of the nation’s residential streets across rural, suburban, and urban forms. Bi-directional streets with parking and measuring 34’ – 50’ comprise a large share of residential roads in the United States, and generally, 44’ of width is the minimum required for traditional bike lanes on a road with those characteristics. The advisory bike lane treatment could be used on many roadways where planners and engineers don’t have the requisite width for traditional bike lanes, and therefore, this treatment can play an important role in expanding bicycle networks nationally in low-stress neighborhood environments

Vehicular Advantages: While not a direct goal of this study, the placement of vehicles in a central position on the roadway suggests a lower risk of sideswipe crashes into parked vehicles. On many of the District’s roadways, there are frequent sideswipe crashes, damage to side mirrors, and related property damage. The ABL treatment creates the expectation that drivers keep to the center of the roadway, resulting in a 5’ or more buffer between moving vehicles and parked vehicles.

A Replacement for Sharrows: Within the context of neighborhoods, DDOT planners were interested in substituting the ABL treatment for the typical sharrow treatment.

BACKGROUND

DDOT is building a citywide network of bicycle facilities for all ages and abilities of riders. In furthering this goal, staff engaged in an experimental effort to build and evaluate advisory bike lanes, with permission from the Federal Highway Administration. This type of bike lane fits into the broader concept of "neighborhood bikeways" - a collection of facility types and installation strategies intended for low-volume, low-stress neighborhood bike routes. DDOT viewed Advisory Bike Lanes (ABLs) as a likely improvement upon using "sharrows" - shared lane arrows - which had typically been used in similar contexts. As part of the experiment, DDOT identified five corridors where ABLs would meet long standing requests for bike lanes where the street width could not accommodate regular bike lanes without significant trade-offs for existing users (parking, one-way conversions), and where traffic volumes were low.

INTRODUCTION

The concept for Advisory Bike Lanes is that the vehicular lane is a single, 10' – 18' wide lane for two-way traffic[3], with no centerline, while a 5' bike lane is continually dashed on the outer edge to indicate that vehicles may cross over this line when necessary to give sufficient clearance to oncoming vehicles. This configuration will allow for bike lanes to be placed on more streets without affecting parking. An ancillary benefit is the anticipated reduction in vehicular speeds on neighborhood roads due to the narrower overall travel lane and absence of a centerline. In October 2019, the FHWA granted the District Department of Transportation (DDOT) permission for a trial of the ABL treatment on five corridors in the Capitol Hill area of the District of Columbia. An experiment was designed to determine the effectiveness of these ABLs by conducting a "before" and "after" observational study to understand the viability of such lanes and see if the practice can be replicated in other parts of the District and the United States.

The experiment consisted of an evaluation process to observe bicyclists' and motorists' behavior along the subject streets based on the presence of the experimental devices. A "before" observation was conducted to determine the number of bicycles traveling on the street or on the sidewalk of the study corridors prior to the installation of the bicycle lanes. The "after"

[3] See Appendix C for further discussion on this topic

observation was conducted for the same locations once DDOT had installed the bicycle lanes. Surveys to assess bicyclists' sense of safety along with motorists' understanding of the purpose of the ABLs were also conducted. Furthermore, interactions between cars / bicyclists, instances of vehicles double parked, and other interactions are documented in this report. Automatic Traffic Recorders (ATR) (pneumatic tubes) were installed on study segments to obtain the Average Daily Traffic (ADT) and vehicular speeds. By observing vehicular and bicycle activities from the video playback, the following questions will be answered for each corridor:

a. Where do bicyclists tend to ride? Does this vary by the presence of parked vehicles or oncoming vehicles?
b. Where do motorists tend to drive? Does this vary by the presence of bicycles or oncoming vehicles?
c. Are motorists yielding to bicyclists before merging into the Advisory Bike Lane? (after only)
d. When a motorist overtakes a bicyclist, are they leaving a safe passing distance?
e. Do the Advisory Bike Lanes and lack of centerline appear to create conflicts among bicyclists and motorists?
f. Does the lack of a centerline appear to create conflicts between motorists?
g. Are bicyclists using the treatment as intended?
h. Are motorists using the treatment as intended?
i. Observations on design parameters with respect to bike lane widths, center travel lane width, maximum vehicle volumes and speeds

The observations were conducted in the following selected corridors:

1. E Street, SE (from 11th Street, SE to 18th Street, SE)
2. Twelfth Street, SE (from East Capitol Street to E Street, SE)
3. Kentucky Avenue, SE (from East Capitol Street to Potomac Ave SE)
4. 200-500 Blocks of Tennessee Avenue, NE (from Constitution Avenue to F Street, NE)
5. 100 Block of North Carolina Avenue, SE

In addition to the video observation, a survey to assess bicyclists' sense of safety along with motorists' understanding of the purpose of the ABLs was conducted with this experiment. The survey forms to the local residents as well as the driving/ cycling population were administered online with the help of local Advisory Neighborhood Commissions (ANCs) and also via Quick Response (QR) codes being posted along the study corridors. Figure 1 represents the proposed road usage configuration with the ABLs.

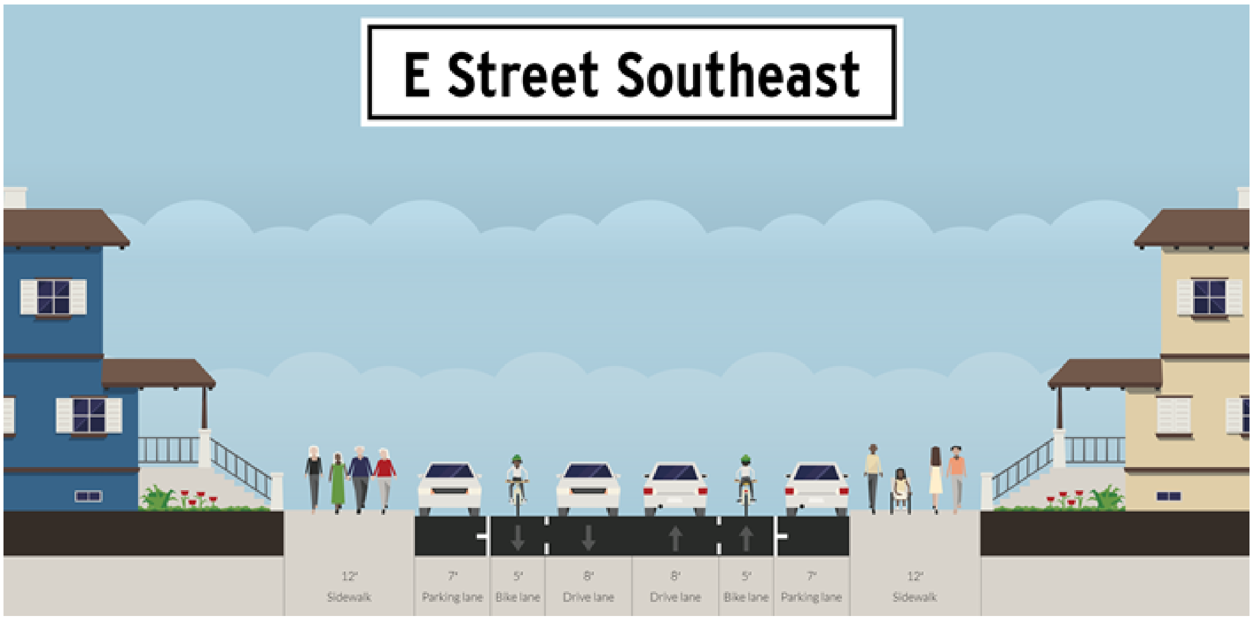

Figure 1: Lane Usage Configuration for a Study Segment

DATA COLLECTION/ METHODOLOGY

The observations for the experiment were conducted using video recording and playback. Cameras were installed to record traffic flow and bicyclists' activities at the selected sites before and after the installation of bicycle lanes. The video equipment that was used and a snapshot of how it captures intersection/site activities are presented in Figure 2.

Figure 2: CountCam Video Equipment and Typical Video Playback

The video equipment was non-intrusive and as such, had little to no influence on bicyclists' and drivers' behaviors. The observations for the "before" was conducted in May 2020 while the "after" scenario videos were collected during December 2021 and March/ August 2022. The video data for the study locations were obtained for 8 hours on a typical weekday (Tuesday – Thursday): 4 hours each in the morning (6:30 AM – 10:30 AM) and evening (3:00 PM – 7:00 PM) peak periods. In addition to installing video recording devices on the selected segments, traffic counting pneumatic tubes were also placed on selected locations along the corridors to collect the 48-hour vehicular volume data. The project team extracted the variables to be used as Measurements of Effectiveness for the study via video playback.

From the video playbacks, the following variables regarding segment traffic flow activities were extracted:

1. Total number of bicyclists on the selected segments.
2. Total number of bicyclists using the sidewalk.

In addition, the following variables regarding vehicular and bicycle interactions were extracted for both of the 4-hour peak-periods:

1. Total number of motorists yielding to bicyclists.
2. Total number of interactions between bicyclists and motorists (at segments without centerlines).
3. Total number of interactions between motorists (at segments without centerlines).
4. Total number of conflicts observed due to vehicles double parked on the study segment.

Description of Study Sites

The observations were made at 5 different corridors in the Southeast quadrant of the District of Columbia. The classifications of all the study corridors mentioned in the report are based on DDOT's 2016 Functional Road Classification. A brief description of the study corridors has been provided in the following section.

1. E Street, SE (11th Street, SE to 17th Street, SE)

The study segment of E Street, SE between 11th Street, SE and 17th Street, SE is classified as a local road. The study segment is oriented in the east-west direction and is approximately 3,000 feet long and 35-40 feet wide. There is on-street parking on both sides of the segment which has a statutory speed limit of 20 MPH. In addition, there are 9 intersections on the corridor within the study limits. Cameras were installed to record traffic flow activities on May 5th, 2020 (before) and December 7th, 2021 (after) at the following locations:

a) 1200 Block of E Street, SE

b) 1300 Block of E Street, SE

c) 1500 Block of E Street, SE

d) 1600 Block of E Street, SE

Pneumatic tube counters were also installed on the 1300 and 1500 blocks of E Street, SE to obtain the ADT volume data of the study corridor. Figure 3 presents the locations of the data collection equipment that were installed along the study corridor of E Street, SE.

Figure 3: Location of Data Collection Equipment on Study Corridor of E Street, SE

2. Twelfth Street, SE (East Capitol Street to E Street, SE)

The study segment of 12th Street, SE between East Capitol Street, SE and E Street, SE is a local road oriented in the north-south direction. The study corridor is approximately 2,300 feet long and 40 feet wide with on-street parking on both sides of the segment. In addition, the speed limit for this corridor is 20 MPH. There are 9 intersections on the study corridor of 12th Street, SE within the study limits. Cameras were installed to record traffic flow activities on May 12th, 2020 (before) and March 22nd, 2022 (after) at the following locations:

a) 100 Block of 12th Street, SE

b) 200 Block of 12th Street, SE

c) 300 Block of 12th Street, SE

d) 400 Block of 12th Street, SE

Automatic Traffic Recorders (Pneumatic tube counters) were also placed on the 200 and 300 blocks of 12th Street, SE to obtain the ADT volume data of the study corridor during both observation periods. Figure 4 presents the locations of the data collection equipment along the study corridor of 12th Street, SE.

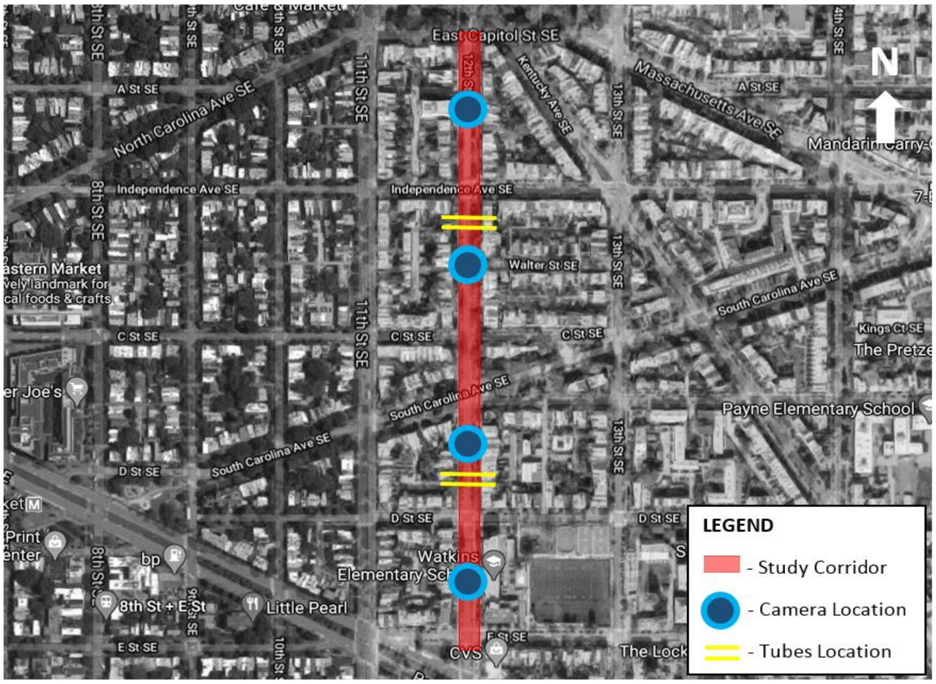

Figure 4: Location of Data Collection Equipment on Study Corridor of 12th Street, SE

3. Kentucky Avenue, SE (East Capitol Street to Barney Circle)

The study segment of Kentucky Avenue, SE between East Capitol Street, SE and Barney Circle is classified as a collector road and is oriented in the northwest-southeast direction. The study corridor is approximately 4,300 feet long and 40 feet wide with on-street parking on both sides of the segment. In addition, the statutory speed limit for this corridor is 20 MPH. There are 10 intersections on the study corridor of Kentucky Avenue, SE within study limits. Cameras were installed to record traffic flow activities on May 12th, 2020 (Before) and December 7th, 2021 (after) at the following locations:

a) 100 Block of Kentucky Avenue, SE

b) 200 Block of Kentucky Avenue, SE

c) 300 Block of Kentucky Avenue, SE

d) 600 Block of Kentucky Avenue, SE

e) 700 Block of Kentucky Avenue, SE

f) 800 Block of Kentucky Avenue, SE

Pneumatic tube counters were also placed within the 200 and 500 blocks of Kentucky Avenue, SE to obtain the ADT of the study corridor. Figure 5 presents the locations of the data collection equipment along the study corridor of Kentucky Avenue, SE.

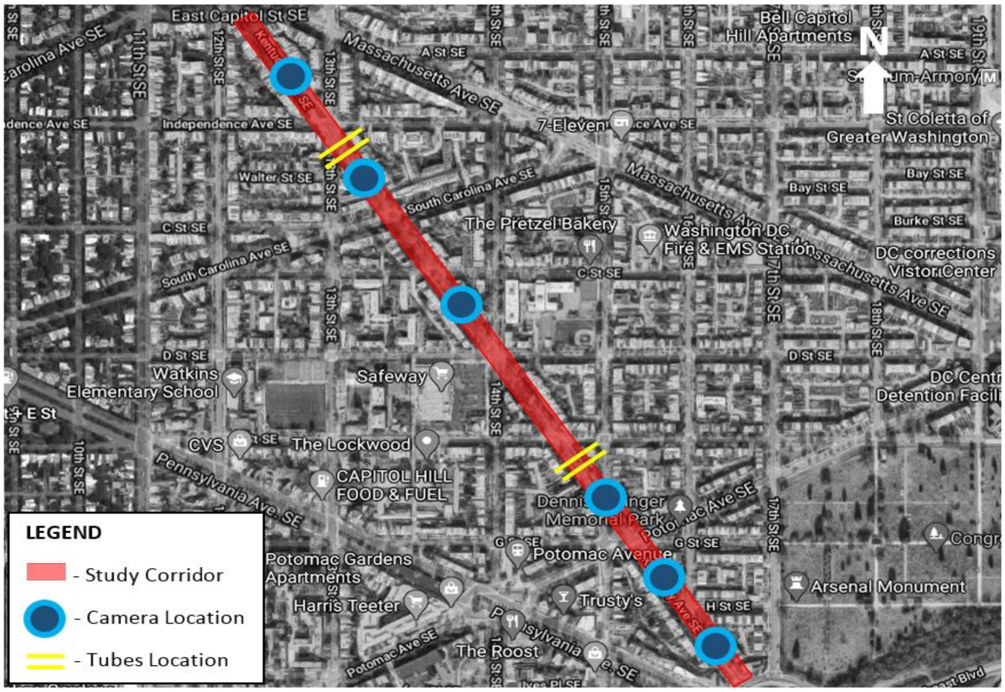

Figure 5: Location of Data Collection Equipment on Study Corridor of Kentucky Avenue, SE

4. Tennessee Avenue, NE (F Street, NE to Constitution Avenue, NE)

The study segment of Tennessee Avenue, NE between Constitution Avenue, NE and F Street, NE is a local road oriented in the northeast-southwest direction. The study corridor is approximately 2,300 feet long and 40 feet wide with on-street parking on both sides of the street. The statutory speed limit for this corridor is 20 MPH with some segments having a posted speed limit of 15 MPH when children are present. There are 7 intersections on the corridor of Tennessee Avenue, NE within the study limits. In addition, there is a bicycle lane located on the 200 block of Tennessee Avenue, NE. Cameras were installed to record traffic flow activities on May 19th, 2020 (before) at the following locations:

a) 200 Block of Tennessee Avenue, NE

b) 300 Block of Tennessee Avenue, NE

c) 400 Block of Tennessee Avenue, NE

d) 500 Block of Tennessee Avenue, NE

For the after scenario, cameras were installed on December 7th, 2021 to record the traffic flow on all of the former locations except the 400 block of Tennessee Avenue, NE. Pneumatic tubes were also placed within the 300 block of Tennessee Avenue, NE to obtain the ADT volume data of the study corridor during both sets of observations. Figure 6 presents the locations of the data collection equipment along the study corridor of Tennessee Avenue, NE.

Figure 6: Location of Data Collection Equipment on Study Corridor of Tennessee Avenue, NE

5. North Carolina Avenue, NE (First Street, SE to 2nd Street, SE)

The study segment of North Carolina Avenue, SE between First Street, SE and 2nd Street, SE is a local road oriented in the northeast-southwest direction. The study corridor is approximately 760 feet long and 40 feet wide with on-street parking on both sides of the segment. In addition, the statutory speed limit for this corridor is 20 MPH. A camera was installed on the 100 block of North Carolina Avenue, SE to record traffic flow activities on May 5th, 2020 (before) and on August 3rd, 2022 (after). Pneumatic tubes were also placed on the same block to obtain the vehicular speed and volume data for both the "before" and "after" scenarios. Figure 7 presents the locations of the data collection equipment along the study corridor of North Carolina Avenue, NE.

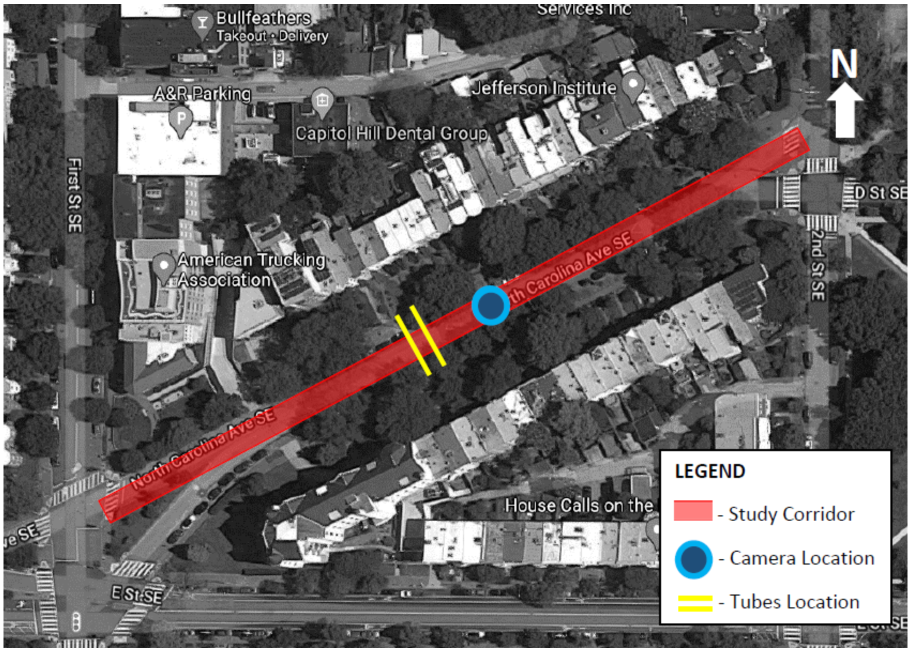

Figure 7: Location of Data Collection Equipment on Study Corridor of Tennessee Avenue, NE

RESULTS

Bicyclists and Motorists Surveys (full survey response in Appendix A)

The purpose of the surveys is to gauge the perceptions of the bicyclists as well as motorists traveling on the corridors with Advisory Bicycle Lanes. The surveys administered either via URL link to the surveys through email lists or through QR Codes on information signs posted across the five corridors sought to understand primarily if bicyclists felt safer after the addition of bicycle lanes, and if the motorists understood the purpose of those lanes. To achieve a 95% confidence level for a population of 18,000 bicyclists and 521,056 motorists with a confidence interval of **95%** and a margin of error of **9%,** a total of 118 bicyclists and 119 motorists were needed to be surveyed via electronic survey instrument.

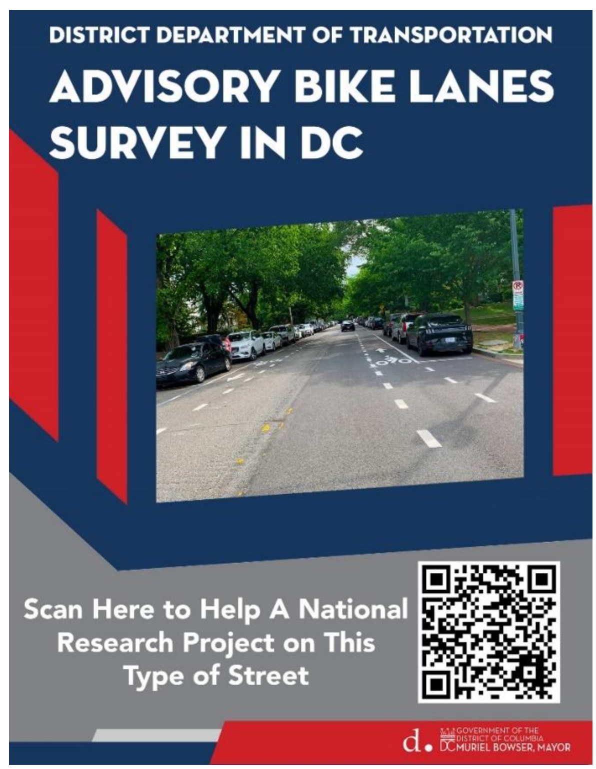

Image 1 - ABL Flyer + QR Code

From July 2nd, 2022 to September 4th, 2022, bicyclists, drivers and pedestrians were encouraged to participate in an online survey at the study sites.

Flyers were placed in the vicinity of the ABLs providing information about the survey and a QR code linked to the online survey platform.

The survey recorded **211** responses. Breakdowns of the survey respondents by gender and age group are presented in Figures 8 and 9.

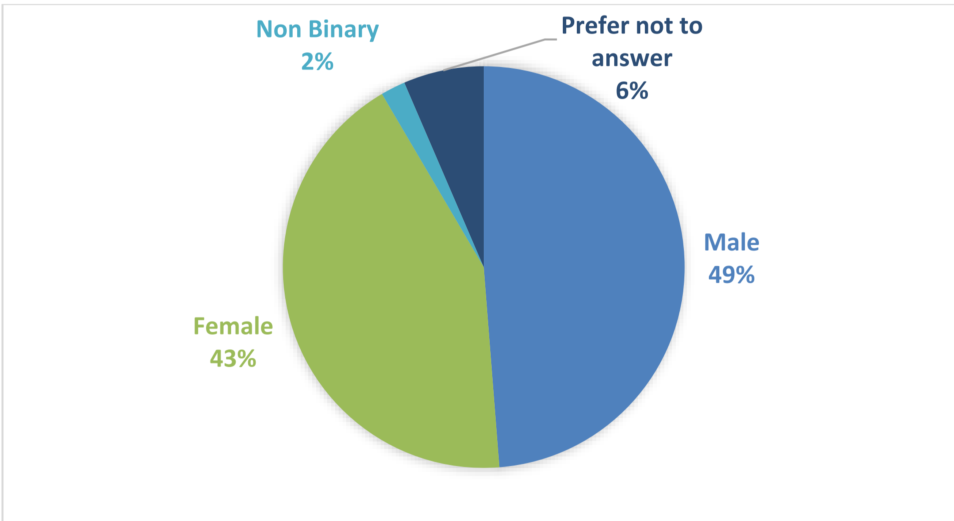

Figure 8: Breakdown of Survey Respondents by Gender

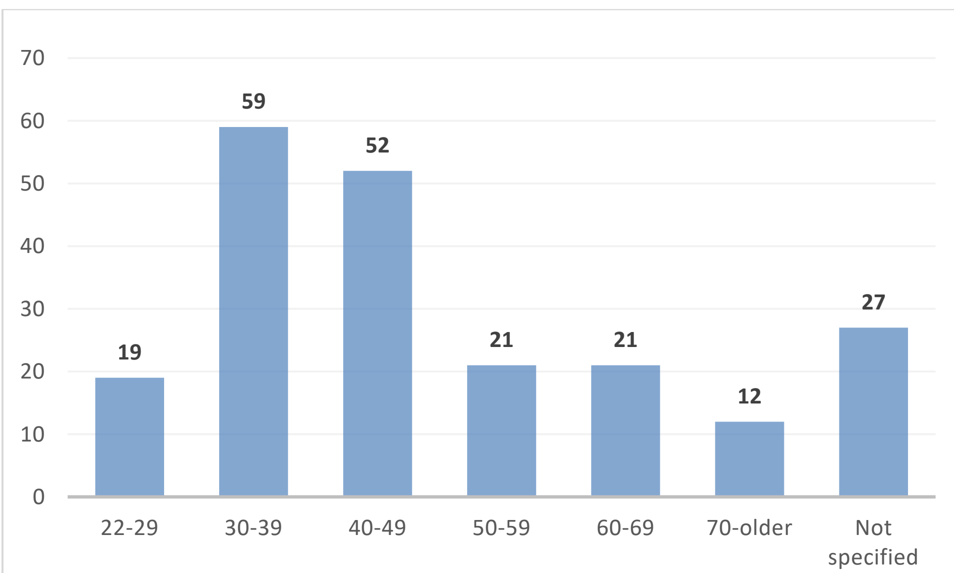

Figure 9: Breakdown of Survey Respondents by Age Group

From figures, the survey results showed that 88% of the respondents had traveled on the ABL locations. Further, from the total number of survey participants, approximately 79% respondents agree with the statement that DC and other cities should continue using ABLs. Figure 10 presents a breakdown of respondents by transportation mode chosen at the corridors of study. Overall, the spread of survey participants was even, with a 3% difference between modes of transportation.

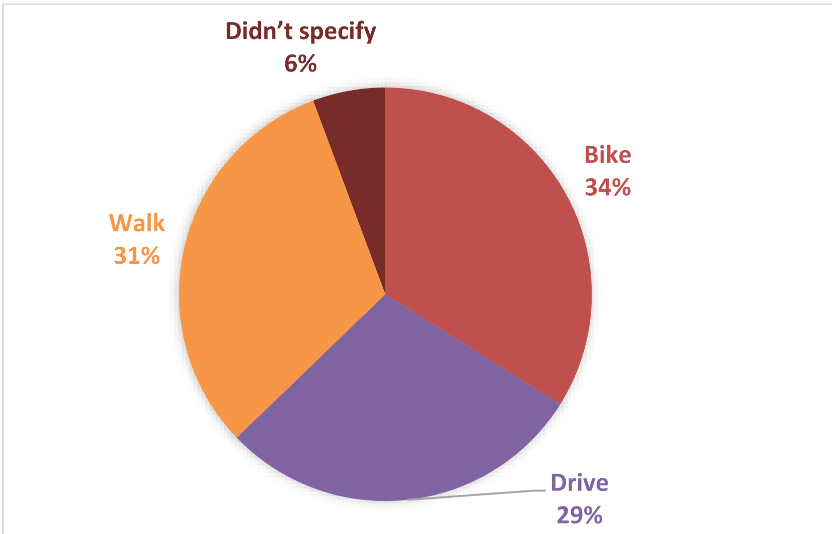

Figure 10: Breakdown of Survey Respondents by Transportation Mode at the Study Corridors

Of the 155 bike riders, 113 had traveled on the study corridors over 10 times. The results also showed that 85% of the bike riders said they understood how to ride on the corridors of study since the installation of the ABLs. A majority (61%) of the respondents found the treatment easy to understand, and biked at the same speed as usual and felt that the ABLs made the corridor feel safer.

Of those who drove through the study corridors, 86% did so over 10 times in the past. Approximately 69% knew how to drive on the corridors since the installation of the ABLs and 66% understood where vehicles should be positioned on the road. 46% stated that the roadway configuration was easy to understand. Overall, the survey showed that majority of drivers lowered their speeds when a bicyclist or another vehicle was present. A majority said the roadways felt safer (42%), or the same (27%), while a minority stated it felt less safe (31%).

Finally, of those who walked through the study corridors, the majority of respondents had done so over 10 times before. 62% of the respondents knew how the ABLs worked, and the majority (79%) indicated that they felt it was safer or the same level of safety when crossing the road.

Bicycle Tally Results

The following tables present the results of the observations made for the AM and PM peak periods at the study locations for scenarios with and without bicycle lanes. The observations of bicyclists traveling on street segments/ bicycle lanes as well as on sidewalks on the study locations before and after the installation of bicycle lanes are summarized in Tables 1 and 2, respectively.

Cycling on the sidewalk

Table 1: Number of Bicyclists Observed on Street Segments and Sidewalks for *Before* Scenario

Corridor	# of Segments Observed	AM		PM		Total # Bicycles Observed on Corridor	Percentage of Bicycles on Sidewalk (%)
		# bicyc. on street	# bicyc. on sidewalk	# bicyc. on street	# bicyc. on sidewalk		
E St, SE	4	21	5	80	22	128	21.1
12th St, SE	4	17	7	87	19	130	27.7
Kentucky Ave, SE	6	60	19	208	64	351	23.7
Tennessee Ave, SE	4	69	15	138	18	240	13.8
North Carolina Ave, SE	1	6	4	9	2	21	28.6

Table 2: Number of Bicyclists Observed Traveling on ABLs and Sidewalks for *After* Scenario

Corridor	# of Segments Observed	AM		PM		Total # Bicycles Observed on Corridor	Percentage of Bicycles on Sidewalk (%)
		# bicyc. on street	# bicyc. on sidewalk	# bicyc. on street	# bicyc. on sidewalk		
E St, SE	4	33	1	55	2	91	3.3
12th St, SE	4	134	42	178	27	381	18.1
Kentucky Ave, SE	6	108	7	180	12	307	6.2
Tennessee Ave, SE	3	61	1	93	3	158	2.5
North Carolina Ave, SE	1	18	0	39	1	58	1.7

From Table 1, we can conclude that the impact on sidewalk riding was profound, with significant reductions consistent on each corridor. The implication is that following installation, most cyclists felt comfortable riding in the ABLs. Before the installation of bicycle lanes, bicyclists traveling on the corridor of North Carolina Avenue, SE had the highest tendency to use the sidewalk (28.6%). However, in the "After" scenario, North Carolina Avenue, NE had the highest percentage of bicyclists using the bicycle lane with approximately 98.3% of the bicyclists traveling on the designated bike lane.

Figure 8 presents a chart comparing the percentage of bicyclists using the sidewalks along the study corridors before and after the implementation of bicycle lanes.

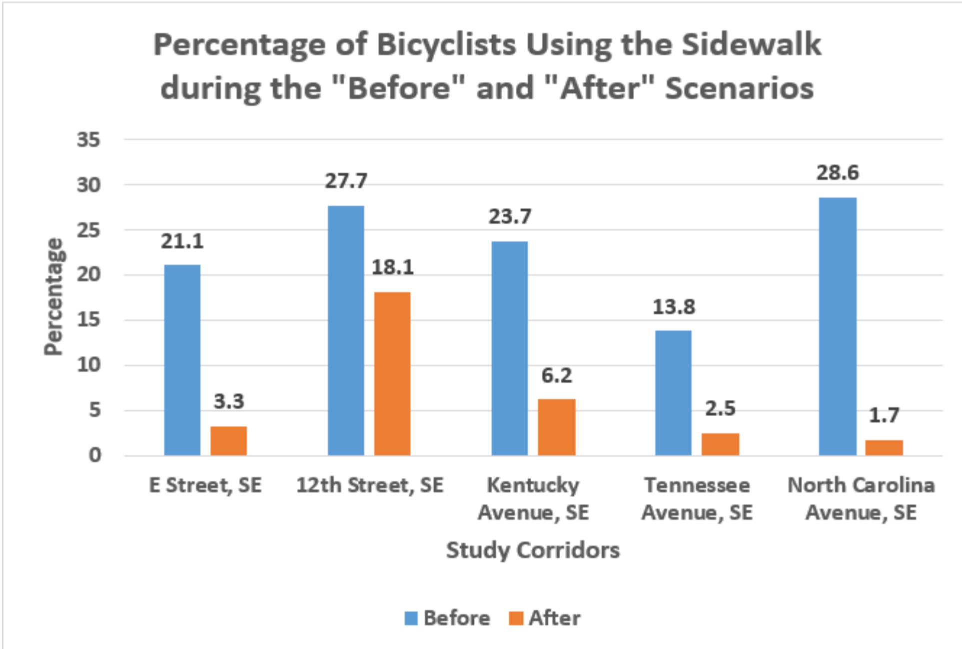

Figure 8: Percentage of Bicyclists using Sidewalk on Study Corridors during the "Before" and "After" Scenarios

From Figure 8, it can be seen that the corridor of North Carolina Avenue, SE had the highest percentages of bicyclists traveling on the sidewalk during both the "before" (28.6%) scenario followed by 12th Street, SE (27.7%). On the other hand, the corridor of Tennessee Avenue, NE had the lowest percentage of bicyclists using the sidewalk during the "before" (13.8%) while North Carolina Avenue, SE had the lowest sidewalk usage in the "after" (1.7%) scenarios. Hence, the highest change in percentage of bicycle sidewalk usage (26.9%) was observed for North Carolina Avenue, SE whereas cyclists traveling on 12th Street, SE still tended to use the sidewalk even after the bicycle lanes were installed. Hence, 12th Street, SE had a sidewalk usage percentage change of only 9.6%.

Driver Interactions

The number of vehicles yielding to bicycles, interactions between bicyclists and motorists, and interactions between two motorists due to absence of roadway centerlines were also observed for all the study segments for both scenarios. Interactions are the predicted, intentional negotiations for right-of-way between users on the corridor, which was expected to increase as there was a new established configuration for sharing the road. Conflicts occurring due to instances where vehicles were double parked on the study segments were also tallied from the video playback. Tables 3 and 4 present the frequency of the different types of interactions observed along the study corridors before and after the installation of bicycle lanes.

Table 3: Interactions Observed During the AM and PM Peak Periods for the "Before" Scenario

Corridor	AM PEAK			PM PEAK		
	# cars yielding to bicyclists	# interactions between bicycles and cars	# interactions between two cars	# cars yielding to bicyclists	# interactions between bicycles and cars	# interactions between two cars
E St, SE	0	0	13	1	0	3
12th St, SE	0	0	1	5	1	21
Kentucky Ave, SE	2	0	4	5	0	6
Tennessee Ave, SE	0	1	5	0	1	9
North Carolina Ave, SE	0	0	0	1	0	0

Table 4: Interactions Observed During the AM and PM Peak Periods for the "After" Scenario

Corridor	AM PEAK			PM PEAK		
	# cars yielding to bicyclists	# interactions between bicycles and cars	# interactions between two cars	# cars yielding to bicyclists	# interactions between bicycles and cars	# interactions between two cars
E St, SE	4	4	128	6	1	31
12th St, SE	17	7	8	11	11	101
Kentucky Ave, SE	18	6	18	27	3	54
Tennessee Ave, SE	1	6	21	3	0	29
North Carolina Ave, SE	0	0	1	0	0	0

From Tables 3 and 4, it can be observed that the interactions between bicycles and cars, as well as between two cars increased after the installation of bicycle lanes on the study corridors, as predicted, and were safe for users at these low speeds. The corridor of 12th Street, SE had the highest number of interactions between bicycles and cars with 7 and 11 interactions during the AM and PM peaks, respectively, in the study duration. Table 5 presents the average number of interactions that were observed on the study segments for both the scenarios. The average number of interactions per segment was calculated by dividing the sum of interaction #1 (motorists yielding to bicyclists) and interaction #2 (interactions between bicyclists and motorists) by the number of segments observed for a corridor.

Table 5: Average Number of Bicycle-Motorist Interactions at Segments of the Corridors

Corridor	# Observed Segments	BEFORE		AFTER	
		Total # Bicycle and Motorist Interactions	Average # Interactions per Segment	Total # Bicycle and Motorist Interactions	Average # Interactions per Segment
E St, SE	4	1	0	15	4
12th Street, SE	4	6	2	46	12
Kentucky Ave, SE	6	7	1	54	9
Tennessee Ave, SE	4	2	1	10	3
North Carolina Ave, SE	1	1	1	0	0

It can be observed from Table 5 that for the “after” scenario, the corridor of 12th Street, SE had the highest average number of interactions (12) followed by the corridor of Kentucky Avenue, SE (9). There were no interactions between bicycles and cars observed for North Carolina Avenue, SE after implementing the advisory bicycle lanes. Table 6 presents the total number of conflicts that occurred in the study segments due to instances of double-parked vehicles.

In summary, interactions between users are part of the design, and are able to occur safely without any driver or cyclist education. The corridors studied continue to have issues with double parked vehicles, but this did not appear to affect the safety of the facility and conflicts resulting from that action were resolved by cyclists riding around – double parking in bike lanes is a routine problem throughout most jurisdictions. Placing users in predictable conflicts can be done safely.

Table 6: Double-Parked Conflicts Observed During the AM and PM Peak Periods for the "Before" and "After" Scenarios

Corridor	BEFORE		AFTER	
	AM PEAK	PM PEAK	AM PEAK	PM PEAK
E St, SE	32	19	9	3
12th St, SE	10	14	8	27
Kentucky Ave, SE	8	16	7	12
Tennessee Ave, SE	0	2	10	7
North Carolina Ave, SE	0	0	0	3

Speed and Volume Data[4]

The 48-hour volume and speed data for the "before" scenario were obtained at the study locations from May 26th to May 27th, 2020. The "after" scenario speed and volume data were obtained at the same locations from December 7th to December 8th, 2021. The data for North Carolina Avenue, SE was collected from August 2nd to August 3rd, 2022 for the "after" scenario. Table 7 presents the summary of the combined (both direction per segment) 85th percentile speed and mean speed for all the ATR (Automatic Traffic Recorder) data collection locations for scenarios with and without the bicycle lanes. A detailed breakdown of the directional speed data for all segments has also been presented in Appendix B.

[4] The pre and post collection periods did occur when traffic patterns were atypical due to various adjustments in behavior due to COVID-19.

Table 7: Summary of Speed Data

#	Study Locations	Center Lane Width	85th Percentile (MPH)		Mean Speed (MPH)	
			Before	After	Before	After
1	1300 E Street, SE	14’	14	19	11	16
2	1500 E Street, SE	11’	19	19	15	15
3	200 12th Street, SE	14’	23	24	19	20
4	300 12th Street, SE	14’	20	18	17	14
5	200 Kentucky Avenue, SE	14’	26	27	21	22
6	500 Kentucky Avenue, SE	14’	23	28	16	22
7	300 Tennessee Avenue, SE	14’	31	27	24	23
8	100 North Carolina Avenue, SE	14’	21	18	16	14

From Table 7, it can be observed that the overall speed of the vehicles during the 48-hour counts decreased in only two of the seven study segments. Vehicles traveling on the 300 block of Tennessee Avenue, SE recorded the highest mean speeds of 24 MPH and 23 MPH before and after the installation of bicycle lanes, respectively. On the other hand, the lowest mean vehicular speeds were obtained on the 1300 block of E Street, SE (11 MPH) before the installation, and on the 300 block of 12th Street, SE and the 100 North Carolina Avenue, SE (14 MPH) after the installation of bicycle lanes. This result suggests that limited sampling days and hours did not achieve representative averages due to the low volumes of these segments, and it is hard to draw a conclusion on the overall effect ABLs have on vehicular speed. However, none of the “after” analysis speed results suggest that drivers are going faster on the corridor, and speeds are within normal range for local streets - this treatment did not create new speeding problems, and while speeding did not seem to be a significant factor in any of the “before” analysis – a reason these corridors were selected - there was a small but consistent downward trend for vehicle speeds across several corridors.

Table 8 presents the summary of the Average Daily Traffic (ADT) along the study corridors for the before and after scenarios. For corridors such as E Street, 12th Street, SE and Kentucky Avenue, SE, where vehicular counts were obtained at two locations, the average ADT volume of both locations per corridor was calculated for both scenarios.

Table 8: Average Daily Traffic on the Study Corridors

Corridor	# Data Collection Locations per Corridor	Combined ADT (BEFORE)	Combined ADT (AFTER)
E St, SE*	2	1,134	1,726
12th St, SE*	2	1,326	1,797
Kentucky Ave, SE*	2	1,277	1,642
Tennessee Ave, SE	1	1,192	1,612
North Carolina Ave, SE	1	2,076	1,015

*Average values of ADTs for 2 or more locations along the corridor presented.

From Table 8, the highest and the lowest ADTs for the before scenario were observed for the segment of North Carolina Avenue, SE and the corridor of E Street, SE, respectively. In the after scenario, the ADT for all the study segments increased with the highest ADT and the lowest recorded for 12th Street, SE and North Carolina Avenue, SE, respectively. A detailed breakdown of vehicular volume at all data collection locations along the study corridors is presented in Appendix B. This is another result that is hard to draw conclusions about since the "before" analysis took place during the COVID years when work/school/travel patterns were atypical.

CONCLUSION

Prior to installation, a significant number of cyclists were riding on the sidewalks, and following installation, that percentage dropped in every corridor - the implication is that riding in the street following ABL installation was perceived as safer and less stressful by cyclists.

Most motorists were observed driving as intended throughout the segments, driving in the center shared lane, and moving into the bike lane when an oncoming vehicle was present. Further, interactions between cyclists and drivers were safe, with drivers generally staying out of the bike lane except for moments when it was needed to pass. Drivers yielded to cyclists in front of them when an oncoming car was approaching.

Notably, no written or other instruction was provided to any user, cyclist or driver, on how to use this roadway configuration. Project planners believed it would be important to determine if the treatment was intuitive to all users. Based on the study results, we think that the treatment *is* intuitive, and can be broadly used without any instruction.

Overall, bicyclists are using the Advisory Bike Lane treatment as intended. Motorists generally avoided traveling on the bicycle lane when bicyclists were not present, indicating that they were using the implemented treatment as intended. The interactions between bicyclists and motorists traveling in the same or opposite direction occurred as predicted in observed instances.

NEXT STEPS

This study effort is intended to determine when and how ABLs should be used broadly. The results suggest that ABLs can play a significant role in improving bicycle safety in the District of Columbia and may be implemented using the following minimum criteria:

- Road width should be greater than 34’ and less than 44’
- Roadway ADT threshold should be < 4,000 trips per day
- Peak Hour volumes should be < 400 trips or the volume to capacity ratio should be ≤ 25%.
- On the higher end of the suggested volume thresholds, directionality of flows may determine if it the ABL treatment should be used (ex: 50/50 bi-directional vehicular flow would create more merges into the advisory bike lanes than a 90/10 bi-directional flow).

There may be other criteria to further explore, but in general, we think this roadway treatment could be broadly used in the U.S. if it followed these basic guidelines.

FURTHER OBSERVATIONS

This study was narrowly tailored to look at the use and safety of the advisory bike lane treatment, and it has largely shown that it is safe within the contexts DC chose to use it, and could have broader applicability. There are additional features of the ABL treatment that bear mentioning and further thinking, and specifically, how this might improve conditions versus a control street that does not have them. For example, the 400 block of 10th St NE has similar dimensions to the 1500 block of E St SE, and is also a two – way street with parking on both sides. In the case of 10th St NE, nearly every driver folds their sideview mirrors in to avoid having them scraped or damaged by sideswipe collisions.

Photo 1 - Vehicles on 10th St NE with side mirrors folded in

If DDOT instead applied the advisory bike lane treatment, it would center vehicular traffic in the roadway, therefore making mirror damage incidents less likely simply through adding 5’ of distance between the parked cars and the moving cars.

ADJUSTMENTS TO ABL REGULATIONS

In installing and observing this treatment, DDOT developed some additional views on necessary elements that we believe would improve broader adoption. In the experimental permissions, the treatment required a “bike lane” R3-17 sign on every block. In the District, these signs are almost never used, and this requirement is not necessary in our experience, especially when the treatment is used as part of a larger bike lane network where bike lane types are a common part of the urban fabric. We recommend removing this signage requirement from the regulation, and allow jurisdictions flexibility to match their typical signage practices.

Additionally, in developing plans for these bike lanes, we realized there was an opportunity to do an additional small setback to parking on intersection approaches and transition the advisory bike lanes into a regular bike lane at the intersection, creating more typical bike lane interactions at the intersections. In our current version, the advisory bike lanes transition to “sharrows” in the same zone. We think bike lanes at the intersection may be more predictable for everyone, while supporting our typical intersection sightline setbacks.

APPENDIX A:

SURVEY RESULTS

Question	
Have you traveled on any of the following corridors with advisory bike lanes?	
Yes	186
No	25
Should DC and other cities in the US continue using Advisory Bike Lanes?	
Yes	166
No	45
What is your gender?	
Male	98
Female	86
Non Binary	4
Prefer not to answer	13
Age	
22-29	19
30-39	59
40-49	52
50-59	21
60-69	21
70-older	12
Not specified	27
What is your zip code?	
20001	4
20002	93
20003	72
20005	1
20007	2
20009	3
20010	2
20011	3
20012	1
20016	1
20017	3
20020	1
20024	1
20036	1
20037	1
20093	1
Not specified	21

6	**Which of the following best describes you?**	
	White	151
	Not listed	3
	Asian	3
	Black	4
	Hispanic	8
	Multiracial	10
7	**Did you ride a bike drive or walk on any of these corridors?**	
	Bike	155
	Drive	132
	Walk	144
	Didn’t specify	26
BIKE		
8	**Did you ride:**	
	Own Bike or scooter	137
	Capital Bikeshare	78
	Other Rental Company	20
9	**How many times have you ridden on these corridors**	
	1 to 3	14
	4 to 10	29
	>10	113
10	**Did you feel like you knew how to ride your bike on this corridor since the installation of the Advisory Bike Lane**	
	Yes	131
	Somewhat	18
	No	7
11	**Did you understand where bicycles should be positioned on the road since the installation of the Advisory Bike Lane**	
	Yes	137
	Somewhat	9
	No	10
12	**Did you think this roadway pattern was easy to understand**	
	Yes	94
	Somewhat	39
	No	23
13	**Did you ride faster than usual the same as usual or slower than usual on this street**	
	Faster	22
	Same	121
	Slower	13

14	**In your opinion the bike lanes made this corridor feel**	
	Safer	106
	Same	33
	Less safe	17
DRIVE		
15	**How many times have you driven on these corridors**	
	1 to 3	8
	4 to 10	13
	>10	124
16	**Did you feel like you knew how to DRIVE your vehicle on this corridor since the installation of the Advisory Bike Lane**	
	Yes	91
	Somewhat	26
	No	15
17	**Did you understand where vehicles should be positioned on the road since the installation of the Advisory Bike Lane**	
	Yes	87
	Somewhat	30
	No	15
18	**Did you think this roadway pattern was easy to understand**	
	Yes	60
	Somewhat	33
	No	39
19	**When a bicyclist was on the road did you drive faster than usual the same as usual or slower than usual on this street**	
	Faster	4
	Same	46
	Slower	81
20	**When there was another vehicle on the road did you drive faster than usual the same as usual or slower than usual on this street**	
	Faster	3
	Same	58
	Slower	69
21	**In your opinion the bike lanes made this corridor feel**	
	Safer	56
	Same	36
	Less safe	40

WALK		
22	**How many times have you walked on these corridors**	
	1 to 3	6
	4 to 10	17
	>10	136
23	**Did you feel like you knew how the advisory bike lane works**	
	Yes	99
	Somewhat	26
	No	16
24	**When crossing the street did you feel**	
	Safer	39
	Same	78
	Less safe	25

APPENDIX B:

SPEED AND VOLUME DATA

#	Study Locations	85th Percentile (MPH)		Mean Speed (MPH)	
		Before	After	Before	After
1	1300 E Street, SE	14	19	11	16
2	1500 E Street, SE	19	19	15	15
3	200 12th Street, SE	23	24	19	20
4	300 12th Street, SE	20	18	17	14
5	200 Kentucky Avenue, SE	26	27	21	22
6	500 Kentucky Avenue, SE	23	28	16	22
7	300 Tennessee Avenue, SE	31	27	24	23
8	100 North Carolina Avenue, SE	21	18	16	14

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Kentucky Ave, SE*	2	1,277	1,642
Tennessee Ave, SE	1	1,192	1,612
North Carolina Ave, SE	1	2,076	1,015

APPENDIX C:

Design Guide References from FHWA and CROW

The FHWA approach differs substantially from the Crow approach by recommending a preferred central travelway that is *not recommended* in the Netherlands while allowing narrower bicycle lanes because it creates an ambiguous central travelway width which creates the appearance that two vehicles can pass each other without encroaching into the bicycle lane. The Crow policy requires the designer choose between creating a distinct space for one vehicle or two vehicles and recommends the in-between dimensions FHWA recommends to be avoided.

- https://ruraldesignguide.com/ which recommends:
  - Maximum Motor Vehicle Volumes
    - preferred 3,000 AADT;
    - acceptable 6,000 AADT
  - Maximum Motor Vehicle Speeds
    - preferred 25 mph or less
    - acceptable 35 mph or less
  - Central Travelway Width for Motorists
    - Preferred 13.5 ft minimum to 16.5 ft maximum
    - Acceptable 10 ft practical minimum to 18 ft absolute maximum
  - Bicycle Lane Widths
    - Bicycle lane widths of 4ft minimum to 6ft preferred

- Dutch Crow Manual
  - Maximum Motor Vehicle Volumes
    - See Central Travelway discussion below
  - Maximum Motor Vehicle Speeds
    - preferred 18 mph or less
  - Central Travelway Width for Motorists
    - Narrow profile, one car only width: 7ft minimum to 12.5 ft maximum (up to 600 PCU/hour)
    - Wider profile, two car width: 12.5 ft to 19.5 ft maximum (up to 1,000 PCU/hour)
  - Bicycle Lane Widths
    - Bicycle lane widths of 5.5 ft minimum to 7 ft preferred