



RICHMOND HIGHWAY (U.S. ROUTE 1) SPEED LIMIT STUDY

Technical Presentation to MWCOG Technical Committee

Presented by Warren Hughes, ATCS, P.L.C.

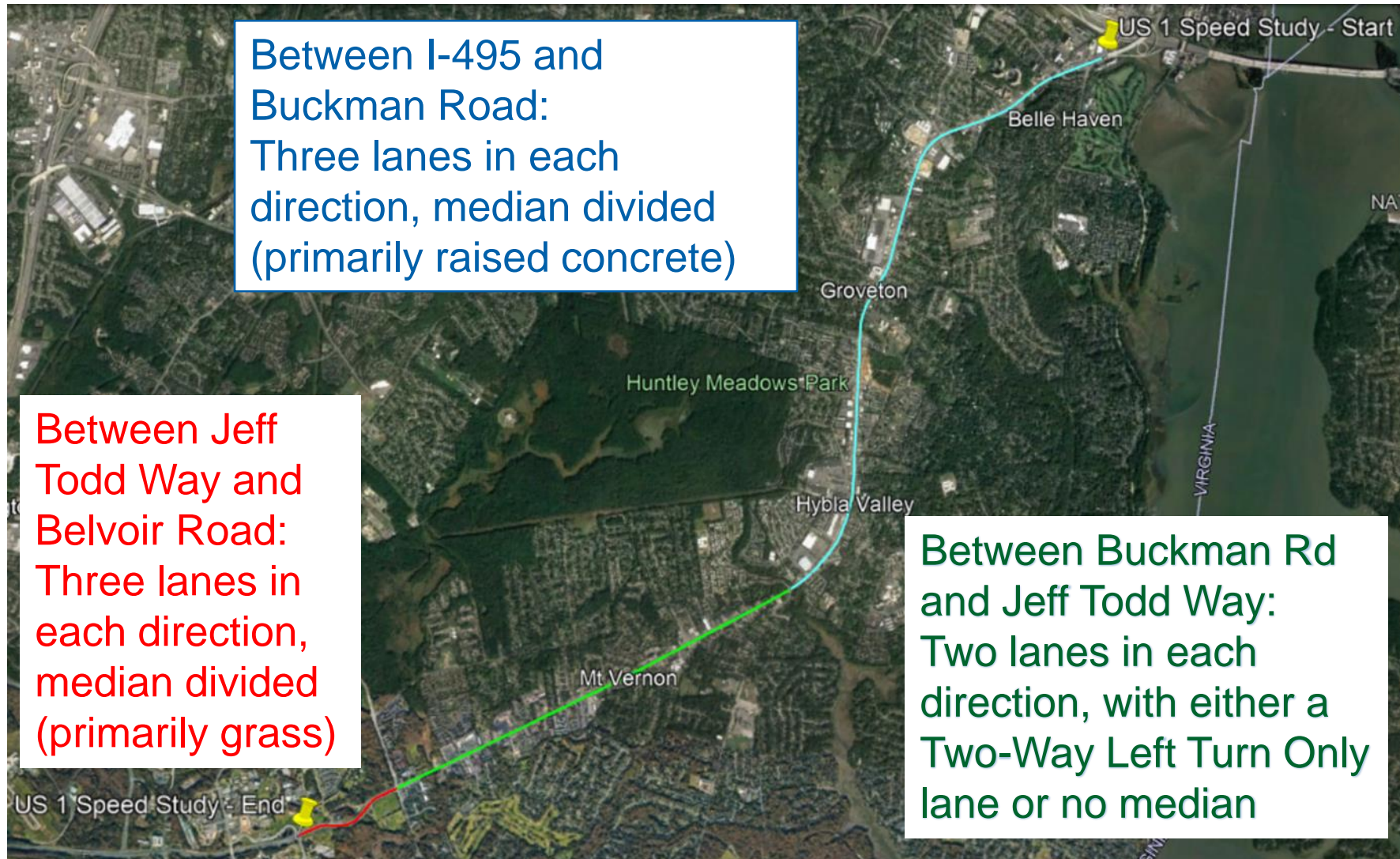
August 9, 2022 2:00 PM

Richmond Highway Speed Limit Study - Objectives

- 7.8-mile segment of Richmond Highway
- Examine the speed limit along Richmond Highway, considering safety for motorists, pedestrians, bicyclists and transit users
- Through technical analysis, develop recommendation for posted speed limit



U.S. Route 1 Study Section



- Current Speed Limit is 45 mph
- Year 2019 Annual Average Daily Traffic (AADT) ranged from 55,000 to 34,000 vehicles per day
- 30 signal-controlled intersections
- Numerous median openings, driveways, & unsignalized intersections
- Majority of study section has sidewalk or path on at least one side of US 1

Traffic Signals on U.S. Route 1



- **30 traffic signal-controlled intersections within the study area**
 - 28 intersections contain pedestrian accommodations across U.S. Route 1
 - Pedestrian signal heads, push buttons and crosswalks (high-visibility & transverse)
 - 2 intersections without pedestrian accommodations (i.e., crosswalks or pedestrian signals)
- **2 “Watch for Pedestrians” signs with flashing beacons**
 - No stop bars on U.S. Route 1 in either direction
 - No pushbuttons or signals
 - No marked crosswalks
 - Little or no ADA curb ramps provided at crossing locations

Signal w/ Peds.



Signal w/o Peds.



Warning Sign with Flashing Beacons

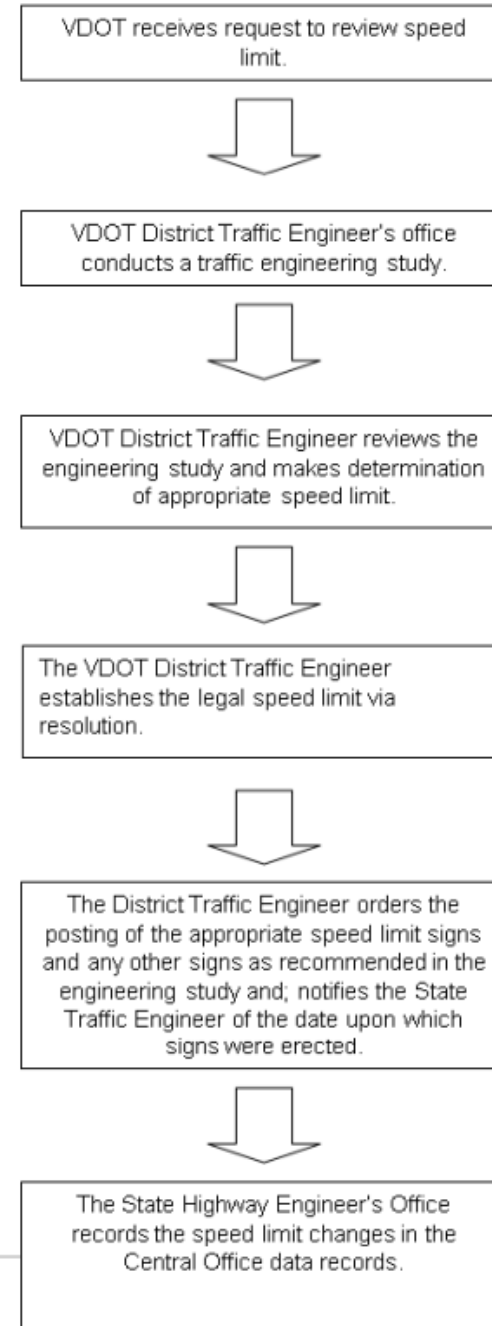


VDOT SPEED LIMIT STUDY PROCEDURES - FOR NON-LIMITED ACCESS HIGHWAYS



Setting Speed Limits – Process & Prescriptions

- **Engineering study required for speed limit changes by VA law**
- **VDOT requires studies to be signed & sealed, using standard Study template**



Most requests come from citizens, state and local police

COV 46.2-878 requires an engineering study prior to change in speed limit.

DTE reviews; VDOT requires studies be signed and sealed

COV grants approval to Commissioner who has delegated to DTE and for Interstate to the DTE and STE

COV 46.2-878 says speed limit changes are effective only after a study and when signs are posted

Speed limit changes are kept on file in the VDOT State Highway Engineer's Office as required by Section 46.2-878,

Speed Limit Study Template

VDOT Speed Study Template - Version Date June, 2017

VDOT Speed Limit Study Region Traffic Engineering

Date / /

Note: All text in gray is for guidance only & should be removed from the final study document.
For an example speed limit study [click here](#) or [here](#)

Study Area describes the route and location(s) of the study area as indicated below. Note the termini of any recommended speed limit change may differ somewhat from the study area.

Route # and Street Name (e.g. Interstate 95, US 1 / Jefferson Davis Highway)

VDOT District

Jurisdiction(s) indicate affected jurisdictions in the study area.

From / To describe the beginning and ending location of the study area – typically the termini of the final speed limit recommendation. **Speed Limit Termini** are important both for establishing the physical location of the speed limit, as well as for legal purposes. Termini coincide with adjacent speed limit termini and typically begin/end at the same location for both travel directions (even on divided facilities) to facilitate enforcement etc. Termini are referenced in a single travel direction (northbound for north-south routes and eastbound for east-west routes) based on distance from a permanent, at-grade roadway feature such as a nearby intersecting ramp junction (measured from the gore) or distance from a nearby intersection of a numbered, VDOT-maintained route. Such features (and the reference to such features) can be expected to exist for the foreseeable future and be readily located (and relocated) in the field for posting speed limit signs and also corresponds to features (and how they are referenced) in VDOT's roadway inventory system. An example terminus for an east-west interstate route is: From - 2.23 miles east of eastbound entrance ramp from Route 696 (near mile-marker 24) To - Rockbridge County Line (near mile-marker 40.00).

Length: Distance between speed limit termini e.g. 20.3 miles

Study Area Map insert/reference map that shows study road(s), affected jurisdictions, proposed speed limit(s), signage etc.

Functional Class e.g. rural interstate, rural principal arterial etc.

Existing Speed limit on study roadway: indicate the governing (posted or statutory) speed limit and termini, the date the signs were installed/posted, and the effective date (date signed by Commissioner of Highways or designee) of the resolution (for non-statutory speed limits only). This information is available from VDOT's Roadway Network System [speed.ccrs.vdot.viclick here](#)

Origin and Nature of Request: Discuss the events, issues etc. that precipitated the initiation of the speed limit study.

Study Results and Recommendations: Convey study recommendations and conclusions based on the analysis of study elements (e.g. roadway characteristics, crashes, law enforcement data/comments, and traffic operations). Primary elements are the **recommended speed limit** (and termini), **safety/crash issues**, and any **improvements identified for implementation** in conjunction with the posting of the recommended speed limit such as those to mitigate crash hot-spots (typically for a speed limit increase). Typical improvements are guardrail replacements or upgrades (LCN, and treatments etc.) rumble strips, pavement markings, warning signs etc.

Study Details Detail the nature and appropriateness of the items below that pertain to the speed limit determination.

A. Vehicle Speed Analysis as per the MUTCD an analysis of the speed distribution of free-flowing vehicles is to be conducted. Accordingly, speed data below should be collected and the indicated speed characteristics derived and analyzed, -including speed distribution graph.

Speed Data vehicle speed data samples should be collected and include the date, location, and source (e.g. speed data was collected from January 1, 2016 to April 30, 2016 using continuous count site data at on I581 Northbound between US 11 Lee Hwy South of Buchanan to Route 614 Arcadia Rd, between MP 168.21 and 168.82). Speed samples reflect free-flowing conditions (LOS C or better) and minimize impacts due to weather or roadway features such as alignment, grade, pavement conditions etc. VDOT's continuous count site typically addresses these various aspects and may be available for use in the study on interstates. Contact COTED's traffic count section for more information. Multiple collection sites may be necessary where roadway or driver characteristics that impact vehicle speeds are significantly different.

Operating (85th percentile) speed(s): Indicate 85th speed derived from the speed data sample each collection site (e.g. 71.5 mph).

Median Speed(s): Indicate median speed derived from the speed data sample for each collection site (e.g. 66 mph).

Pace Speed(s): Indicate Pace speed derived from the speed data sample for each collection site (e.g. 61 to 74 mph).

B. Roadway Characteristics consider the adequacy of physical roadway features that pertain to vehicle speeds and the speed limit.

Physical Roadway Consider # of lanes; median/lane/shoulder/clear zone type/width/condition; grade, alignment, sight distance, acceleration and deceleration lane lengths, rumble strips, guardrail (LCN, location and condition) and any other roadway hardware and appurtenances that impact vehicle speeds and safety.

Traffic Control Devices Consider the suitability of roadway delineation and signage (e.g. pavement markings for travel lanes -centerlines, edge lines etc.), gore markings, raised pavement markings, warning and regulatory signing, guidance signing, curve warning [and delineation etc.](#) Identify warning (or any other) signage necessary to support the speed limit recommendation such as curve warning signs where the proposed speed limit exceeds the maximum speed for a curve (A ball-bank analysis may be necessary to identify such curves and the recommended advisory speed).

Traffic and Operations Detail traffic volumes and vehicle mix (e.g. % trucks, [click here](#) for official AADT publications for Interstates & Primary Routes or [click here](#) to query any highway by location etc.). Assess the operational aspects (e.g. density and LOS for limited access facilities). Consider the impacts on mainline vehicle speeds, including speed differential effects, due to the nature and extent of entering and exiting traffic (e.g. heavy vehicles) from interchanges (e.g. interchange density) or from roadside environment/development.

C. Roadside Environment THIS SECTION DOES NOT APPLY FOR LIMITED ACCESS FACILITIES. Otherwise, describe the nature of roadside development (e.g. rural, residential, commercial, or industrial) as well as the extent and concentration/density (e.g. subdivision, shopping center, apartment complex, community center, industrial plant/park, school, park, playground etc.).

PLACE
SEAL
HERE

PLACE ELECTRONIC
SIGNATURE HERE

VDOT - Traffic Engineering
[OFFICE LOCATION]
Traffic Engineer

VDOT Speed Study Template - Version Date June, 2017

D. Parking and Pedestrian Activity for limited access facilities indicate THIS SECTION DOES NOT APPLY FOR THIS LIMITED ACCESS HIGHWAY. Otherwise, discuss the nature of on-street parking and observed pedestrian activity (including any development that would be expected to generate pedestrian activity such as schools, parks, playgrounds, community centers, shopping centers etc.) and the appropriateness of accommodations for such activity such as sidewalks, marked crosswalks, delineated parking etc. and related signage.

E. Reported Crash Experience and Analysis this section analyzes the nature and extent of crashes/injuries/fatalities on the study section, with a particular focus on those associated with vehicle speeds and speed differential effects. Where a **speed limit increase** is being considered, a "hotspot" crash analysis is conducted to identify high-crash locations and associated improvements to accommodate a risk of speed-related crashes (see example study). Also the analysis compares the nature of crash/injury/fatal characteristics with VDOT's rates as laid out below.

Crash Records are for the period: From: Month/Day/Year To: Month/Day/Year 3 years of the most recent and complete crash data from VDOT's RNS crash module should be used for the analysis if available as indicated by the currency date in RNS. Note: The applicability of crash data for time periods where there has been extended construction etc. should be considered.

NOTE: Crash records are from VDOT's Roadway Network System (RNS) crash module based on the Department of Motor Vehicle's official record of reportable crashes (those involving an injury or fatality or property damage exceeding \$1,500). Due to the time required to process and code reported crashes data for the most recent 1-2 months (or more) may not be available.

For this section of highway for interstates and some other limited-access, multi-lane, divided roads (e.g. 695, 286 etc.) the summary computation below is done separately for each travel direction since crashes are coded separately by direction.

There were:

<u> </u> Crashes	<u> </u> Injuries	<u> </u> Fatalities and a
<u> </u> Crash Rate	<u> </u> Injury Rate	<u> </u> Fatality Rate
per 100 million VMT	per 100 million VMT	per 100 million VMT

According to VDOT's "Summary of Crash Data" Report for Year , for this

for limited access facilities indicate either (1) urban or rural interstate or (2) "divided, full control of access" as applicable. For non-limited access highways indicate the applicable facility type (e.g. two-way, non-divided etc.).

Facility, the Statewide Average:

Crash Rate is <u> </u>	Injury Rate is <u> </u>	Fatality Rate is <u> </u>
per 100 million VMT	per 100 million VMT	per 100 million VMT

* Alternatively, for secondary highways in VDOT's District, the Average:

Crash Rate is <u> </u>	Injury Rate is <u> </u>	Fatality Rate is <u> </u>
per 100 million VMT	per 100 million VMT	per 100 million VMT

* For secondary roads the VDOT District average crash/injury/fatality rates may be used in lieu of the statewide averages.

Use the statewide crash/injury/fatality rates for the applicable facility type from VDOT's most recent annual "Summary of Crash Data" Report ([click here](#)) in order to compare the rates or, alternatively, for secondary roads the District average crash/injury/fatality rates may be used in lieu of statewide averages. As noted above.

F. Analysis of available and appropriate accident and law-enforcement data Code of VA section 46-2-870 requires the "analysis of available and appropriate law-enforcement data" in order to post the maximum allowable speed limit of (1) 70 mph on interstates or other limited access, multi-lane, divided highways or (2) 80 mph on U.S. Route 23, U.S. Route 29, U.S. Route 58, U.S. Alternate Route 58, U.S. Route 260, U.S. Route 460, or U.S. Route 17 between the Town of Port Royal and Saluda where they are non-limited access, multi-lane, divided highways. For affected highways where these maximum speed limits are being considered, a request for "law-enforcement" data should be conveyed to the VSP at the appropriate district ([click here](#) for VSP districts) and to local law enforcement of any affected jurisdiction. The request to the law enforcement officer(s) and officer(s) and any data/documentation they convey should be documented here and incorporated into the study analysis as applicable, prior to the request for Law Enforcement consensus (Section G below) on the final study recommendation.

G. Law Enforcement Consensus: Where a speed limit change is proposed the study and speed limit recommendation, along with a request for comments and concurrence, should be conveyed to the Virginia State Police (VSP) at the appropriate district ([click here](#) for VSP districts) and to local law enforcement for the affected jurisdiction(s) and their response detailed as laid out below. A response from VSP is required in the final study. Generally, it is anticipated that VSP concurrence with the study recommendations will be achieved prior to implementing a speed limit change.

The recommended speed limit change has been discussed with

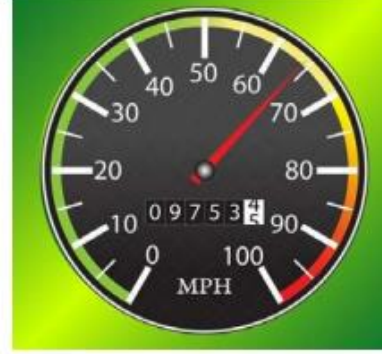
Indicate officers name of the Virginia State Police and; Indicate officers name of the (Indicate jurisdiction) Local Police who (Indicate either concurs or opposes as appropriate) the recommended speed limit within their jurisdiction.

The Virginia State Police Officer: Concurs with Opposes the recommended speed limit

Law enforcement comments: document any comments from local law enforcement and VSP here.

H. Additional comments: provide any additional relevant details not covered in the previous sections.

Speed Limit Study Template (cont.)



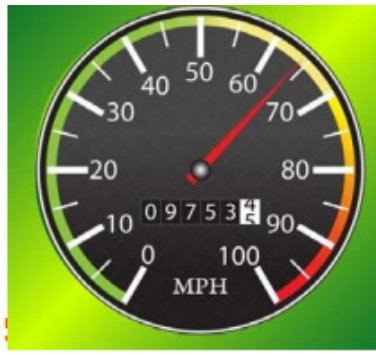
Study template – Consideration of all relevant factors

Vehicle Speed Profile –Operating, mean and pace speeds

Physical Roadway features –geometry, pavement / shoulder / clear zone width, traffic control (delineation and signage)

Traffic & Operational Aspects –consider extent and type of traffic on and entering/exiting highway, provision of auxiliary lanes, traffic control

Speed Limit Study Template (cont.)



Roadside Development –Type (e.g. residential) and extent, pedestrian activity and provisions for (e.g. sidewalks, crosswalks etc.)

Crash Evaluation – consider all aspects of roadway in conjunction with 3-year historical crashes, type (particularly speed-related), extent and spatial aspects, hot-spot analysis not only average crash rates

State / Local Police review and concurrence

Additional Factors Considered in this Speed Limit Study

- **Information from latest national research with best practices for setting speed limits on arterial highways**
 - **National Cooperative Highway Research Program Study #17-76, Guidance for the Setting of Speed Limits**
 - **NCHRP Report 966: Posted Speed Limit Setting Procedure and Tool: User Guide**
 - **National Transportation Safety Board's publication on "Reducing Speeding-Related Crashes Involving Passenger Vehicles"**
- **Roadway context and roadway type**
- **Decision rules based on speed distribution, roadway conditions, human factors (driver speed choice), and safety**

NCHRP REPORT 966 - PROPOSED SPEED SETTING PROCEDURES

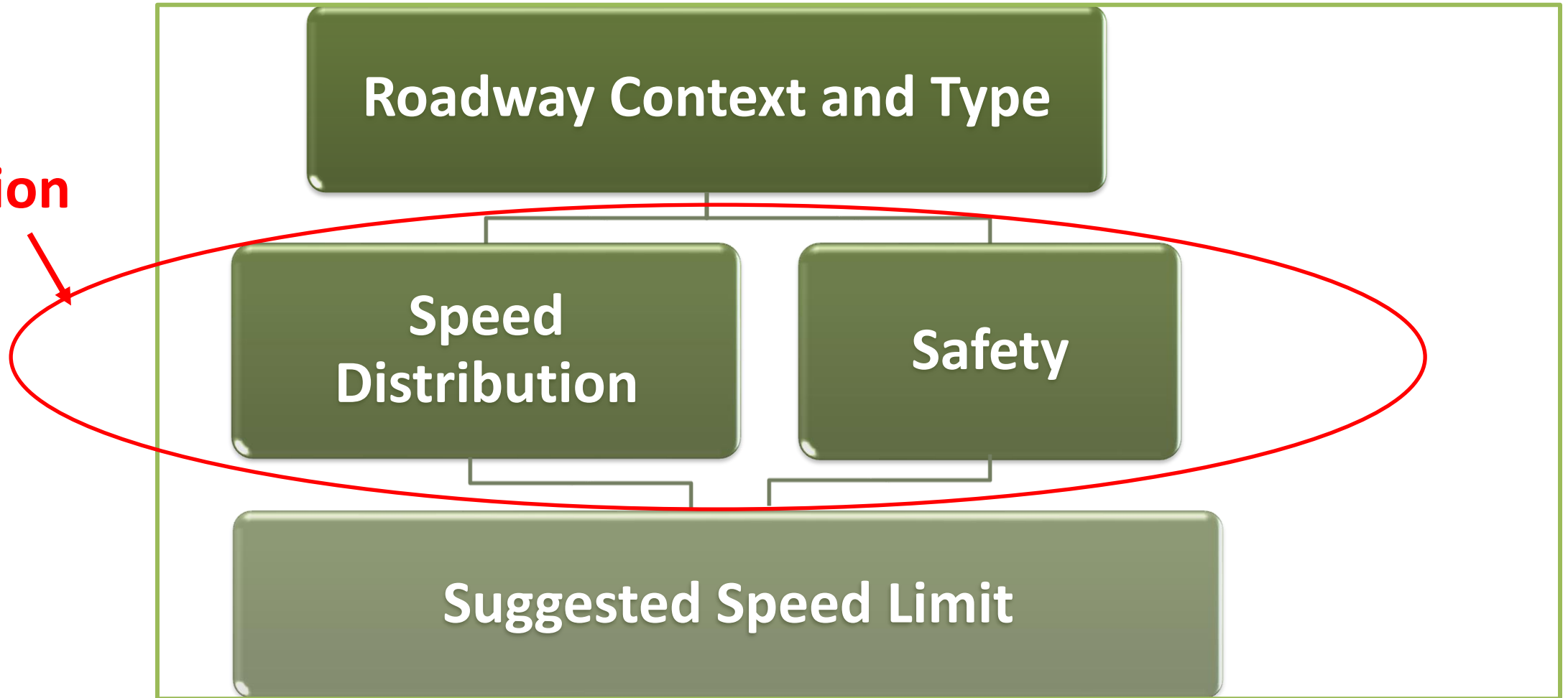


Methodology from NCHRP Study #17-76, Documented in NCHRP Report 966






- **Road function, site vicinity/area type, pedestrian facilities, and other factors all considered**
- **Set speed limit based on 50th, Rounded down 85th, or rounded off 85th Percentile Speeds, depending on classification of roadway segment and conditions**

Speed Limit Setting Procedure

**Decision
Rules**



Roadway Context (NCHRP Report 855)

Context	Density	Illustration
Rural	Lowest (few houses or other structures)	
Rural Town	Low to medium (single family houses and other single purpose structures)	
Suburban	Low to medium (single and multifamily structures and multi-story commercial)	
Urban	High (multi-story, low rise structures with designated off-street parking)	
Urban Core	Highest (multi-story and high-rise structures)	

Roadway Type (NCHRP Report 855)

- Interstates/Freeways/Expressways
- Principal Arterials
- Minor Arterials
- Collectors
- Locals

Speed Limit Setting Groups

Context Type	Rural	Rural Town	Suburban	Urban	Urban Core
Freeways	Limited Access	Limited Access	Limited Access	Limited Access	Limited Access
Principal Arterial	Undeveloped	Developed	Developed	Developed	Full Access
Minor Arterial	Undeveloped	Developed	Developed	Developed	Full Access
Collector	Undeveloped	Full Access	Developed	Full Access	Full Access
Local	Undeveloped	Full Access	Full Access	Full Access	Full Access

Suggested Speed Limit Starting Point...

Speed Limit Setting Groups	Method, Engineering	
Limited access Undeveloped Developed	<ul style="list-style-type: none"> Closest 85th (C85) 	<ul style="list-style-type: none"> Roadway conditions OK
	<ul style="list-style-type: none"> Rounded down from 85th (RD85) 	<ul style="list-style-type: none"> Between
	<ul style="list-style-type: none"> Closest 50th (C50) 	<ul style="list-style-type: none"> Not favorable to all users or crashes a significant concern
Full Access (< 30 mph typically)	<ul style="list-style-type: none"> Closest 50th (C50) 	<ul style="list-style-type: none"> Roadway conditions OK
	<ul style="list-style-type: none"> Rounded down from 50th (RD50) 	<ul style="list-style-type: none"> Not favorable to all users or crashes a significant concern

Input Data

Site Description Data			
	Roadway context		<input type="radio"/>
	Roadway type	Clear all data	<input type="radio"/>
	Are crash data available?		<input type="radio"/>
	Analyst		
	Date	Enter default data	
	Roadway name		
	Description		
	Current speed limit (mph)	Test macros	
	Notes		

Analysis Results	
Speed limit setting group	<input type="text"/>
Suggested speed limit (mph)	<input type="text"/>

Speed Data		
	Maximum speed limit (mph)	<input type="radio"/>
	85th-percentile speed (mph)	<input type="radio"/>
	50th-percentile speed (mph)	<input type="radio"/>

Crash Data			
	Number of years of crash data		<input type="radio"/>
	Average AADT for crash data period (veh/d)		<input type="radio"/>
	Is the segment a one-way street?		
	All (KABCO) crashes for crash data period		<input type="radio"/>
	Fatal & injury (KABC) crashes for crash data period		<input type="radio"/>
	Average KABCO crash rate (crashes / 100 MVMT)		
	Average KABC crash rate (crashes / 100 MVMT)		
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	<input type="text"/>	
	1.3 x average KABC crash rate (crashes / 100 MVMT)	<input type="text"/>	
	Critical KABCO crash rate (crashes / 100 MVMT)	<input type="text"/>	
	Critical KABC crash rate (crashes / 100 MVMT)	<input type="text"/>	

Input Cells	Description	Output Cells
24	Site Characteristics	
25	Segment length (mi)	<input type="radio"/>
26	AADT (two-way total) (veh/d)	
27	Number of lanes (two-way total)	<input type="radio"/>
28	Directional design-hour truck volume (trk/hr)	
29	Number of interchanges	
30	Design speed (mph)	
31	Grade (%)	
32	Outside shoulder width (ft)	
33	Inside shoulder width (ft)	
34	Median type	
35	Number of traffic signals	
36	Number of access points (total of both directions)	
37	Bicyclist activity / bike lane type	
38	Sidewalk presence / width	
39	Sidewalk buffer	
40	Pedestrian activity	
41	On-street parking activity	
42	Parallel parking permitted?	
43	Angle parking present?	
44	Median type	
45	Number of access points (total of both directions)	
46	Lane width (ft)	
47	Shoulder width (ft)	
48	Median type	
49	Number of traffic signals	
50	Number of access points (total of both directions)	
51	Bicyclist activity / bike lane type	
52	Sidewalk presence / width	
53	Sidewalk buffer	
54	Pedestrian activity	
55	On-street parking activity	
56	Angle parking present?	
57	Adverse alignment present?	

Color-Coding Legend
Aqua = basic input cell
Denim = basic input cell with drop-down menu
Orange = optional input cell (not needed for calculations)
Green = optional input cell (use if data for agency & region are available, leave blank otherwise)
Rose = intermediate calculations
Purple = final analysis results

ANALYSIS OF SPEED DATA

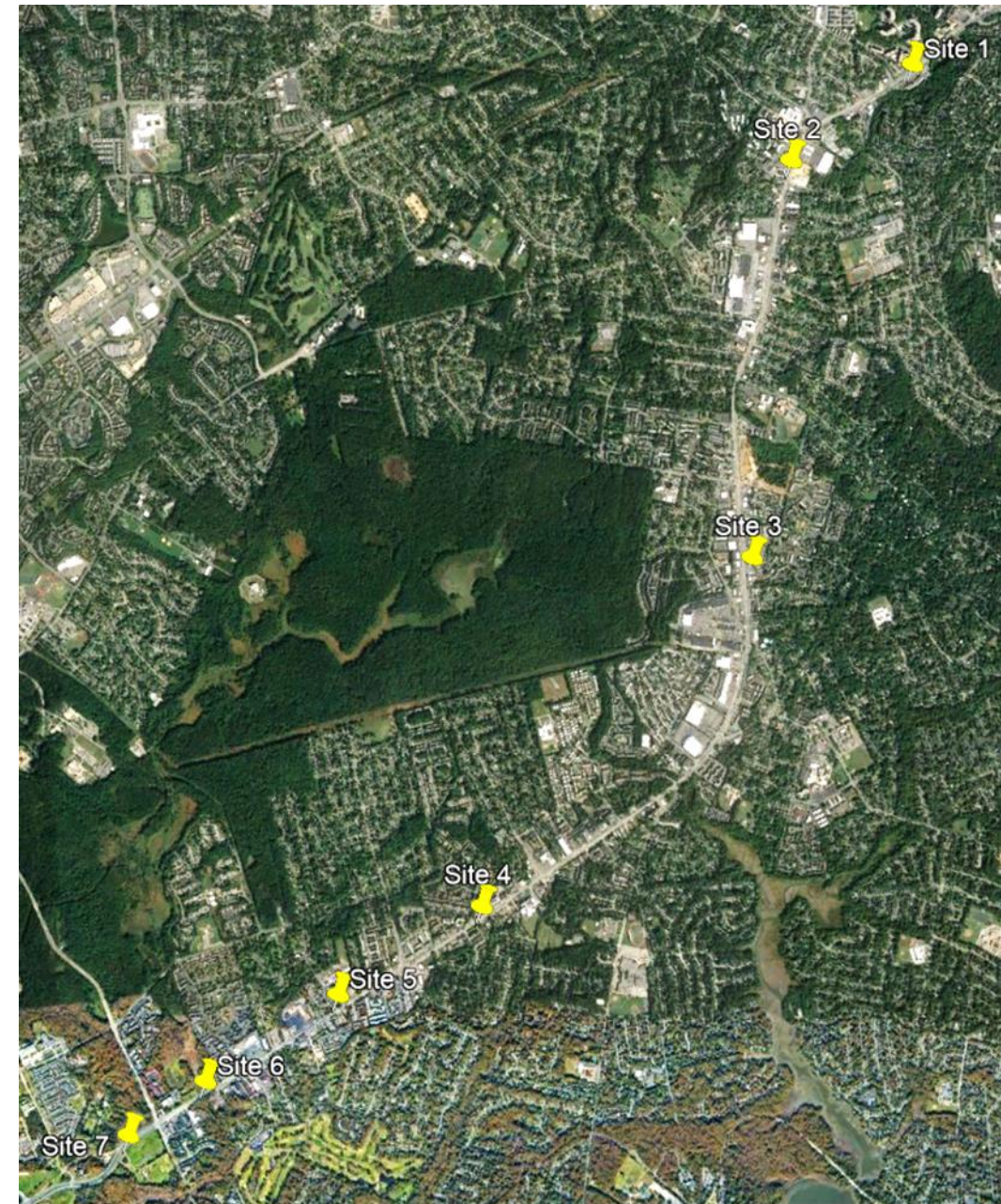


Analysis

- **Summarized Speed and AADT data for each data collection location:**

Site #	Data Collection Location	50th Percentile Speed (mph)	85th Percentile Speed (MPH)	Average Annual Daily Traffic
1	Adjacent to Spring Hill Suites	40.8	48.8	47,069
2	Adjacent to Wingstop Driveway	38.5	46.8	52,319
3	150 ft south of Belvoir Drive	37.7	44.8	50,299
4	300 ft east of Radford Avenue	39.5	46.8	35,910
5	Between Highland Lane & Ingleside Street	38.8	45.7	36,504
6	1,000 ft east of Jeff Todd Way	42.4	49.1	34,028
7	1,000 ft west of Jeff Todd Way	45.1	52.2	43,545

- **Applied NCHRP methodology using speed data at the 7 locations**
 - Suburban roadway context, changing to more urbanized
 - Pedestrian activity in each segment
 - Crash rates for 2016-2020 utilized



Illustrative Conditions - Site 3

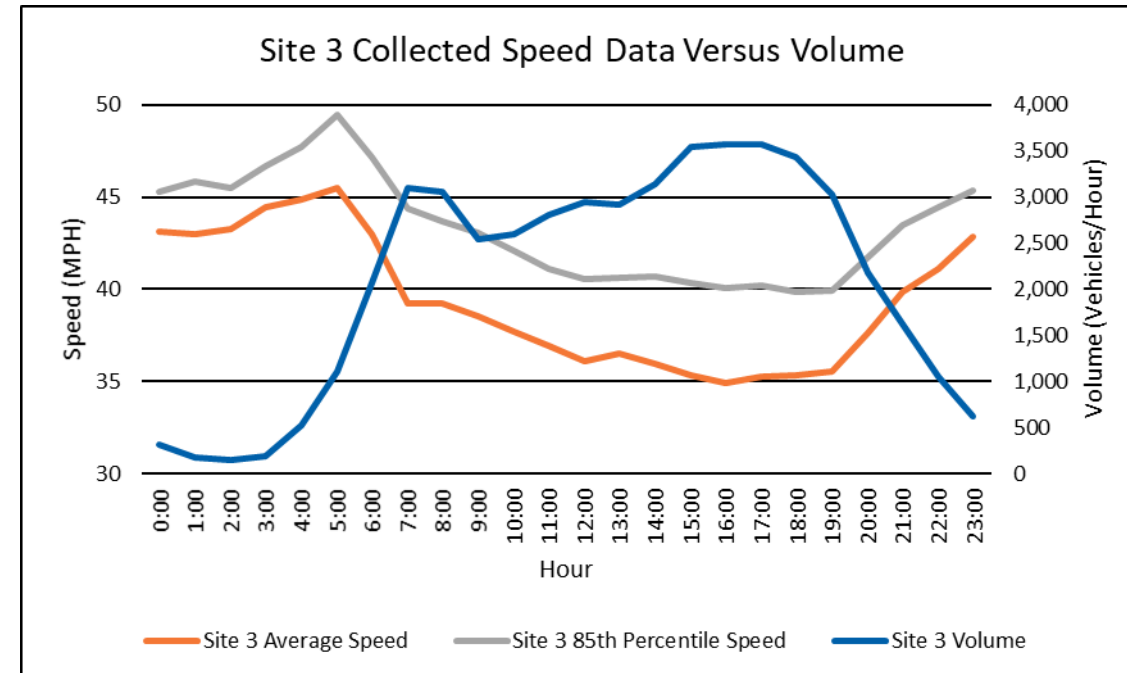
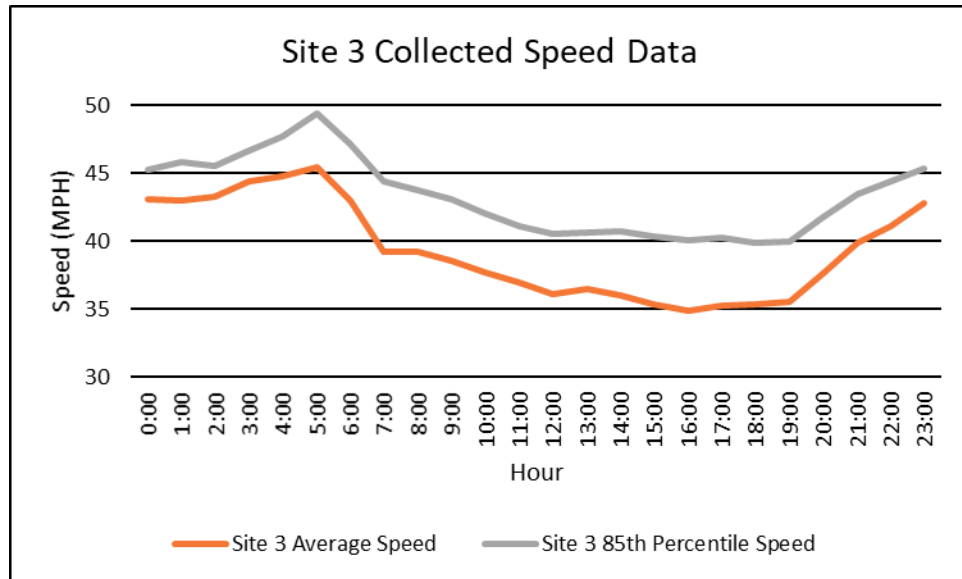
- **Site Conditions**
 - Located between Belvoir Drive and Woodlawn Trail, approximately 3.4 miles south of I-495 interchange
 - Raised concrete median
 - Numerous commercial access driveways
 - Six through lanes
 - Left turn lane adjacent to site
- **Reported Crash Locations**
 - Pedestrian, bicycle, and speeding crashes in the vicinity of Site 3 from 2016-2020



Site 3 Speed and Volume Data

Mean speed without left turn lane: 37.5 MPH

- **Mean Speed: 35.8 MPH**
- **50th Percentile Speed (Not Plotted): 37.7 MPH**
- **85th Percentile Speed: 44.8 MPH**



Site 3 Collected Speed Data Distribution														
≤ 15 MPH	≤ 25 MPH	≤ 30 MPH	≤ 35 MPH	≤ 40 MPH	≤ 45 MPH	≤ 50 MPH	≤ 55 MPH	≤ 60 MPH	≤ 65 MPH	≤ 70 MPH	≤ 75 MPH	≤ 80 MPH	≤ 85 MPH	> 85 MPH
824	6,533	13,938	30,877	43,304	33,974	15,242	4,696	1,087	292	77	34	6	5	8

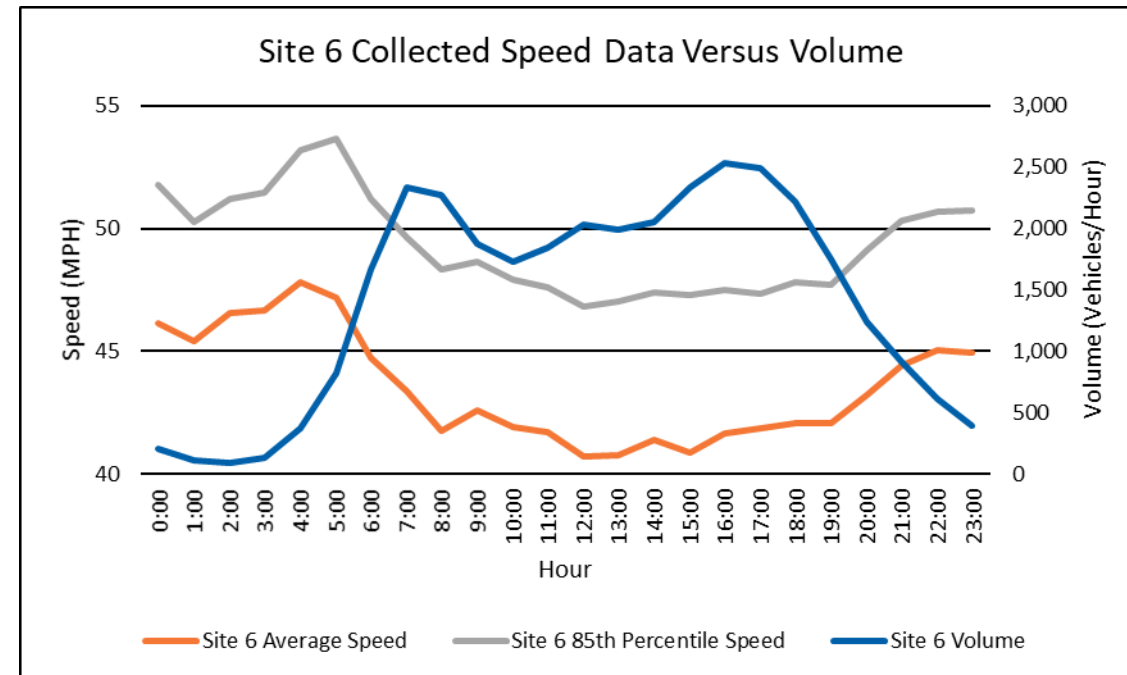
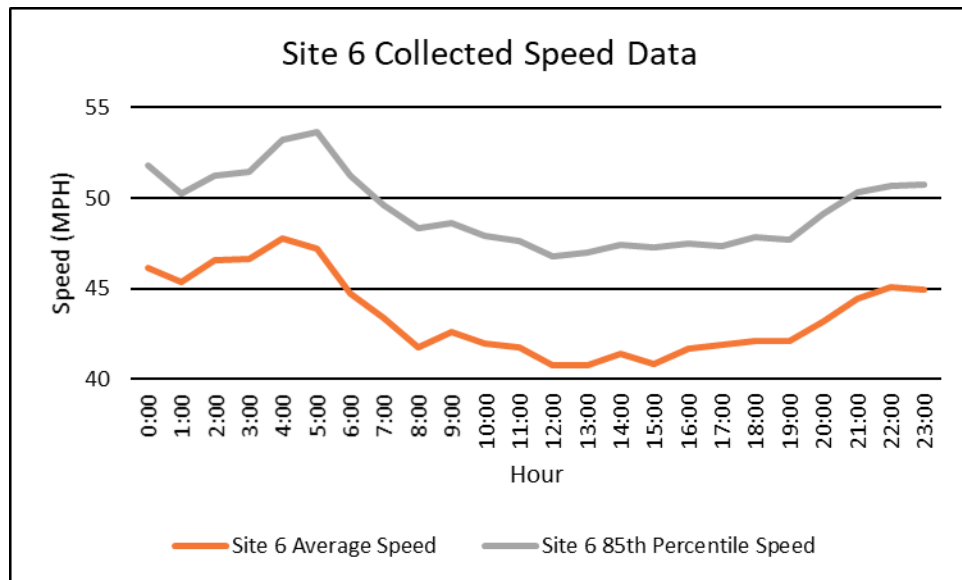
Illustrative Conditions - Site 6

- **Site Conditions**
 - Located halfway between Jeff Todd Way and Sacramento Drive
 - No median
 - No driveways in immediate vicinity
 - Four through lanes
 - No turn lanes
- **Reported Crash Locations**
 - Pedestrian, bicycle, and speeding crashes in the vicinity of Site 3 from 2016-2020



Site 6 Data

- **Mean Speed: 42.4 MPH**
- **50th Percentile Speed (Not Plotted): 42.4 MPH**
- **85th Percentile Speed: 49.1 MPH**



Site 6 Collected Speed Data Distribution														
≤ 15 MPH	≤ 25 MPH	≤ 30 MPH	≤ 35 MPH	≤ 40 MPH	≤ 45 MPH	≤ 50 MPH	≤ 55 MPH	≤ 60 MPH	≤ 65 MPH	≤ 70 MPH	≤ 75 MPH	≤ 80 MPH	≤ 85 MPH	> 85 MPH
142	690	2,096	8,643	23,968	32,583	22,585	8,792	2,043	411	77	30	14	2	9

APPLICATION OF NCHRP SPEED SETTING PROCEDURES



Analysis Overview

- **NCHRP Procedure applied as another tool to assist in developing recommendations for speed limits based on conditions at each site**
 - **50th / 85th percentile speeds**
 - **Crash data**
 - **Median type Signals and access points**
 - **Segment length**
 - **Number of lanes**
 - **Pedestrian/bike/parking activity and facilities**

Site 1 NCHRP Tool Evaluation

- **Decision rule: Round to closest 50th percentile speed**
- **Determining factors:**
 - Number of signals
 - Number of access points

Analysis Results		Speed limit setting group	Developed	Advisory, Calculated, or Warning Messages
Suggested speed limit (mph)			40	This value is determined by speed data & site characteristics.
Speed Data		Advisory, Calculated, or Warning Messages		
45	Maximum speed limit (mph)			
48.8	85th-percentile speed (mph)			
40.78	50th-percentile speed (mph)			
Site Characteristics		Advisory, Calculated, or Warning Messages		
1.4	Segment length (mi)			
6	Number of lanes (two-way total)			
Divided	Median type			
6	Number of traffic signals	Closest 50th (4.29 signals / mi)		
44	Number of access points (total of both directions)	31.43 access points / mi		
Not high / Any type	Bicyclist activity / bike lane type			
Adequate	Sidewalk presence / width			
Not present	Sidewalk buffer			
Some	Pedestrian activity			
Not high	On-street parking activity			
No	Parallel parking permitted?			
No	Angle parking present?			
No	Adverse alignment present?			
Crash Data		Advisory, Calculated, or Warning Messages		
5	Number of years of crash data			
46,600	Average AADT for crash data period (veh/d)			
No	Is the segment a one-way street?			
217	All (KABCO) crashes for crash data period	Observed KABCO crash rate = 182.26 crashes / 100 MVMT		
94	Fatal & injury (KABC) crashes for crash data period	Observed KABC crash rate = 78.95 crashes / 100 MVMT		
	Average KABCO crash rate (crashes / 100 MVMT)	HSIS average KABCO crash rate = 205.73 crashes / 100 MVMT		
	Average KABC crash rate (crashes / 100 MVMT)	HSIS average KABC crash rate = 70.84 crashes / 100 MVMT		
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	267.4		
	1.3 x average KABC crash rate (crashes / 100 MVMT)	92.1		
	Critical KABCO crash rate (crashes / 100 MVMT)	227.8		
	Critical KABC crash rate (crashes / 100 MVMT)	83.9		

Site 2 NCHRP Tool Evaluation

- Decision rule: Round to closest 50th percentile speed
- Determining factors:
 - Critical crash rate

Analysis Results		Speed limit setting group	Developed	Advisory, Calculated, or Warning Messages
Suggested speed limit (mph)			40	This value is determined by speed data, site characteristics, & crash data.
Speed Data				Advisory, Calculated, or Warning Messages
45	Maximum speed limit (mph)			
46.8	85th-percentile speed (mph)			
38.45	50th-percentile speed (mph)			
Site Characteristics				Advisory, Calculated, or Warning Messages
1.55	Segment length (mi)			
6	Number of lanes (two-way total)			
Divided	Median type			
5	Number of traffic signals			Rounded-Down 85th (3.23 signals / mi)
64	Number of access points (total of both directions)			Rounded-Down 85th (41.29 access points / mi)
Not high / Any type	Bicyclist activity / bike lane type			
Adequate	Sidewalk presence / width			
Present	Sidewalk buffer			
Some	Pedestrian activity			
Not high	On-street parking activity			
No	Parallel parking permitted?			
No	Angle parking present?			
	Adverse alignment present?			
Crash Data				Advisory, Calculated, or Warning Messages
5	Number of years of crash data			
48,847	Average AADT for crash data period (veh/d)			
No	Is the segment a one-way street?			
251	All (KABCO) crashes for crash data period			Observed KABCO crash rate = 181.65 crashes / 100 MVMT
115	Fatal & injury (KABC) crashes for crash data period			Observed KABC crash rate = 83.23 crashes / 100 MVMT
	Average KABCO crash rate (crashes / 100 MVMT)			HSIS average KABCO crash rate = 205.73 crashes / 100 MVMT
	Average KABC crash rate (crashes / 100 MVMT)			HSIS average KABC crash rate = 70.84 crashes / 100 MVMT
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	267.4		
	1.3 x average KABC crash rate (crashes / 100 MVMT)	92.1		
	Critical KABCO crash rate (crashes / 100 MVMT)	226.2		
	Critical KABC crash rate (crashes / 100 MVMT)	83.0		Closest 50th

Site 3 NCHRP Tool Evaluation

- **Decision rule: Round to closest 50th percentile speed**
- **Determining factors:**
 - **Critical crash rate**
 - **Number of signals**

Analysis Results		Advisory, Calculated, or Warning Messages
Speed limit setting group	Developed	This value is determined by speed data, site characteristics, & crash data.
Suggested speed limit (mph)	40	
Speed Data		Advisory, Calculated, or Warning Messages
45	Maximum speed limit (mph)	
44.83	85th-percentile speed (mph)	
37.69	50th-percentile speed (mph)	
Site Characteristics		Advisory, Calculated, or Warning Messages
1.52	Segment length (mi)	Closest 50th (4.61 signals / mi) Rounded-Down 85th (45.39 access points / mi)
6	Number of lanes (two-way total)	
Divided	Median type	
7	Number of traffic signals	
69	Number of access points (total of both directions)	
Not high / Any type	Bicyclist activity / bike lane type	
Adequate	Sidewalk presence / width	
Present	Sidewalk buffer	
Some	Pedestrian activity	
Not high	On-street parking activity	
No	Parallel parking permitted?	
No	Angle parking present?	
	Adverse alignment present?	
Crash Data		Advisory, Calculated, or Warning Messages
5	Number of years of crash data	Observed KABCO crash rate = 261.72 crashes / 100 MVMT Observed KABC crash rate = 110.52 crashes / 100 MVMT HSIS average KABCO crash rate = 205.73 crashes / 100 MVMT HSIS average KABC crash rate = 70.84 crashes / 100 MVMT
46,969	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
341	All (KABCO) crashes for crash data period	
144	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	
	1.3 x average KABC crash rate (crashes / 100 MVMT)	
	Critical KABCO crash rate (crashes / 100 MVMT)	
	Critical KABC crash rate (crashes / 100 MVMT)	
		Closest 50th Closest 50th

Site 4 NCHRP Tool Evaluation

- **Decision rule: Rounded down 85th percentile speed**
- **Determining factors:**
 - **Number of signals**
 - **Number of access points**

Analysis Results		Speed limit setting group	Developed	Advisory, Calculated, or Warning Messages
Suggested speed limit (mph)		45		This value is determined by speed data & site characteristics.
Speed Data				Advisory, Calculated, or Warning Messages
45	Maximum speed limit (mph)			
46.76	85th-percentile speed (mph)			
39.53	50th-percentile speed (mph)			
Site Characteristics				Advisory, Calculated, or Warning Messages
1.18	Segment length (mi)			
4	Number of lanes (two-way total)			
Undivided	Median type			Rounded-Down 85th
4	Number of traffic signals			Rounded-Down 85th (3.39 signals / mi)
56	Number of access points (total of both directions)			Rounded-Down 85th (47.46 access points / mi)
Not high / Any type	Bicyclist activity / bike lane type			
Adequate	Sidewalk presence / width			
Present	Sidewalk buffer			
Some	Pedestrian activity			
Not high	On-street parking activity			
No	Parallel parking permitted?			
No	Angle parking present?			
	Adverse alignment present?			
Crash Data				Advisory, Calculated, or Warning Messages
5	Number of years of crash data			
33,544	Average AADT for crash data period (veh/d)			
No	Is the segment a one-way street?			
138	All (KABCO) crashes for crash data period			Observed KABCO crash rate = 191.04 crashes / 100 MVMT
66	Fatal & injury (KABC) crashes for crash data period			Observed KABC crash rate = 91.37 crashes / 100 MVMT
	Average KABCO crash rate (crashes / 100 MVMT)			HSIS average KABCO crash rate = 431.25 crashes / 100 MVMT
	Average KABC crash rate (crashes / 100 MVMT)			HSIS average KABC crash rate = 131.1 crashes / 100 MVMT
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	560.6		
	1.3 x average KABC crash rate (crashes / 100 MVMT)	170.4		
	Critical KABCO crash rate (crashes / 100 MVMT)	472.1		
	Critical KABC crash rate (crashes / 100 MVMT)	154.0		

Site 5 NCHRP Tool Evaluation

- **Decision rule: Rounded down 85th percentile speed**
- **Determining factors:**
 - Median type
 - Number of access points

Analysis Results		Speed limit setting group	Developed	Advisory, Calculated, or Warning Messages
Suggested speed limit (mph)			45	This value is determined by speed data & site characteristics.
Speed Data				Advisory, Calculated, or Warning Messages
45	Maximum speed limit (mph)			
45.72	85th-percentile speed (mph)			
38.81	50th-percentile speed (mph)			
Site Characteristics				Advisory, Calculated, or Warning Messages
0.81	Segment length (mi)			
4	Number of lanes (two-way total)			
Undivided	Median type			Rounded-Down 85th
2	Number of traffic signals			2.47 signals / mi
46	Number of access points (total of both directions)			Rounded-Down 85th (56.79 access points / mi)
Not high / Any type	Bicyclist activity / bike lane type			
Adequate	Sidewalk presence / width			
Present	Sidewalk buffer			
Some	Pedestrian activity			
Not high	On-street parking activity			
No	Parallel parking permitted?			
No	Angle parking present?			
	Adverse alignment present?			
Crash Data				Advisory, Calculated, or Warning Messages
5	Number of years of crash data			
34,099	Average AADT for crash data period (veh/d)			
No	Is the segment a one-way street?			
92	All (KABCO) crashes for crash data period			Observed KABCO crash rate = 182.51 crashes / 100 MVMT
39	Fatal & injury (KABC) crashes for crash data period			Observed KABC crash rate = 77.37 crashes / 100 MVMT
	Average KABCO crash rate (crashes / 100 MVMT)			HSIS average KABCO crash rate = 431.25 crashes / 100 MVMT
	Average KABC crash rate (crashes / 100 MVMT)			HSIS average KABC crash rate = 131.1 crashes / 100 MVMT
	1.3 x average KABCO crash rate (crashes / 100 MVMT)		560.6	
	1.3 x average KABC crash rate (crashes / 100 MVMT)		170.4	
	Critical KABCO crash rate (crashes / 100 MVMT)		480.4	
	Critical KABC crash rate (crashes / 100 MVMT)		158.6	

Site 6 NCHRP Tool Evaluation

- **Decision rule: Rounded down 85th percentile speed**
- **Determining factors:**
 - **Median type**
 - **Number of signals**

Analysis Results		Advisory, Calculated, or Warning Messages
Speed limit setting group	Developed	This value is determined by speed data & site characteristics.
Suggested speed limit (mph)	45	
Speed Data		Advisory, Calculated, or Warning Messages
45	Maximum speed limit (mph)	
49.13	85th-percentile speed (mph)	
42.38	50th-percentile speed (mph)	
Site Characteristics		Advisory, Calculated, or Warning Messages
0.85	Segment length (mi)	Rounded-Down 85th Rounded-Down 85th (3.53 signals / mi) 38.82 access points / mi
4	Number of lanes (two-way total)	
Undivided	Median type	
3	Number of traffic signals	
33	Number of access points (total of both directions)	
Not high / Any type	Bicyclist activity / bike lane type	
Adequate	Sidewalk presence / width	
Present	Sidewalk buffer	
Some	Pedestrian activity	
Not high	On-street parking activity	
No	Parallel parking permitted?	
No	Angle parking present?	
	Adverse alignment present?	
Crash Data		Advisory, Calculated, or Warning Messages
5	Number of years of crash data	Observed KABCO crash rate = 257 crashes / 100 MVMT Observed KABC crash rate = 87.02 crashes / 100 MVMT HSIS average KABCO crash rate = 431.25 crashes / 100 MVMT HSIS average KABC crash rate = 131.1 crashes / 100 MVMT
31,856	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
127	All (KABCO) crashes for crash data period	
43	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	
	1.3 x average KABC crash rate (crashes / 100 MVMT)	
	Critical KABC crash rate (crashes / 100 MVMT)	
	Critical KABC crash rate (crashes / 100 MVMT)	

Site 7 NCHRP Tool Evaluation

- **Decision rule: Use pre-set maximum speed limit**
- **Determining factors:**
 - **Maximum speed limit**

Analysis Results		Speed limit setting group	Developed	Advisory, Calculated, or Warning Messages
Suggested speed limit (mph)			45	This value is determined by the maximum speed limit.
Speed Data		Advisory, Calculated, or Warning Messages		
45	Maximum speed limit (mph)			
52.23	85th-percentile speed (mph)			
45.1	50th-percentile speed (mph)			
Site Characteristics		Advisory, Calculated, or Warning Messages		
0.72	Segment length (mi)			
6	Number of lanes (two-way total)			
Divided	Median type			
2	Number of traffic signals	2.78 signals / mi		
5	Number of access points (total of both directions)	6.94 access points / mi		
Not high / Any type	Bicyclist activity / bike lane type			
Adequate	Sidewalk presence / width			
Present	Sidewalk buffer			
Some	Pedestrian activity			
Not high	On-street parking activity			
No	Parallel parking permitted?			
No	Angle parking present?			
	Adverse alignment present?			
Crash Data		Advisory, Calculated, or Warning Messages		
5	Number of years of crash data			
36,300	Average AADT for crash data period (veh/d)			
No	Is the segment a one-way street?			
37	All (KABCO) crashes for crash data period			
12	Fatal & injury (KABC) crashes for crash data period			
	Average KABCO crash rate (crashes / 100 MVMT)	Observed KABCO crash rate = 77.57 crashes / 100 MVMT		
	Average KABC crash rate (crashes / 100 MVMT)	Observed KABC crash rate = 25.16 crashes / 100 MVMT		
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	HSIS average KABCO crash rate = 228.37 crashes / 100 MVMT		
	1.3 x average KABC crash rate (crashes / 100 MVMT)	HSIS average KABC crash rate = 74.01 crashes / 100 MVMT		
	Critical KABCO crash rate (crashes / 100 MVMT)	296.9		
	Critical KABC crash rate (crashes / 100 MVMT)	96.2		
	Critical KABCO crash rate (crashes / 100 MVMT)	265.4		
	Critical KABC crash rate (crashes / 100 MVMT)	95.5		

RICHMOND HIGHWAY SPEED LIMIT STUDY - CONCLUSIONS AND RECOMMENDATIONS



Factors Considered in Speed Limit Study

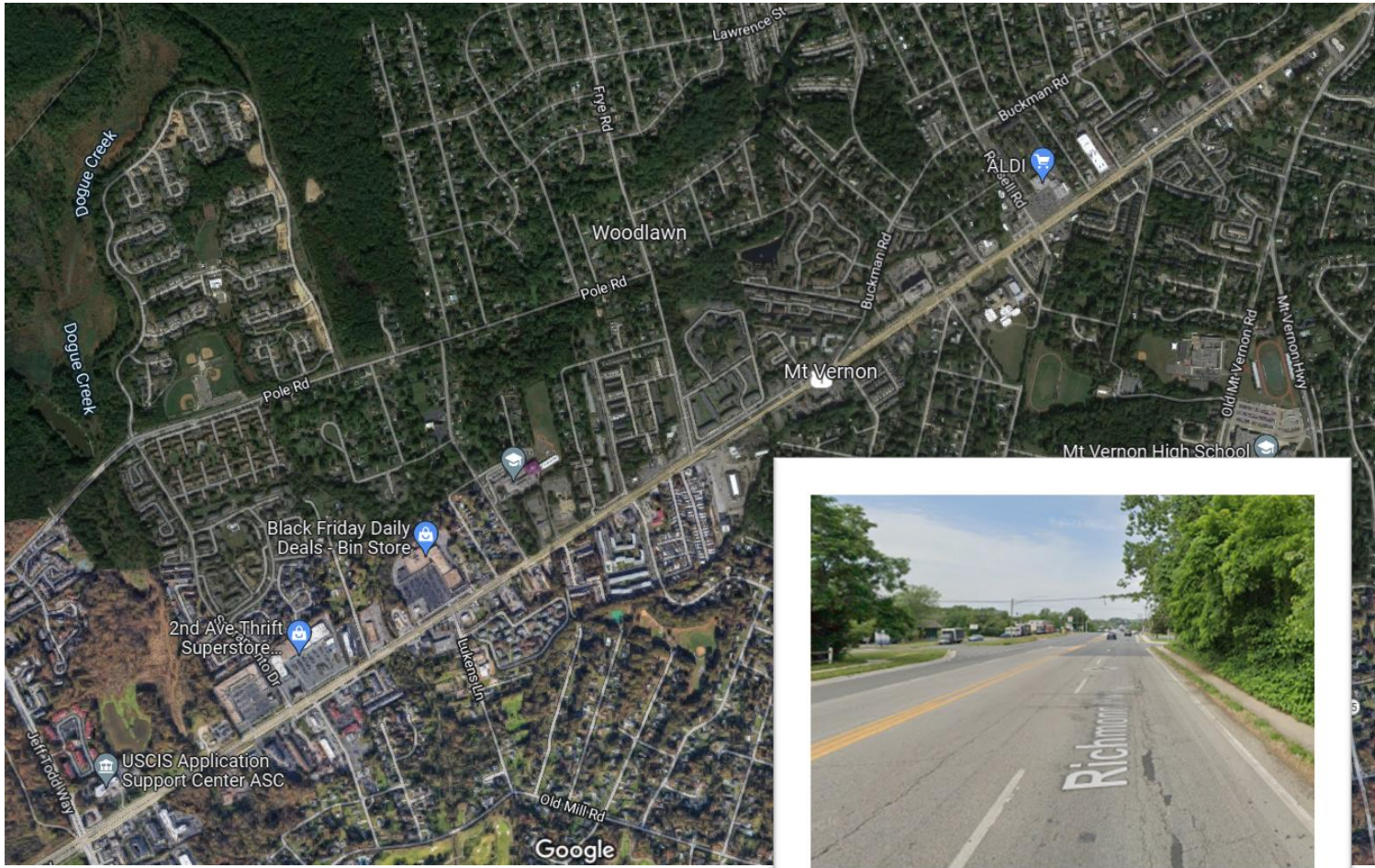
- **Vehicle speeds and distributions**
- **Reported crash experience**
- **Pedestrian-vehicle and vehicle-vehicle conflict points**
- **Driveways, access points**
- **Pedestrian generators and pedestrian crossing activity**
- **Bus stops and transit operations**
- **Type of roadway cross-section**
- **Roadway character, roadway context, and road type**
- **Traffic signal locations and spacings**
- **State and local police inputs**

Richmond Highway between Belvoir Rd and Jeff Todd Way



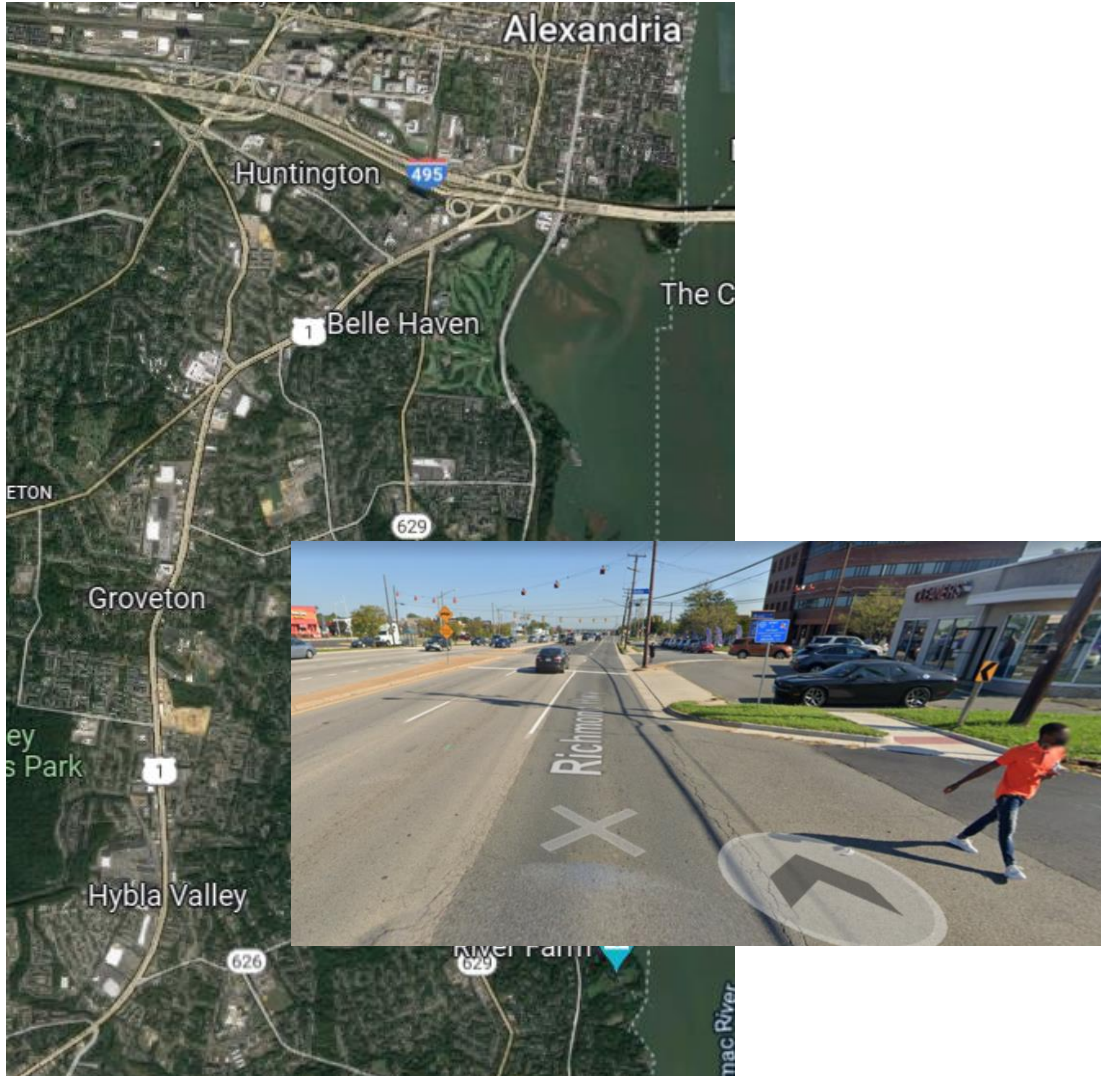
- Three lanes in each direction
- Wide grass median divided highway
- Limited number of signals and access points
- Good design features
- High observed speeds:
 - 50th percentile = 45.1 mph
 - 85th percentile = 52.2 mph
- Relatively lower crash rate (77.6 crashes / 100 Million Vehicle Miles)
 - Statewide Primary Highway Crash Rate = 124.3
 - VDOT NoVA District Primary Crash Rate = 125.9
- Enforcement likely to be lower priority

Richmond Highway between Jeff Todd Way & Buckman Road/Mt. Vernon Highway



- Two travel lanes in each direction
- Varying median:
 - None
 - Painted transitions for turn lanes
 - Two-way center left-turn only lane
- Observed speeds:
 - 50th percentile: 42.4, 38.8 & 40.8 mph
 - 85th percentile = 49.1, 45.7 & 48.8 mph
- High crash rate (216.6 crashes / 100 Million Vehicle Miles)
 - Statewide Primary Highway Average Crash Rate = 124.2
 - VDOT NoVA District Average Crash Rate = 125.9

Richmond Highway between Buckman Road/Mt. Vernon Highway & the Capital Beltway (I-495/I-95)



- Three travel lanes in each direction
- Median divided
- Frequent signal-controlled intersections
- Frequent driveways and access points
- Numerous pedestrian-vehicle and vehicle-vehicle crossing conflict points
- Observed speeds:
 - 50th percentiles = 38.5, 37.7 & 39.5 mph
 - 85th percentile = 46.8, 44.8, & 46.8 mph
- High crash rate (174.8 – 205.6 crashes / 100 Million Vehicle Miles)
 - Statewide Primary Highway Average Crash Rate = 124.2
 - VDOT NoVA District Average Crash Rate = 125.9
- Higher incidence of ped/bike crashes and speed-related crashes compared to other sections

Speed Limit Study – Recommendations

Section	Length (miles)	Current Speed Limit (mph)	Recommended Speed Limit (mph)
From Belvoir Road to Jeff Todd Way	0.72	45	45
From Jeff Todd Way to I-495 / I-95 (Capital Beltway)	7.31	45	35

- Speed limit on Richmond Highway south of Belvoir Road would be maintained at 45 mph

