

## RESEARCH METHODOLOGY

ATRI conducted an in-depth analysis of each of 250 freight significant highway interchanges using truck position and speed data that were derived from wireless onboard communications systems used by the trucking industry. The four steps in this analysis are as follows:

1. Identification of Study Population: This step consisted of extraction of data for commercial vehicles during all of 2010 at 250 specific locations from a large, anonymous database;
2. Application of Data Quality Tools and Techniques;
3. Application of a Four-Step Analysis Process that Utilizes Vehicle Time, Date and Speed information; and
4. Final Production of Total Freight Congestion Values and Ranking.

The final result of this analysis is a ranking of the 250 bottlenecks.

Each bottleneck was given a “total freight congestion value” using a calculation that factors in the impact of congestion on average commercial vehicle speeds in each study area, includes analysis for 24 one-hour blocks of time, and addresses freight demand for road segments that are located within the study area during each hour-long block of time. The “total freight congestion value” does not represent hours lost, or financial costs due to this delay, but is simply a means by which the researchers could compare the level of severity of each individual bottleneck.

Table 1 displays the calculations used to produce a “total freight congestion value” for an individual bottleneck; the methods are also described below.

The first step in the process is to set a free flow speed. In this research, 55 mph is used for free flow on all 250 bottlenecks.

The second step is a calculation of the miles per hour below free flow; this number is then multiplied on an hour-by-hour basis by the number of commercial vehicles that were part of the corresponding hour block. Thus, commercial vehicles that are not affected by delay produce a delay value of 0. Essentially, for each of the 24 one-hour blocks of time, “vehicle population by hour” is multiplied by “(Free Flow – Average MPH)” to produce an “hourly freight congestion value.”

Finally, the sum of 24 hourly freight congestion values is calculated to produce the “total freight congestion value,” which is the number used to rank the severity of the 250 bottlenecks.

As a final note, the study period (i.e. the timeframe from which data was extracted) included one year of weekday truck position data during all of 2010.

During those time periods (and for specific bottlenecks) certain external factors may have played a role in the final total freight congestion value. This is especially true for those areas that were influenced by ongoing, long-term construction projects.

| Hour of Day | Vehicle Population by Hour | Average MPH by Hour | MPH Below Free Flow<br>=(Free Flow [55]- Average MPH) | Hourly Freight Congestion Value = (MPH Below Free Flow) * (Vehicle Population by Hour) |
|-------------|----------------------------|---------------------|---|--|
| 00:00-01:00 | 687                        | 55.00               | 0.00  | 0  |
| 01:00-02:00 | 711                        | 55.00               | 0.00  | 0  |
| 02:00-03:00 | 744                        | 55.00               | 0.00  | 0  |
| 03:00-04:00 | 700                        | 55.00               | 0.00  | 0  |
| 04:00-05:00 | 784                        | 55.00               | 0.00  | 0  |
| 05:00-06:00 | 979                        | 55.00               | 0.00  | 0  |
| 06:00-07:00 | 1015                       | 53.98               | 1.02  | 1,032  |
| 07:00-08:00 | 1473                       | 38.48               | 16.52   | 24,333   |
| 08:00-09:00 | 1536                       | 38.59               | 16.41   | 25,203   |
| 09:00-10:00 | 1585                       | 49.06               | 5.94  | 9,418  |
| 10:00-11:00 | 1456                       | 54.27               | 0.73  | 1,070  |
| 11:00-12:00 | 1537                       | 55.00               | 0.00  | 0  |
| 12:00-13:00 | 1358                       | 55.00               | 0.00  | 0  |
| 13:00-14:00 | 1420                       | 53.44               | 1.56  | 2,209  |
| 14:00-15:00 | 1521                       | 46.80               | 8.20  | 12,467   |
| 15:00-16:00 | 1654                       | 39.85               | 15.15   | 25,057   |
| 16:00-17:00 | 1465                       | 39.68               | 15.32   | 22,446   |
| 17:00-18:00 | 1609                       | 39.36               | 15.64   | 25,164   |
| 18:00-19:00 | 1186                       | 47.76               | 7.24  | 8,588  |
| 19:00-20:00 | 998                        | 55.00               | 0.00  | 0  |
| 20:00-21:00 | 835                        | 55.00               | 0.00  | 0  |
| 21:00-22:00 | 862                        | 55.00               | 0.00  | 0  |
| 22:00-23:00 | 753                        | 55.00               | 0.00  | 0  |
| 23:00-00:00 | 751                        | 55.00               | 0.00  | 0  |
|             |                            |                     |   | Total Freight Congestion Value = 156,987   |
|             |                            |                     |   | (Sum of Hourly Freight Congestion Values)  |

Table 1: Example of Total Freight Congestion Value Calculation for a Single Freight Bottleneck