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Michigan Street Bicycle Accommodation Study

Prepared for the City of Duluth

By LHB Architects/Engineers in association with SRF Consulting Group, Inc.

September 22, 2015

Study Intent

This study intent was to examine whether bicycle accommodation could occur on Michigan Street as part of a broader goal to foster safe and convenient bicycle movement to and through downtown Duluth and its central business district. The study's outcome could assist the City in determining the most appropriate corridor(s) to host bicyclists destined for the downtown commercial core and/or route connections as a means of passing through the downtown. Study recommendations and findings identified issues to be addressed, options to be considered and compromises that may be needed for implementation.

Study Area

The corridor studied is Michigan Street right of way from 6th Avenue West to Michigan Street's intersection with Superior Street at 4th Avenue East. A connection is assumed to be made with the existing off road trail in the southwest quadrant of 6th Avenue West/Michigan Street, and with potential bicycle facilities extending eastward from 4th Avenue East/Superior Street.

Assumptions

Several assumptions were implicit for the study, including;

a. Bicycle movement would be available year around.
b. No new public right of way would be acquired.
c. Sidewalk/pedestrian movement would remain.
d. Cross street intersections would be maintained and traffic flow preserved.

State and National design guidelines would be adhered to including;

a. MnDOT State Aid standards 8820.9951 (Michigan Street is a municipal state aid route)
b. NACTO Urban Bikeway Design Guide
c. NACTO Urban Street Design Guide
d. FHWA Separated Bike Lane planning and Design Guide
e. ADA/PROWAG Design Criteria

Study Approach

Members of the consulting team conducted a field walk of the study corridor to examine physical characteristics of the street and sidewalk areas, to comprehend adjacent land uses and vehicle access, and to diagram on street parking and service delivery functions. Existing topographic survey mapping

was supplemented with additional field survey where needed. A conceptual plan was arrived upon, evaluated and revised by civil engineers, traffic/signal engineers and landscape architects.

Existing Conditions

The vast majority of the Michigan Street right of way width is 50 feet. East of Lake Avenue, the right of way varies from 22 feet to 50 feet. Typical roadway width is 32 feet, operating as an east bound one way. On street parking and designated service/delivery zones occur along most of the corridor west of Lake Avenue with the exception of curb space designated for turn lanes. Average daily traffic (ADT) varies from 2,500 west of Lake Avenue to 4,500 west of Lake Avenue.

East of Lake Avenue, the geometric alignment and profile also changes due to topography, building configuration and the Interstate 35 improvements.

Numerous driveways, service drives and curb cuts exist along Michigan Street to serve the diverse land uses abutting the corridor. These uses include commercial/light industry, drive in banking, and parking lots and structures. The Duluth Transit Authority transit center is nearing completion adjacent the street.

Primary Issues to be Resolved

During the initial review and analysis of the corridor, several overriding issues and challenges became apparent in providing a two way bicycle accommodation.

- Logical linkages for bicycle users must be provided at the west and east ends of Michigan Street to provide connectivity and continuity. Cross street connections from Michigan Street would need to be relied upon for destinations north or south from the street.
- Service and freight delivery is key to the adjacent businesses and any reduction of designated zones would need to be resolved.
- On street parking could be reduced.
- Tight right of way dimensions present limited space for vehicle, pedestrian, bicycle and service operations.
- Sight distance is limited due to buildings adjacent the right of way line and other physical constraints.

Concept Design Overview

The proposed typical cross section for the bicycle accommodation to be strived for (refer to Layout) is an 11 foot wide bikeway separated from the vehicle travelled way by a 3 foot wide buffer zone with tubular markers. Given the typical representative cross section of existing Michigan Street is 32 feet wide, the remaining width would allow for an 11 foot wide driving lane and a 7 foot wide parking/service delivery lane. This cross section was tested with the bicycle accommodation on the north side of the street and the south side. The north side was found to be a better location for the bikeway based upon the following;

a. Michigan Street is currently functioning as an east bound one-way and retention of the south side of the street for vehicle flow was more consistent with existing vehicle flow.
b. Major parking structures with ingress/egress needs are located on the south side of Michigan Street.
c. The soon to be completed DTA Transit Center is located on the south side of the street.

d. Intersection movement for vehicles and bicycles is better accommodated with the proposed configuration.
e. Bicycle connections to Superior Street and other north side destinations would not be required to cross Michigan Street vehicle lanes.
f. There would be reduced bicycle/vehicle conflicts east of Lake Avenue, in particular for east bound traffic entering I-35.

However, it is also recognized that bicycle accommodation on the north side of Michigan Street will have impacts for the existing north side parking and service/delivery lane as well as ingress/egress to north side parcels and buildings.

An over view of the bikeway layout, west to east, follows (refer to Layout).

The western terminus of the study area would connect to the existing off road trail located on the south side of Michigan Street, west of 6th Avenue W. Three alternatives were arrived upon for this connection to maneuver the crossing of the intersection:

a. A traditional intersection crossing with individual legs of the intersection crossed.
b. A diagonal crossing from the northeast quadrant to the southwest quadrant.
c. Construction of a curb extension in the northwest quadrant as a means to control vehicle turns, reduce the crossing distance, increase sight distance and bicycle visibility, and decrease illegal bicycle movement.

The typical cross section recommended from 6th Avenue W. to Lake Avenue is an 11 foot wide, two-way bikeway separated from the vehicle travelled way by a 3 foot wide buffer zone, an 11 foot wide north bound one way driving lane and a 7 foot wide parking/service delivery lane on the south side. As per the detail (refer to Layout) the bikeway is comprised of two – 5.5 foot wide lanes with dashed centerline, and lanes marked with bikeway symbols. The 3 foot wide buffer is identified with diagonal striping and tubular markers. Conflict zones or areas of increased safety should be marked with green surface paint.

From 6th Avenue W. to Lake Avenue, an alternate cross section was examined to reduce potential pedestrian/vehicle conflicts and improve service/delivery functions (refer to Layout). This alternate places the parking and service/delivery lane adjacent the bicycle buffer zone rather than on the south curb line. Bikeway width is reduced to 9 feet to compensate for required curb reaction requirements.

East of Lake Avenue, the bikeway follows the street geometry imposed by the I-35 northbound access and overhead structure to support the Lakewalk. In limited locations between Lake Avenue and 1st Avenue E., bikeway width may be reduced due to adjacent vertical elements.

East of 1st Avenue E., the roadway width narrows and begins to increase in elevation. From 1st Avenue E. to 3rd Avenue E., the recommended cross section is a 7 foot wide west bound bikeway in a contraflow configuration. The east bound bicycle movement would be mixed in a 12-15 foot wide lane with the east bound one way traffic. The mixed lane would be striped with a bike boulevard symbol. From 3rd Avenue E. to 4th Avenue E., the west bound contraflow lane would be 6-7 feet wide.

The bikeway segment east of 1st Avenue E. compromises the desired bikeway accommodation due to available space. Also, sight lines and gradient, up to 10.8%, present limitations. Several options for connecting to Superior Street were studied.

a. Bike lanes on either side of the street could be added to 1st Avenue E., between Michigan and Superior. This block has a gradient of 11.3%.
b. Bike lanes on either side of the street could be added to 2nd Avenue E., between Michigan and Superior. This block has a gradient of 10%.

3rd Avenue East has a gradient of 12.4% and presents issues for safe bicycle use.

Lakewalk Connections

Connections from a Michigan Street bikeway to the Lakewalk could occur at several locations.

- An existing staircase located immediately east of Lake Avenue and north or Michigan Street.
- The southeast quadrant of 1st Avenue E. at Superior Street.
- An indirect connection to the Lakewalk access, Superior Street between 2nd and 3rd Avenues E.

Intersections, Traffic Analysis and Recommendations

Accommodating a two-way bikeway adjacent to one-way vehicular traffic required a review of potential modifications to intersection control needs along Michigan Street. The following key intersections were reviewed to determine the most appropriate intersection control treatment:

- 6th Avenue W / Michigan Street
- 5th Avenue W / Michigan Street
- 4th Avenue W / Michigan Street
- 3rd Avenue W /Michigan Street
- 2nd Avenue W / Michigan Street
- 1st Avenue W / Michigan Street
- 1st Avenue E / Michigan Street
- 2nd Avenue E / Michigan Street
- 3rd Avenue E / Michigan Street
- Superior Street / Michigan Street

Current intersection controls along Michigan Street are comprised of side-street stop, all-way stop and traffic signal control. Michigan Street is one-way in the eastbound direction and no control exists for westbound traffic which would comprise of a contraflow lane for bicycles under the proposed concept.

Based on Minnesota statutes bicyclists are to be operated in accordance with traffic laws. Therefore, recommendations for intersection control treatments are based on standard traffic signal control, signing and striping requirements. Guidance for intersection control for two-way bikeways adjacent to one-way traffic is provided in both the NACTO and FHWA bike lane guides. Addressing vehicle turning conflicts with bicyclists are critical to providing a safe multimodal environment.

Existing average daily traffic (ADT) along Michigan Street varies from 2,500 ADT east of Lake Avenue to 4,500 ADT west of Lake Avenue. Existing ADTs along the intersecting streets with Michigan Street range from 630 ADT to 2,100 ADT. No additional traffic data, including peak hour data, was collected for this study. It is also important to note the bikeway will potentially eliminate on-street parking along the north side of Michigan Street. Because of the low daily volumes in the study area coupled with no changes in the number of traffic lanes (except for removing the eastbound right-turn lane at 5th Avenue W / Michigan Street) and the reduction in traffic from the loss of on-street parking, it is expected that any potential degradation traffic operations as a result of the bikeway would be minimal.

The following summarizes the recommended future intersection control modifications to accommodate the two-way bike lanes assuming the roadway modifications and intersection control improvements included with the new DTA transit center are in place:

6th Avenue W / Michigan Street

- Maintain existing all-way stop control.
- Install "Stop" signs for the contra flow bike lane.
- Install conflict zone markings through the intersection.
- Install signing (see below) for vehicular-bicycle left-turning conflict.

5th Avenue W / Michigan Street and 3rd Avenue W / Michigan Street

- Maintain existing traffic signal control (Traffic signal at 3rd Avenue W to be installed as part of DTA transit center project).
- Install bicycle signal indications for the contra flow bike lane.
- Install conflict zone markings through the intersection.
- Truncate the bike lane buffer approximately 50 feet from the intersection in the eastbound direction and install a bike boulevard symbol. This provides for combined vehicular-bicycle flows thereby improving the left-turning vehicular-bicycle conflict.
- Optimize traffic signal timing based on current traffic volumes.
- Install signing (see below) for vehicular-bicycle left-turning conflict.

4th Avenue W / Michigan Street and 2nd Avenue W / Michigan Street

- Maintain existing all-way stop control.
- Install "Stop" signs for the contra flow bike lane.
- Install conflict zone markings through the intersection.
- Truncate the bike lane buffer approximately 50 feet from the intersection in the eastbound direction and install a bike boulevard symbol. This provides for combined vehicular-bicycle flows thereby improving the left-turning vehicular-bicycle conflict.
- Install signing (see below) for vehicular-bicycle left-turning conflict.

1st Avenue W / Michigan Street and 1st Avenue E / Michigan Street

- Maintain existing side-street stop control.
- Install conflict zone markings through the intersection.
- Truncate the bike lane buffer approximately 50 feet from the intersection in the eastbound direction and install a bike boulevard symbol. This provides for combined vehicular-bicycle flows thereby improving the left-turning vehicular-bicycle conflict.
- Install signing (see below) for vehicular-bicycle left-turning conflict.

2nd Avenue E / Michigan Street and 3rd Avenue E / Michigan Street

- Maintain existing side-street stop control.
- Install "Stop" signs for the contra flow bike lane.
- Install conflict zone markings through the intersection.
- Install signing (see below) for vehicular-bicycle left-turning conflict.

No modifications are needed to the Superior Street / Michigan Street intersection.

It is preferred to not install stop signs for the two-way bikeway at locations where traffic does not stop under existing conditions, except for at 2nd Avenue E and 3rd Avenue E in the westbound direction, since bicycles are instructed to operate as vehicles by law. Installing stop signs for bicycles but not for cars would introduce conflicts of right-of-way. Additionally, the low traffic volumes in the study area would increase the possibility of low compliance for bicycles obeying the signs.

There are two options for signing the vehicular-bicycle left-turning conflict: 1) "Left-turns Yield to Bikes" (R10-15 modified) as shown on the layout; and 2) adding an "Except Bikes" plaque to the one-way signs for Michigan Street. The R10-15 modified signs are not currently approved and would require a request to experiment from FHWA; however, there is a high probability that these signs will be approved in the next FHWA MUTCD as they are currently being shown in the FHWA bike guide. The "Except Bikes" plaque should also be installed to supplement any conflicting "Do Not Enter" signs with the contra flow bike lane.

Design Standard Variances

As noted earlier, Michigan Street is a Municipal State-aid Street from 6th Ave West to 3rd Ave East and design standards apply. An existing variance (December, 1996) for Michigan Street between 1st Ave West and 7th Ave West permits a 32-ft curb-to-curb with one traffic lane and parking on both sides of the street in lieu of the standard 37-ft curb-to-curb with two lanes of traffic and parking on both sides. If the bikeway as suggested is to be implemented, design standard variances would be required to extend the existing variance and to accommodate the proposed configuration.

Design guidelines apply to the bicycle accommodation rather than design standards. Whenever possible, the applicable design guidelines should be adhered to.

Estimate of Construction Costs

The total estimated cost to implement the changes described is approximately $230,000 as follows:

ENGINEER'S ESTIMATE

LINE	SPEC. NO.	DESCRIPTION	UNIT	TOTAL PROJECT		
				TOTAL ESTIMATED QUANTITY	UNIT COST	TOTAL COST
1						
2	2021.501	MOBILIZATION	LUMP SUM	1	$15,000.00	$ 15,000
3						
4	2104.501	REMOVE PAVEMENT MARKING	LUMP SUM	1	$10,000.00	$ 10,000
5	2104.509	REMOVE SIGNS AND PARKING METERS	LUMP SUM	1	$ 2,250.00	$ 2,250
6						
7	2554.601	WHITE TUBULAR MARKERS-FIXED	EACH	250	$ 45.00	$ 11,250
8						
9	2563.601	TRAFFIC CONTROL	LUMP SUM	1	$15,000.00	$ 15,000
10						
11	2564.515	SIGN SUPPORT	EACH	14	$ 150.00	$ 2,100
12	2564.531	SIGN PANELS TYPE C	SQ FT	130	$ 28.00	$ 3,640
13						
14	2565.601	TRAFFIC SIGNAL RETROFIT**	LUMP SUM	1	$45,264.00	$ 45,264
15						
16	2582.501	PAVEMENT MESSAGE (BIKE SYMBOL WITH ARROW)	EACH	39	$ 250.00	$ 9,750
17	2582.501	PAVEMENT MESSAGE (BIKE SYMBOL WITH CHEVRON)	EACH	12	$ 300.00	$ 3,600
18	2582.502	12" STOP LINE WHITE-POLY PREF	LIN FT	400	$ 10.00	$ 4,000
19	2582.502	4" SOLID LINE WHITE-EPOXY	LIN FT	9 704	$ 2.00	$ 19,408
20	2582.502	4" BROKEN LINE YELLOW-EPOXY	LIN FT	3 541	$ 2.50	$ 8,853
21	2582.502	4" DOUBLE SOLID YELLOW-EPOXY	LIN FT	864	$ 3.50	$ 3,024
22	2582.502	12" BROKEN LINE WHITE-EPOXY	LIN FT	1 622	$ 8.00	$ 12,976
23	2582.601	PAVEMENT MARKINGS - GREEN LATEX	SQ FT	9 673	$ 3.50	$ 33,856
24						

SUBTOTAL	$ 199,970
CONTINGENCY (15%)	$ 29,996
TOTAL	$ 229,966