Sabra, Wang & Associates, Inc.

Engineers • Planners • Analysts

MEMORANDUM

To: Bill Schulthiess, P.E., Toole Design Group

From: Paul Silberman, P.E., PTOE, Sabra, Wang & Associates, Inc

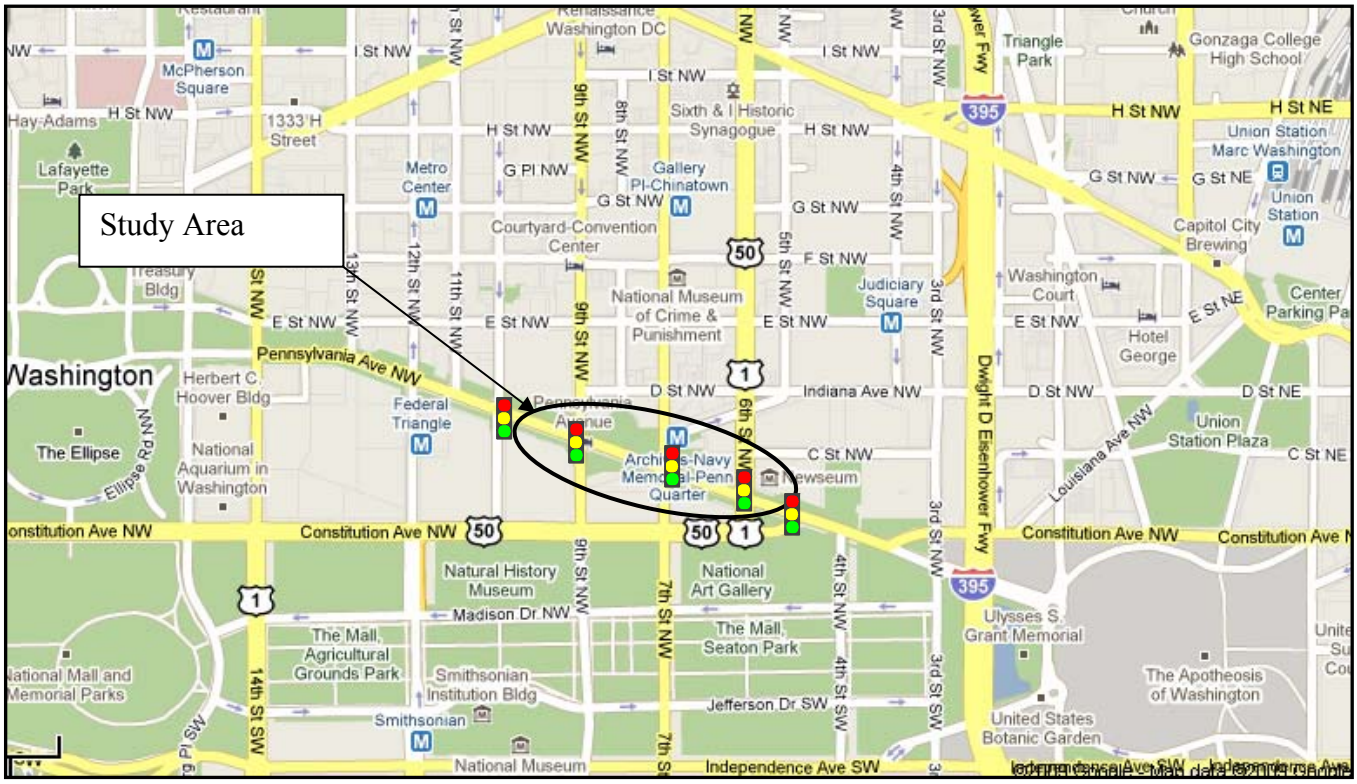
Subject: Pennsylvania Avenue Traffic Analysis

Date: November 12, 2009

A. Introduction

The District of Columbia Department of Transportation (DDOT) requested a traffic analysis be performed for a proposed roadway diet including a full-time bicycle lane to be located on Pennsylvania Ave in the northwest quadrant of Washington, DC. The purpose of this study is to evaluate existing roadway capacity and level of service and analyze the impacts of a bicycle-compatible lane configuration, specifically a road diet lane reduction between 6th and 9th Streets. A location map of the study area is shown in **Figure 1**.

Figure 1. Area Map (Not to Scale)



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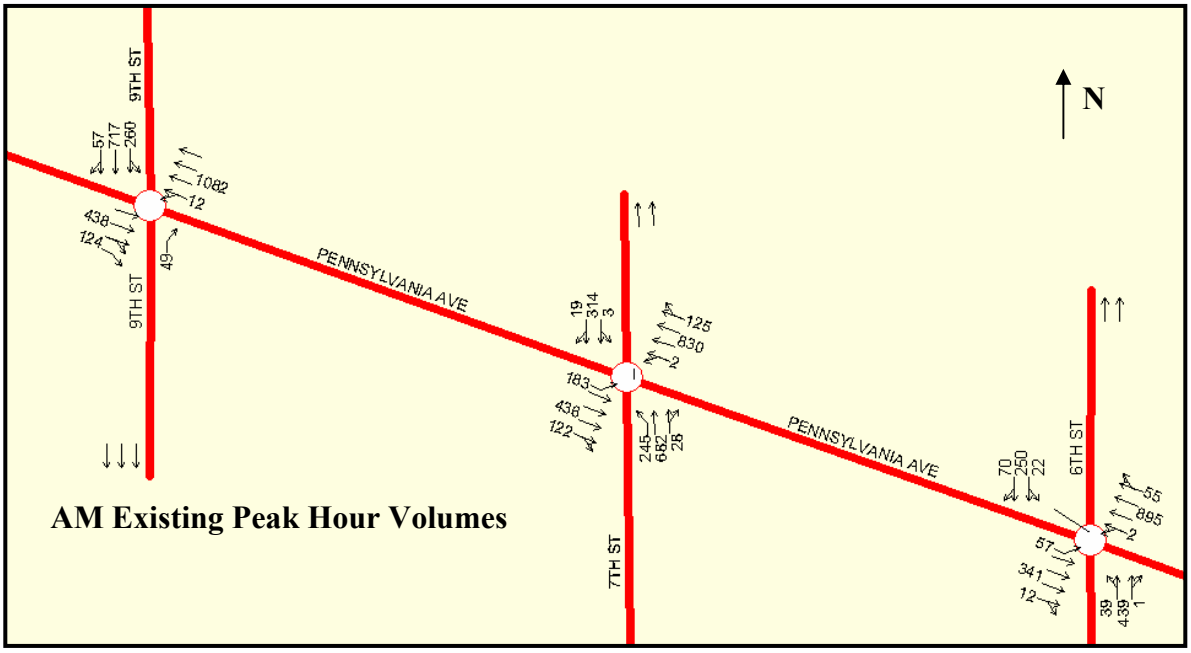
B. Existing Conditions Analysis

Pennsylvania Avenue is currently an eight-lane undivided roadway with a posted speed limit of 25 mph. Limited on-street parking exists along Pennsylvania Avenue and 6th, 7th and 9th Streets, with most on-street parking having peak hour restrictions. The travel lanes are typically 11' wide throughout the study section. Other notable traffic operational characteristics include:

- An existing bicycle lane is currently striped along 9th Street along the west curb.
- The segment of Pennsylvania Avenue is served by over a dozen WMATA bus routes: lines 13A-G (Pentagon-National-DC), 32 and 36 (Pennsylvania Avenue), 34 (Naylor Road), 37 (Wisconsin Avenue Express) 39 (Pennsylvania Ave Express) 63 (Takoma-Petworth), 64 (Fort Totten-Petworth), 70 (Georgia Ave-7th Street), 79 (Georgia Avenue Metro Extra), A42, A46, A48 (Congress Heights-Anacostia), N3 (Massachusetts Ave), P6 (Anacostia-Eckington), S2, S4 (16th Street). Typical rush hour headways range between 5 to 15 minutes, and near-side bus stops are located EB at 6th and 7th Street.
- Private tour bus operators were also noted to occasionally stage in the curb lane of Pennsylvania Avenue, more frequently in the evening peak hours.
- There is one Metro Station, Archives-Navy Memorial-Penn Quarter located in the study area at the intersection of Pennsylvania Avenue and 7th Street NW. Additional pedestrian traffic generators include the National Archives, FBI headquarters, the Old Post Office, the Newseum and the FTC.
- Median refuge islands for pedestrian crossings are provided at all study intersections.

Existing peak hour traffic volumes were collected in October, 2009. Morning and evening peak hour weekday turning movement counts including pedestrians and bicycles were obtained at all study intersections. **Figures 2** summarize the AM, and PM existing peak hour traffic volumes. **Table 1** summarizes pedestrian treatments and amenities.

Figure 2. Existing Peak Hour Traffic Volumes



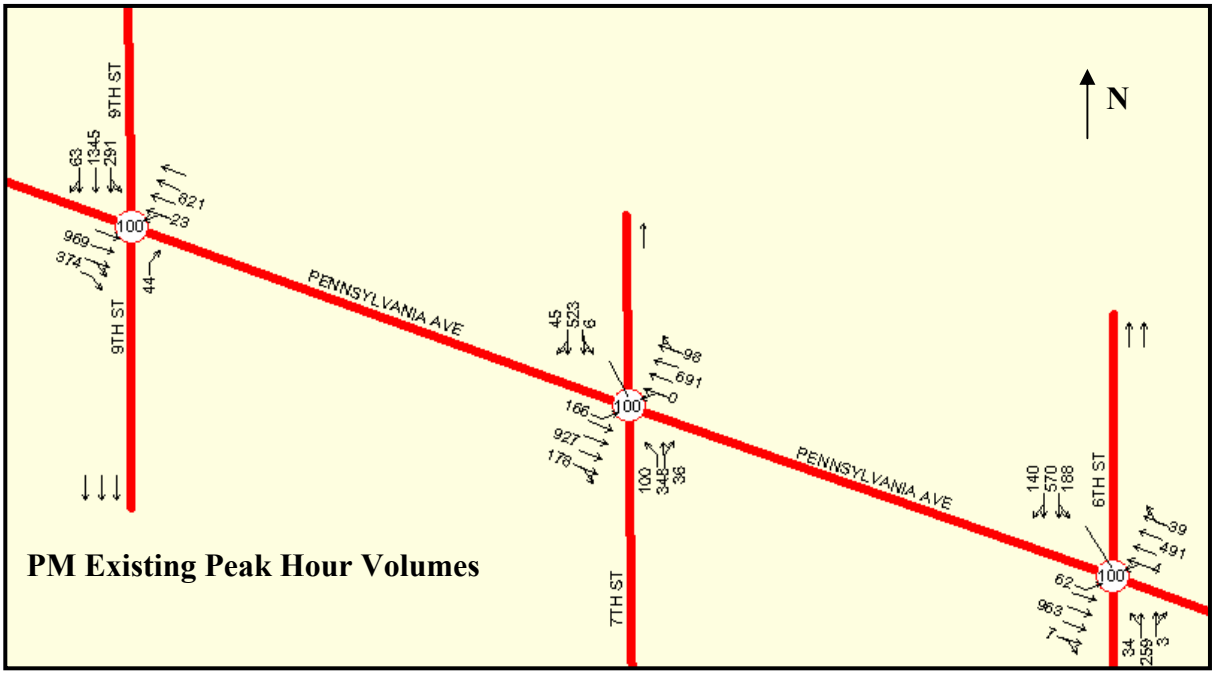


Table 1. Summary of Pennsylvania Avenue Pedestrian Signal Treatment

Intersection	AM (PM)Total Entering Pedestrian Volumes	AM (PM)Total Entering Bicycle Volumes	Countdown Signals & X-walks?	Pedestrian Phasing?	Refuge Island?
Pennsylvania Ave at 6th Street	1200 (1750)	25 (18)	Yes all 4 legs	None	Yes
Pennsylvania Ave at 7th Street	750 (1675)	55 (46)	Yes all 4 legs	Protected NB Left	Yes
Pennsylvania Ave at 9th Street	250 (350)	9 (9)	Yes all 4 legs	EB right NTOR	Yes

Existing signal timing and phasing data, including cycle lengths, splits and offsets, was obtained from the D.C. Department of Transportation in the form of a Synchro traffic model. The signals in the study area operate in a fixed and time-based coordinated mode, primarily running a 100-second cycle length during the AM, Midday and PM peak hours. Clearance intervals (yellow + all red) typically range from 5 to 7 seconds. Pedestrian signal timing, including walk/ flashing walk and flashing don't walk times were also reviewed. Signal phasing, lane configurations, turn lane lengths, turn restrictions, parking regulations and bus stop locations were field-verified by an Engineer.

A capacity analysis was performed for the existing conditions using the Highway Capacity Manual (HCM) methodology. Level of service is defined by the HCM as a "qualitative measure describing operational conditions within a traffic stream". Levels of service range from 'A" to "F" where A represents optimal conditions and F represents saturated or failing conditions. The volume-to-capacity ratio (v/c ratio) is the ratio of current flow rate to the capacity of the intersection. This ratio is often used to determine how sufficient capacity is on a given roadway. Generally speaking, a ratio of 1.0 indicates that the roadway is operating at capacity. A ratio of greater than 1.0 indicates that the facility is failing as the number of vehicles exceeds the roadway capacity.

The existing capacity and level of service is summarized in **Table 2**. . The results of the existing conditions capacity analysis indicate all intersections are currently performing at a ***level of service C or better during both peak hours.***

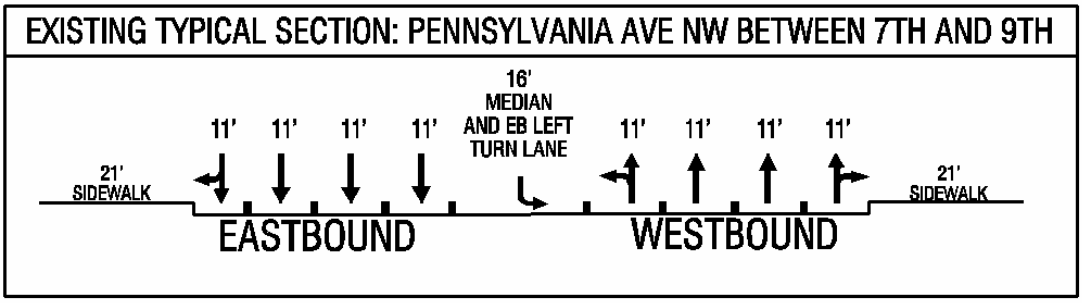
Table 2. Summary of Existing Intersection Capacity – AM (PM)

Intersection	Level of Service	Volume-to-Capacity Ratio	Average Delay
Pennsylvania Avenue at 6th Street	B (C)	0.38 (0.58)	15.2 (27.5)
Pennsylvania Avenue at 7th Street	C (C)	0.66 (0.51)	20.6 (20.7)
Pennsylvania Avenue at 9th Street	B (C)	0.47 (0.69)	10.0 (21.1)

A review of queue lengths for critical movements was performed using the model, and the following observations were noted:

- AM peak hour northbound 7th Street, left-turn lane 95th-percentile queues extend back to Constitution Avenue
- PM peak hour southbound 9th Street queues extend back to D Street
- PM peak hour southbound 6th Street queues extend back to C Street

The existing typical cross-section for Pennsylvania Avenue is shown below:

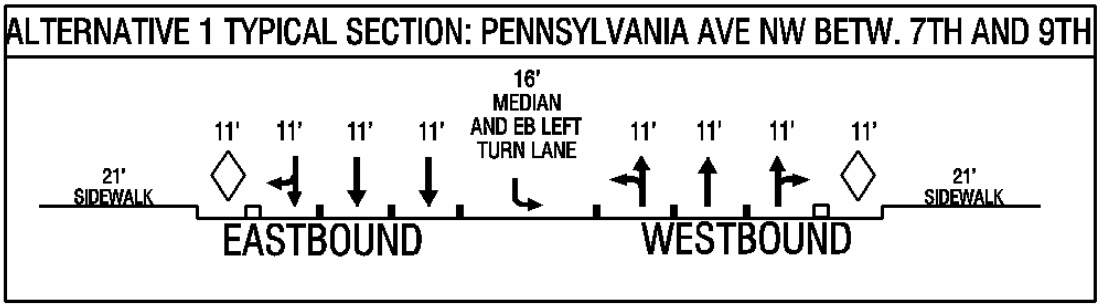


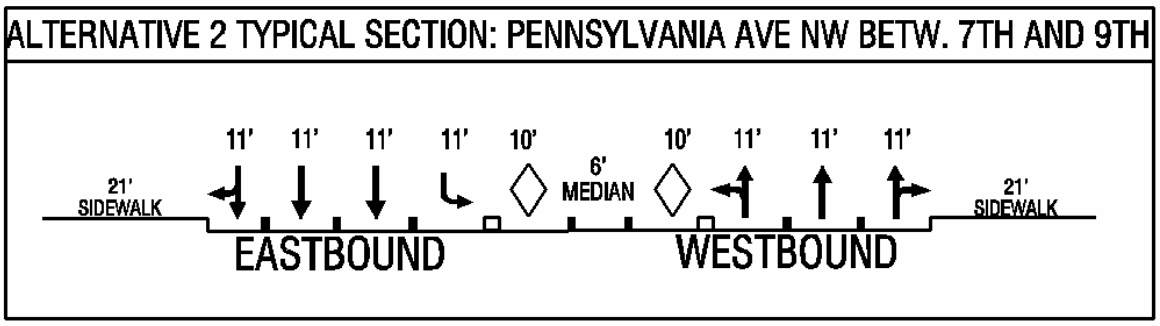
C. Alternatives Conditions Analysis

Alternative bicycle-compatible lane configurations were analyzed to assess the feasibility of the proposed roadway diet including a full-time bicycle lane to be located. Three

- Alternative 1- Elimination of the curb lane in both directions for bicycle track
- Alternative 2 - Elimination of one travel lane in each direction with a median cycle track
- Alternative 3 - Conversion of curb lane in both directions to bicycle and right-turn traffic only

Alternative lane configurations are shown in **Figures 5**.


ALTERNATIVE 1 TYPICAL SECTION: PENNSYLVANIA AVE NW BETW. 7TH AND 9TH
16'
MEDIAN
AND EB LEFT
TURN LANE
11'
11'
11'
11'
11'
11'
11'
11'
21'
SIDEWALK
21'
SIDEWALK
EASTBOUND
WESTBOUND


ALTERNATIVE 2 TYPICAL SECTION: PENNSYLVANIA AVE NW BETW. 7TH AND 9TH
11'
11'
11'
11'
10'
6'
MEDIAN
10'
11'
11'
11'
21'
SIDEWALK
21'
SIDEWALK
EASTBOUND
WESTBOUND

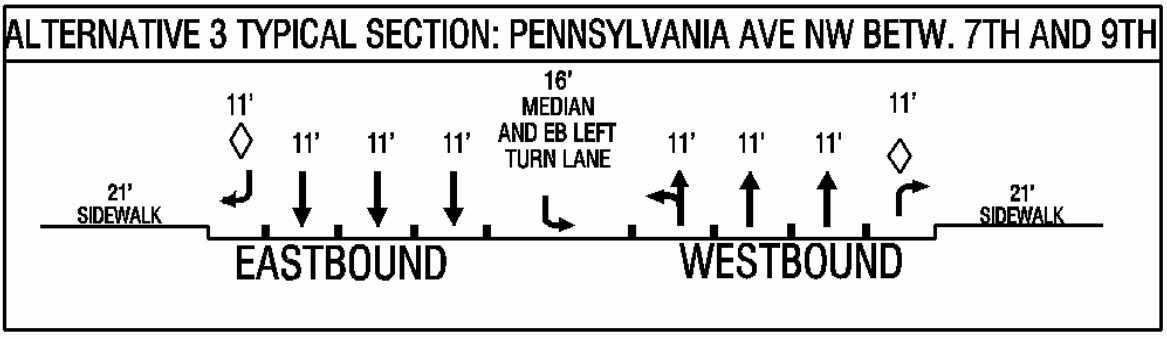

ALTERNATIVE 3 TYPICAL SECTION: PENNSYLVANIA AVE NW BETW. 7TH AND 9TH
16'
MEDIAN
AND EB LEFT
TURN LANE
11'
11'
11'
11'
11'
11'
11'
11'
21'
SIDEWALK
21'
SIDEWALK
EASTBOUND
WESTBOUND

Table 3. Summary of Alternative Intersection Capacity – AM (PM)

Intersection	Level of Service	Volume-to-Capacity Ratio	Average Delay
Existing Conditions			
Pennsylvania Avenue at 6th Street	B (C)	0.38 (0.58)	15.2 (27.5)
Pennsylvania Avenue at 7th Street	C (C)	0.66 (0.51)	20.6 (20.7)
Pennsylvania Avenue at 9th Street	B (C)	0.47 (0.69)	10.0 (21.1)
Alternative 1 - Curb Lane Cycle Track			
Pennsylvania Avenue at 6th Street	B (C)	0.43 (0.65)	18.1 (28.3)
Pennsylvania Avenue at 7th Street	C (C)	0.68 (0.52)	25.4 (24.7)
Pennsylvania Avenue at 9th Street	B (C)	0.53 (0.74)	14.0 (25.0)
Alternative 2 – North Curb Lane Cycle Track with Median Shift			
Pennsylvania Avenue at 6th Street	B (C)	0.43 (0.65)	18.1 (28.3)
Pennsylvania Avenue at 7th Street	C (C)	0.68 (0.52)	25.4 (24.7)
Pennsylvania Avenue at 9th Street	B (C)	0.53 (0.74)	14.0 (25.0)
Alternative 3 – Exclusive Bicycle, Bus and Right-Turn Curb Lane			
Pennsylvania Avenue at 6th Street	B (C)	0.41 (0.64)	18.4 (28.3)
Pennsylvania Avenue at 7th Street	C (C)	0.63 (0.47)	23.8 (27.3)
Pennsylvania Avenue at 9th Street	B (C)	0.53 (0.76)	14.0 (25.0)

The results of the alternatives analysis indicate that any of the bicycle compatible roadway diets would result in acceptable vehicular intersection operations. However, a curb lane cycle track design would need careful consideration of curb side operations such as deliveries, tour bus, and transit bus stop operations, including possible creation of bus bays. Therefore, a median aligned cycle track may be safest and most efficient for bicyclists, and should be explored further for the entire length of the Pennsylvania Avenue NW corridor.

Further analysis of signal timing, phasing and signal equipment location would be necessary with a median cycle track alignment at all intersections to optimize operations and limit conflicts between bicyclists and left turning motorists. It is anticipated that new signal equipment and phasing such as lag and protected left-turn phasing, may be desirable to control the bicycle traffic and left-turning traffic.