



# District of Columbia Department of Transportation

## TECHNICAL MEMORANDUM

### **Intersection Evaluation – Van Ness Street at 46th Street, NW**

A preliminary intersection evaluation was performed at the intersection of Van Ness Street NW at 46th Street NW in Washington, D.C., evaluating the need for replacing the existing traffic control signal with four-way stop control or other traffic safety measures. The study evaluated the traffic control signal criteria as specified by the Manual on Uniform Traffic Control Devices (MUTCD 2009). The intersection does not satisfy the criteria for the installation of a traffic signal; however, it does satisfy the criteria for the installation of an all-way stop. The following paragraphs summarize the preliminary findings and specific recommendations.

#### **Primary Concern**

The primary concern is that the existing traffic signal may encourage motorist speeding through the intersection to avoid delay at this signalized location. The safe crossing of pedestrians at this intersection is a priority. The request was made in response to citizen concerns.

#### **Site Description**

Van Ness Street and 46th Street are each two-lane, undivided collectors in the vicinity of the study intersection. The study intersection is controlled by a traffic signal and is located within a residential neighborhood with single-family homes. On-street parking is available on both sides of each road. Parking on the west leg of Van Ness Street is restricted to two hours from 7:00 AM to 8:30 PM with Zone 3 permit holders excepted. No bus stops are located at this intersection. Sidewalk is provided along the streets in the vicinity of the study intersection except on the northwest side of Van Ness Street and the northeast side of 46th Street. Stop bars and marked crosswalks striped with two parallel lines are provided on all four approaches. A Capital Bikeshare facility is located one-half mile southeast at Ward Circle/American University. Friendship Park is located one block east of the intersection.

All other intersections along Van Ness Street between Massachusetts and Nebraska Avenues and on 46th Street between Massachusetts Avenue and River Road are two-way or all-way stop controlled intersections.

**Figure 1** shows an aerial with the location of the study intersection.

Figure 1: Aerial Map



### Existing Conditions

Traffic volumes were counted at the intersection on Thursday, November 13, 2014.

- 1) PEAK HOURS: The AM and PM vehicular peak hours for the study intersection occurred between 8:00 AM and 9:00 AM and from 5:00 PM to 6:00 PM, respectively.
- 2) VEHICULAR TRAFFIC: Approximately 188 vehicles traveled on Van Ness Street and 272 vehicles traveled on 46th Street during the morning peak hour; 294 vehicles traveled on Van Ness Street and 258 vehicles traveled on 46th Street during the afternoon peak hour.
- 3) PEDESTRIAN TRAFFIC: During the peak hours, the number of pedestrians entering the intersection ranged from 22 to 25 per hour. The south and west crosswalks had the higher volumes. During the field visit, few pedestrians were observed crossing Van Ness Street.
- 4) SPEED LIMIT: The posted speed limit is 25 mph on Van Ness Street and on 46th Street in the vicinity of the intersection.

- 5) CRASH ANALYSIS: Crash data was analyzed for the period beginning January 1, 2011, to December 31, 2013, at the intersection of Van Ness Street at 46th Street. The crash history shows that no pedestrians or bicyclists were involved in crashes at this location in the past three years. Of the two crashes occurring at the study intersection, one occurred in 2012 and one occurred in 2013. Both collisions resulted in property damage only and were a rear end and a sideswipe.
- 6) EXISTING TRAFFIC CONTROL: The existing pavement markings and traffic signs are placed correctly per the MUTCD. Crosswalks with parallel lines are located on all four legs of the intersection. Traffic signal heads and pedestrian signals are located on the right and left side of the roadway for each approach. No turn on red signs are present on the southbound and eastbound approaches.

**Field Measurements**

AM and PM peak hour field observations of the traffic operations were made by a professional traffic engineer on Wednesday, December 3, 2014, at the study intersection. Spot speeds were measured along 46th Street during off-peak hours. Stopping and intersection sight distance measurements were made for each approach, and measurements were taken of the approach grades.

**SPOT SPEED STUDY**

A “free-flow” spot speed study was performed along 46th Street near Van Ness Street on Wednesday, December 3, 2014. The posted speed limit for 46th Street in this area is 25 miles per hour. Speeds were collected during off-peak hours. A minimum of 75 data points were recorded in each direction for vehicles approaching the intersection. Due to the extremely short green time on Van Ness Street, “free-flow” rarely occurred, causing almost all vehicles to stop at the intersection; therefore, no spot speeds were taken for this street. The results are summarized in **Table 1**.

**Table 1: Summary of Spot Speed Study: Van Ness Street (MPH)**

Direction	Posted Speed	Median Speed <sup>1</sup>	85 <sup>th</sup> Percentile <sup>2</sup>	10 MPH Pace <sup>3</sup>	% in Pace <sup>4</sup>	Percent Enforceable <sup>5</sup>
Northbound (46th Street)	25	23	28	20-29	87%	1%
Southbound (46th Street)	25	24	28	20-29	84%	0%

1. Median speed is the speed at which an equal number of vehicles were traveling above and below.
2. The 85<sup>th</sup> percentile speed is the speed at which 85 percent of the vehicles were traveling below when unaffected by other vehicles. It is used by engineers as a good indication of the speed that the majority of motorists find safe and reasonable.
3. The 10 mile-per-hour pace is the range of speeds containing the greatest number of observed vehicles.
4. The percent in the 10 mile-per-hour pace reflects the percentage of vehicles that were traveling within this pace and is a good indicator of the range of speeds along a particular segment of roadway.
5. Percent enforceable refers to the percentage of vehicles traveling 10 mph or more above the speed limit.

The results of the analysis indicate that the 85<sup>th</sup>-percentile speed is 28 miles per hour in both the northbound and southbound directions.

## SIGHT DISTANCE

Stopping and intersection sight distances were evaluated at the study intersection. AASHTO's Geometric Design of Highways and Streets (Green Book) describes the sight distance criteria required for intersections: At intersections with signalized or all-way stop control, the first stopped vehicle on one approach should be visible to the drivers of the first stopped vehicles on each of the other approaches. For a signalized intersection, left turning vehicles should have sufficient sight distance to select gaps in oncoming traffic and complete left turns.

Using a design speed of 30 mph, the required minimum stopping sight distance is 205 feet, which is met for all four approaches. If the intersection of 46th Street and Van Ness Street were to operate under two-way stop control, the required minimum intersection sight distance would not be met for any approach. Large, mature trees block the sight distance and parked vehicles add to the difficulty of seeing oncoming traffic.

## GENERAL OBSERVATIONS

The intersection was observed during the AM and PM peak hours, specifically focusing on driver behavior, traffic patterns, geometry, and overall traffic operations. The following summarizes the observations:

- A speed hump is located on 46th Street approximately 350 feet south of the intersection.
- The majority of pedestrians observed did not wait on the signal indications to cross the street.
- Automatic pedestrian timings are provided to cross Van Ness Street with seven seconds of flashing don't walk. Push buttons are provided to cross 46th Street with nine seconds of flashing don't walk.
- A couple schoolchildren were observed utilizing the crosswalks.
- In the morning, the peak direction is southbound; in the afternoon, the peak direction is westbound.
- Some vehicles speed up to cross the intersection before the red light on both streets.
- A few vehicles were observed treating the signal like a stop sign and running the red light on Van Ness Street. Others were observed stopping at the intersection on a green light prior to proceeding on 46th Street.
- A queue of four vehicles on Van Ness Street would not always clear the intersection in one cycle, especially if one of the vehicles were making a left turn movement.
- Maximum queuing of four vehicles was noted during the AM peak hour on Van Ness Street and 46th Street. During the afternoon off-peak and peak hours, a maximum queue of four vehicles was noted on all approaches except in the westbound direction, which consistently exceeded queues of this length. Westbound queues frequently reached six or seven vehicles and by 5:15 PM were reaching lengths of ten to thirteen vehicles during the red cycle.
- As queues lengthened, drivers (especially westbound during the evening) more frequently ran the yellow light and sometimes the red light to avoid waiting through additional cycles.

### Signal Warrant Summary

The traffic signal warrant analysis evaluation performed for the study intersection was based on the nine warrants outlined in Section 4C of the Manual on Uniform Traffic Control Devices (MUTCD), 2009 Edition. The first three warrants focus on the vehicle volumes at the intersection (eight-hour volumes, four-hour volumes, and peak-hour volume) while the fourth warrant focuses on pedestrian volumes. Warrant 7 examines the crash history of the intersection. The other warrants are not applicable to this location.

*Warrant #1 (Eight Hour Volume), Warrant #2 (Four Hour Volume), and Warrant #3 (Peak Hour Volume)* have minimum requirements for vehicles per hour on both streets. These minimum volumes are not met for this intersection; therefore, Warrants 1, 2, and 3 are **NOT MET**. *Warrant #4 (Pedestrian Volume)* requires a minimum traffic volume and minimum corresponding pedestrians per hour crossing the major street. The total volume on Van Ness Street and 46th Street is consistently less than 300 vehicles per hour, and the highest volume of pedestrians crossing one of the streets was 20 people. Therefore, Warrant 4 is **NOT MET**. *Warrant #7 (Crash Experience)* requires five or more reported crashes, minimum volumes, and testing of alternatives before warranting a traffic signal. In order for the intersection of Van Ness Street and 46th Street to meet this warrant, all three conditions must be satisfied. Based on the three most recent years of available crash data, five or more crashes have not occurred within a 12-month period (none in 2011, one in 2012, and one in 2013); therefore, Warrant 7 is **NOT MET**.

**Table 2** summarizes the signal warrants. The results of the traffic signal warrant analysis indicate that none of the nine warrants are met. Hence, a traffic signal is not warranted at the study intersection.

**Table 2: Summary of Signal Warrant Analysis**

Warrant	Description	Warrant Met?
1	Eight Hour Vehicular Volume	NO
2	Four Hour Vehicular Volume	NO
3	Peak Hour	NO
4	Pedestrian Volume	NO
5	School Crossing	NO
6	Coordinated Signal System	NO
7	Crash Experience	NO
8	Roadway Network	NO
9	Intersection Near a Grade Crossing	NO

### Multi-Way Stop Control Analysis

The installation of an all-way stop at the intersection was examined following guidance from Section 2B of the 2009 MUTCD. According to the MUTCD, an all-way stop can be considered if:

- A. It is an interim measure for the installation of a traffic control signal.
- B. Five or more crashes susceptible to correction by a multi-way stop were reported.
- C. The following minimum volumes are met:
  1. The vehicular volume entering the intersection from the major street approaches averages at least 300 vehicles per hour for any 8 hours, and

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Van Ness Street and 46<sup>th</sup> Street NW, Washington, D.C.

2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches averages at least 200 units per hour for the same 8 hours, and
  3. The average delay to minor-street vehicular traffic is at least 30 seconds per vehicle during the highest hour.
  4. If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.
- D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

The intersection of Van Ness Street and 46th Street does not meet the warrants for the installation of a traffic control signal; therefore, Condition A is not met. Two crashes were reported during the most recent three years; therefore, Condition B is not met. The vehicular volume entering the intersection from the major street does not exceed 300 vehicles per hour even during the peak hour, so Condition C is not met. Since none of these conditions are satisfied, the guidelines established by the MUTCD are not satisfied.

In addition to the previous listed guidelines, the MUTCD provides other optional criteria that may be considered when performing an engineering study, including:

- A. The need to control left-turn conflicts;
- B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;
- C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and
- D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.

Following these criteria, the intersection of Van Ness Street at 46th Street would be well-served by a four-way stop. While pedestrian volumes are not overly high, the intersection is still located in a residential neighborhood with sidewalks where residents walk, and a park is located one block away. Option B allows all-way stop control to reduce pedestrian/vehicle conflicts, and is satisfied. The available intersection sight distance from the four approaches is inhibited by mature trees and parked vehicles. Requiring both directions to stop before proceeding through the intersection allows drivers a view of conflicting traffic; therefore, Option C is satisfied. While the peak direction of travel in the morning is southbound, the peak direction in the PM peak period is westbound. Since the peak direction in the morning and evening is on two different streets, it requires a more equal treatment of the two roadways. Additionally, both Van Ness Street and 46th Street are classified as collectors in a residential neighborhood, and both roadways have similar design and operating characteristics. Multi-way stop control would improve the traffic operations at the intersection without adding to increased delay caused by the existing signal; therefore, Option D is satisfied.

### **Capacity and Level of Service**

A capacity analysis was performed using Synchro 8 and 2000 Highway Capacity Manual (HCM) methodology for both the existing signalized and potentially unsignalized conditions.

The measures of effectiveness evaluated in the study include average control delay, level of service (LOS) and volume to capacity (v/c) ratio. LOS, as defined by the HCM, is a “qualitative measure describing operational conditions within a traffic stream.” LOS ranges from A to F, where a LOS A represents optimal conditions and a LOS F represents saturated or failing conditions. The v/c ratio is the ratio of the current flow rate to capacity and is used to assess the sufficiency of a roadway facility such as an intersection. A v/c ratio of 1.0 indicates that the facility is operating at capacity, and a ratio greater than 1.0 indicates that the facility is failing as the number of vehicles exceeds the roadway capacity. The results of the analysis are summarized in **Table 3**.

**Table 3: Summary of Capacity Analysis: Van Ness Street at 46th Street: AM (PM)**

Control Type	Movement	Synchro 8 - HCM Results*					
		Delay (sec/veh)		v/c Ratio		Level of Service	
		AM	PM	AM	PM	AM	PM
<b>Existing Conditions: Signalized</b>	<b>Overall</b>	<b>11.3</b>	<b>18.8</b>	<b>0.26</b>	<b>0.25</b>	<b>B</b>	<b>B</b>
	Eastbound Approach	19.7	20.0	0.15	0.21	B	B
	Westbound Approach	24.4	36.8	0.60	0.99	C	D
	Northbound Approach	3.1	3.3	0.05	0.11	A	A
	Southbound Approach	3.6	3.3	0.19	0.13	A	A
<b>Unsignalized</b>	<b>Overall</b>	<b>8.8</b>	<b>9.4</b>	-	-	<b>A</b>	<b>A</b>
	Eastbound Approach	8.1	8.4	-	-	A	A
	Westbound Approach	8.8	10.0	-	-	A	A
	Northbound Approach	8.0	9.0	-	-	A	A
	Southbound Approach	9.2	9.1	-	-	A	A

\*Note: v/c calculated via HCM2000 method because HCM 2010 does not give v/c ratio results.

If the signal were removed and all-way stop control were installed at the intersection of Van Ness Street and 46th Street, the delay for the side street approaches would decrease significantly. The level of service under unsignalized conditions is acceptable LOS A for all approaches and the overall intersection, as opposed to signalized control, where the westbound approach experiences LOS D in the evening peak period and the overall LOS is LOS B for both peak hours.

Minimal impacts to the signal system are anticipated. The nearest signal is south of the intersection approximately 560 feet. The maximum southbound queue observed at Massachusetts Avenue was approximately 150 feet, which leaves adequate space between intersections.

## Summary of Findings

- 1) A traffic signal is not warranted at this location under current conditions.
- 2) All-way stop control should be considered based on criteria in the MUTCD.
- 3) Motorist non-compliance was observed during the field visit with some drivers stopping on green and others running the red light.
- 4) Pedestrian traffic is relatively low.
- 5) There is no documented safety issue with only two crashes, neither involving pedestrians nor bicycles, in the last three years.
- 6) Spot speed study shows an 85<sup>th</sup>-percentile speed of 28 miles per hour on 46th Street.
- 7) The required minimum intersection sight distance to operate without a signal or all-way stop is not met for any approach.
- 8) Level of service and delay are similar or better under all-way stop control than under signalized operations.
- 9) Removal of traffic signal will reduce maintenance costs.

## Recommendations

Regarding unwarranted signals, the MUTCD notes that they are “adversely affecting the safety and efficiency of vehicular, bicycle, and pedestrian traffic,” and that “Improper or unjustified traffic control signals can result in one or more of the following disadvantages:

- A. Excessive delay;
- B. Excessive disobedience of the signal indications;
- C. Increased use of less adequate routes as road users attempt to avoid the traffic control signals; and
- D. Significant increases in the frequency of collisions (especially rear-end collisions).”

An analysis of the MUTCD signal criteria showed that the signal at Van Ness Street and 46th Street is not warranted and should be removed. A review of the intersection operations showed that, if this signal were removed, intersection delays would be reduced significantly. Review of the study area showed that all neighboring intersections operate under stop control. Having this location operate with a signal is contrary to driver expectation, as emphasized by the number of drivers that stop when the light is green or that stop then go when the light is red. Prior to removal, the signal should be put on flashing operation as indicated in the MUTCD.

The recommendations for the intersection of Van Ness Street and 46th Street include:

- Deactivate the existing traffic control signal and convert intersection to all-way stop control. Follow DDOT’s signal removal process.
- Activate all-way flashing red.
- Provide additional enforcement.
- Monitor speeding and motorist compliance with stop signs.
- Potentially deactivate traffic signal.
  - Remove vehicle heads only and deactivate signal. Install all-way STOP control.
  - Keep traffic signal pole, mast arm, and controller cabinet in place.

# APPENDIX

## Approach Photos

**Northbound 46th Street**



**Eastbound Van Ness Street**



**Southbound 46th Street**



**Westbound Van Ness Street**

