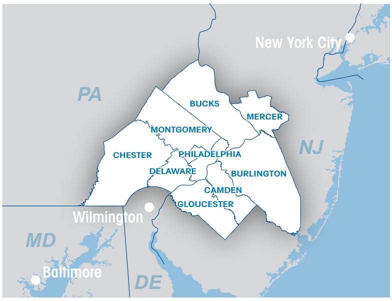
VISSIM STANDARDS PROJECT

Summary of Year Two Findings

June 2013

DELAWARE VALLEY
dvrpc
REGIONAL PLANNING COMMISSION



The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

DVRPC fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. DVRPC's website (www.dvrpc.org) may be translated into multiple languages. Publications and other public documents can be made available in alternative languages and formats, if requested. For more information, please call (215) 238-2871.

Table of Contents

Figures and Tables

I. Introduction

This report presents the second year's findings for the VISSIM Standards Project (VSP). The VSP was a two-year effort conducted by Delaware Valley Regional Planning Commission (DVRPC) staff to quantify several microsimulation default values and calibration factors (measurements), ultimately to assist in improving microsimulation modeling in the Delaware Valley. Combined, the two years' work quantified the following measurements.

Year One (DVRPC Publication # 12011)

- free-flow speed;
- signal throughput; and
- rolling-stop speed.

Year Two

- vehicle composition;
- heavy vehicle speed on steep slopes; and
- standstill distance.

DVRPC staff primarily use the VISSIM platform for microsimulation modeling. VISSIM is a microscopic-scale traffic flow modeling software program. The work conducted for this study was intended to be useful when working with VISSIM, though the results may have value for users of other microsimulation platforms.

This project resulted from encountering unknown variables during the course of prior VISSIM projects. The study team felt that by conducting a study such as this, future microsimulation modeling efforts would benefit. The results were to be shared to extend the benefit to the widest audience possible.

The results of this project are not meant to replace data collection for individual microsimulation projects. However, for various reasons the values determined for this project may suffice for individual projects, or at least aspects of individual projects. The best source of data remains site-specific data collection.

Site-Specific Data

VISSIM Standards Project Results

Default Values

Data collection for this project was conducted at a wide variety of locations and contexts so as to be representative of the nine-county DVRPC region. When applicable, results were subcategorized into context-derived subcategories, similar to those shown in the *Smart Transportation Guidebook* (2008, DVRPC Pub. No. 08030A).

As a capstone to this project, all project results that could be preloaded into a VISSIM input file were loaded. The electronic file is available by request.

II. Study Process

At the start of this project, the study team sought a diverse group of VISSIM users from throughout the DVRPC region to serve as study advisors. PTV America, the software vendor, supplied a list of local users. Invitations were sent and an advisory committee was formed. For Year One, the advisory committee consisted of 12 individuals representing 10 organizations or consulting firms. For Year Two, two individuals had moved on from their place of employment, leaving the advisory committee with 10 members representing nine organizations or consulting firms. Year Two study advisors are listed below. The study advisors were tasked with recommending measurements and reviewing findings.

- Christopher Burke, PE, Urban Engineers;
- Michael Howard, Delaware River Port Authority;
- Troy Illig, PE, PTOE, Parsons Brinkerhoff;
- Randy Johnson, PE, PTV America;
- Regan Miller, PE, Michael Baker Corporation;
- Raj Paradkar, PE, Michael Baker Corporation;
- Dave Petrucci, PE, PTOE, Borton-Lawson;
- Emily Scholl, EI, McCormick Taylor;
- Fang Yuan, Delaware Valley Regional Planning Commission; and
- Jason Zhang, PE, Orth-Rodgers and Associates.

Based on input received from the study advisors, the study team selected three measurements for Year Two. The study team collected and formatted data, and sought feedback from the study advisors. Feedback was incorporated into future iterations of the work.


SPRING GARDEN ST
TRANSCOR
77033
332

III. Vehicle Composition

Vehicle composition in VISSIM refers to the proportion of each of three basic vehicle types that operate on a road network. VISSIM uses Car, HGV (heavy goods vehicle), and Bus as vehicle types. The data used to formulate the vehicle composition values was obtained from recent vehicle classification counts conducted by DVPRC's Office of Travel Monitoring. DVRPC classifies vehicles in accordance with the Pennsylvania Department of Transportation's (PennDOT) Roadway Management System (RMS) Traffic Data Screen Vehicle Classification 13-class scheme. Classes 1 through 3 correspond with Car, Class 4 is equivalent to Bus, and the remainder comprise HGV. The data was subcategorized by context. An Urban Freeway subcategory was considered, though there was insufficient data available to create a credible sample.

Methodology

The following actions were undertaken to complete this measurement.

- ➔ Recent vehicle classification counts were reviewed and sorted by context.
- ➔ The data was combined and reformatted to the Car, HGV, and Bus subcategories.
- ➔ Data was disaggregated by time of day.
- ➔ Statistics were calculated and the resulting tables were built.

Results

The results are presented in **Tables 1–4**. Results are presented for the total day, and for common analysis time periods. The minimum, average, and maximum vehicle composition percentages are given for each vehicle class, by time period, and further by context. Many of the vehicle classifications counts used for this analysis were by direction, thereby explaining why the number of counts exceeds the number of locations.

Table 1: Suburban Center Vehicle Composition

SUBURBAN CENTER									
Measurement Locations									6
Total Classification Counts									12
Total 24-Hour Volume									70,417
PERCENTAGE by VEHICLE TYPE									
	Car			Bus			HGV		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Total Day	92.6	**95.2**	96.8	0.3	**0.8**	1.9	2.8	**4.0**	5.9
AM Peak (7 AM-9 AM)	88.5	**93.4**	95.9	0.1	**1.1**	4.9	3.5	**5.5**	7.4
Midday (9 AM-4 PM)	92.5	**95.9**	97.9	0.1	**0.5**	1.6	1.4	**3.6**	7.2
PM Peak (4 PM-6 PM)	92.1	**94.5**	96.4	0.3	**0.8**	1.9	3.1	**4.7**	6.8
Evening (6 PM-7 AM)	93.9	**96.6**	98.5	0.1	**0.6**	2.2	1.5	**2.8**	5.7

DVRPC, 2012

Table 2: Suburban Corridor Vehicle Composition

SUBURBAN CORRIDOR									
Measurement Locations									5
Total Classification Counts									10
Total 24-Hour Volume									106,738
PERCENTAGE by VEHICLE TYPE									
	Car			Bus			HGV		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Total Day	87.8	**93.3**	96.9	0.3	**0.7**	1.2	2.8	**6.0**	11.3
AM Peak (7 AM-9 AM)	84.6	**92.6**	96.0	0.4	**0.9**	1.8	3.5	**6.5**	13.7
Midday (9 AM-4 PM)	89.6	**94.9**	98.3	0.1	**0.4**	0.8	1.6	**4.7**	10.0
PM Peak (4 PM-6 PM)	84.8	**91.8**	95.6	0.4	**0.8**	1.8	4.0	**7.4**	14.1
Evening (6 PM-7 AM)	90.2	**94.9**	98.4	0.3	**0.6**	1.5	1.4	**4.5**	9.0

DVRPC, 2012

Table 3: Suburban Freeway Vehicle Composition

SUBURBAN FREEWAY									
Measurement Locations									5
Total Classification Counts									9
Total 24-Hour Volume									183,653
PERCENTAGE by VEHICLE TYPE									
	Car			**Bus**			**HGV**		
	Min	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
Total Day	85.5	**89.2**	94.0	0.5	**1.1**	2.0	5.6	**9.7**	12.8
AM Peak (7 AM-9 AM)	79.8	**88.2**	93.3	0.3	**1.3**	3.4	6.3	**10.5**	16.7
Midday (9 AM-4 PM)	89.3	**93.1**	97.2	0.2	**0.6**	1.2	2.4	**6.3**	10.3
PM Peak (4 PM-6 PM)	78.6	**86.4**	93.0	0.7	**1.5**	3.0	6.3	**12.1**	18.4
Evening (6 PM-7 AM)	87.3	**91.0**	94.7	0.3	**0.8**	1.8	4.8	**8.2**	11.8

DVRPC, 2012

Table 4: Urban Road Vehicle Composition

URBAN ROAD									
Measurement Locations									6
Total Classification Counts									10
Total 24-Hour Volume									66,158
PERCENTAGE by VEHICLE TYPE									
	Car			**Bus**			**HGV**		
	Min	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
Total Day	92.9	**95.2**	97.5	0.5	**1.1**	1.7	1.7	**3.7**	5.7
AM Peak (7 AM-9 AM)	90.1	**93.2**	97.5	0.7	**1.6**	3.5	1.4	**5.2**	8.2
Midday (9 AM-4 PM)	94.3	**96.5**	98.4	0.0	**0.8**	1.8	0.9	**2.7**	4.7
PM Peak (4 PM-6 PM)	90.3	**94.2**	98.1	0.6	**1.2**	1.9	1.0	**4.6**	8.3
Evening (6 PM-7 AM)	94.1	**96.6**	98.1	0.2	**0.9**	1.4	1.0	**2.5**	4.7

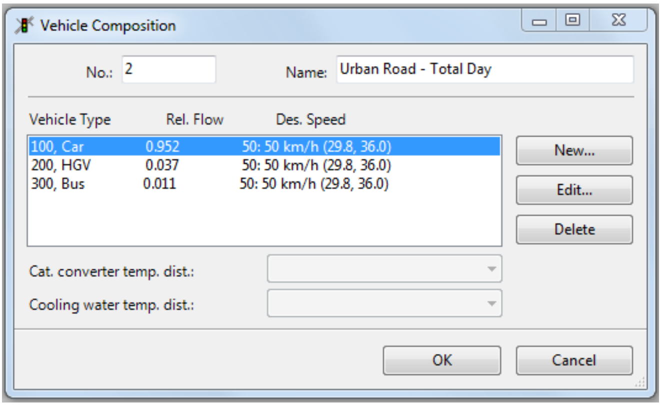
DVRPC, 2012

Incorporation into VISSIM

Vehicle compositions in VISSIM are defined as the proportion of each vehicle class (Car, HGV, or Bus) that enters the network at a given vehicle input location. Vehicle composition distributions are formulated in VISSIM through the Traffic menu, and the appropriately named Vehicle Compositions submenu. Vehicle compositions may be edited or created. When creating a new vehicle composition, select *new*, name the new vehicle composition, and select *new* to add vehicle classes. Add the relative flow rate accordingly. The relative flow rate is what is shown as "PERCENTAGE by

VEHICLE TYPE” in **Tables 1–4**. **Figure 1** shows a sample Vehicle Composition.

Figure 1: Sample Vehicle Composition



No.: 2

Name: Urban Road - Total Day

Vehicle Type	Rel. Flow	Des. Speed
100, Car	0.952	50: 50 km/h (29.8, 36.0)
200, HGV	0.037	50: 50 km/h (29.8, 36.0)
300, Bus	0.011	50: 50 km/h (29.8, 36.0)

Cat. converter temp. dist.:

Cooling water temp. dist.:

DVRPC, 2012

After one or more vehicle classifications are defined, they are then applied to vehicle inputs. This is accomplished by right clicking on a vehicle input and using the pull-down menu to select the desired vehicle input.

Observations

A few observations were noted during data collection and analysis.

- The proportion of HGV traffic is greatest during peak periods.
- Buses do not constitute a significant proportion of vehicle traffic during any time period, or on any road context.
- Suburban freeways exhibit the widest variation of vehicle composition across the time periods.

- The default VISSIM vehicle composition is 98 percent Car, 2 percent HGV, and 0 percent Bus.
- Across all road contexts and time periods, heavy vehicles constitute a significantly larger percentage of total traffic than the 2 percent VISSIM default value—ranging between 2.5 and 12.1 percent.
- If data specific to a study area is not available, the values found in this analysis provide a better representation of vehicle composition in the Delaware Valley Region than the VISSIM default values.

In summary, this measurement considered 22 facilities under four context subcategories. Forty-one vehicle classification counts, all pneumatic tube type, with a total sample size of 426,966 vehicles were used for this analysis.

IV. Heavy Vehicle Speed on Steep Slopes

The purpose of this measurement was to quantify the degree to which heavy vehicles travel at slower speeds on steep slopes. For this measurement, heavy vehicles are defined as Classes 4 through 13 in PennDOT's RMS Traffic Data Screen Vehicle Classification scheme, which includes buses. Due to the nature of this measurement, data collection took place in suburban and rural areas.

The terms *slope* and *grade* are interchangeable in this chapter, and refer only to the ascending direction.

Methodology

The following actions were undertaken to complete this measurement.

- ➔ Five locations were identified and prescreened. Each location has a long, consistent slope, and some type of accommodation for data collection. The five locations follow:
    - o US 30, WB, West Sadsbury Township, Chester County, 4.1 percent;
    - o US 322, NB, East Brandywine Township, Chester County, 4.4 percent;
    - o PA 611, SB, Warrington Township, Bucks County, 5.1 percent;
    - o Ridge Pike, EB, Lower Providence Township, Montgomery County, 5.9 percent ; and
    - o PA 100, NB, West Vincent Township, Chester County, 8.5 percent.
- ➔ Data was collected at each location with a radar gun for both cars and heavy vehicles.

- Collected data was combined, formatted, and analyzed.
- A table and graph were prepared.

Results

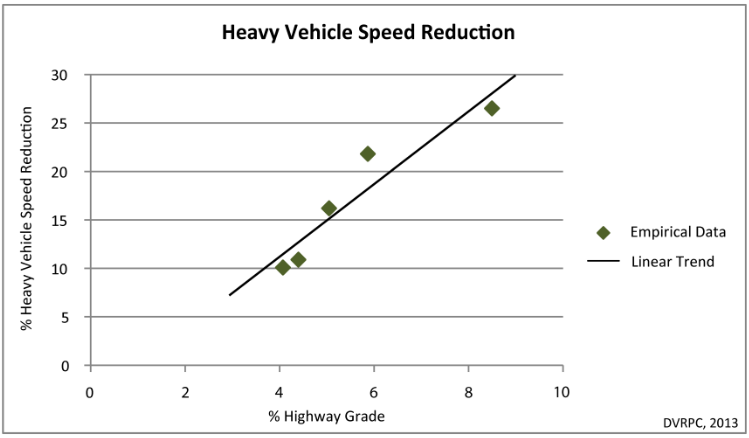
The results are presented in both table and graph format. Results from each location were plotted and a linear trend was identified. The results follow in **Table 5** and **Figure 2**.

Table 5: Heavy Vehicle Speed Reduction Data

		Grade	Speed			HGV
Route	Municipality	(%)	Limit	Car	HGV	Reduction (%)
US 30	West Sadsbury Township	4.1	55	50.8	45.7	10.0
US 322	East Brandywine Township	4.4	45	44.0	39.2	10.9
PA 611	Warrington Township	5.1	45	45.2	37.9	16.2
Ridge Pike	Lower Providence Township	5.9	45	48.4	37.8	21.9
PA 100	West Vincent Township	8.5	45	44.2	32.5	26.5

DVRPC, 2013

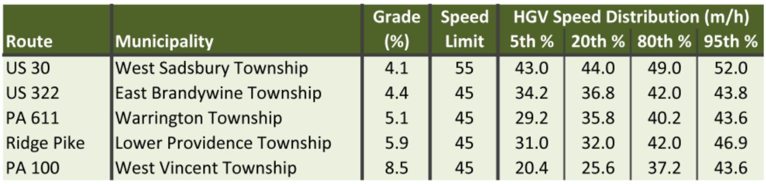
Figure 2: Heavy Vehicle Speed Reduction Graph



Incorporation into VISSIM

VISSIM assigns weight and power distributions randomly, with certain limits, to vehicles classified as HGV. These distributions, when combined, determine the speed of HGVs on slopes. Tests were conducted using the measurement locations and the default HGV classification, as well as the default weight and power distributions. The results of the tests found that the greater the slope, the greater error between observed and modeled results (4.1 percent slope modeled 1.5 miles per hour slower; 8.5 percent slope modeled 6 miles per hour slower). The findings indicate that the default values should not be used, particularly for steep slopes. To accurately model HGV speed on slopes, two methods are available: (1) use the weight and power distributions to calibrate slopes; or (2) do not enter slopes into the network and control speed via desired speed decisions—this study's recommendation. Calibrating weight and power distributions may be difficult if there is more than one slope in a VISSIM network. **Table 6** provides the speed distributions for each of the measurement locations.

Table 6: Heavy Vehicle Speed Distributions



Route	Municipality	Grade (%)	Speed Limit	HGV Speed Distribution (m/h) 5th %	20th %	80th %	95th %
US 30	West Sadsbury Township	4.1	55	43.0	44.0	49.0	52.0
US 322	East Brandywine Township	4.4	45	34.2	36.8	42.0	43.8
PA 611	Warrington Township	5.1	45	29.2	35.8	40.2	43.6
Ridge Pike	Lower Providence Township	5.9	45	31.0	32.0	42.0	46.9
PA 100	West Vincent Township	8.5	45	20.4	25.6	37.2	43.6

DVRPC, 2013

To model heavy vehicle speed on slopes, the following course of action is recommended.

- ➔ Determine the heavy vehicle speed reduction percentage using **Figure 2**.
- ➔ Construct desired speed distributions as necessary using values from **Table 6**, or interpolated values. *Summary of Year One Findings*, page 13, has detailed

instructions for constructing desired speed distributions.

- ➔ Place desired speed distributions at the beginning and end of up-slope grade changes.
- ➔ Assign the desired speed distribution which reflects the heavy vehicle speed reduction to the beginning of the up-slope. Assign only for HGV and Bus classes.
- ➔ Revert to the previously assigned speed at the point where the up-slope ends.

Do not enter a gradient percentage in the Link Data—Other attributes.

Observations

A few observations were noted during data collection and analysis.

- ➔ Composition within heavy vehicle classes varied widely by location. For instance, the US 30 location was nearly all Class 9 (18-wheel semi) while other locations had few Class 9 vehicles.
- ➔ A few heavy vehicles traveled at higher speeds than passenger cars.
- ➔ The suburban corridor free-flow speed data collected in *Year One* provides a fair representation of Car classes (1–3).
- ➔ VISSIM default power and weight distributions do not provide results similar to those found in this analysis. Heavy vehicle speed on steep slopes can more accurately be modeled by adjusting power and weight distribution values, or by using reduced speed areas.

- ➔ Though it ultimately did not factor into the process, there was no way to determine if heavy vehicles were loaded or empty.
- ➔ The results of this analysis found average heavy vehicle speeds on steep slopes approximately 3 to 13 percent higher than the VISSIM default values provide.

In summary, vehicles traveling on five slopes with varying gradients had their speed recorded to determine the degree to which heavy vehicles travel slower than vehicles classified as Car. The ultimate result was a trend line reflective of the percentage difference between Car classes and Bus and HGV classes on varying degrees of gradient. Despite composition differences among heavy vehicles by location, a logical trend line was able to be developed. Using the results of this analysis, heavy vehicle speeds on slopes in the Delaware Valley may be more accurately modeled.

Heavy vehicle speeds on down-slopes were not measured. Considering that trucks often use reduced gears on down-slopes, this may be a measurement for consideration if future analyses are performed or, at a minimum, be considered when modeling down-slopes.


NOT IN SERVICE

V. Standstill Distance

Standstill distance refers to the distance between queued vehicles—rear bumper to front bumper. It is useful for calibrating controlled intersections and queue lengths. VISSIM offers two default standstill distances: (1) the Wiedemann 74 approach has a 6.56-foot average standstill distance with a variation of +/– 3.28 feet (one meter), and (2) the Wiedemann 99 approach uses an average standstill distance of 4.92 feet. Wiedemann 99 considers standstill distance as the driver behavior CC0 parameter. The standstill distance is used to calculate the additive part of desired safety distance for Wiedemann 74, and driver behavior CC1—Headway time and safety distance for Wiedemann 99.

The purpose of this measurement was to develop a default standstill distance for the Delaware Valley. Considering that standstill distance factors into other model parameters, the ultimate purpose of each model should determine the degree to which the standstill distance reflects reality.

Methodology

A diverse set of measurement locations were selected. Both left-turn and through/right queues were considered.

- ➔ Using chalk and a measuring wheel, 5-foot segments were clearly marked along approaches to signalized intersections.
- ➔ During red signal phases when queues were building, observers walked along the queues noting the distances between stopped vehicles. The distances were estimated from the known 5-foot segments, and therefore are likely accurate to the nearest foot.
- ➔ Data was input into a spreadsheet and analyzed.

- A table summarizing the findings was prepared.

Results

The results are presented in **Table 7**. Samples were collected at both urban and suburban locations. Additionally, data was collected for left-turn queues at two locations. Results were not significantly different, in aggregate, for left-turn queues versus through/right queues, or between urban and suburban contexts.

Table 7: Standstill Distance

	Urban	Suburban	Through/ Right	Left Turn	Aggregate
Average (ft.)	9.1	9.2	9.1	9.3	9.1
Max (ft.)	20	20	20	20	20
Min (ft.)	3	3	3	4	3
Standard Deviation (ft.)	3.1	3.3	3.0	3.3	3.2
Number of Samples	274	282	466	90	556

DVRPC, 2013

Incorporation into VISSIM

Standstill distances are adjusted by link behavior type in the Base Data—Driving Behavior Parameter Sets menu. As standstill distance affects other driver behaviors, caution should be exercised when changing standstill distances. Other parameters may need to be adjusted to accommodate the differences, and to avoid adversely affecting driver behaviors.

Observations

A few observations were noted during data collection and analysis.

- There was wide variation in standstill distances, even in individual queues.

- The standstill distances ahead of and behind large trucks was comparable to car—car standstill distances.
- The standstill distance for protected left-turn lane queues did not significantly differ from standstill distances for through-travel lanes.
- Drivers who were not paying attention, or leaving an unreasonably large gap, were not counted. This was rare, though there were instances of gaps of approximately 40 feet.
- The results from this analysis found average standstill distance exceeds the two VISSIM default values. To more accurately model queue lengths and controlled intersection performance the results found in this analysis should be substituted.
- Measured average standstill distance is approximately 40 to 90 percent greater than the VISSIM default values.

In summary, standstill distance data was collected at 12 locations for a total of 566 samples. The analysis found average standstill distance exceeds the VISSIM default values.

VI. Conclusion

This project was conceived as a way to explore several data needs associated with traffic modeling using the VISSIM software platform. To that end, the project was a success in collecting and analyzing an extensive amount of data to assist with future VISSIM modeling projects. Though DVRPC staff often use VISSIM for microsimulation modeling, the results may be useful to users of other microsimulation platforms.

This report complements the *VISSIM Standards Project: Summary of Year One Findings* report (July 2012, DVRPC Pub. No. 12011). During the project's first year free-flow speed, traffic signal throughput, and rolling-stop speed were analyzed. Combined with the project's second year, six VISSIM calibration factors and default values were quantified.

As a capstone to this project a VISSIM input (.inp) file preloaded with the project's findings was thought to be of potential value. As such, a VISSIM input file was prepared. VISSIM version 5.30 was used for the file's creation. Several of the measurements taken for this project could not be preloaded. The preloaded data includes the following:

- free-flow speed distributions for each context and various posted speed limits;
- rolling-stop speed distribution; and
- vehicle compositions by context category and for each analysis time period.

Raw data and the VISSIM input file are available by request.

This report concludes the *VISSIM Standards Project*.

Publication Title: VISSIM Standards Project: Summary of Year Two Findings

Publication Number: 13021

Date Published: June 2013

Geographic Area Covered: Nine-county Delaware Valley Region: Bucks, Chester, Delaware, Montgomery, Philadelphia, Burlington, Camden, Gloucester, and Mercer counties

Key Words: Traffic Modeling, Model Calibration, Microsimulation Modeling, Calibration Parameters

Abstract: This report presents the results of the second year's analyses for the VISSIM Standards Project. Three VISSIM model calibration factors or default input values were quantified in the project's second year: vehicle composition, heavy vehicle speed on steep slopes, and standstill distance. The results can be used to improve microsimulation modeling conducted by DVRPC staff and the region's traffic engineers.

Staff Contact:

Michael Becker
Senior Transportation Planner
☎ (215) 238-2834
🖱 mbecker@dvrpc.org

Delaware Valley Regional Planning Commission
190 N. Independence Mall West, 8th Floor
Philadelphia PA 19106
Phone: (215) 592-1800
Fax: (215) 592-9125
Internet: www.dvrpc.org

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION