CITY OF OAKLAND

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Public Works Agency
Vitaly B. Troyan, P.E.
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October 25, 2012

Mr. Bruce Friedman
Federal Highway Administration
Office of Transportation Operations
1200 New Jersey Avenue, S.E., HOTO-1
Washington, DC 20590

Mr. Jeff Knowles
California Traffic Control Devices Committee
c/o City of Vacaville, Public Works Department
650 Merchant St.
Vacaville, CA 95688

Subject: Request to Experiment with Green & Shared Roadway Bicycle Markings, Oakland, CA

Dear Mr. Friedman and Mr. Knowles:

The City of Oakland requests permission to experiment with green color on the pavement surface as a traffic control device in conjunction with the shared roadway bicycle marking (sharrow). The purpose of the pilot is to confirm whether we may improve traffic operations on multi-lane urban arterials and collectors frequented by bicyclists. The experiment is proposed for 40th Street between Adeline Street and Webster Street in proximity of the MacArthur BART Transit Station and Transit Village development.

Existing traffic control devices do not provide sufficient guidance to roadway users on the safe and legal path of travel for bicyclists in shared lane situations. To date, experiments in Salt Lake City, Long Beach, and Minneapolis have addressed this issue by installing bands of green color pavement in conjunction with sharrows. The Oakland experiment will further develop this knowledge base with a phased implementation of standard traffic control devices plus the experimental treatment. The experiment includes video data collection and statistical analysis to examine behavioral change.

This experiment will advance professional understanding on design solutions for multi-lane urban streets where bicycle lanes are not possible despite significant numbers of bicyclists. We look forward to partnering with the Federal Highway Administration and the California Traffic

Control Devices Committee on this important effort. For questions regarding this request, contact Jason Patton, Bicycle & Pedestrian Program Manager (510-238-7049, jpatton@oaklandnet.com).

Sincerely,

Vitaly B.

Vitaly B. Troyan, P.E.
Director, Public Works Agency

Encl: Green & Shared Roadway Bicycle Markings, Oakland, CA – Request to Experiment

Cc: Devinder Singh, Caltrans Division of Traffic Operations (CTCDC)
Deborah Lynch, Caltrans Office of Special & Discretionary Programs (CBAC)

Green & Shared Roadway Bicycle Markings
Oakland, CA

Request to Experiment

Submitted To:
California Traffic Control Devices Committee
California Bicycle Advisory Committee
Federal Highway Administration, Office of Traffic Operations

Submitted By:
City of Oakland, Public Works Agency,
Department of Engineering and Construction,
Transportation Infrastructure Plans & Programming Division

October 25, 2012

Overview

The City of Oakland requests permission to experiment with green color on the pavement surface as a traffic control device in conjunction with the shared roadway bicycle marking (sharrow). The purpose of the experiment is to improve traffic operations on multi-lane urban arterials and collectors frequented by bicyclists. The experiment is proposed for 40th Street between Adeline Street and Webster Street in proximity of the MacArthur BART Transit Station and Transit Village development. The experiment includes the phased implementation of standard traffic control devices plus the experimental treatment, video data collection, and statistical analysis to examine behavioral change.

As specified by Section 1A.10 of the Manual on Uniform Traffic Control Devices (MUTCD), this request includes the following information: a problem statement, description and use of the proposed traffic control device, evaluation plan, reporting requirements, experiment termination/site restoration, and patent/copyright protection.

Problem Statement

On multi-lane urban arterials and collectors that are too narrow for bicycle lanes, bicyclists typically ride in the “door zone”: the area immediately adjacent to curbside parallel parking into which car doors open. Overtaking drivers typically pass such bicyclists without changing lanes, encroaching into the adjoining travel lane, and providing insufficient width for the bicyclist to operate safely.

The California Vehicle Code requires bicyclists to “ride as close as practicable to the right-hand curb or edge of the roadway” (CVC 21202(a)). Exceptions to this requirement include roadways with “a substandard width lane” defined as “a lane that is too narrow for a bicycle and a vehicle to travel safely side by side within the lane” (CVC 21202(a)(3)). This exception is the basis for the “Bicycles May Use Full Lane” sign (R4-11) that is included in the 2012 California Manual on Uniform Traffic Control Devices.

In the City of Oakland, the majority of urban arterials and collectors have lane widths that are too narrow for a bicycle and vehicle to operate side by side in a safe manner. Oakland’s design approach provides a minimum of 23’ for side-by-side lane sharing where curbside parallel parking is allowed: 9.5’ parking lane and door zone, 3.5’ bicyclist operating space, 3’ passing space for overtaking drivers, 6’ width of a large passenger car, and 1’ buffer to the travel lane line. Where this width is available, the City is in the process of adding bicycle lanes as per a citywide analysis of roadway widths completed for the City of Oakland’s Bicycle Master Plan (2007). Where traffic volumes allow, the City is reducing the number of travel lanes to create space for bicycle lanes.

On multi-lane roadways, CVC 21654(a) requires slow moving vehicles to operate "in the right-hand lane for traffic or as close as practicable to the right-hand edge or curb." Exceptions to CVC 21202(a) allow a bicyclist to use the full extent of the right-hand lane if that lane is too narrow for a bicycle and vehicle to travel safely side by side. Thus the safe and legal behavior for the bicyclist is to "control" the travel lane, riding clear of the door zone with overtaking drivers deliberately changing lanes to pass safely. A minority of bicyclists operates in this manner because the cultural expectation is that bicyclists should "get out of the way" of overtaking drivers. Incidents include drivers honking, yelling, driving aggressively, and physically assaulting bicyclists who were using the travel lane in a manner that inconvenienced drivers.[1]

Traffic operations on multi-lane urban streets frequented by bicyclists are thus prone to the following operational issues:

(1) Bicyclists ride too close to vehicles parked parallel along the street, exposing themselves to collisions with opening car doors.

(2) Overtaking drivers pass bicyclists by "squeezing by," encroaching on the adjoining travel lane, creating conflicts with other drivers, and providing insufficient width for bicyclists to operate safely.

(3) Bicyclists controlling the right-hand lane in a safe and legal manner are subject to intimidation by overtaking drivers.

Existing traffic control devices do not provide sufficient guidance to roadway users on the safe and legal path of travel for bicyclists in shared lane situations. Currently, the City's design options include sharrows, parking edge line stripes or parking Ts to help delineate the door zone, and bicycle-related signage. These treatments are in place on other multi-lane roadways in Oakland but they have been insufficient in addressing the operational issues noted above.

The City seeks to address these operational issues by experimenting with roadway delineation for shared lane situations that may promote: (a) safe and legal lane positioning by bicyclists; and (b) safe and legal passing by drivers.

Location of Proposed Experiment

The City of Oakland's Bicycle Master Plan, part of the Oakland General Plan, calls for the installation of bikeways to improve access to major transit stations. One of the busiest stations is MacArthur BART, located in North Oakland and operated by the Bay Area Rapid Transit District. As of 2008, 8.2% of BART patrons accessed the station by bicycle despite there being no bikeways serving the station. The station has the fourth largest number of bicyclists accessing the station out of the 43 BART stations in the San Francisco Bay Area. The station entrance is on

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[1] Peter G. Furth, Daniel M. Dulaski, Dan Bergenthal, and Shannon Brown. "More Than Sharrows: Lane-Within-A-Lane Bicycle Priority Treatments in Three U.S. Cities." Transportation Research Board Annual Meeting, 2011.

40th Street, a four-lane urban arterial with two travel lanes in each direction, a 16-foot raised median with turn pockets at the intersections, and parallel parking lanes on both sides of the street. Average daily traffic is approximately 16,000 vehicles and there are seven traffic signals on this 1.0 mile segment of roadway. **Figure 1** is a context map showing the location of the proposed experiment and Oakland's bikeway network in the vicinity of MacArthur BART. **Figure 2** presents photographs of the existing conditions.

The City has made multiple efforts to develop a bikeway in the 40th Street corridor to serve MacArthur BART. In 2006 and 2008, the City completed two studies on the removal of travel lanes and the installation of bicycle lanes. The City is not implementing the "road diet" option because of (1) concerns from the public transit agency – Alameda-Contra Costa Transit District (AC Transit) – regarding delays to bus operations; and (2) future year traffic forecasts whereby the road diet would create significant and unavoidable impacts to motor vehicle delay under the California Environmental Quality Act. The City then studied the feasibility of maintaining the four travel lanes and adding bicycle lanes by narrowing the raised medians. This proposal was opposed by neighborhood groups who, over the duration of the City's studies have adopted and landscaped the medians. Given these constraints, the City seeks an additional design treatment that will improve the positive effects of sharrows in delineating the safe and legal path of travel for bicyclists.

Description and Use of the Proposed Traffic Control Device

The City will install a five-foot wide band of green color, applied to the surface of the pavement, and centered in the #2 travel lane. The green band will extend the length of the shared lane condition in the project area, excluding intersections and crosswalks. This experimental traffic control device will provide continuous guidance in delineating the safe and legal path of travel for bicyclists. It will be used in conjunction with the following standard traffic control devices:

- Sharrows spaced at intervals of approximately 135 to 200 feet with a minimum of two sharrows in each direction on each block;
- Parking edge line stripes (Detail 27B) delineating the right edge of the #2 (outside) travel lane along the length of the project, excluding intersections, crosswalks, and bus stops; and
- "Bicycles May Use Full Lane" (R4-11) signs on the far-side of each intersection with a collector or arterial roadway (6 intersections total).

Figures 3 and 4 present a conceptual section and striping plan for the experimental treatment. It is proposed for 0.8 miles of 40th Street from Adeline Street to Martin Luther King, Jr Way and from Telegraph Avenue to Webster Street. No change is proposed on the connecting 0.2 miles of 40th Street from Martin Luther King, Jr Way to Telegraph Avenue. Bicycle lanes were installed along this segment at the MacArthur BART station entrance (and under State Highway 24) as part of a streetscape project in 2009. Bicycle Route Signs (D11-1) were installed along the length of the corridor in May 2010 and will remain throughout the project.

With this experiment, the City of Oakland seeks to deepen and clarify professional understanding of green color pavement for bikeways. The green band will delineate the bicyclists' path of travel in a shared lane condition. It does not denote a zone for the preferential or exclusive use of bicyclists. To date the use of green color pavement on bikeways has this underlying consistency: to indicate the bicyclists' path of travel to drivers and bicyclists. The green color is used to enhance the delineation established by standard traffic control devices: bike lane stripes and sharrow markings. This underlying consistency creates an overall condition that is understandable to roadway users. Standard lane lines and markings allocate the roadway width for established purposes while the green band clearly indicates where to expect bicyclists. This experiment will help focus professional discussion on green color pavement to the design challenges of multi-lane urban streets where bicycle lanes are not possible despite significant numbers of bicyclists.[2]

The green band will be five feet wide to: (1) match established practice on bicycle operating and facility widths; (2) align with the center of the travel lane over a range of urban lane widths; and (3) ensure a prominent visual presence. The five-foot (60") green band is comparable to the width of sharrows (39"), bike lane symbols (40"), AASHTO's minimum width to operate a bicycle (40"), and bike lane widths (≥60"). In particular, the sharrow at 39" in width and the green band at 60" in width will allow 10.5" of green on either side of the sharrow. This overlap will improve the visibility of the sharrow and create a consistent appearance for the green band. A five-foot band can be located in the effective center of a travel lane and remain clear of the door zone over the range of typical urban lane widths: 17 feet to 20+ feet (measured from face of curb to lane line). In communicating the bicyclists' path of travel, a five-foot green band is thus narrow enough to center in the lane, remain clear of the door zone, and be visually prominent.

State of the Practice

To date, four projects have installed continuous bands of green color pavement in conjunction with sharrows: 200 South in Salt Lake City, 2nd Street in Long Beach, Hennepin Avenue in Minneapolis, and Bryant Avenue South in Minneapolis. Two additional experiments are closely related: Philadelphia's sharrows on rectangular patches of green color pavement on South 59th Street; and sharrows flanked by dashed white lines on Longwood Avenue in Brookline, MA.

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[2] If the proposed experimental treatment is successful, we anticipate that it would be applicable to 5.0 miles of multilane arterial and collector roadways in Oakland. This figure is based on a citywide analysis of such roadways where bicycle lanes are likely to be infeasible. In comparison, Oakland is in the process of installing 105 miles of bike lanes, 40 miles of which are currently complete.

Figure 5 provides citations for these experiments. **Figure 6** presents selected photographs of the projects.

The projects with sharrows and green color pavement share the following characteristics:

- Sharrows typically centered on the effective width of the outside travel lane;
- Continuous green bands of four to six feet in width, underneath the sharrows and also centered on the effective lane width of the outside travel lane;
- Signs communicating shared lane messages (e.g., “bikes may use full lane,” “share the road,” and experimental alternatives); and
- Locations where bicycle lanes are infeasible due to insufficient width.

The projects in Salt Lake City, Long Beach, and Minneapolis (Hennepin Avenue) were implemented on four-lane urban arterials. **Figure 7** summarizes the specific characteristics and evaluation methodologies for these six experiments.

Across the studies, the green shared lane was found to shift a substantial percentage of bicyclists away from the door zone (or curb) and closer to the center of the lane. The changes in lateral positioning were more pronounced than those found in studies of sharrows without the green color pavement. The green shared lane experiments in Long Beach and Minneapolis (Hennepin Avenue) both documented corresponding decreases in auto-bicycle collision rates.

Figure 8 summarizes the findings of the four completed projects and identifies outstanding issues to be addressed by the City of Oakland’s experiment:

- Comparative effects of sharrows versus sharrows plus the green band;
- Changes in passing distance between overtaking drivers and bicyclists;
- Changes in auto lane utilization; and
- Effects on transit (including passing distance, leap-frogging, and delay).

Evaluation Plan

The City of Oakland will complete a phased before/after study to evaluate the effectiveness of the experimental treatment and to monitor safety. The implementation phases are as follows:

(1) existing condition;
(2) sharrows, parking edge line stripes (Detail 27B), and “Bicycles May Use Full Lane” (R4-11) signs; and
(3) above plus five-foot wide green band.

The study is deliberately phased to use standard treatments first and then add the experimental device. The green band is introduced last in order to compare its efficacy with the standard and simpler treatments.

Each phase will remain in place for a minimum of eight weeks. Data collection will occur in the final two weeks of each phase, allowing six weeks for traffic operations to adjust to the newly introduced treatments. Each phase will include two-hour data collection windows: weekday AM and PM peak (7:00-9:00AM and 4:00-6:00PM on Tuesdays, Wednesdays, or Thursdays); and off-peak (Saturday afternoons, 2:00-4:00PM). Each phase will collect approximately 50 hours of data. For each phase, the study will measure the following:

- bicyclist volumes on 40th Street and parallel streets;
- bicyclist lane positioning relative to parked cars;
- motorist passing distance when overtaking bicyclists;
- frequency of motorists changing lanes to pass bicyclists;
- frequency of gaps in traffic that allow overtaking drivers to change lanes to pass;
- vehicle speeds in both lanes;
- bus driver behavior at mid-block and intersection locations; and
- collisions involving all roadway users.

The collision analysis will be completed for the entire corridor, ultimately comparing one year of before data to one year of after data using Oakland Police Department and California Highway Patrol collision reports. For all other measures, data will be collected for both directions of travel between Market Street and West Street, the midpoint of the corridor.

Reporting Requirements (MUTCD Section 1A.10.11.I)
The City of Oakland will provide semi-annual progress reports for the duration of the experiment, and will provide a copy of the final results within three months following the completion of the experiment.

Experiment Termination/Site Restoration (MUTCD Section 1A.10.11.H)
The City of Oakland will restore the site of the experiment to a condition that complies with the provisions of the MUTCD within three months following the end of the time period of the experiment. The City agrees to terminate the experiment if the City or the California Traffic Control Devices Committee (CTCDC) or the FHWA determines that significant safety concerns are directly or indirectly attributable to the experiment. The City understands that if, as a result of the experiment, a request is made that the MUTCD be changed to include the treatment being experimented with, the treatment will be permitted to remain in place until an official rulemaking action has occurred.

Patent/Copyright Protection (MUTCD Section 1A.10.11.E)

To the best of our knowledge based on the comparable experiments in Long Beach, Salt Lake City, and Minneapolis, the use of green color on the pavement surface in conjunction with the shared roadway bicycle marking is not protected by patent or copyright.

Conclusion

The City of Oakland seeks approval from the CTCDC and FHWA to contribute research on green color pavement and shared roadway bicycle markings. The experiment addresses multi-lane urban streets where bicycle lanes are not feasible despite significant numbers of bicyclists. Common issues on such streets include: bicyclists riding too close to vehicles parked parallel along the street; overtaking drivers “squeezing by” bicyclists and encroaching on the adjoining travel lane; and drivers intimidating bicyclists who are riding outside of the door zone in a safe and legal manner. The experiment will evaluate if this treatment promotes: (a) safe and legal lane positioning by bicyclists; and (b) safe and legal passing by drivers in shared lane situations. We look forward to partnering with the CTCDC and the FHWA on this experiment.

List of Figures

Figure 1 Context Map

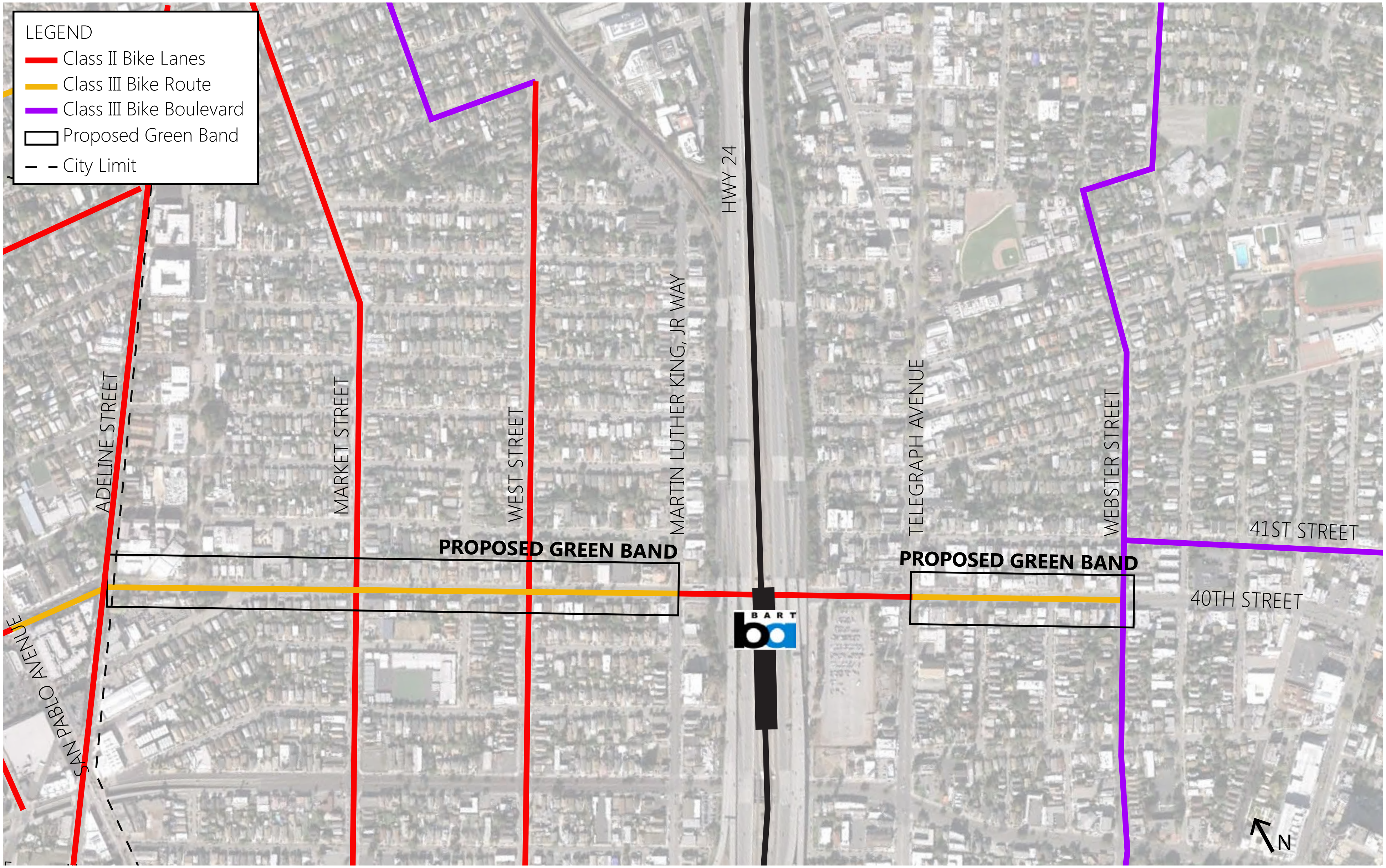


Figure 2 Existing Conditions Photographs

40th Street Existing Conditions

Looking east toward BART, cyclists on 40th Street ride within the door-zone even with no autos present in the #2 lane.

Looking west, travel lanes appear wide from motorist's viewpoint, which may increase "squeeze-by" passing behavior.

Looking east toward BART, multiple transit routes exist on the corridor, including near-side and far-side bus stops.

Looking west, Class II Bicycle Lanes in front of the MacArthur BART Station end at Martin Luther King, Jr Way.

Adjoining Bikeways

Class II Bicycle Lanes on West Street

Class II Bicycle Lanes on Adeline Street

Class II Bicycle Lanes on 40th Street, near BART

Figure 3 Green Shared Lane Conceptual Cross-Section

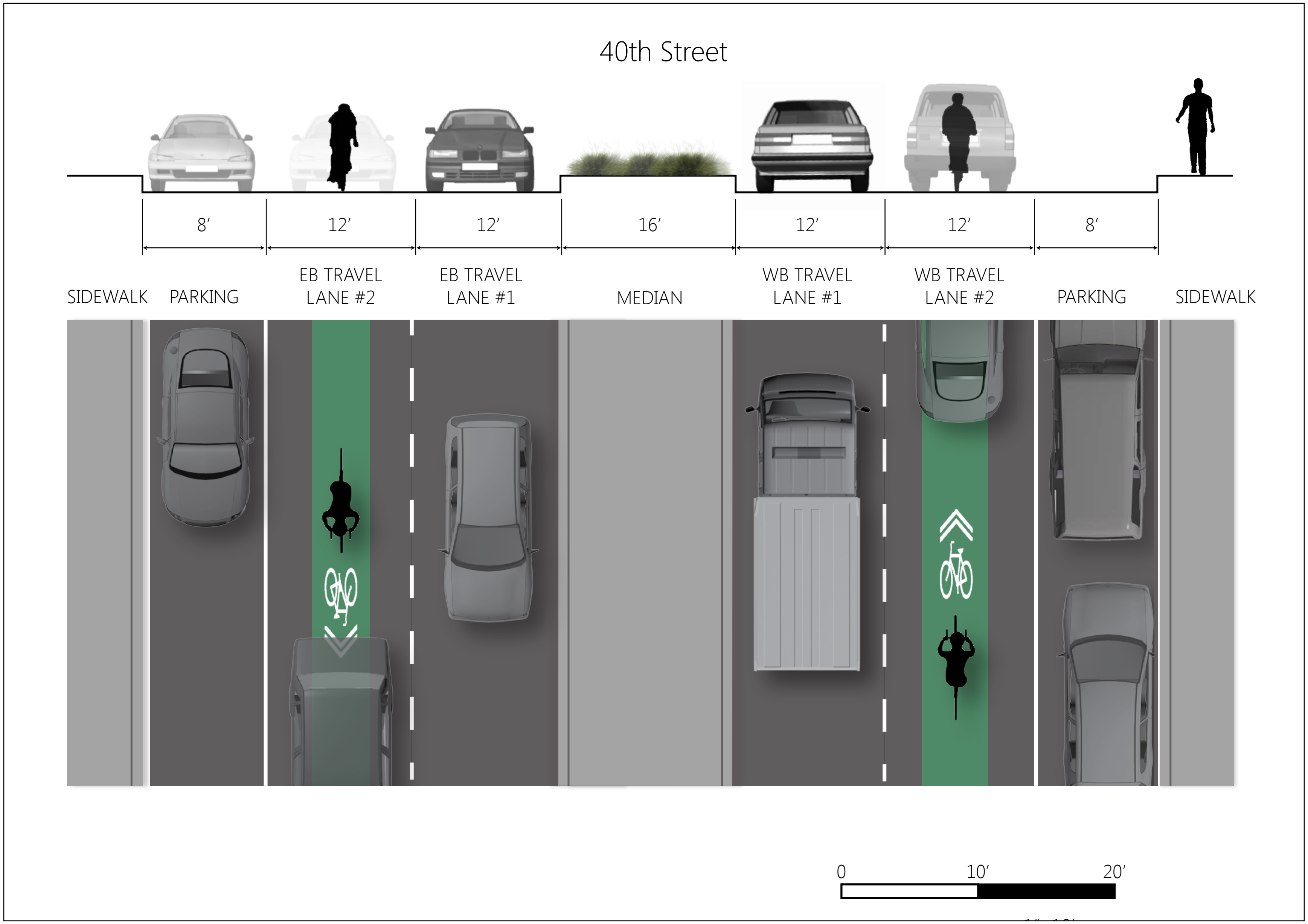
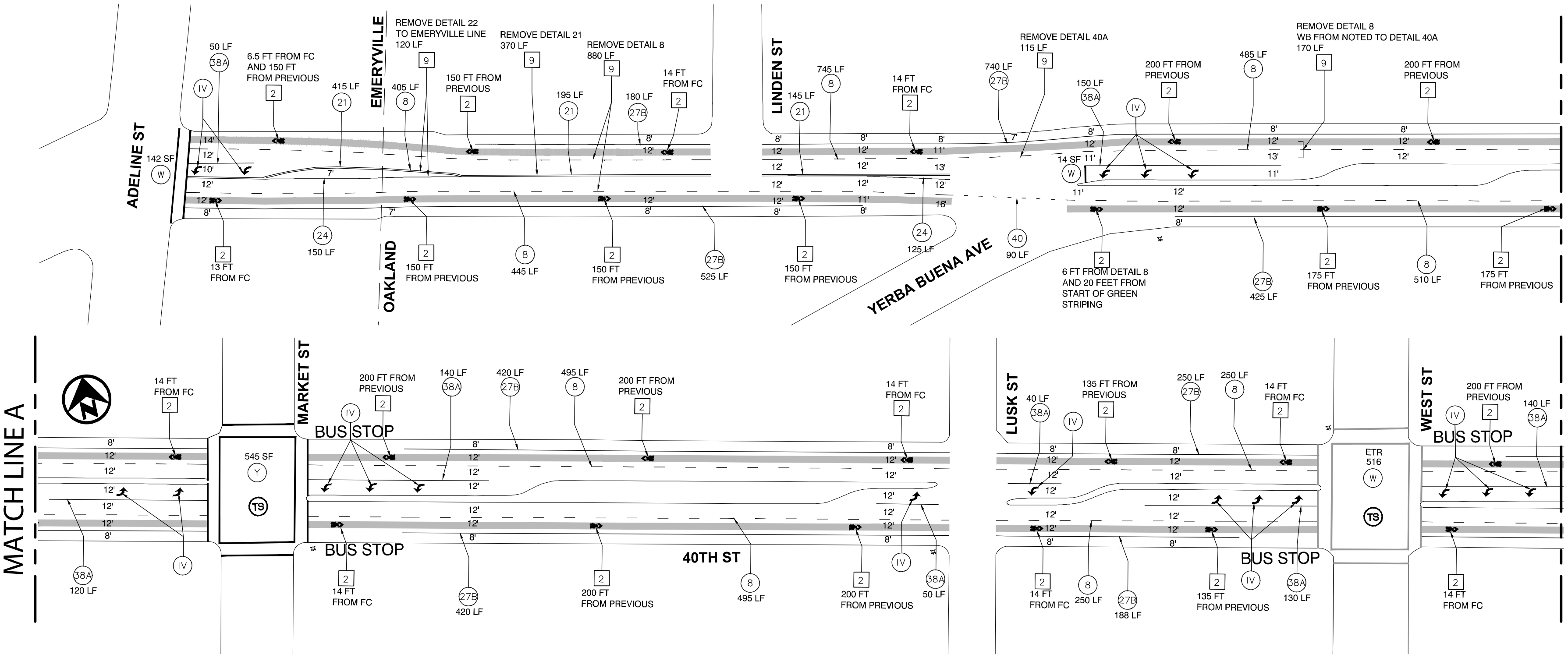


Figure 4 Striping Plan



LEGEND

#	STRIPING CONSTRUCTION NOTE NUMBER
(#)	DETAIL NUMBER PER CALTRANS STD PLANS Traffic lines as cardinal number Arrows as roman numeral
(TS)	TRAFFIC SIGNAL
(W)	CROSSWALK/LIMIT LINE (SOLID ONE FOOT WHITE LINE)
(Y)	CROSSWALK/LIMIT LINE (SOLID ONE FOOT YELLOW LINE)
	FIRE HYDRANT
	BLUE FIRE HYDRANT MARKER
ETR	EXISTING TO REMAIN
LF	LINEAR FEET
SF	SQUARE FEET
CR	CURB RETURN
FC	FACE OF CURB

CONSTRUCTION NOTES

1. BIKE LANE SYMBOL & ARROW
Install bike lane symbol and bike lane arrow markings 20 feet after curb return (as measured from base of symbol) and/or as noted. Space symbol and arrow 6 feet apart. See Detail.

2. SHARROW
Install first sharrow marking 20 feet after curb return or as noted. Install other sharrow markings as noted. See Detail.

3. PARKING TEE
Install short stem toward curb, distance measured from center of cross. Spacing between tees to be determined by engineer. See Detail.

4. BIKE DETECTOR SYMBOL
Install bike detector pavement marking 6 feet from lane line and 1 foot from limit line or as noted. See Detail.

5. SPEED HUMP STRIPING
Install 1 foot white stripes on speed humps, 5 feet apart, on center. See Detail.

6. LADDER CROSSWALK
Install 2 foot stripes spaced 2 feet apart, bounded by standard 1 foot crosswalk stripes, white unless otherwise noted. See Detail.

7. WHITE BUFFER STRIPING
Install 6 inch white striping every 8 feet at 45 degree angle, or as noted.

8. YELLOW BUFFER STRIPING
Install 6 inch yellow striping every 15 feet at 45 degree angle, or as noted.

9. REMOVE CONFLICTING STRIPING

10. REMOVE CONFLICTING MARKINGS

GRAPHIC SCALE (IN FEET)
20' 40' 80' 160'

CITY OF OAKLAND
DEPARTMENT OF ENGINEERING AND CONSTRUCTION
250 FRANK H. OGAWA PLAZA, SUITE 4344 * OAKLAND CA, 94612
(510) 238-3466 * FAX (510) 238-7415

40TH ST
ADELINE ST TO WEBSTER ST

REVIEWED BY PETER CHUN
DESIGNED BY JASON PATTON
DRAWN BY ML

No.	DATE	BY	REFERENCE

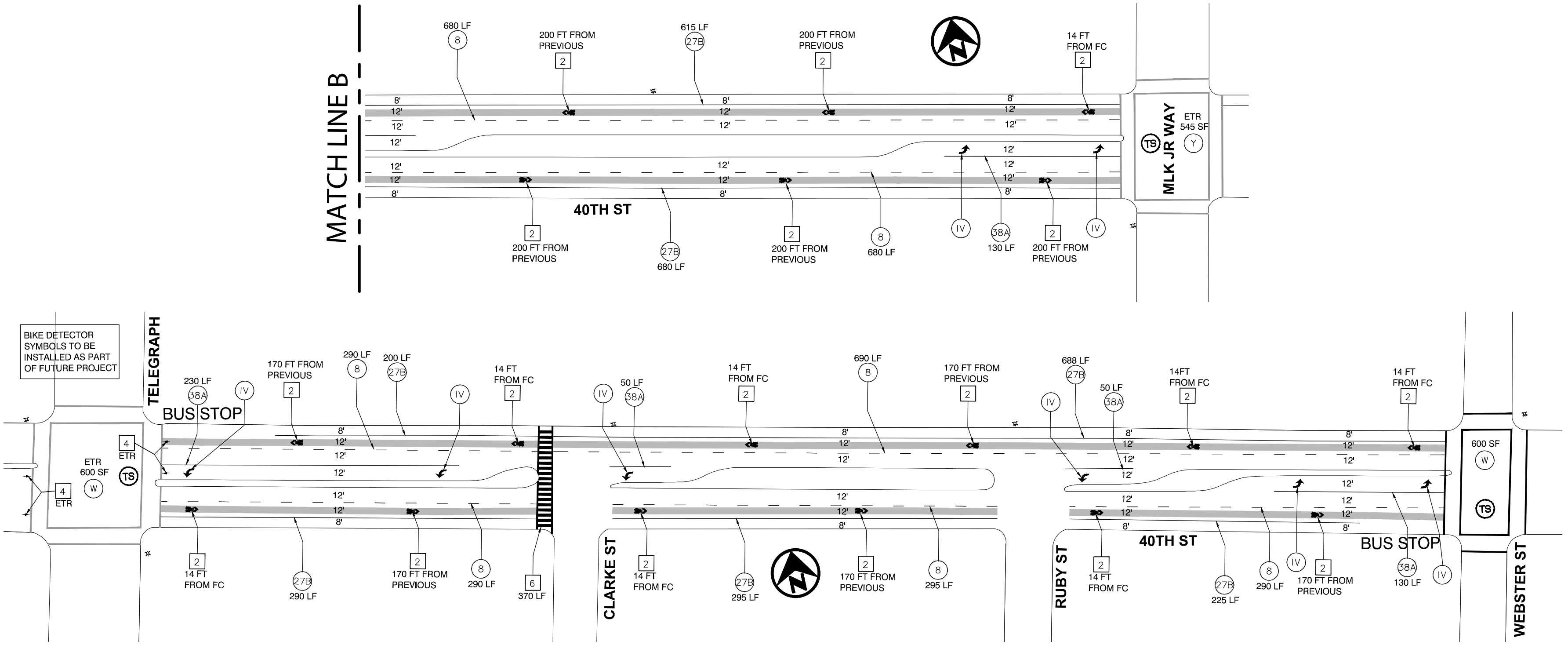
STRIPING PLAN

PROJECT NO.
TBD
SCALE: 1" = 80'
DATE: DATE
SHEET NO.
1 OF 2

PROJECT TITLE

DRAWING NAME: C:\Users\bikedesigner\appdata\local\temp\AcPublish_1524\40thSt_Adeline_Webster.dwg
PLOT DATE: 10-25-12
PLOTTED BY: bikedesigner

Figure 4 **(continued)** Striping Plan



LEGEND

#	STRIPING CONSTRUCTION NOTE NUMBER	HYD	FIRE HYDRANT
(#)	DETAIL NUMBER PER CALTRANS STD PLANS Traffic lines as cardinal number Arrows as roman numeral	▨	BLUE FIRE HYDRANT MARKER
(TS)	TRAFFIC SIGNAL	ETR	EXISTING TO REMAIN
(W)	CROSSWALK/LIMIT LINE (SOLID ONE FOOT WHITE LINE)	LF	LINEAR FEET
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20' 40' 80' 160'

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40TH ST
ADELINE ST TO WEBSTER ST

REVIEWED BY PETER CHUN
DESIGNED BY JASON PATTON
DRAWN BY ML

No.	DATE	BY	REFERENCE

STRIPING PLAN

PROJECT NO.
TBD

SCALE: 1" = 80'
SHEET NO.
2 OF 2
DATE: DATE

DRAWING NAME: C:\Users\bikedesigner\appdata\local\temp\AcPublish_1524\40thSt_Adeline_Webster.dwg
PLOT DATE: 10-25-12
PLOTTED BY: bikedesigner

FIGURE 5: REFERENCES FOR SIMILAR EXPERIMENTS

Project	Citation
2nd Street **Long Beach, CA**	• Experimental Authorization No. 9-113 Green & Shared Lane Markings and Bikes in Lane Symbol Sign on 2nd Street between Livingston Avenue and Bay Shore Drive in the City of Long Beach, California. City of Long Beach Department of Public Works. Progress Report (USDOT file HOTO-1). December, 2009.
Hennepin Ave. **Minneapolis, MN**	• Hennepin Avenue Shared Green Lane Study, City of Minneapolis Department of Public Works Traffic and Parking Services Division. August, 2011.
200 South **Salt Lake City, UT**	• More Than Sharrows: Lane-Within-A-Lane Bicycle Priority Treatments in Three U.S. Cities. Peter Furth el al. Transportation Research Board. July, 2010.
Longwood Ave. **Brookline, MA**	• More Than Sharrows: Lane-Within-A-Lane Bicycle Priority Treatments in Three U.S. Cities. Peter Furth el al. Transportation Research Board. July, 2010.

Figure 6 Photographs of Similar Experimental Treatments


Long Beach, CA
Second Street


Salt Lake City, UT
200 South

Figure 6 (continued) Photographs of Similar Experimental Treatments

Figure 6 **(continued)** Photographs of Similar Experimental Treatments

FIGURE 7: CHARACTERISTICS OF SIMILAR EXPERIMENTS

Location	Design	Signage	Adjacent Bicycle Network	Project Characteristics	Methodology
Second Street Long Beach, CA	• 6′ green band centered on effective lane width with sharrows • Mixed flow lanes • Continuous	Modified "Share the Road" signs	Connects to Class II and III segments of Downtown bicycle network	• 4-lane commercial arterial with on-street parallel parking • 1,200 bicyclists over 3-day count • 12-foot outside travel lane	• Before and after crash history • Before and after general bicyclist position in roadway (sidewalk, door zone, green band, travel lane) • Anecdotal observations on transit bus interaction
South 200 Salt Lake City, UT	• 4′ green band 3′ from curb face with sharrows • Mixed flow lanes • Continuous	None identified	Connects Class II bike lanes through two-block long constrained area	• 4-lane commercial arterial with no on-street parking • Carries 20,000 vehicles and 200 bicyclists per day • 12-foot outside travel lane	• Analysis of bicycle positioning for 3 days before and 3 days after striping, including on-street and sidewalk riding • Anecdotal observation of motorists' use of shared lane • Data collection on crashes after shared lane installed
Hennepin Avenue Minneapolis, MN	• 4′ green band, 3.5′ from curb with sharrows • Bus/Bicycle/Right-Turn lanes • Continuous	"Bus Bikes & Right Turns" and "Share the Road" signs plus variable overhead signs	Key cross town spine route connecting multiple facilities	• 4-lane commercial arterial with no on-street parking • Carries 20,000 vehicles and 1,000 bicyclists per day and 20 to 30 buses per peak hour. • Outside travel lane varies from 13.5 to 18 feet across the corridor.	• Measured bicyclist, motor vehicle, and bus positioning at 3 points along the green shared lane using hatch marks and compared against a control location on Hennepin Avenue with Class II bicycle lanes • Survey-based analysis of driver and bicyclist education on positioning in the shared lane • Before and after reported crash history • Before and after reported bicycle volumes
Bryant Avenue South Minneapolis, MN	• 4′ green band with sharrows centered on effective lane width • Mixed flow lane • Discontinuous: 100′ green strip every 100′	"Bikes May Use Full Lane" signs	Connects two segments of Class III bike boulevard	• 2-lane residential collector • 20-foot outside lane including parallel parking	No evaluation study completed to date
Longwood Avenue Brookline, MA	• "Bicycle Priority Lane" • 2 dotted 4" lines with sharrows • Outside edge of priority lane line marked 10.33′ from curb • Discontinuous: 80′ gaps in between modules	None identified	East-west connection between commercial centers	• 2-lane residential collector with on-street parking • Carries 8,000 vehicles • 20-foot outside travel lane including parallel parking, plus eastbound bicycle lane only.	• Phased installation of bicycle priority lane: (1) striped outside dashed priority lane lines; (2) marked shared use lane markings 6 months later; • Analysis of bicycle positioning based on chalked hatch lines only when parking lane was unoccupied for 75 feet or less. (3 days of data for dashed priority lane lines, 3 day for dashed priority lane lines and shared use pavement markings) • Survey data of bicyclist and driver understanding of treatment
S 59th St Philadelphia, PA	• Rectangular patch of green pavement with sharrow • Discontinuous	Not implemented	On-street connection to regional multi-use path	• 2-lane residential collector with on-street parking • 20-foot outside lane including parallel parking	Project not yet implemented—Goal of the project is to provide wayfinding to multi-use path

FIGURE 8: OUTCOMES OF SIMILAR EXPERIMENTS

Location	Key Findings/Measures of Effectiveness	Factors Not Addressed in Evaluation Study
Second Street Long Beach, CA	• Doubling of bicycle usage over year of existence • After installation, the majority of cyclists positioned in the green band • Sidewalk riding decreased by 20% • Bicyclists familiar with standard sharrows noted that the additional emphasis resulting from the green pavement appears to be creating a heightened awareness by the motorists of bicycle usage in the lane • Special share the road signage was added approximately 2 months after the striping to enhance bicyclist understanding but only spot observations were made of effects • Crash experience involving bicyclists is largely unchanged, while the crash rate per bicyclist is reduced from pre-project levels • Crash rate not involving bicyclists was higher than in the previous year but does not appear to be related to the installation of the green band	• Analysis of passing distance/separation when motorists overtake bicyclists • Effect of green shared lane and increased presence of bicyclists on transit operations, where bus transit exists • Number of motorists shifting to the inside lane • Comparative analysis of shared-use pavement arrows versus the complete shared-green lane package of treatments (raised by CTCDC)
200 South Salt Lake City, UT[1]	• Before installation, 31% of bicyclists rode 0 to 4 feet from the curb; after installation, 41% of bicyclists (92% of in-road riders) traveled in the remaining 8 feet of the shared lane, including on the green band • 46% of bicyclists continued to use the sidewalk both before and after the shared lane installation	• Analysis of passing distance when motorists overtake bicyclists • Comparative analysis of sharrows versus the complete shared-green lane package of treatments (raised by CTCDC) • Analysis of any increase in bicycle ridership • Effect of oversized sidewalks in relation to sidewalk riding • Effect of green shared lane on transit operations
Hennepin Avenue Minneapolis, MN	• Most bicyclists (79-93%) use the green band • On the 13.5-foot travel lane, vehicles typically positioned themselves 4.4-feet from the curb on average, with approximately half the vehicles on the green band; vehicles traveled to the left of the green band in the 18-foot lane. • Buses positioned on top of the green band • Measured data on motor vehicles passing bicyclists and bicyclists passing stopped buses was inconclusive due to small sample size • Bicycle volumes decreased though this was attributed to new or improved facilities on parallel corridors • Reported bicycle crash rates decreased from 1.03% to 0.4%, and survey results indicated that 1/3 of bicyclists felt safer with the green band • Survey results indicated that motorists think vehicles should position to the left of the green band; however, the graphic on the survey and the actual lane width may sway that understanding	• Analysis of passing distance/separation when motorists overtake bicyclists • Effect of green shared lane and increased presence of bicyclists on transit operations • Comparative analysis of shared-use pavement arrows versus the complete shared-green lane package of treatments (raised by CTCDC)
Longwood Avenue Brookline, MA	• Before, bicyclists positioned 10.4 feet from the curb, which increased to 11.1 feet 5 weeks after the installation of the bicycle priority lane, both with and without the presence of passing cars • Of surveyed drivers, 50% said the markings had made them more considerate of how they passed bicyclists; 21% of drivers noticed the markings; 70% were confident that the markings indicated a preferred zone for bicycling	• Analysis of passing distance/separation when motorists overtake bicyclists • Analysis of increase in bicycle ridership • Comparative analysis of shared-use pavement arrows versus the complete bicycle priority lane package of treatments

1. Additional study information requested from Dan Bergenthal, Salt Lake City Transportation