Amherst Village Strategic Plan

Supporting Transportation Documents

Village Traffic Spot Speed Study
Data and Analysis

Revision History

Date	Rev.	Name	Comment
12/17/2014	0.1	A. Patnaude	Working Draft (shared w/ Amherst PD & DPW)
12/28/2015	0.2	A. Patnaude	Incorporated remaining data sets (draft version sent for internal review and overview given at 1/13/15 Village Strategic Planning meeting)
1/31/2015	0.3	A. Patnaude	Incorporated the new data collection efforts initiated w/ Amherst PD
6/8/2015	1.0	A. Patnaude	First Draft (no comments from working group)

- The intended audience for this report is the Traffic & Safety Working Group. However, the traffic speed graphs, volume graphs and initial observations are of general interest.
  - This document will remain “Preliminary” until reviewed and approved by the Traffic & Safety Working Group.
- This report purposefully avoids proposing any traffic mitigation strategies, its sole purpose is a quantitative problem statement .
- This report is intended to be a working document meaning revisions will be made as other data sets are analyzed or refinements in the analysis are required.

Acknowledgement

- Special Thanks to Matt Waitkins at NRPC for his help and interest in providing the needed data sets to perform this analysis.

Data Reduction
Field Observations to Frequency Table

Field Observations

Vehicle	Speed (mph)
Car 1	20
Car 2	7
Car 3	11
Bus 1	17
Bus 2	21
Car 4	17
Car 5	5
Car 6	25
Truck 1	30
Car 7	11
Car 8	7
Car 9	18
Truck 2	29
Car 10	12
Bus 3	10
Bus 4	16
Car 11	24
Car 12	15
Bike 1	17
Car 13	13
Car 14	20
Car 15	23
Car 16	33
Car 17	18
Truck 3	40
Truck 4	23
Bike 2	4
Car 18	19
Car 19	16
Car 20	28

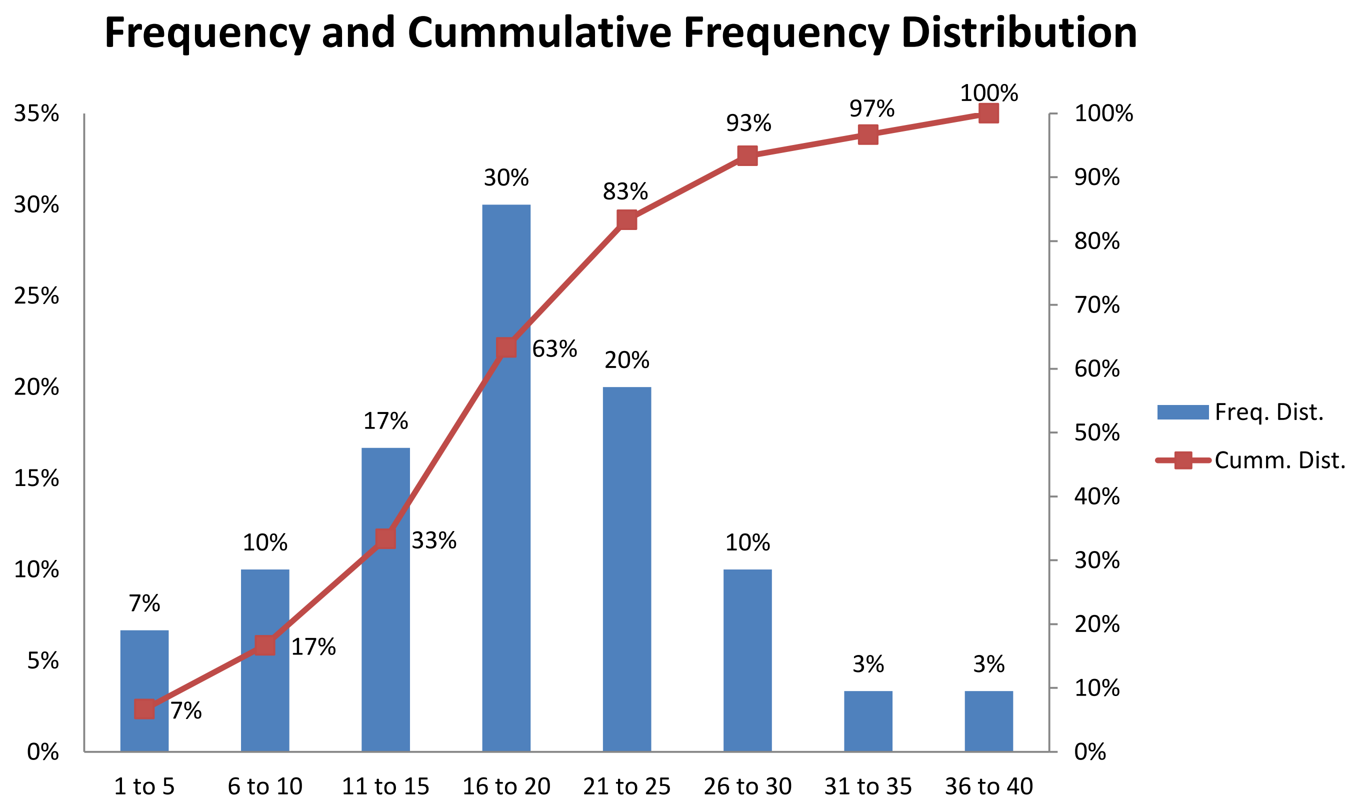
Reduction of
many observations

into a possibly much
smaller number of buckets

Frequency Table with 5 mph Buckets

Speed (mph)	Frequency	% Frequency	Cummulative Speed (mph)	Cummulative Frequncy	% Cummulative Frequency
1 to 5	2	7%	1 to 5	2	7%
6 to 10	3	10%	1 to 10	5	17%
11 to 15	5	17%	1 to 15	10	33%
16 to 20	9	30%	1 to 20	19	63%
21 to 25	6	20%	1 to 25	25	83%
26 to 30	3	10%	1 to 30	28	93%
31 to 35	1	3%	1 to 35	29	97%
36 to 40	1	3%	1 to 40	30	100%

Data Reduction
Frequency and Cumulative Distribution



- Graphical representation of previous frequency table

Measure of Central Tendency
Mean

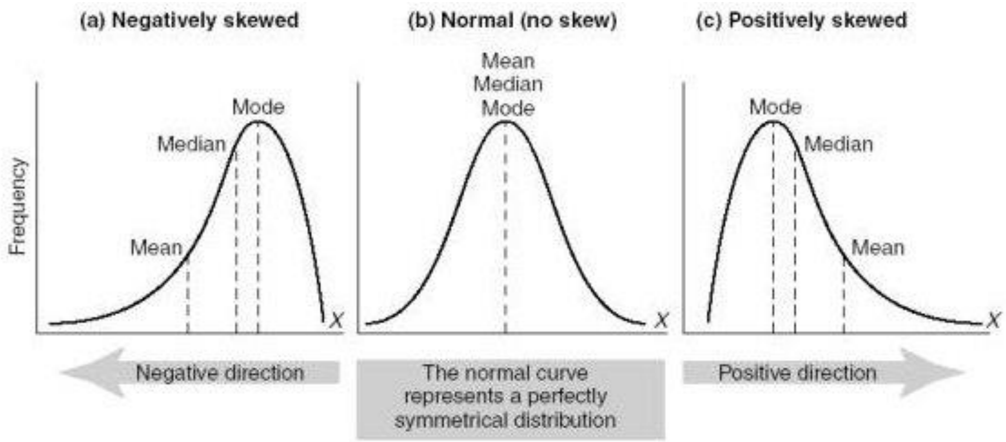
- Mean (μ) – the first moment or physically represents the center of gravity of a probability distribution
- The estimate of the mean ($\hat{\mu}$) calculated from the frequency distribution is given by:

$$\hat{\mu} = \frac{1}{N}\sum_{i=1}^{M} f_i \cdot mp_i$$

  - Where N is the total number of observations
  - M is the total number of frequency bins or buckets
  - f_i is the frequency count for the i^{th} point in the frequency distribution
  - mp_i is the mid-point of the frequency bin or bucket
- Physical Interpretation: The mean is the speed at which the frequency distribution would balance.

More Measures of Central Tendency

- Median – The speed that divides the distribution into equal parts.
  - There are as many observations higher than the median as there are lower than the median
- Mode – The single value speed that is most likely to occur.



- Pace – the 10 mph increment in which the highest percentage of drivers are observed.

Measures of Dispersion

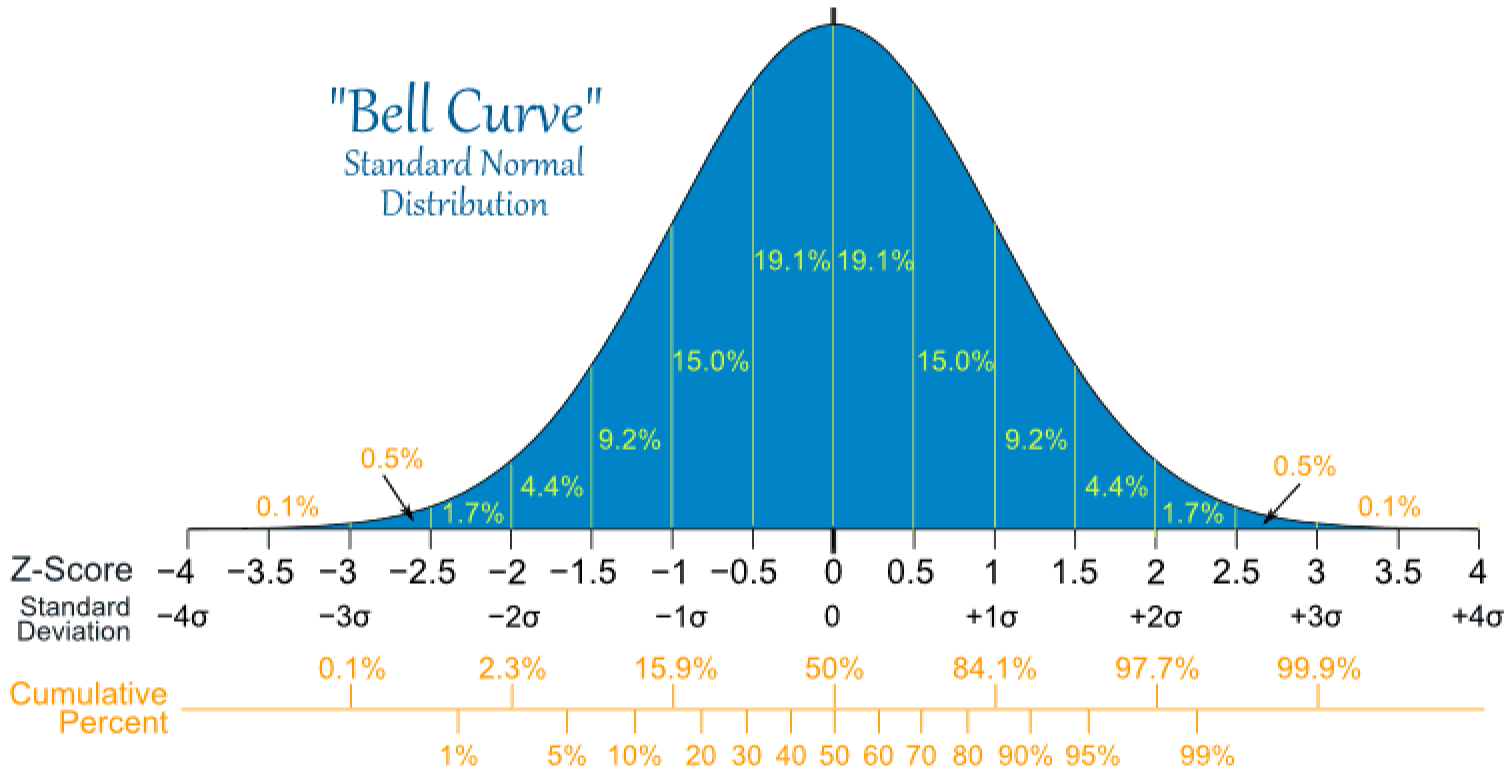
- Variance (σ^2) – the 2nd moment or physically represents the moment inertia of a probability distribution
- The estimate of the variance ($\hat{\sigma}^2$) calculated from the frequency distribution is given by:

$$\hat{\sigma}^2 = \frac{1}{N}\sum_{i=1}^{M} f_i \cdot (mp_i - \hat{\mu})^2$$

  - Where N is the total number of observations
  - M is the total number of frequency bins or buckets
  - f_i is the frequency count for the i^{th} point in the frequency distribution
  - mp_i is the mid-point of the frequency bin or bucket
  - $\hat{\mu}$ is the estimate of the mean previously described
- Physical Interpretation: Given the frequency distribution was spinning about the center of gravity (mean)
  - The moment of inertia is the measure of how difficult it would be to stop the frequency distribution from spinning
  - Figure skaters pull in their arms to decrease their moment of inertia there by increasing angular velocity (this is the conservation of angular momentum)
- Standard Deviation (σ) – simply the square root of the variance

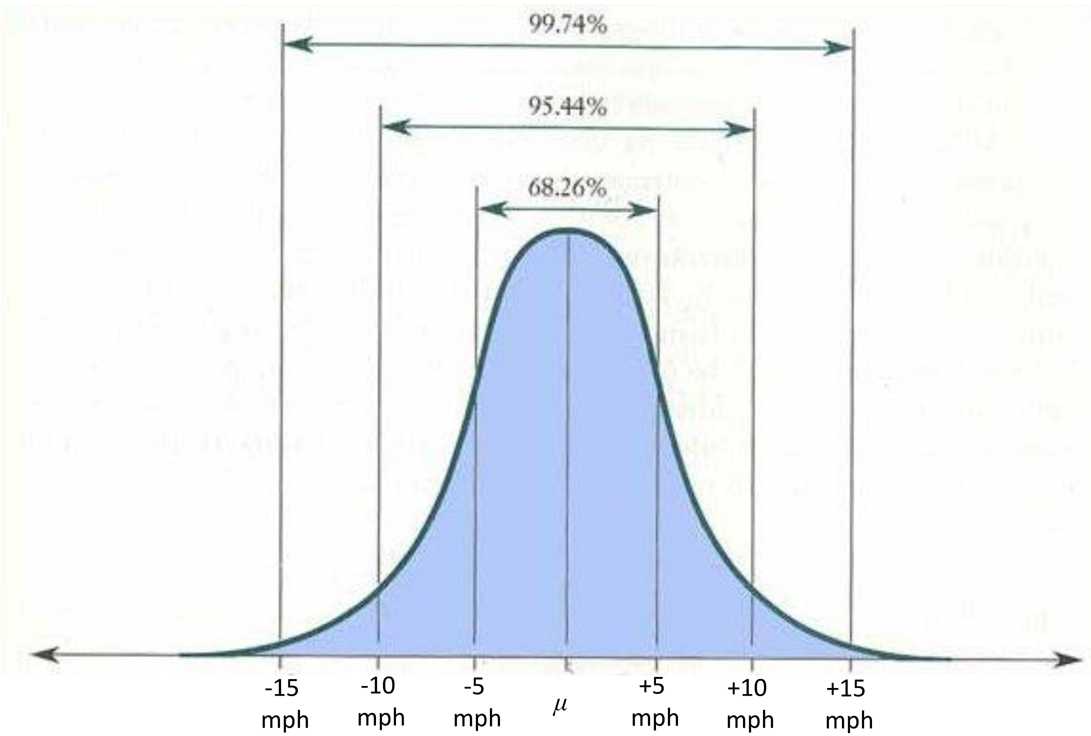
Normal Gaussian Distribution
(aka Bell Curve)

- Most speed distributions tend to be statistically normal
  - The frequency distribution can be fully described with just the mean and variance
  - The standard deviation has a well known relationship to both the cumulative and frequency distribution



Free Flow Speed Distribution

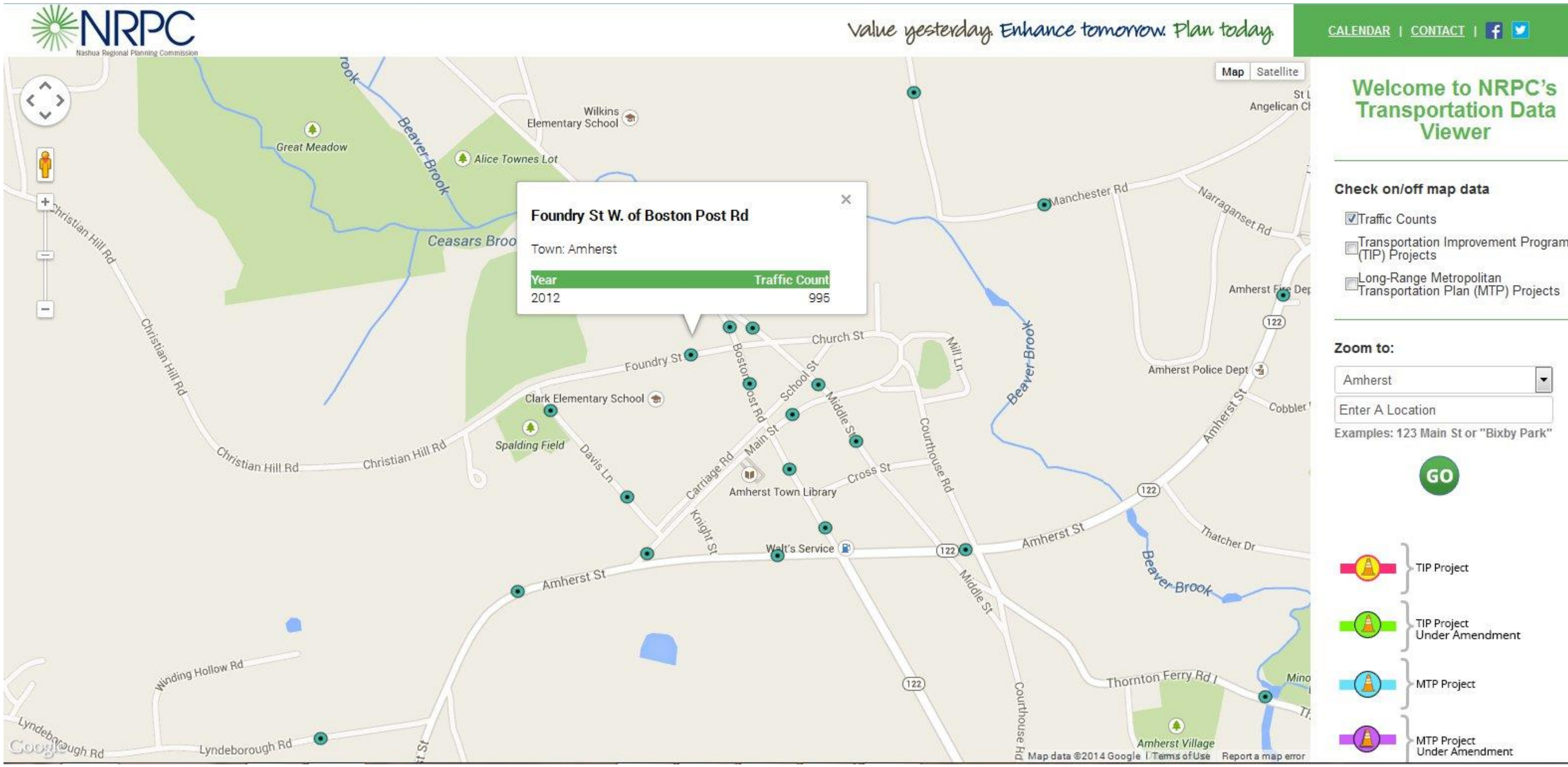
- Free flowing traffic is traffic where there are no constraints placed on a driver by other vehicles on the road
  - Traffic is said not be free flowing when it exceeds some critical flow density that is found at maximum throughput
- Typically free-flowing traffic has a standard deviation of 5 mph
  - 10 mph Pace contains approximately 68% of the speed observations



Effective Speed Limit within a Free Flow Distribution

- The 85th percentile speed reflects the collective judgment of the vast majority of drivers as to a reasonable speed for given traffic and roadway conditions.
  - Notice the 85% cumulative speed is approximately one standard deviation above the mean speed
  - The Manual on Uniform Traffic Control Devices (MUTCD) recommends that the speed limit near the 85th percentile speed of free-flowing traffic.
  - For our purposes we will be using it as the effective speed limit for an existing population as to compare with the posted speed limit
    - Its original purpose was for the operating speed method setting speed limits
- From the previous typical speed frequency distribution w/ standard deviation of 5mph
  - 85% of the traffic is traveling at the speed limit or below
  - 10% of the traffic is traveling at the speed limit to 5 mph above
  - 4.8% of the traffic is traveling at the 5mph to 10 mph above the speed limit
    - Warning might be issued
  - 0.2% of the traffic is traveling at the 10 mph above the speed limit
    - Citation might be issued
- For example, given an approx. 6,000 cars/day on Boston Post Road this could equate to (assuming an impractical 24/7 police presence):
  - 288 warnings/day
  - 12 citations/day
  - Or put another way, a random 1-hour daily police spot check could result on average in 12 warnings and 1 citation every other day for conforming traffic.
- So even with a traffic population effectively obeying the speed limit per MUTCD guidelines, there may be warnings and citations issued

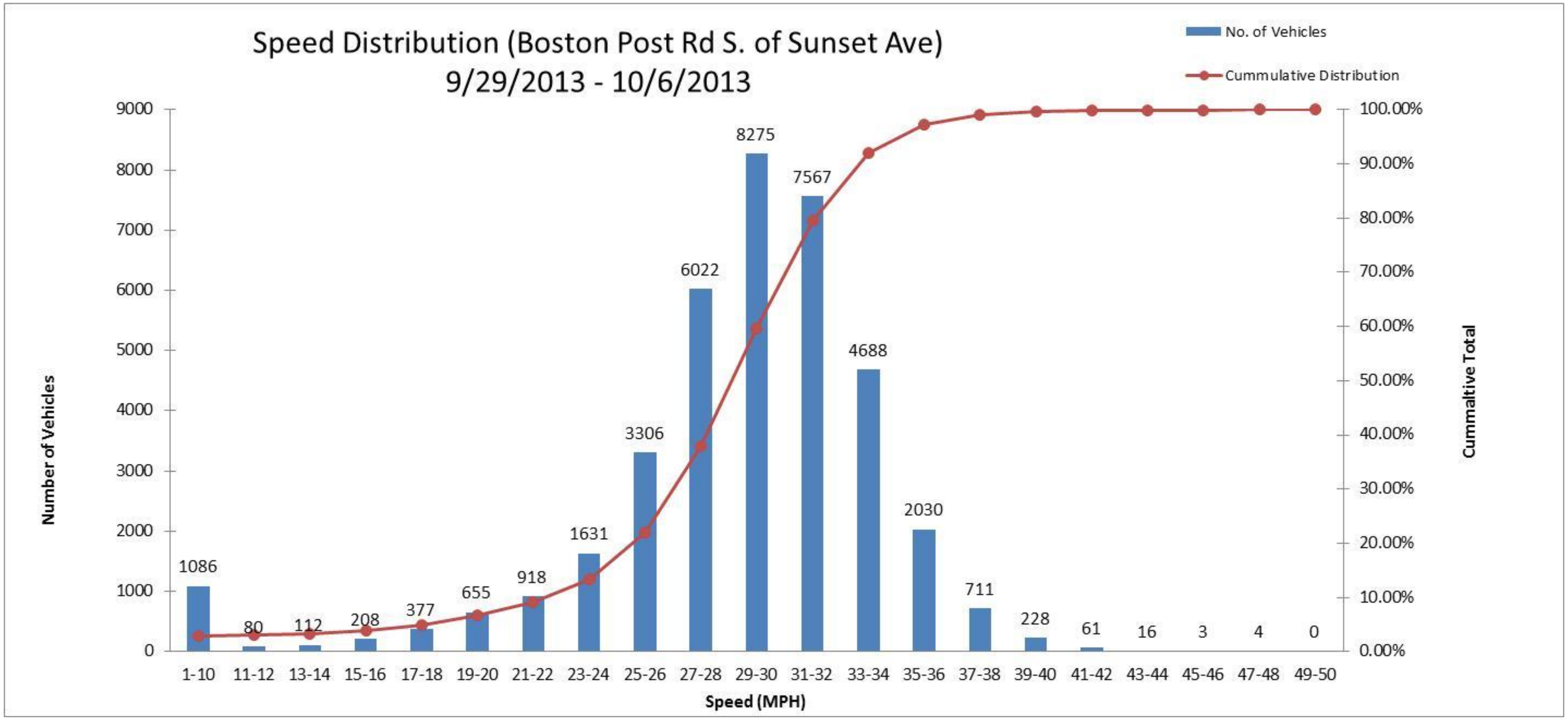
NRPC Traffic Data
Web-Based Traffic Count Map



Example Data Set Walk Through
Boston Post Rd S. of Sunset Ave

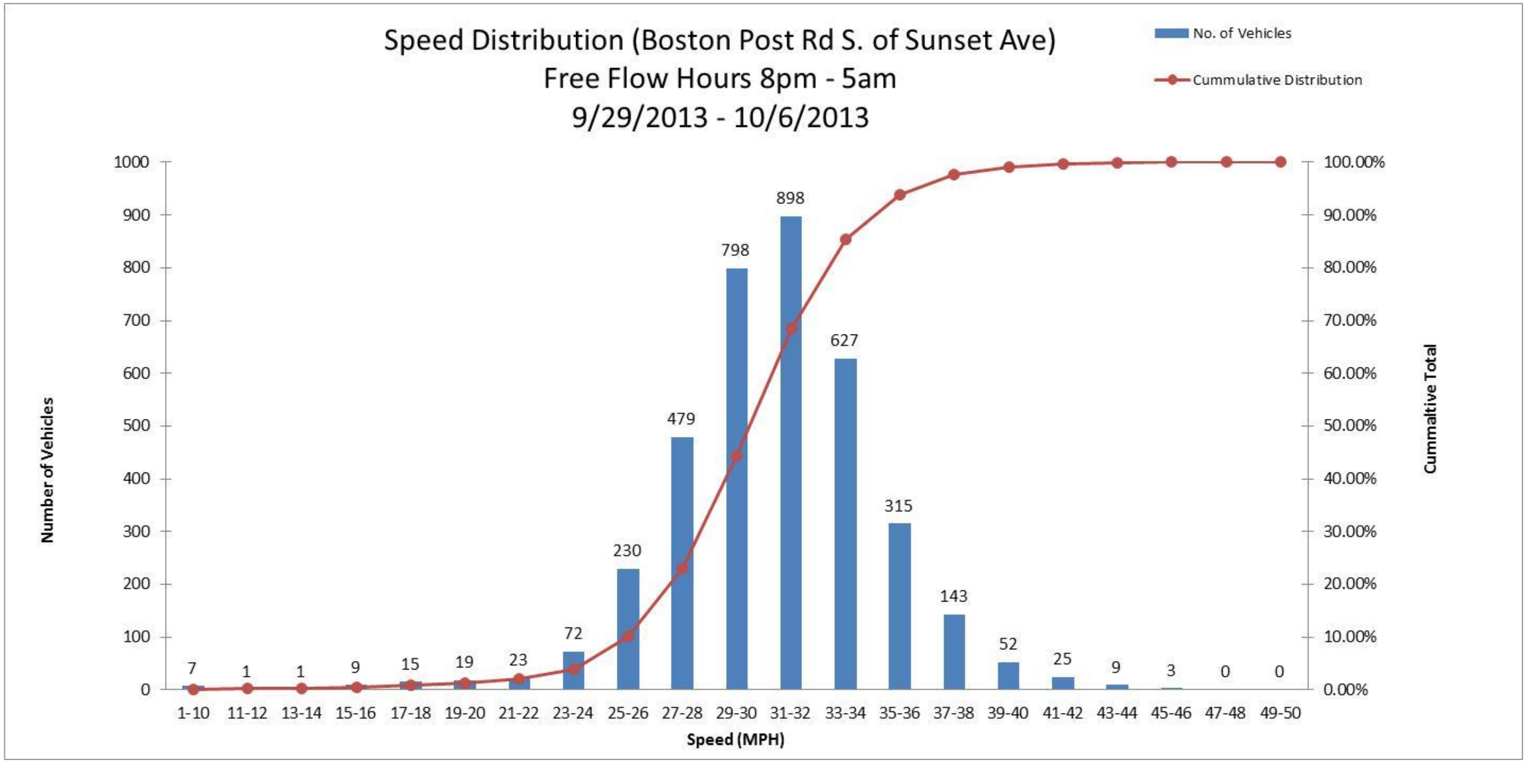
- Data Set Summary:
  - Site Code: 013546
  - 11:00am on Sunday 9/29/2013 thru 8:00am on Sunday 10/6/2013
  - 37,978 speed and vehicle type observations (including northbound and southbound)

Combined NB & SB Stats



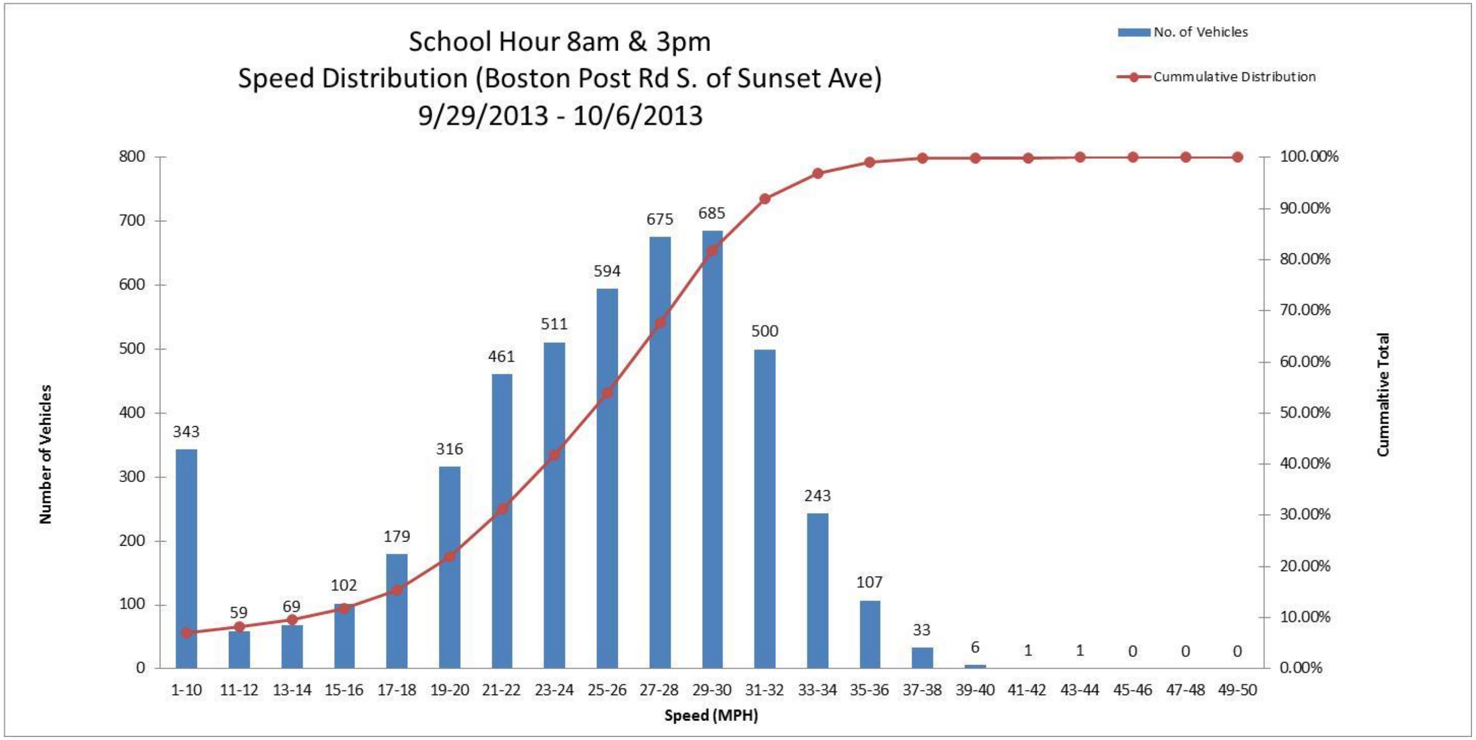
- 85% cumulative speed of 32.9 mph
  - Combined Northbound and Southbound traffic
- 10 mph pace of 25 mph - 34 mph containing 79.8% of the observed traffic
- Mean of 28.7 mph with a median of 29.1 mph (slightly skewed)
- Standard Deviation of 5.8 mph

Combined NB & SB Free Flow Stats



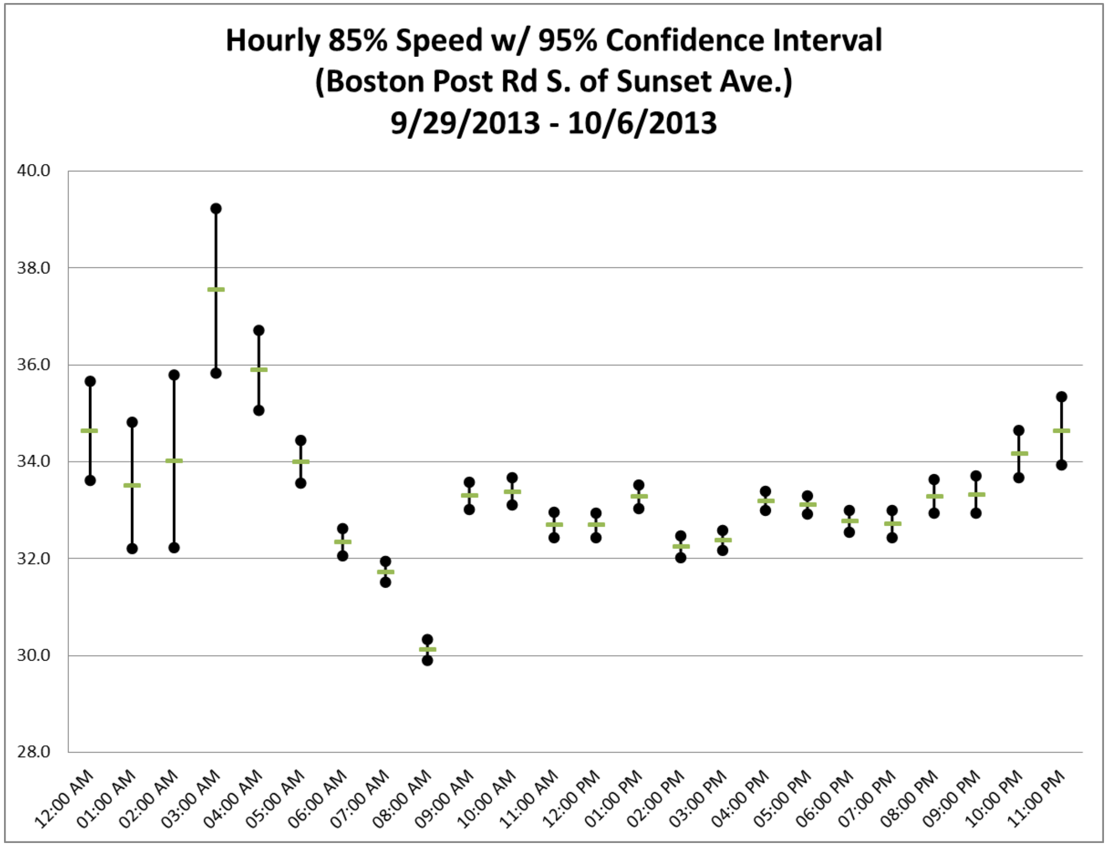
- 85% cumulative speed of 34.0 mph
- 10 mph pace of 27 mph – 36 mph containing 83.7% of the observed traffic
- Mean of 30.9 mph with a median of 30.5 mph (slightly skewed)
  - approaching normal as expected
- Standard Deviation of 4.0 mph

Combined NB & SB School Hour Stats



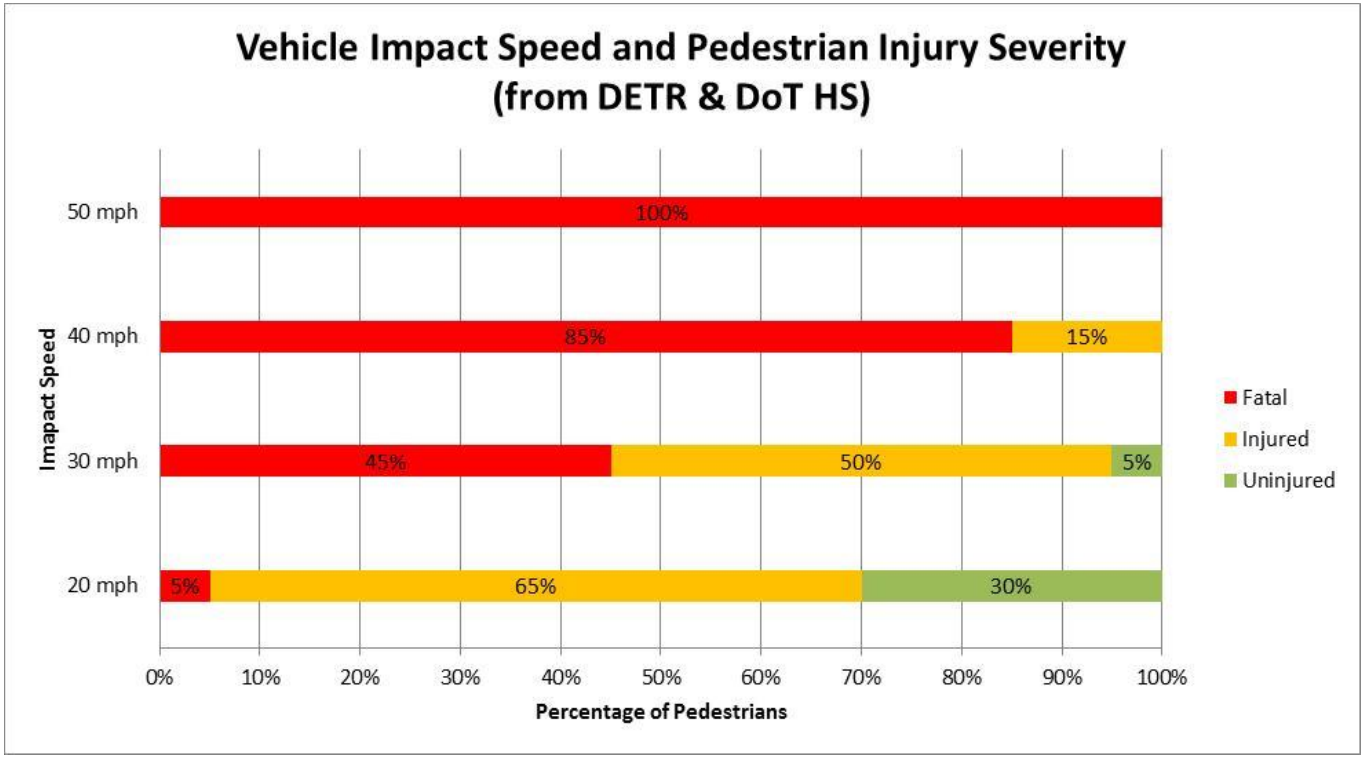
- 85% cumulative speed of 30.6 mph
- 10 mph pace of 23 mph - 32 mph containing 60.7% of the observed traffic
- Mean of 24.5 mph with a median of 25.4 mph (heavily skewed)
- Standard Deviation of 7.3 mph

85% Cumulative Speed vs. Time of Day



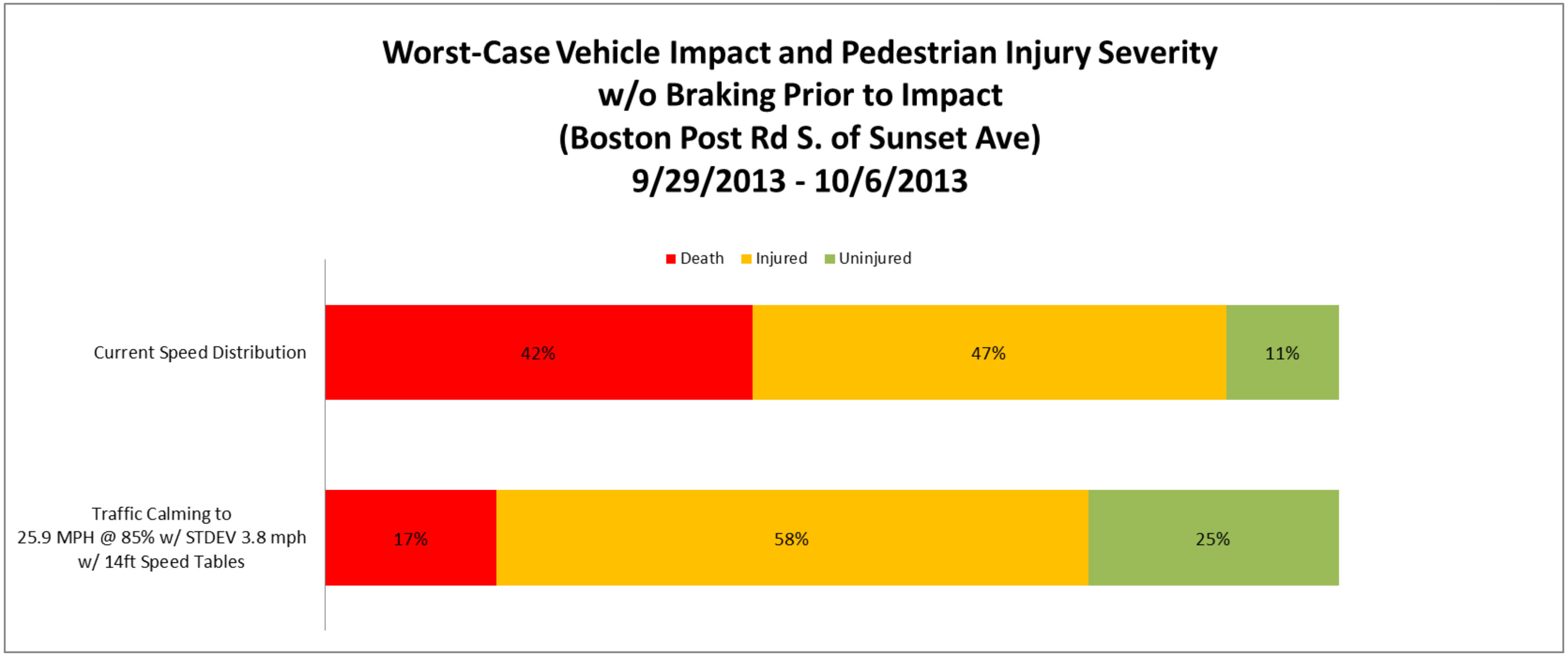
- Highest 85% speeds seen on off hours
  - Particularly very early in the morning during pre-commute hours
- Lowest 85% speeds seen during morning school hour
  - Still well above posted speed limit
  - Morning traffic congestion seemingly the largest contributor to downward shift, otherwise the 3:00 school hour would have a similar 85% cumulative speed due to changes in collective judgment

DoT HS Injury/Fatality Stats



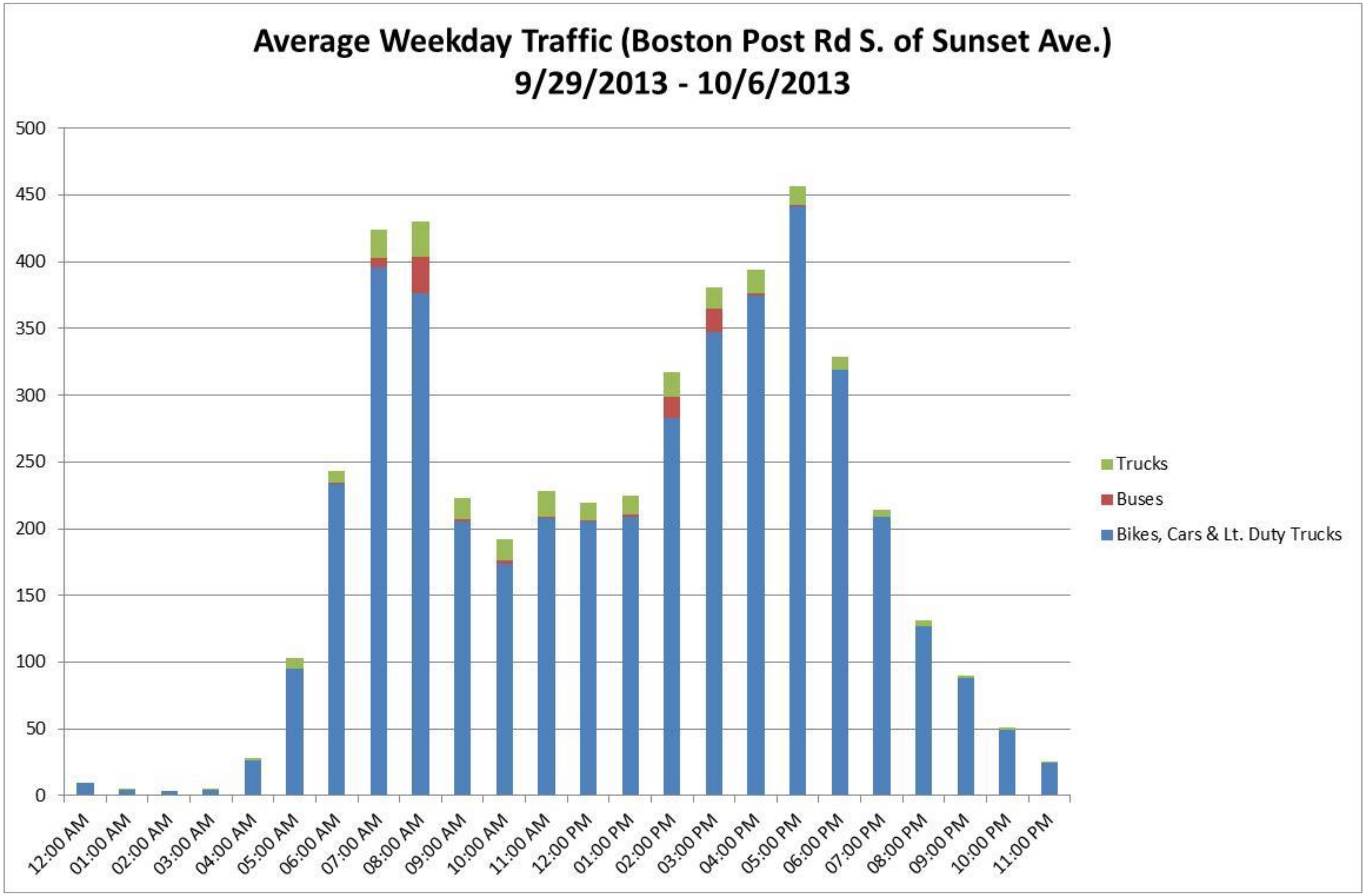
- DERT (UK Department of Environmental, Transport and Regions) leaflet for 20 mph, 30 mph, and 40 mph injury rate is widely referenced and thusly used here
- This was augmented with the fairly uniform conclusion (ref. DoT HR 809 021) that pedestrian fatality is nearly 100% for vehicles traveling above 50 mph
- These injury stats clearly show why a 25 mph speed limit is favored for residential areas
- There exist other pedestrian injury and vehicle speed studies that yield slightly different fatality and injury rates
  - Ex. 2011 Report from the AAA Foundation for Traffic Safety

Application of DoT HS Stats

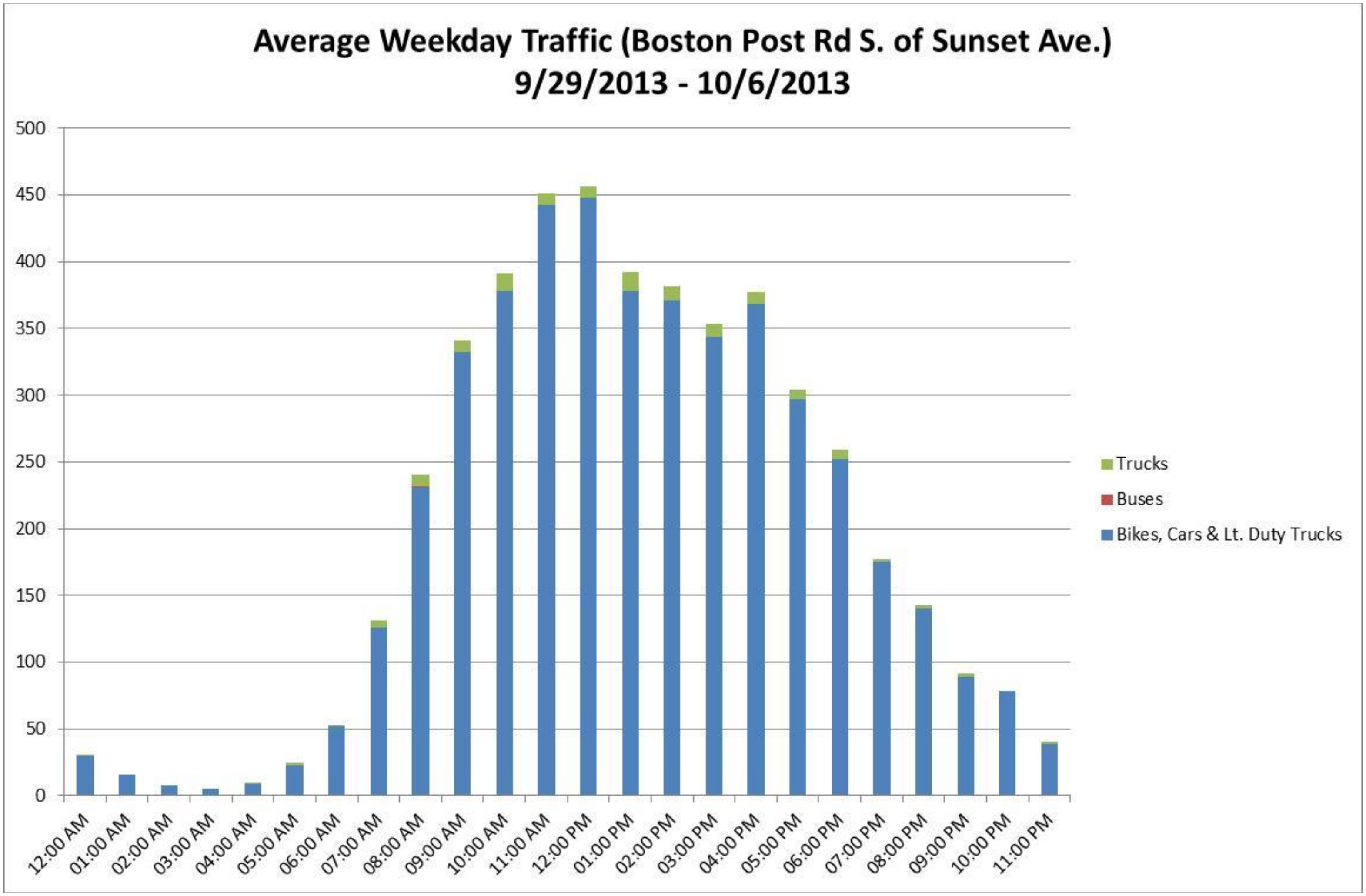


- **Caution must be used** when referencing the above graph as it represents absolute worse-case scenario
  - Assumes **zero** driver reaction/braking prior to impact
  - Traffic calmed pedestrian injury severity stats represent best case improvement localized near a traffic calming measure
  - Speed table used as an **example only**. The resultant speed distribution based on 2002 Minnesota DoT Investigative Report into effectiveness of traffic calming measures.
- It is however illustrative in depicting the improvements in safety for the worst-case scenario by having the overall population speed be essentially conforming to the posted speed limit

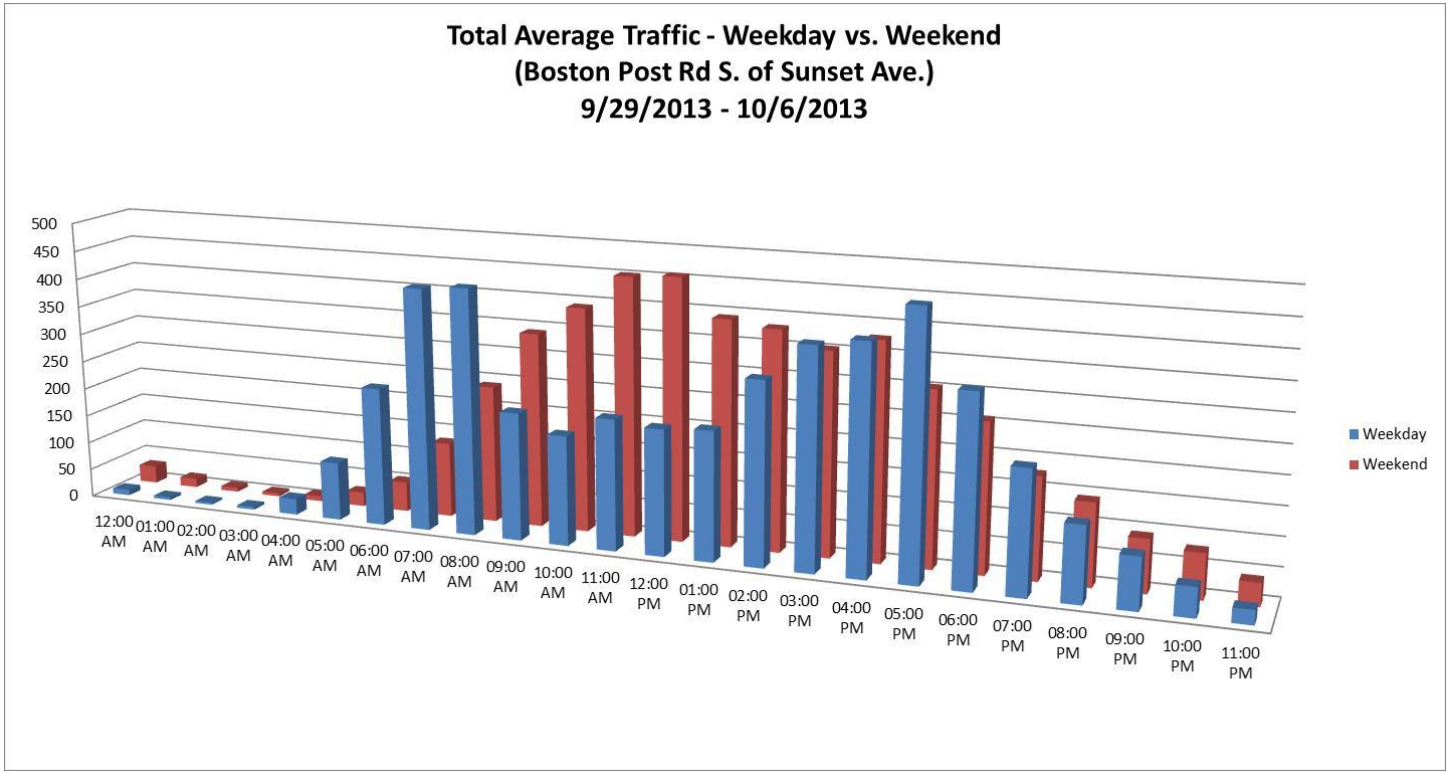
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Assuming there is a significant percentage of cut-through traffic during peak commuting hours:
  - The fact that the weekend peak volume equals weekday peak volume is highly suggestive that there is a significant percentage of cut-through traffic at every hour for the entire week.

Preliminary Observations Boston Post Rd S. of Sunset Ave

- Effective Speed Limit: 33 mph
- Posted Speed Limit: 25 mph
- Northbound and Southbound Speed Differential: 0.0 mph
  - for 85% cumulative speed
- This location has the unfortunate confluence of one of the worst conforming traffic speeds (thus far studied) and high volume of school aged pedestrian traffic
- The 8 am school hour has the best conformance but is likely due to congestion rather than adjustments in the collective judgment
- Off-peak commute volumes suggest significant percentage of cut-through traffic at all times
  - For example: Peak weekday commute volume matches weekend peak volume
  - Cut-through traffic defined as volume levels not explained by Amherst residents
  - It is not known if the percentage of cut-through traffic varies or is constant throughout the day

Potential Future Collection and Analysis

- Fill-in major gaps for existing spot speed study traffic data
  - Amherst PD has new traffic volume and speed collection devices that will be used to this end
    - May require some calibration for effective comparison
    - The collection of the additional data has been initiated – weather and road conditions permitting
  - Amherst DPW has some historical data which might be harvested
  - Mack Hill Road is currently the largest such omission being the second highest volume road in the Village (per NRPC traffic count data)
- Data could potentially be used to create a one-page traffic “heat” map of the village to further aid in data reduction and visualization/understanding of the problem statement
- It may be prudent to baseline traffic volume for all roads in the Village for the purposes of monitoring changes in driver behavior with the potential introduction of traffic calming measures.
  - This represents a fairly significant effort that would need to occur in a relatively short space of time
  - Would allow for traffic flow analysis at intersections

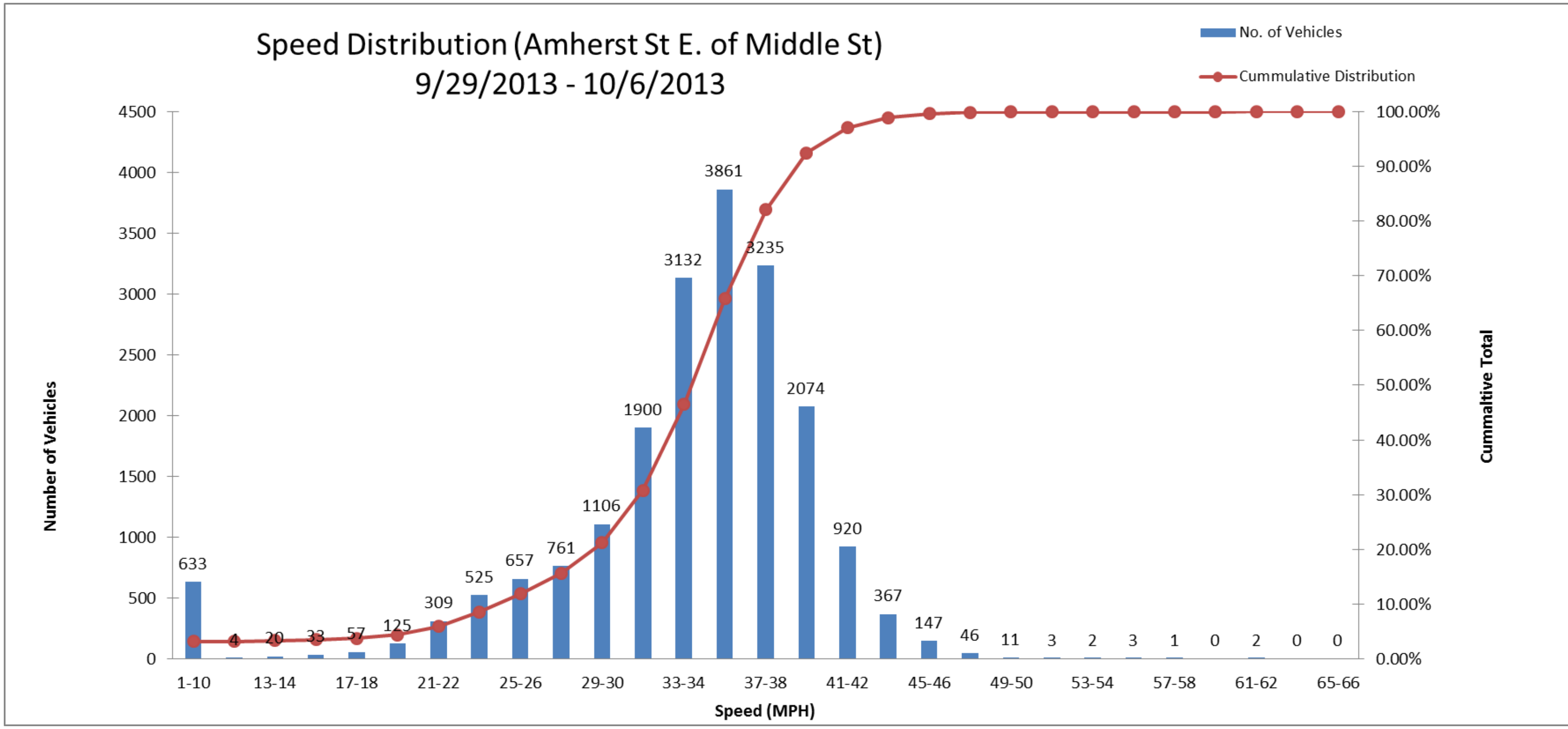
Appendix – Analyzed Data Sets

- Notes:
  - The locations for the data can be found at the NRPC traffic count map
    - http://www.nashuarpc.org/transview
    - **Caution:** The speed and volume data are localized to the point shown on the map, both may vary at different locations along the same road.
  - If not specified the traffic should be assumed to be bi-directional
  - There was little attempt made at reducing the data further, rather it was thought to let the data speak for itself at this early stage.
    - Further graphical reductions such as a one page “Village Traffic Heat Map” will require additional data plus some decided guidelines on what is considered acceptable conforming traffic
  - Analysis was performed on Amherst St. for the purposed of understanding the characteristics of a major thoroughfare
    - The location of Amherst St. East of Middle St. on the NRPC map is part of Rt. 122
    - Amherst St. also represent another major bi-section of the historical district
    - DoT HS death and injury stats were not applied to this set as it was not considered a major school pedestrian route

Amherst St E. of Middle St
Data Set

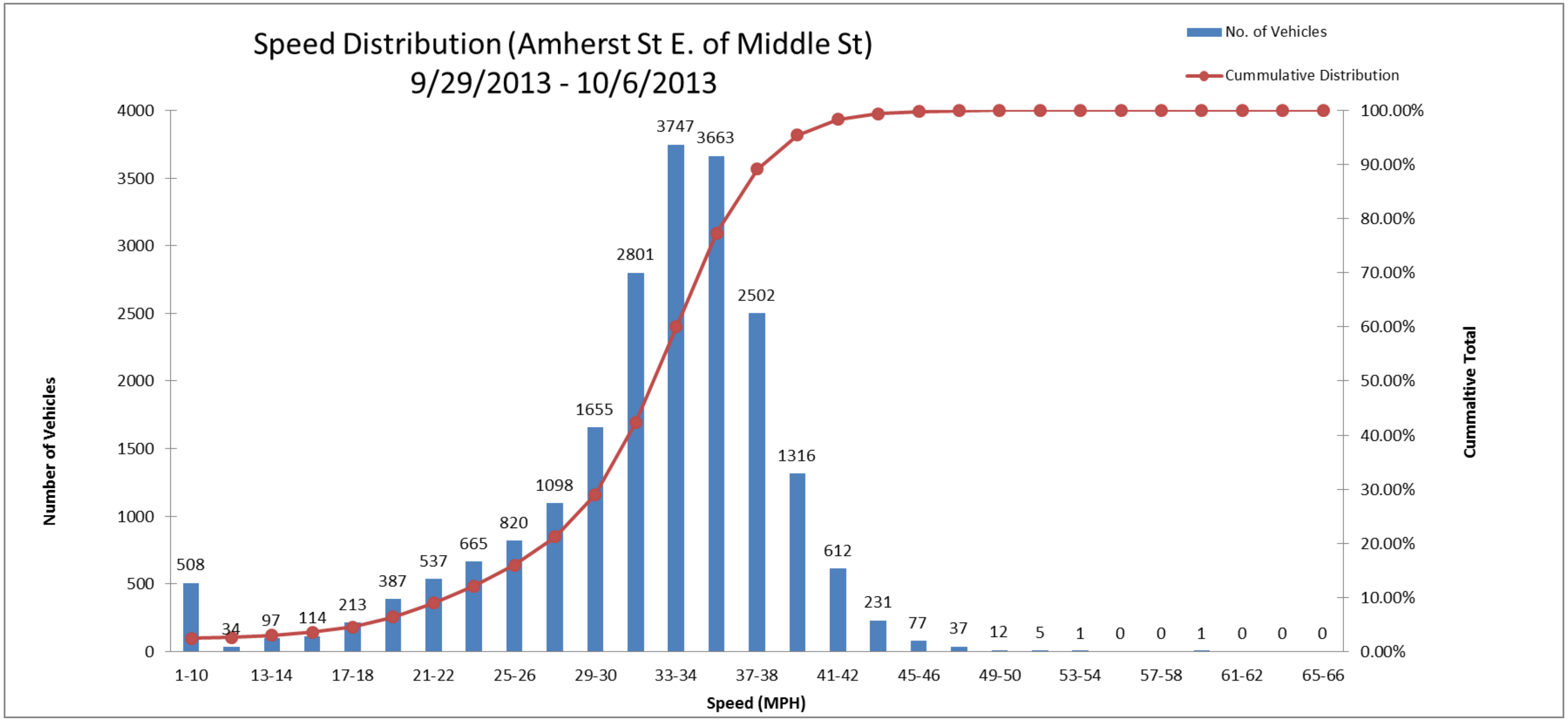
- Data Set Summary:
  - Site Code: 013543
  - 11:00am on Sunday 9/29/2013 thru 7:00am on Sunday 10/6/2013
  - 41,068 speed and vehicle type observations (including eastbound and westbound)

Eastbound Stats



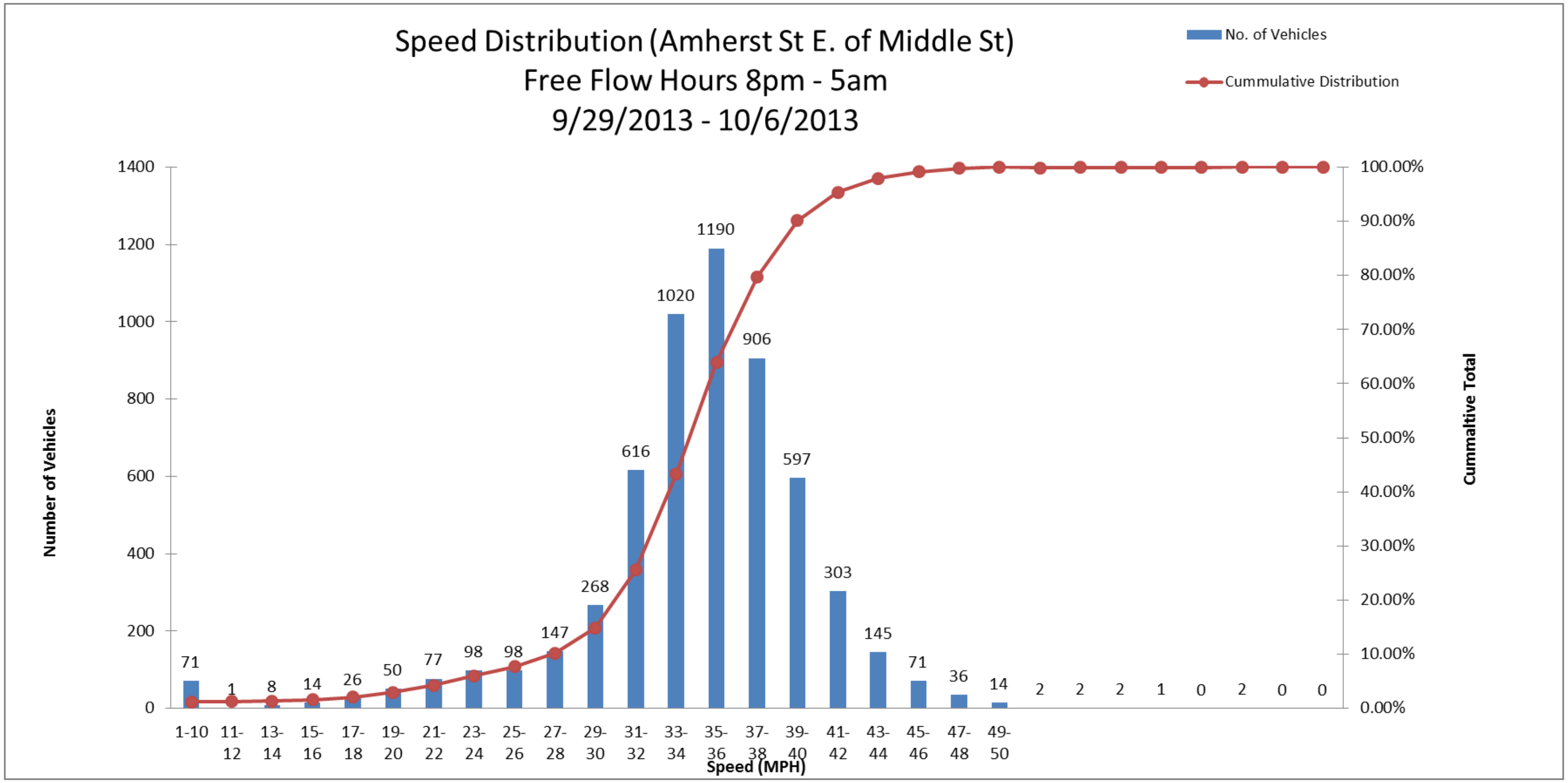
- 85% cumulative speed of 38.6 mph
- 10 mph pace of 31 mph - 40 mph containing 71.2% of the observed traffic
- Mean of 33.4 mph with a median of 34.4 mph (essentially normal)
- Standard Deviation of 7.2 mph

Westbound Stats



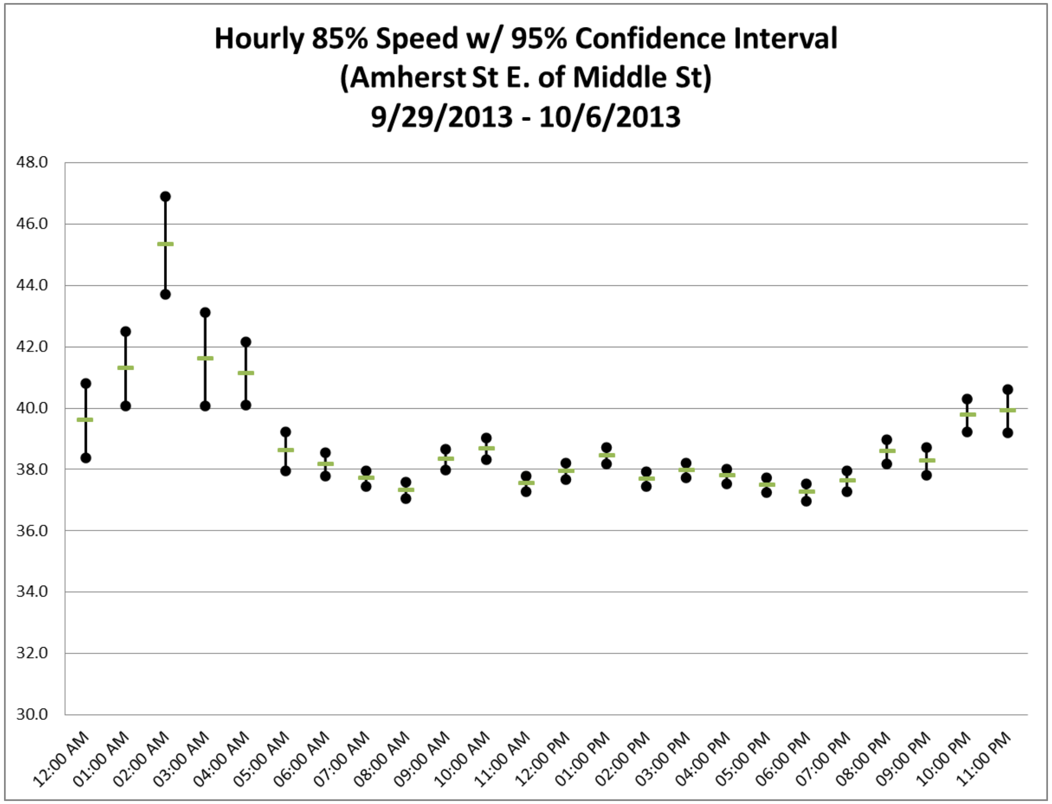
- 85% cumulative speed of 37.3 mph
- 10 mph pace of 29 mph - 38 mph containing 68.0% of the observed traffic
- Mean of 32.0 mph with a median of 32.9 mph (slightly skewed)
- Standard Deviation of 7.1 mph

Combined EB & WB Free Flow Stats



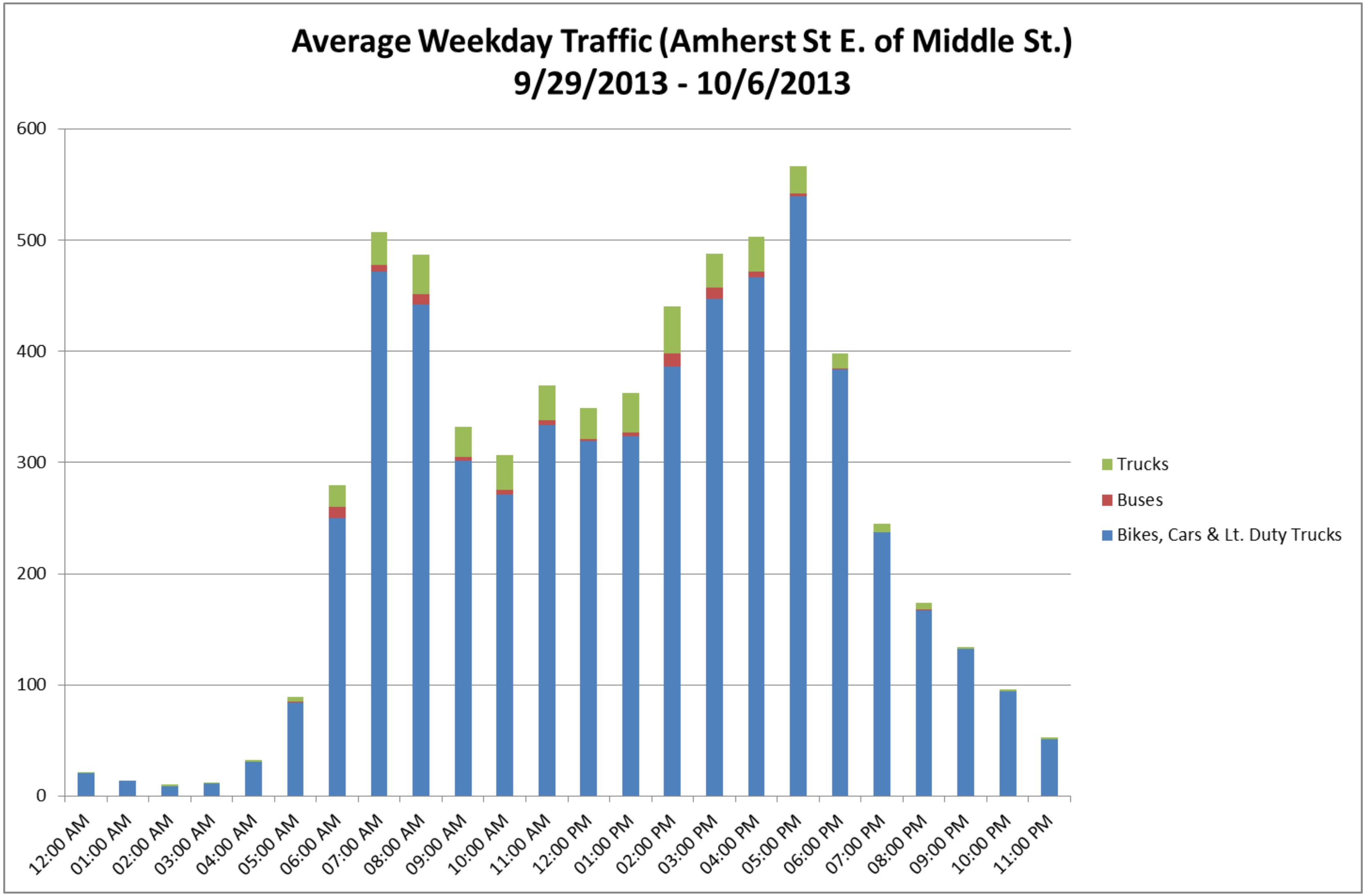
- 85% cumulative speed of 39.0 mph
- 10 mph pace of 31 mph - 40 mph containing 75.2% of the observed traffic
- Mean of 34.5 mph with a median of 34.6 mph (normal)
- Standard Deviation of 6.1 mph

85% Cumulative Speed vs. Time of Day

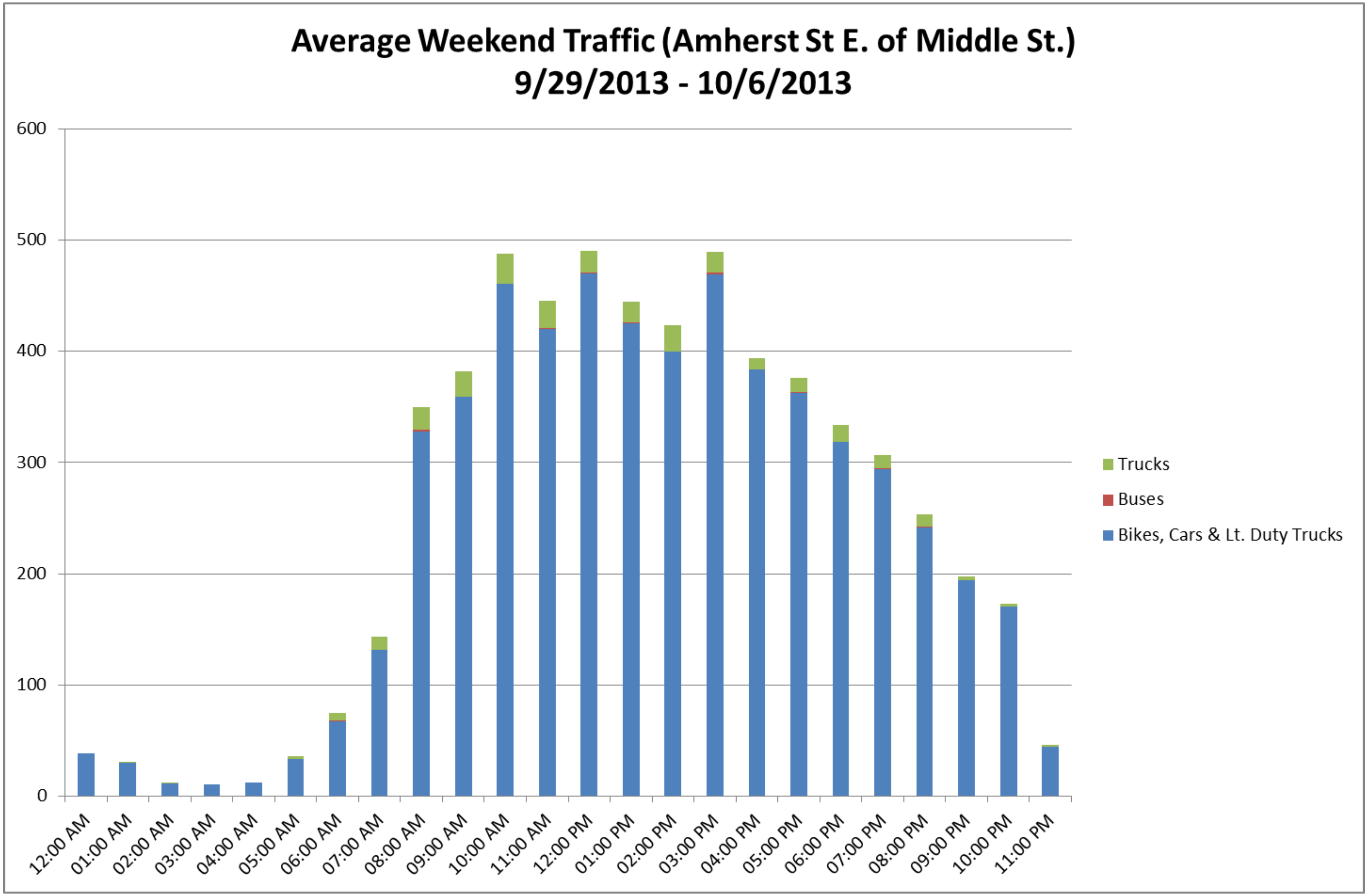


- Highest 85% speeds seen on off hours
  - Particularly very early in the morning even accounting for larger confidence interval due to smaller sample size
- Fairly consistent 85% speed from 5:00am thru 8:00pm

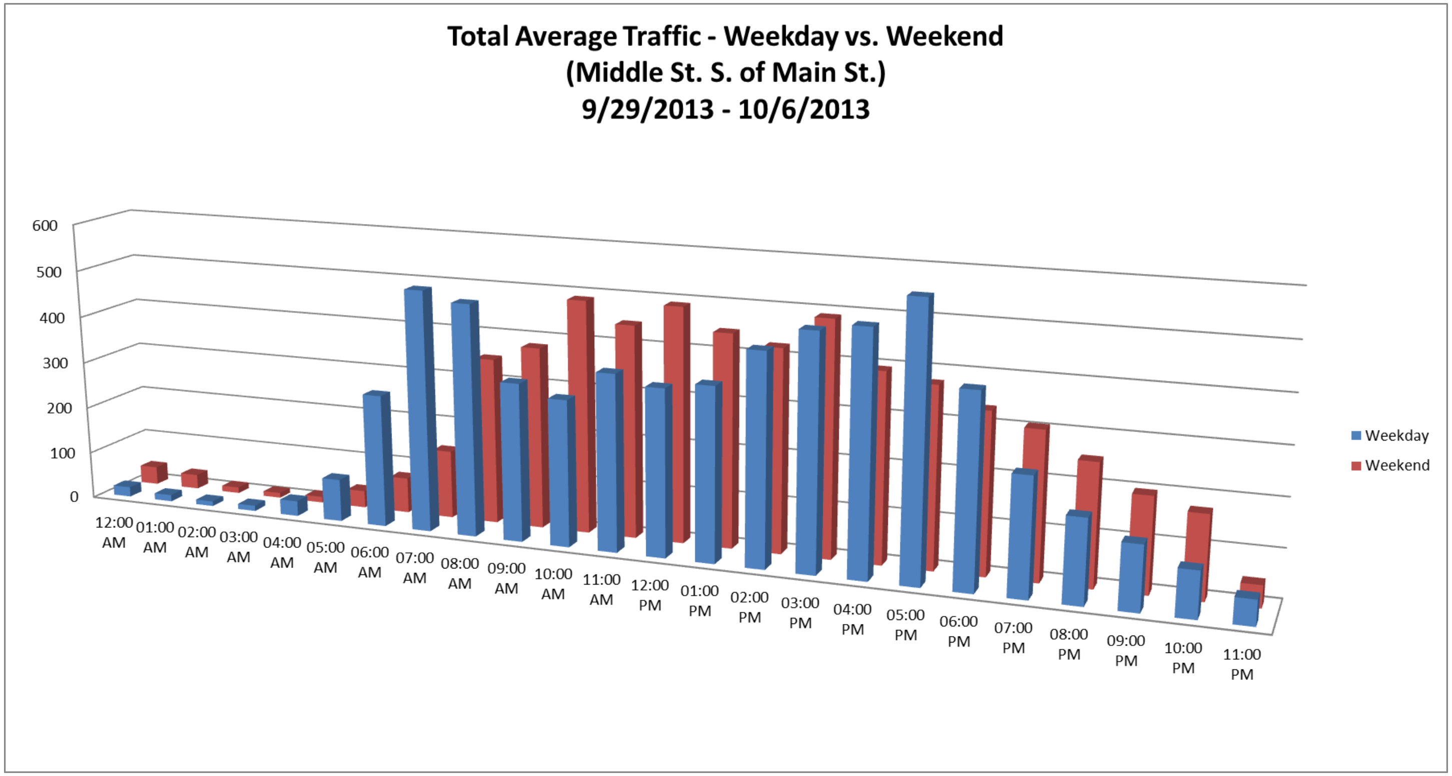
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Assuming there is a some percentage of cut-through traffic during peak commuting hours:
  - The fact that the weekend peak volume equals weekday peak volume is highly suggestive that there is a similar percentage of cut-through traffic at every hour for the entire week.

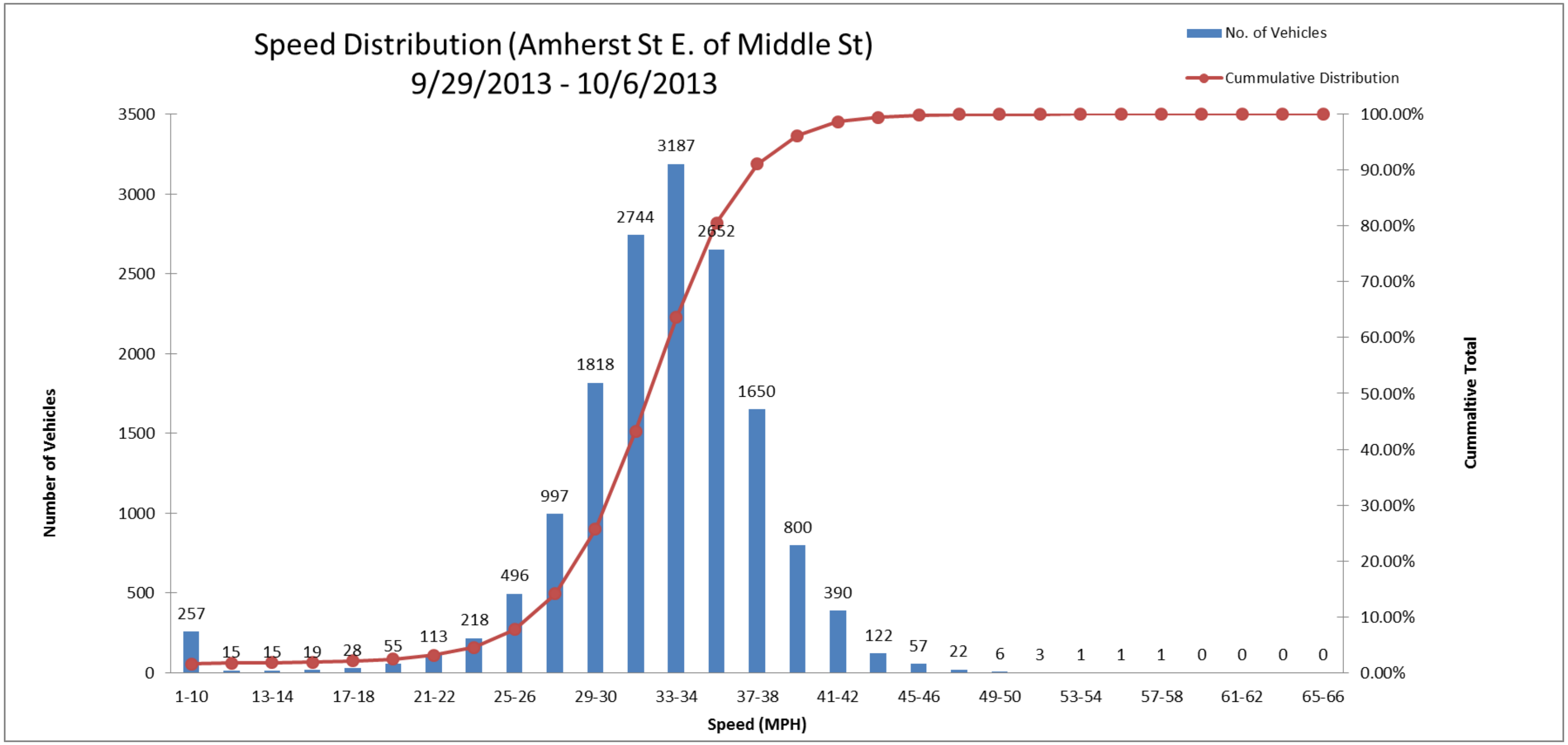
Preliminary Observations
Amherst St E. of Middle St

- Effective Speed Limit: 37.9 mph
- Posted Speed Limit: 35 mph
- Eastbound and Westbound Speed Differential: 1.3 mph
  - for 85% cumulative speed
  - Basically symmetrical but small reduction in speed inbound to village stoplight may be attributed to collective judgment or congestion.
  - A Speed differential greater than 0.2 mph is statistically significant with a 95% confidence
- Consistent conformance seen from 5:00am thru 8:00pm
- Highest speeds seen in the early morning hours from 1:00am to 5:00am

Amherst St. W. of Boston Post Rd. Data Set

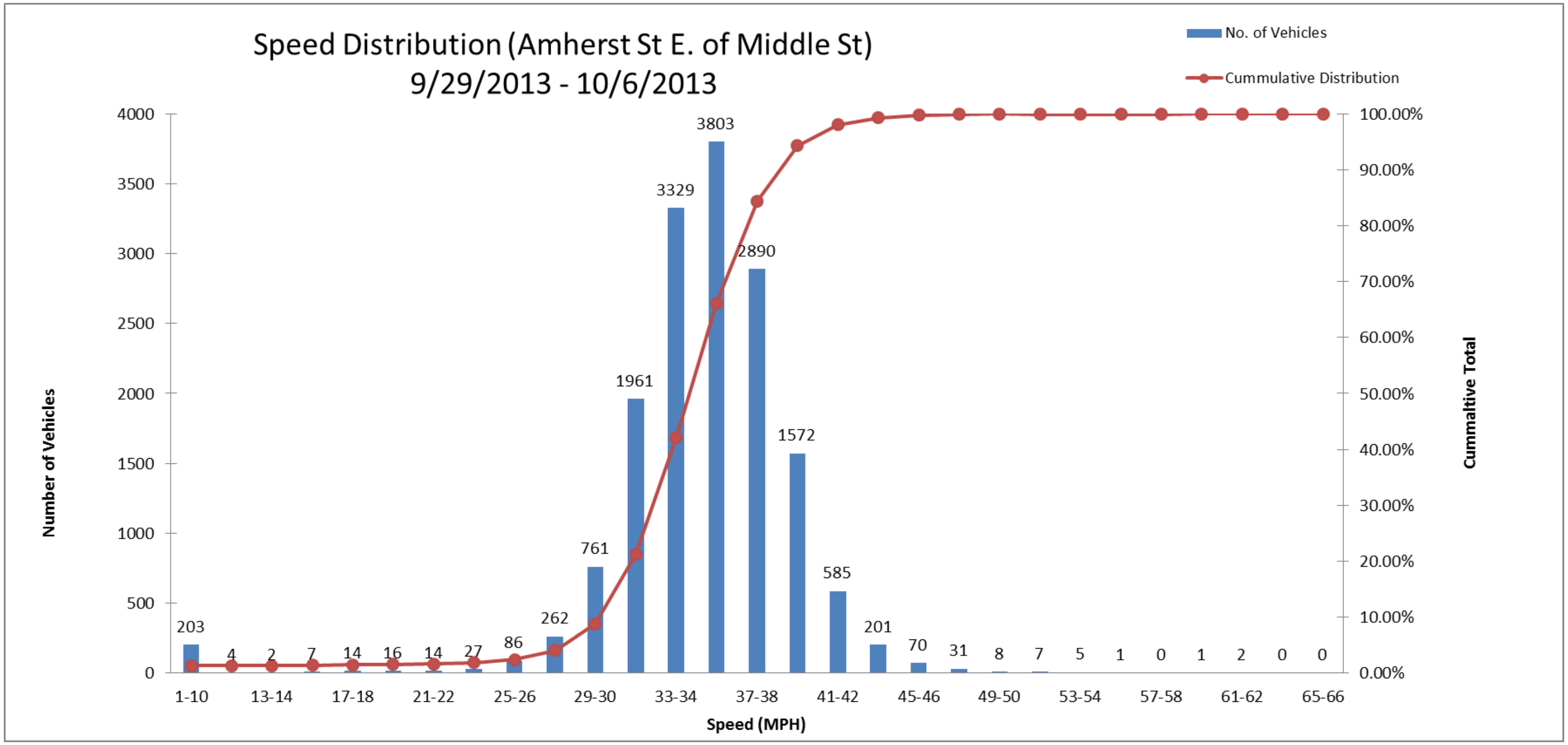
- Data Set Summary:
  - Site Code: 013544
  - 10:00am on Sunday 9/29/2013 thru 10:00am on Sunday 10/6/2013
  - 31,153 speed and vehicle type observations (including eastbound and westbound)

Eastbound Stats



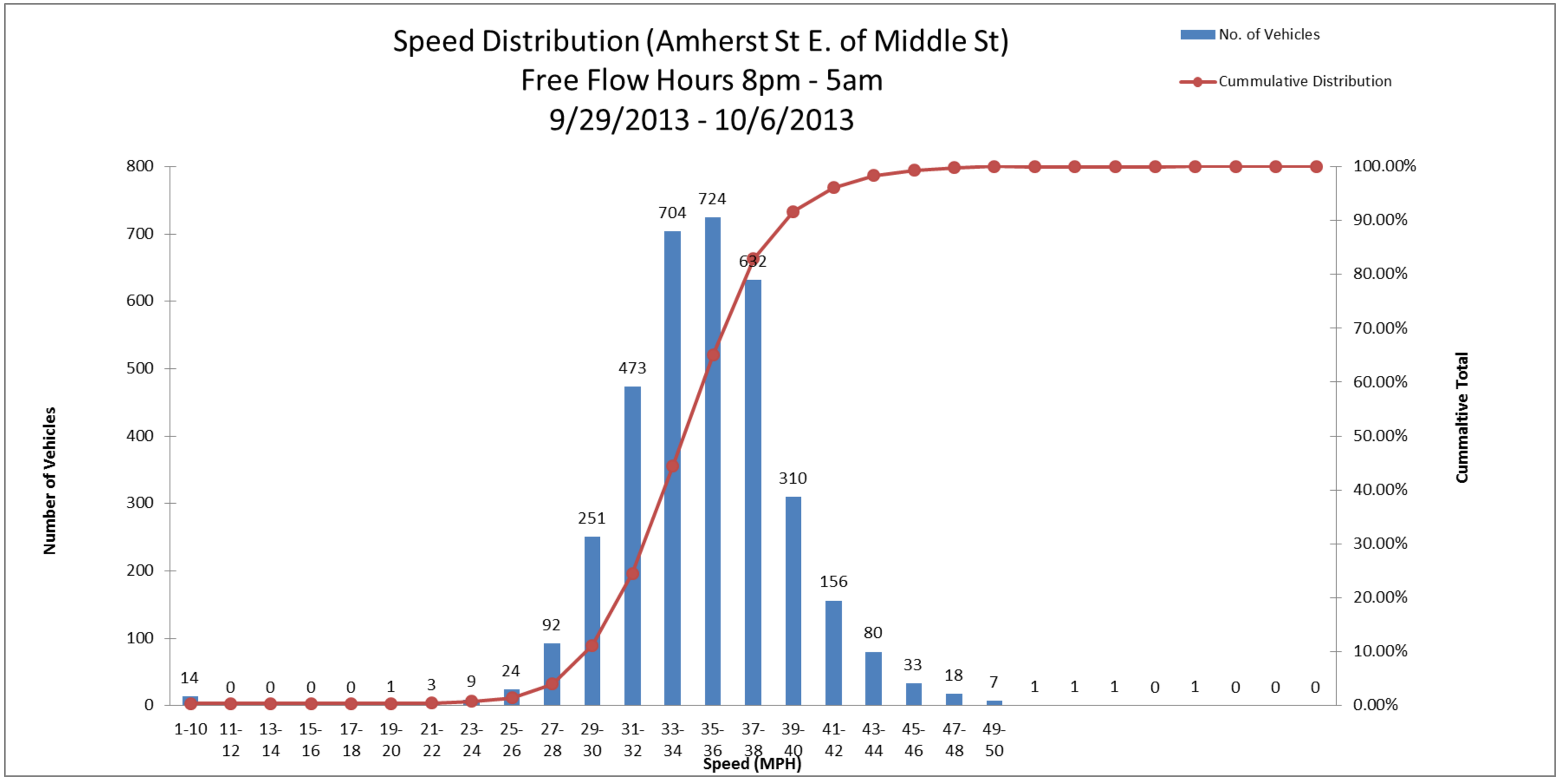
- 85% cumulative speed of 36.9 mph
- 10 mph pace of 29 mph - 38 mph containing 76.9% of the observed traffic
- Mean of 32.6 mph with a median of 34.7 mph (essentially normal)
- Standard Deviation of 5.6 mph

Westbound Stats



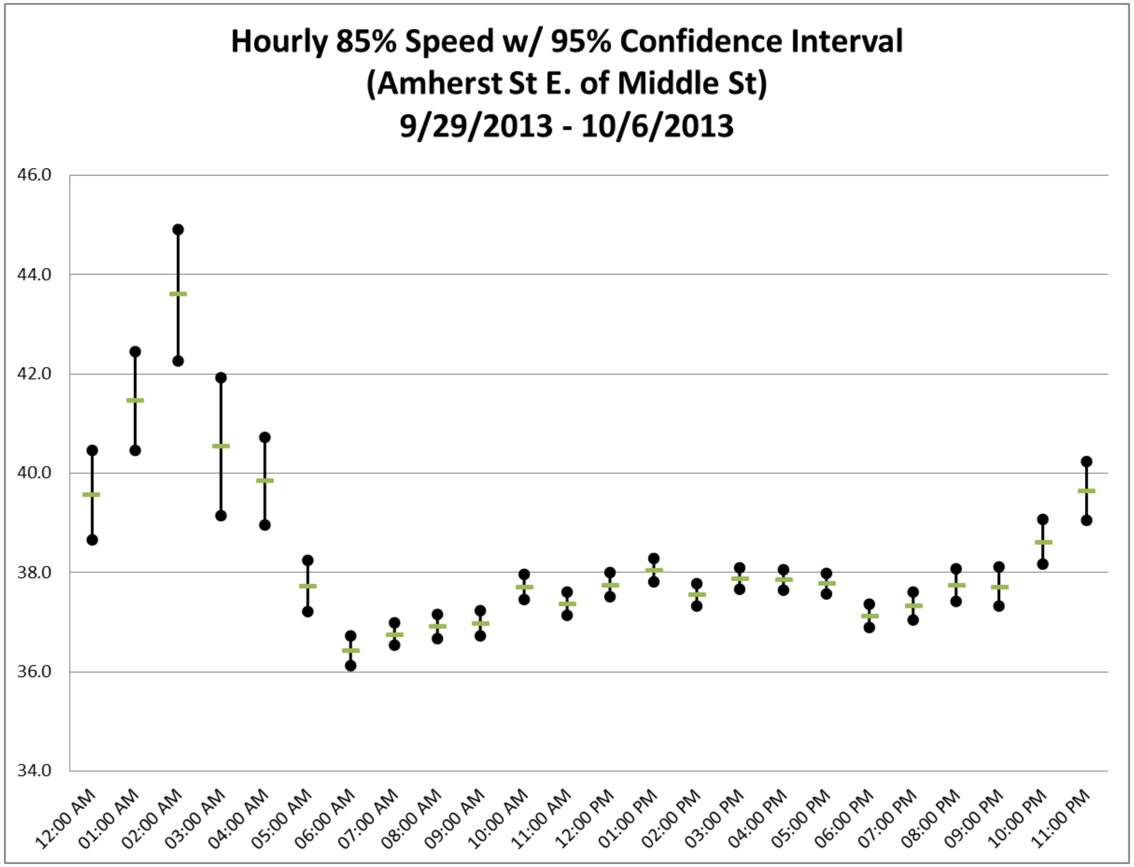
- 85% cumulative speed of 38.1 mph
- 10 mph pace of 31 mph - 40 mph containing 85.5% of the observed traffic
- Mean of 34.8 mph with a median of 34.7 mph (essentially normal)
- Standard Deviation of 5.2 mph

Combined EB & WB Free Flow Stats



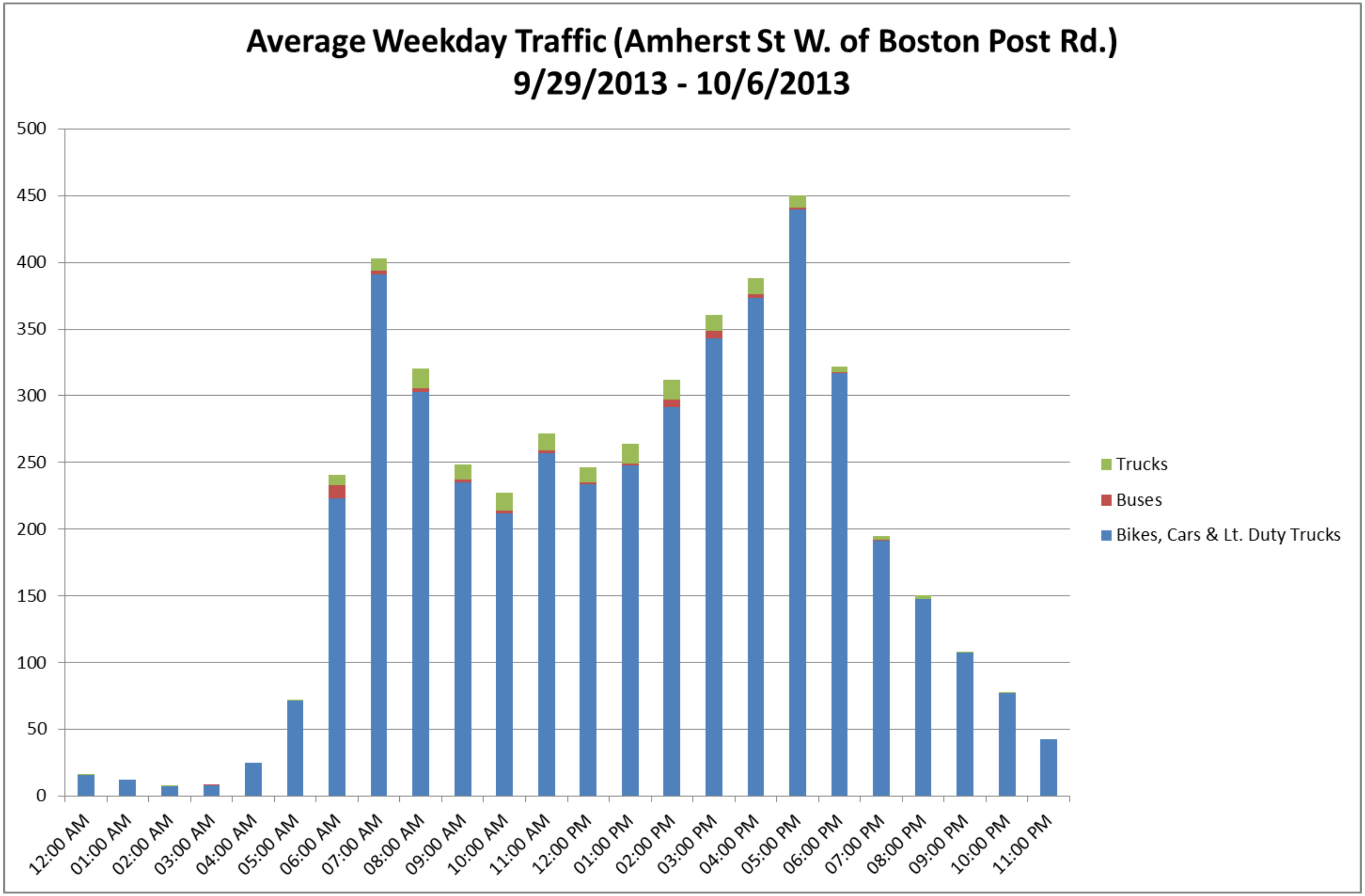
- 85% cumulative speed of 38.5 mph
- 10 mph pace of 31 mph - 40 mph containing 80.4% of the observed traffic
- Mean of 35.1 mph with a median of 34.5 mph (slightly skewed)
- Standard Deviation of 4.4 mph

85% Cumulative Speed vs. Time of Day

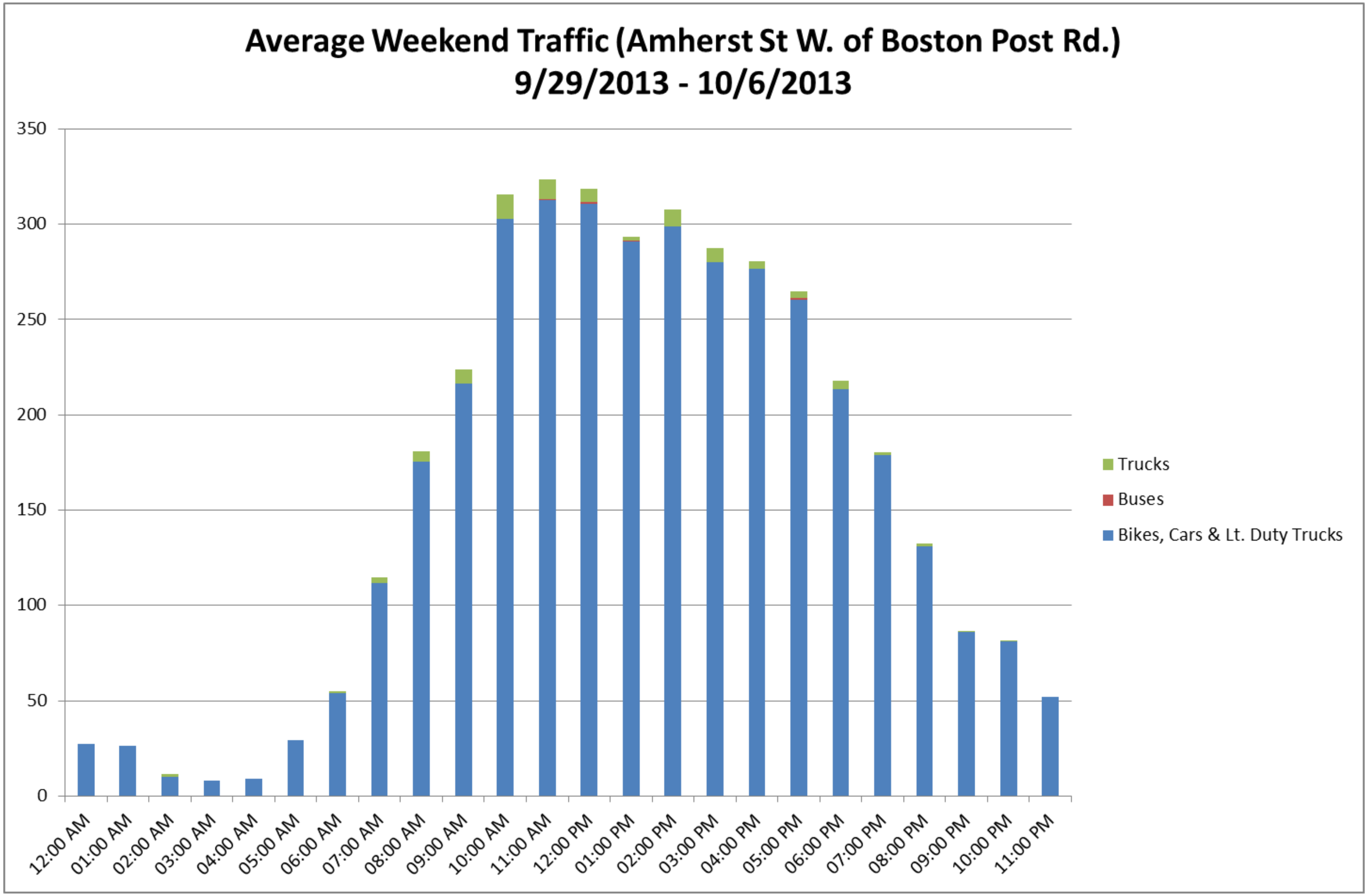


- Highest 85% speeds seen on off hours
  - Particularly very early in the morning even accounting for larger confidence interval due to smaller sample size
- Fairly consistent 85% speed from 5:00am thru 10:00pm

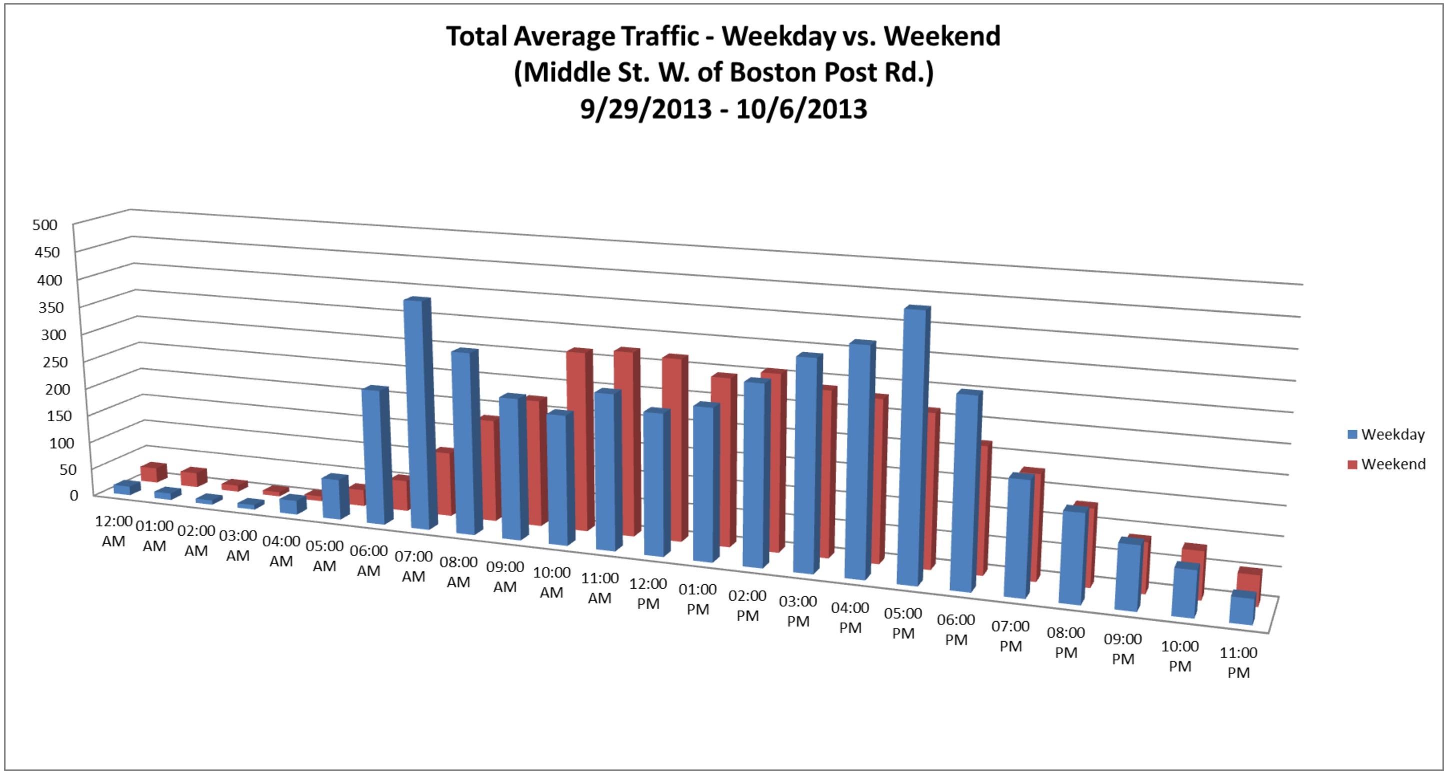
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Assuming there is a some percentage of cut-through traffic during peak commuting hours:
  - The fact that the weekend peak volume exceeds the mid-day weekday trough volume is suggestive that there is a some reduced percentage of cut-through traffic during the weekend.

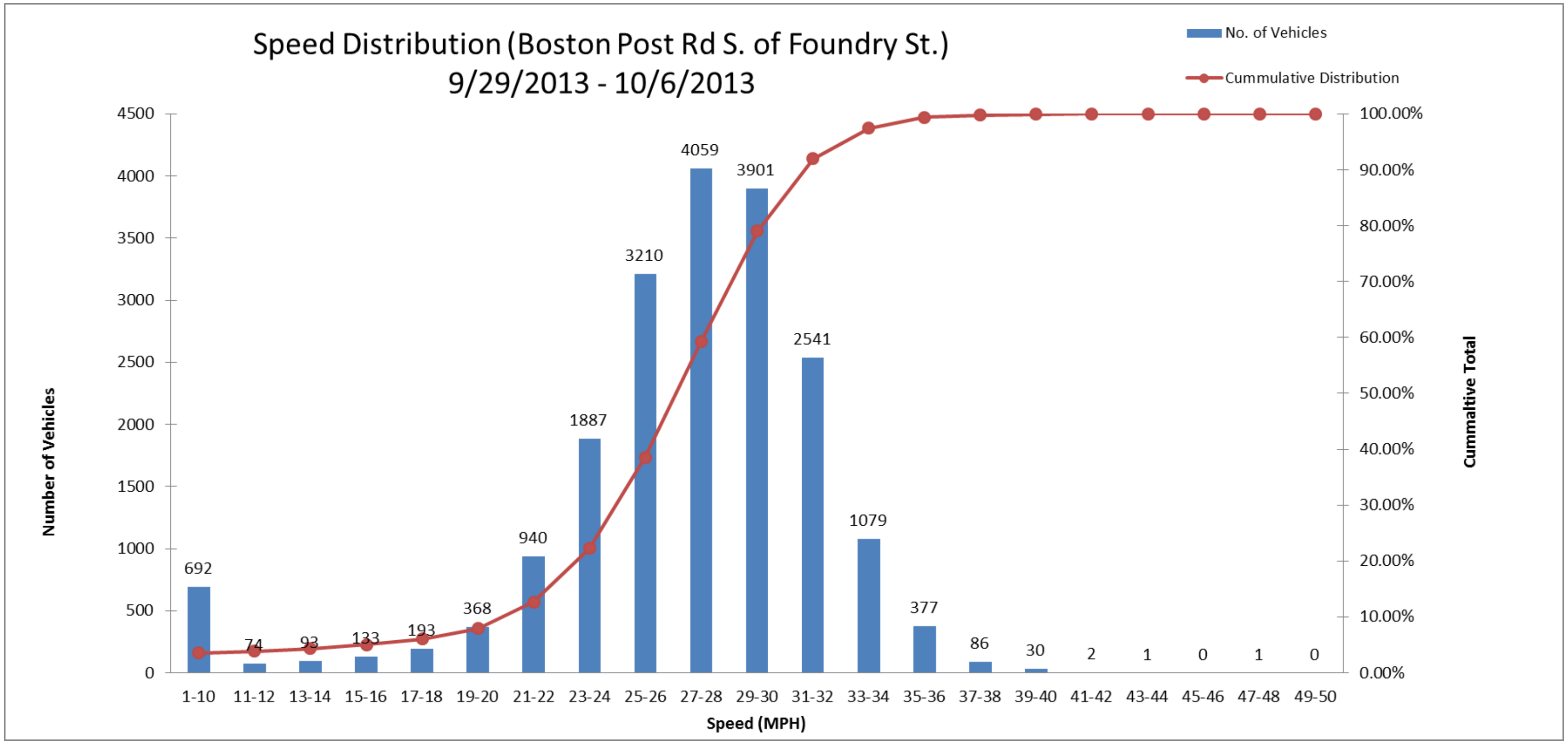
Preliminary Observations
Amherst St. W. of Boston Post Rd.

- Effective Speed Limit: 37.6 mph
- Posted Speed Limit: 35 mph
- Eastbound and Westbound Speed Differential: -1.2 mph
  - for 85% cumulative speed
  - Basically symmetrical but small reduction in speed inbound to village stoplight may be attributed to collective judgment or congestion.
  - A Speed differential greater than 0.2 mph is statistically significant with a 95% confidence
- Consistent conformance seen from 5:00am thru 8:00pm
- Highest speeds seen in the early morning hours from 1:00am to 5:00am

Boston Post Rd S. of Foundry St. Data Set

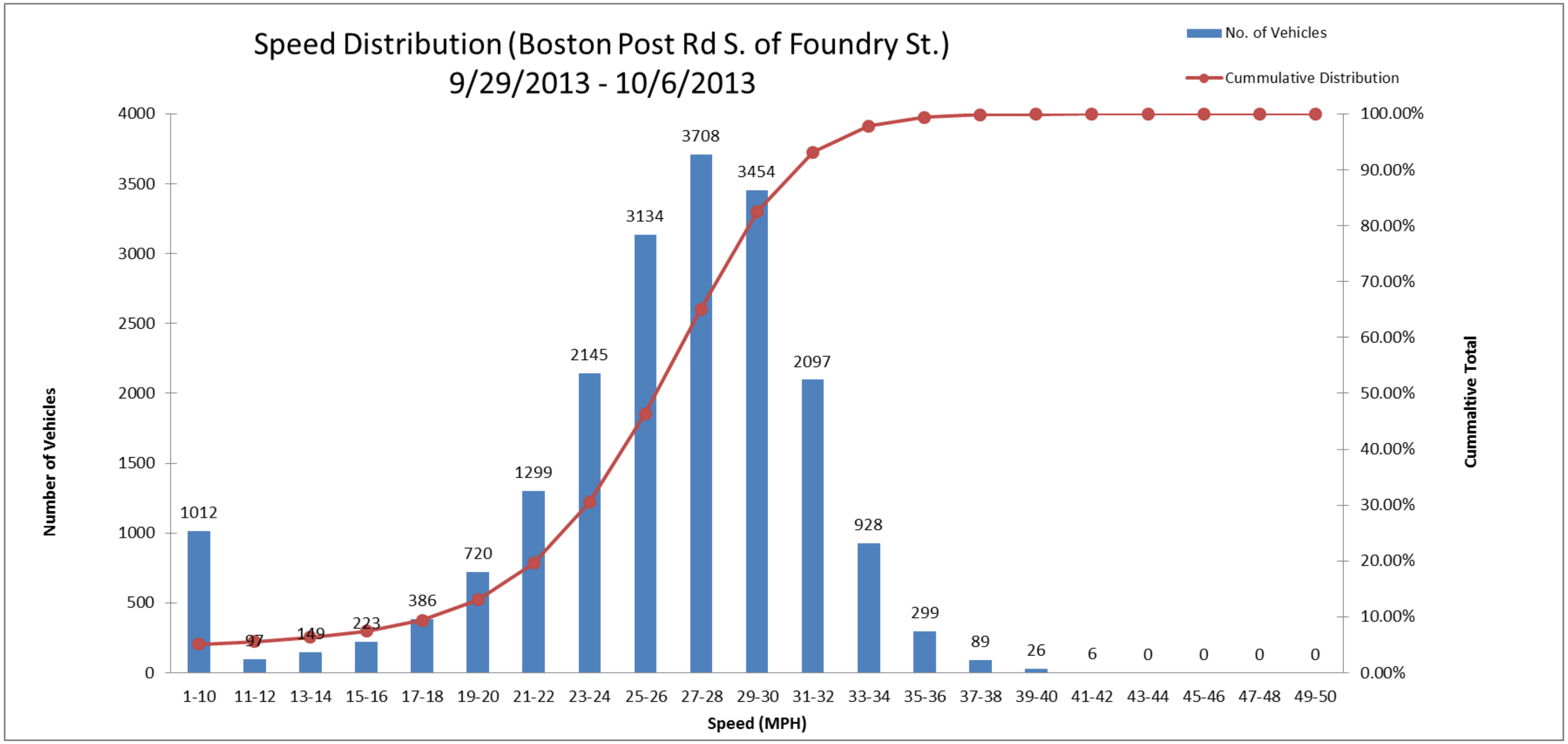
- Data Set Summary:
  - Site Code: 013531
  - 12:00pm on Sunday 9/29/2013 thru 8:00am on Sunday 10/6/2013
  - 39,439 speed and vehicle type observations (including northbound and southbound)

Northbound Stats



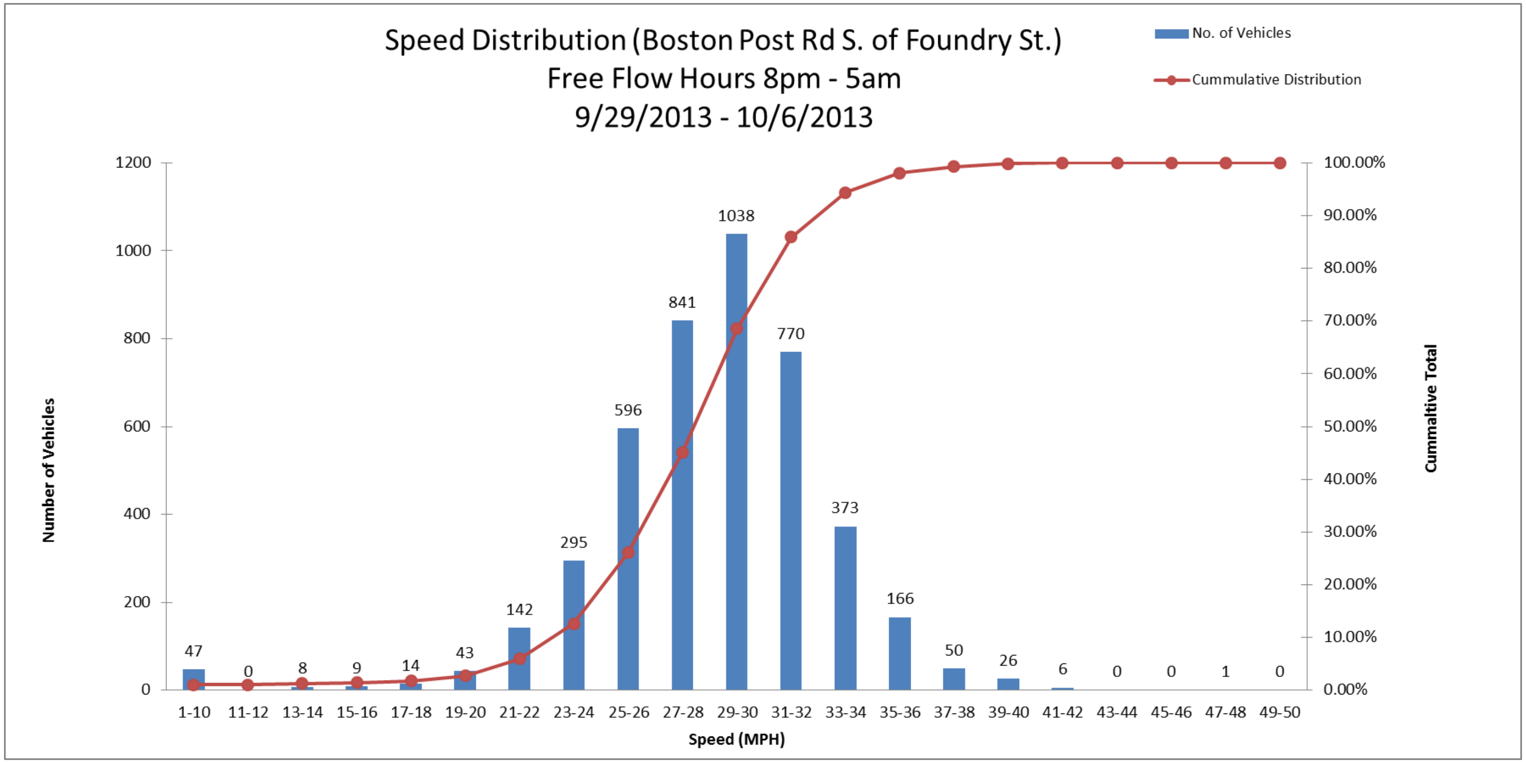
- 85% cumulative speed of 30.9 mph
- 10 mph pace of 23 mph - 32 mph containing 79.3% of the observed traffic
- Mean of 26.7 mph with a median of 27.1 mph (slightly skewed)
- Standard Deviation of 5.7 mph

Southbound Stats



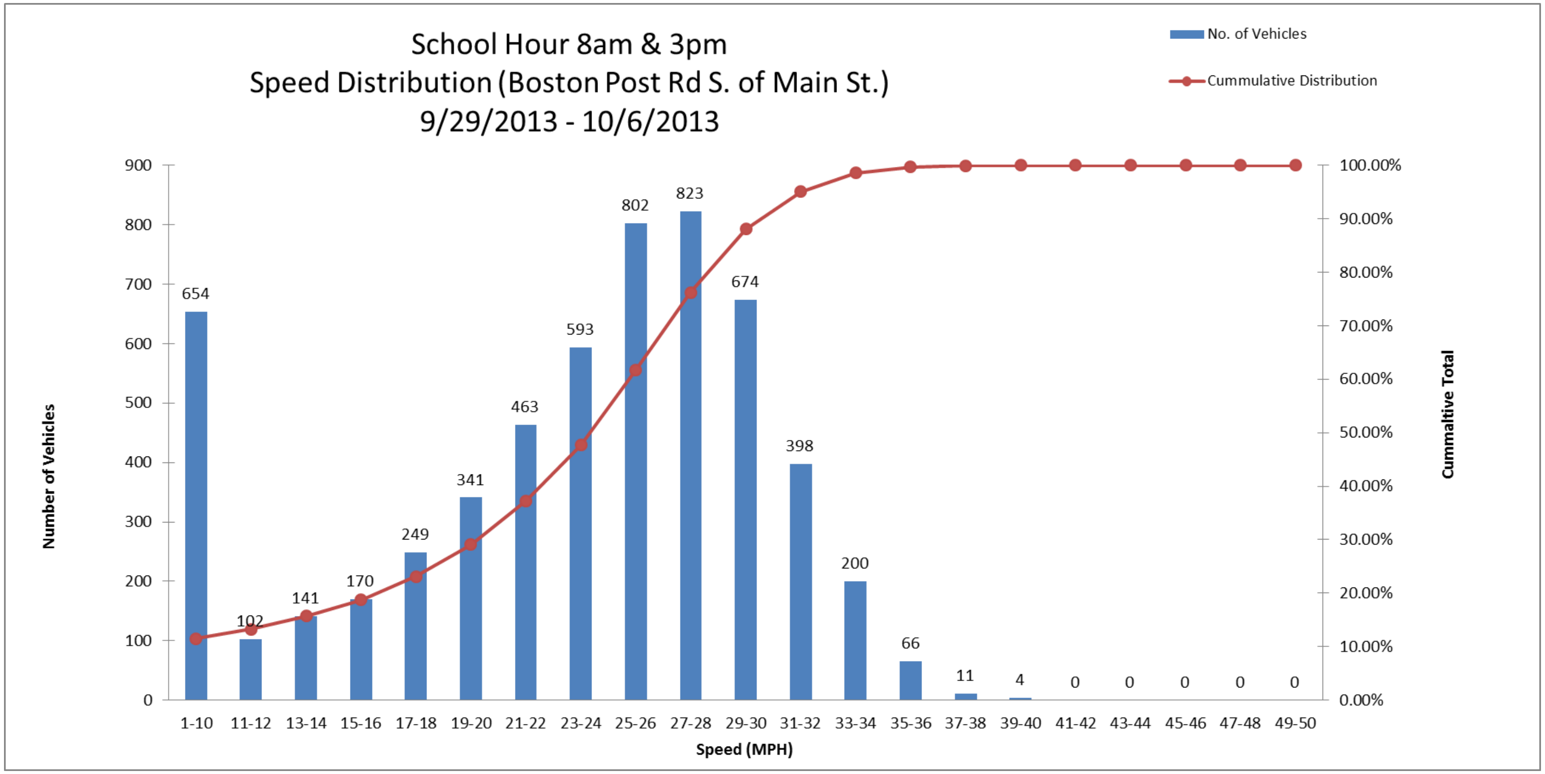
- 85% cumulative speed of 30.5 mph
- 10 mph pace of 23 mph - 32 mph containing 73.5% of the observed traffic
- Mean of 25.7 mph with a median of 26.4 mph (slightly skewed)
- Standard Deviation of 6.4 mph

Combined EB & WB Free Flow Stats



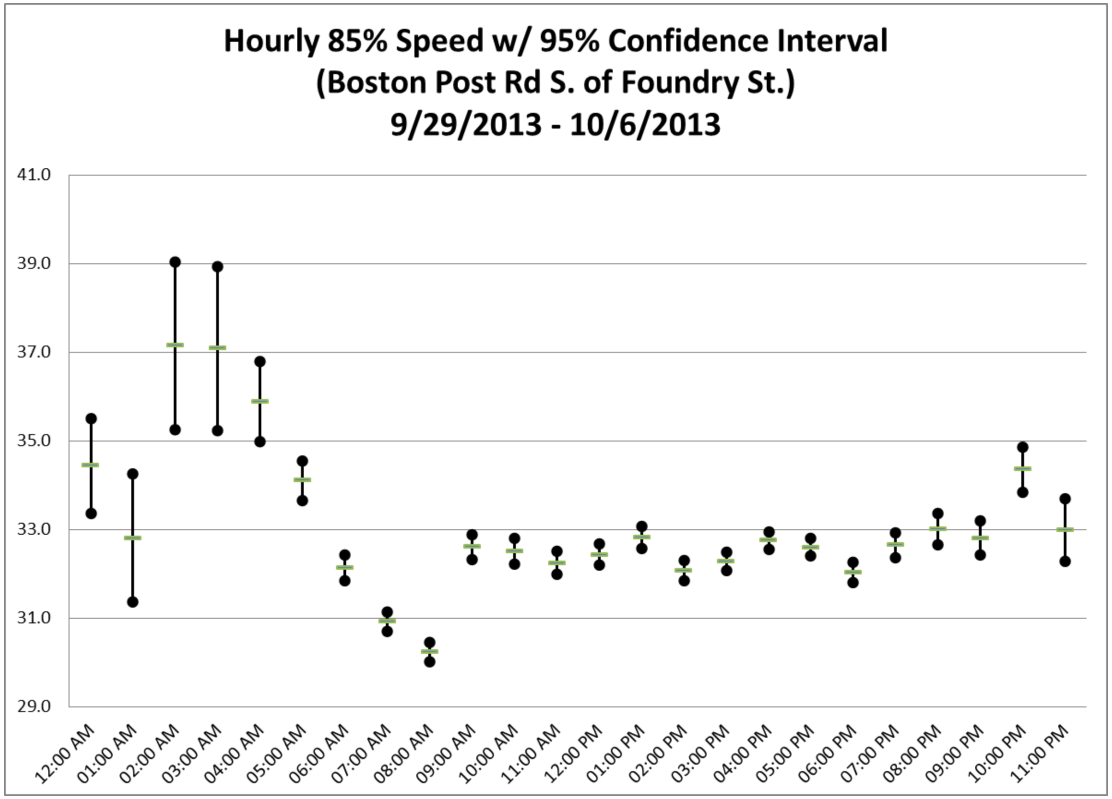
- 85% cumulative speed of 31.9 mph
- 10 mph pace of 25 mph – 34 mph containing 81.8% of the observed traffic
- Mean of 28.6 mph with a median of 28.4 mph (approx. normal)
- Standard Deviation of 4.5 mph

Stats School Hour NB & SB



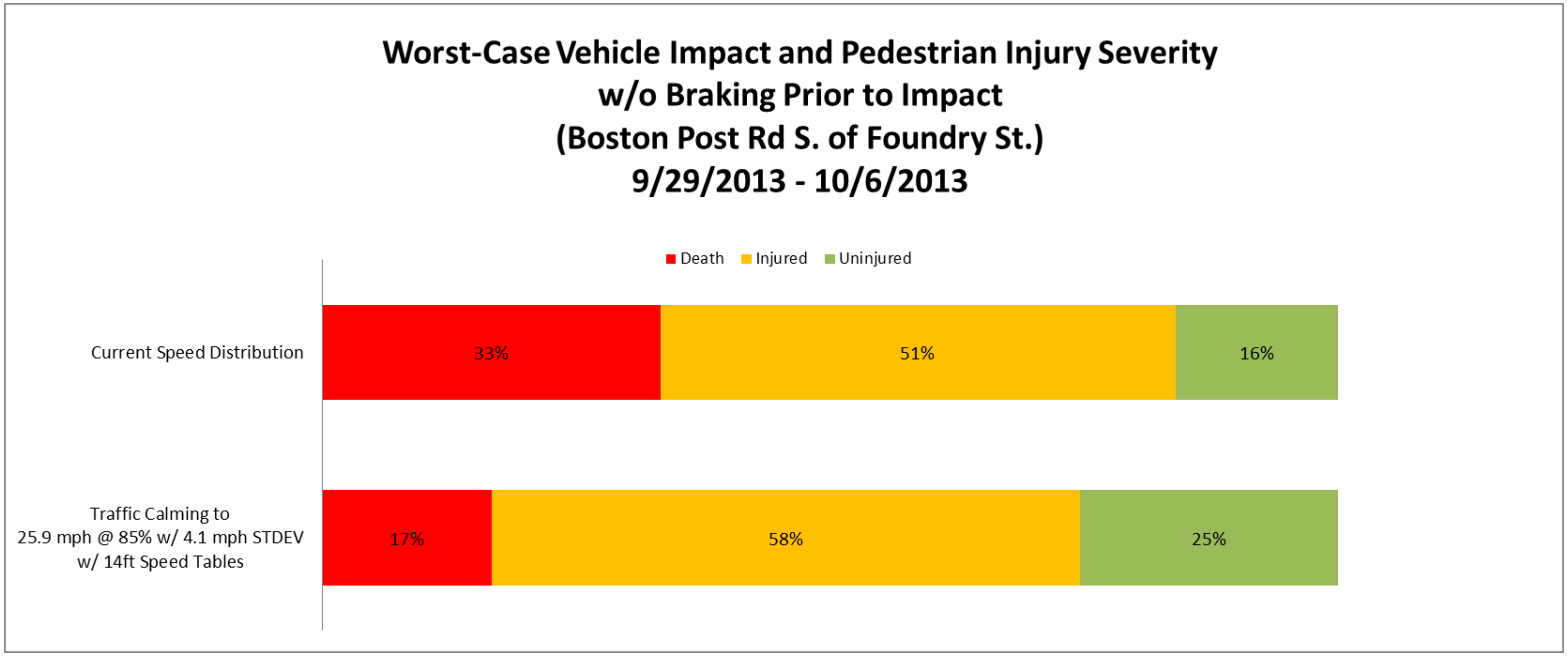
- 85% cumulative speed of 29.5 mph
- 10 mph pace of 21 mph - 30 mph containing 59.0% of the observed traffic
- Mean of 22.7 mph with a median of 24.3 mph (heavily skewed)
- Standard Deviation of 8.0 mph

85% Cumulative Speed vs. Time of Day



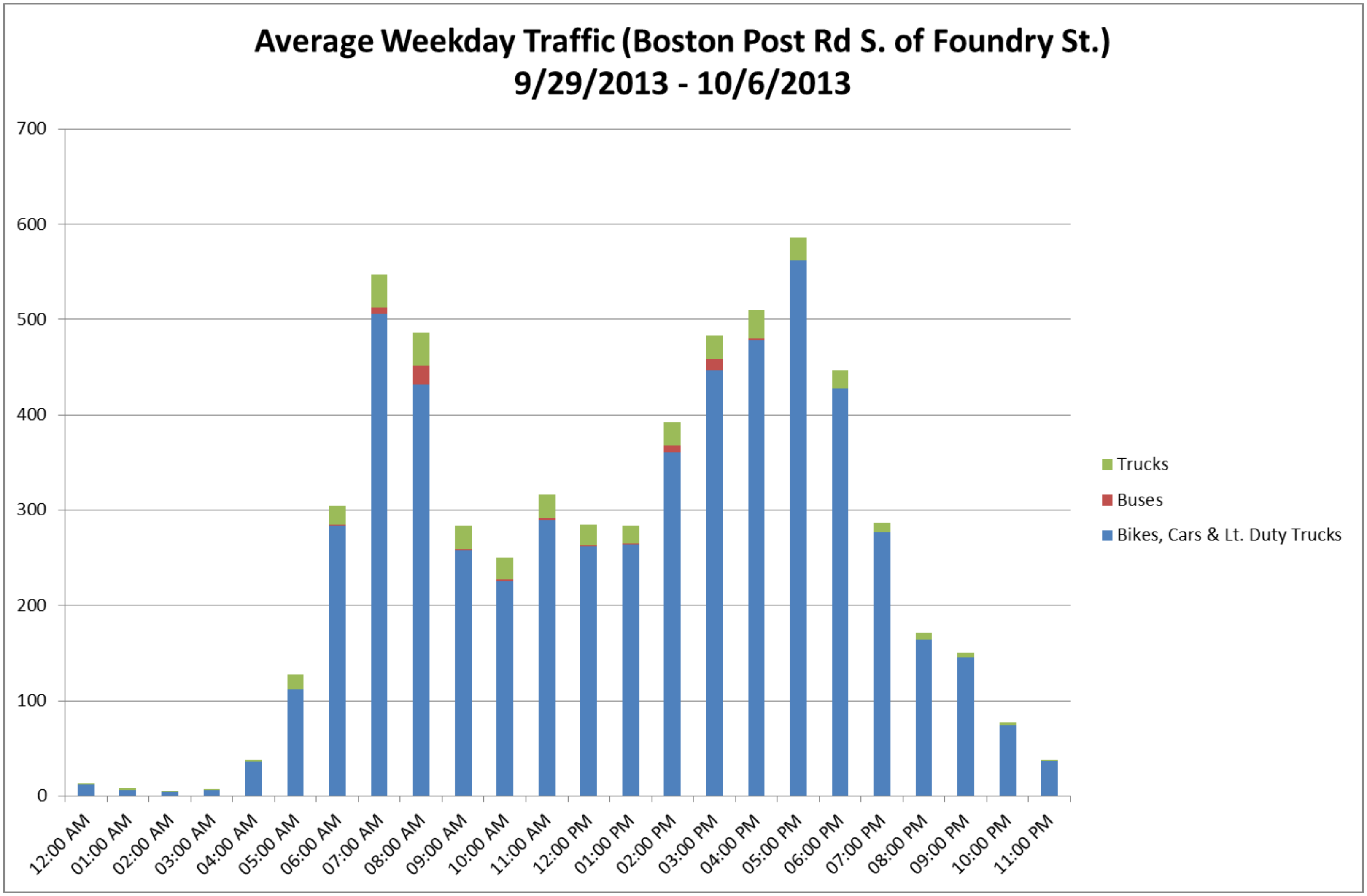
- Highest 85% speeds seen on off hours
  - Particularly very early in the morning during pre-commute hours
- Lowest 85% speeds seen during morning school hour
  - Still well above posted speed limit
  - Morning traffic congestion seemingly the largest contributor to downward shift, otherwise the 3:00 school hour would have a similar 85% cumulative speed due to collective judgment

Application of DoT HS Stats

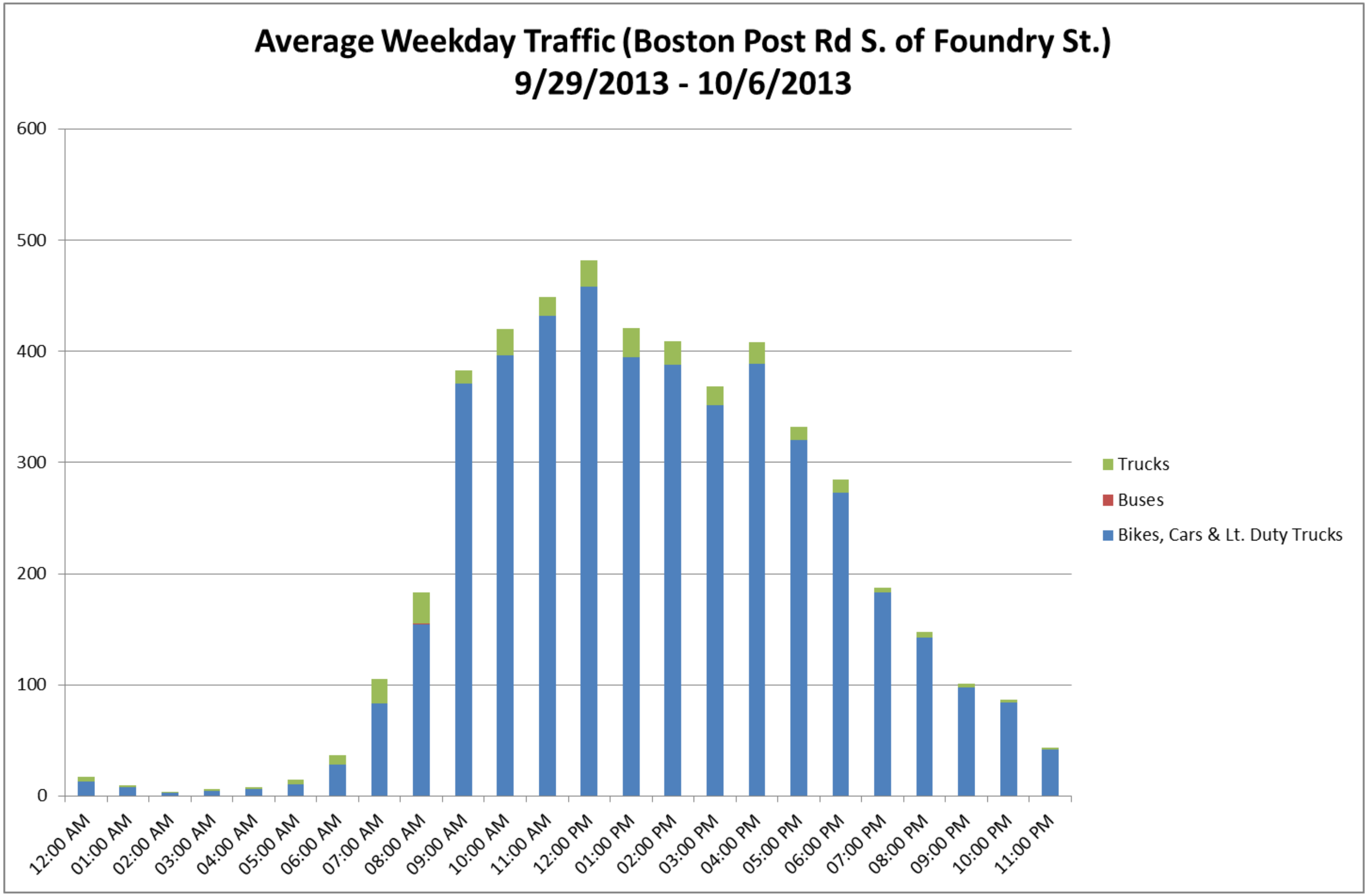


- **<u>Caution must be used</u>** when referencing the above graph as it represents absolute worse-case scenario
  - Assumes **<u>zero</u>** driver reaction/braking prior to impact
  - Traffic calmed pedestrian injury severity stats represent best case improvement localized near a traffic calming measure
  - Speed table used as an **<u>example only</u>**. The resultant speed distribution based on 2002 Minnesota DoT Investigative Report into effectiveness of traffic calming measures.
- It is however illustrative in depicting the improvements in safety for the worst-case scenario by having the overall population speed be essentially conforming to the posted speed limit

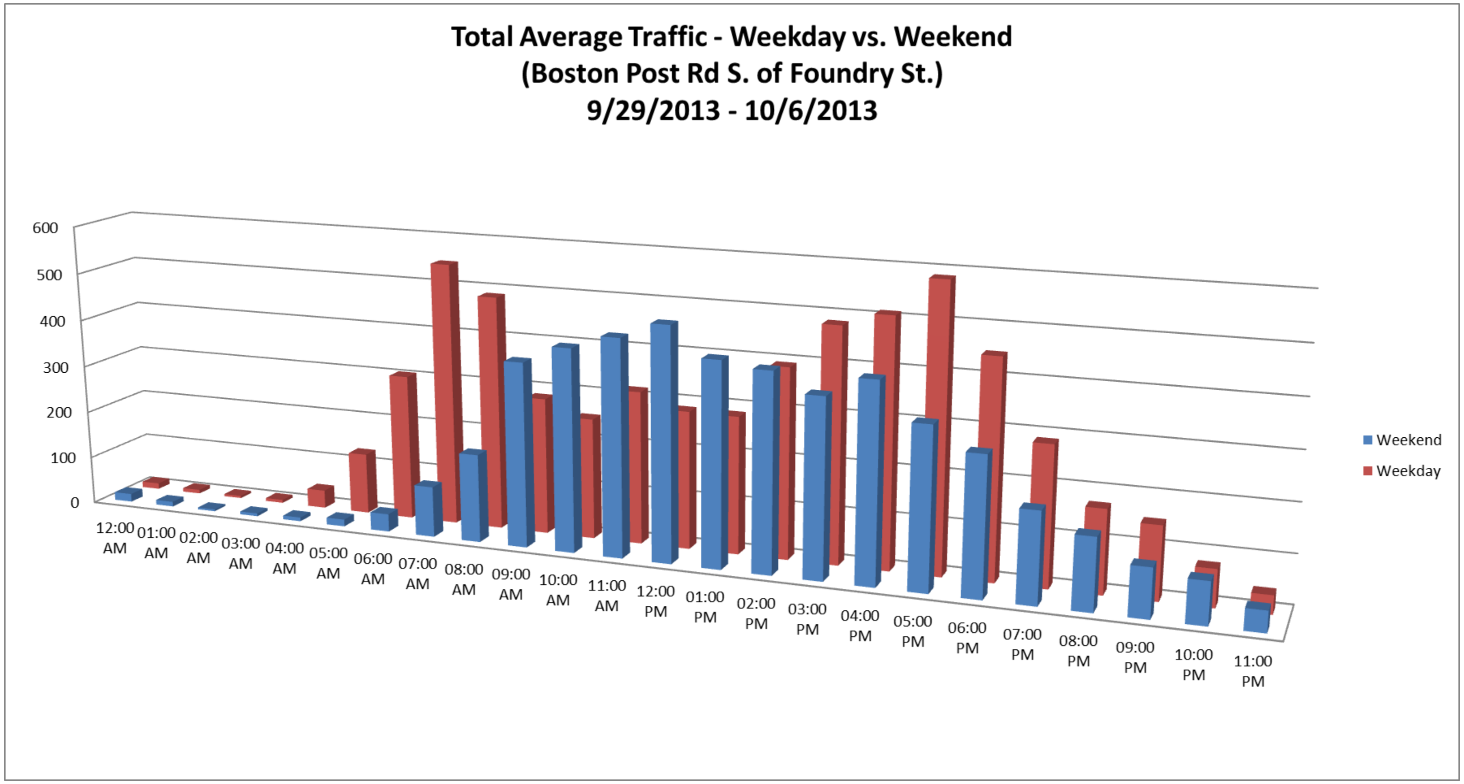
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Assuming there is a significant percentage of cut-through traffic during peak commuting hours:
  - The fact that the weekend peak volume equals weekday peak volume is highly suggestive that there is a significant percentage of cut-through traffic at every hour for the entire week.

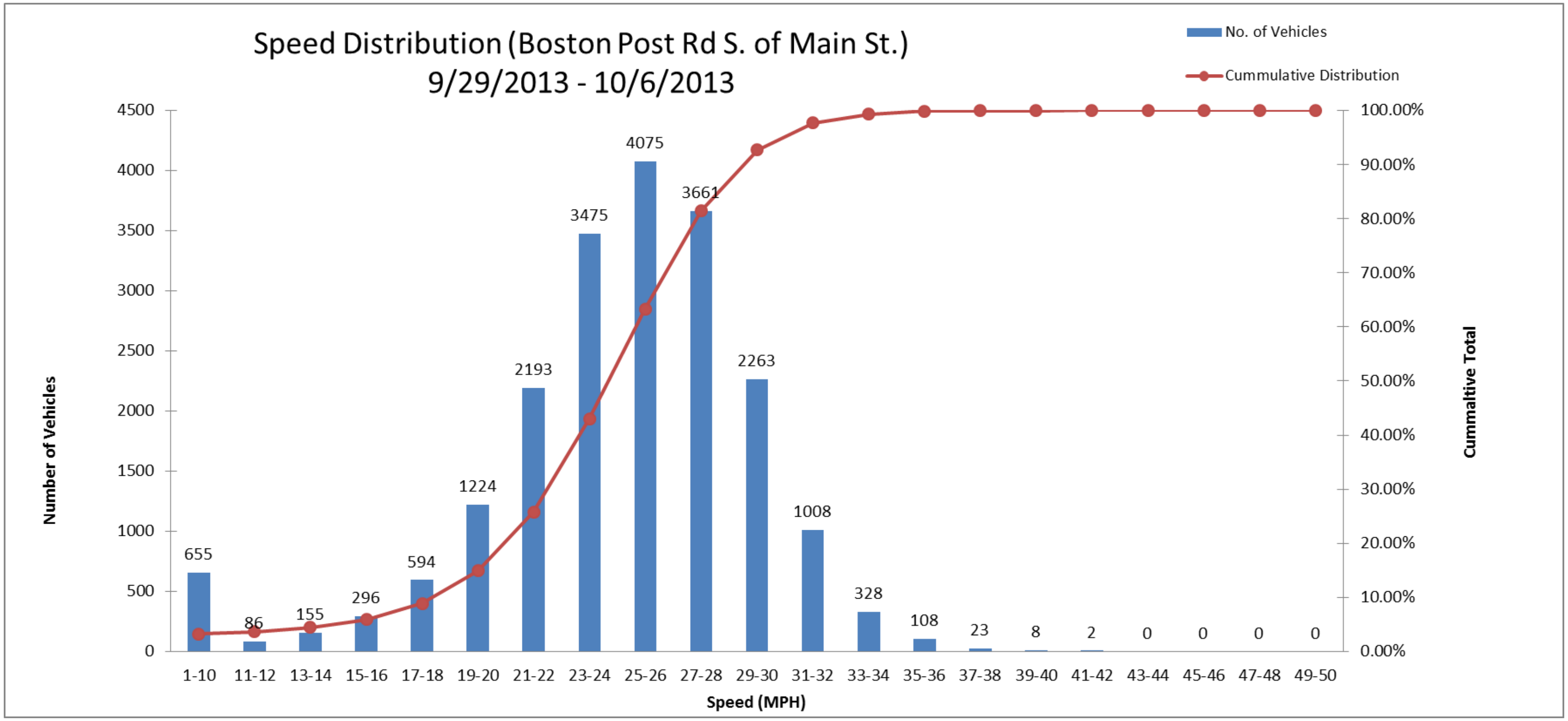
Preliminary Observations
Boston Post Rd S. of Foundry St.

- Effective Speed Limit: 31 mph
- Posted Speed Limit: 25 mph
- Northbound and Southbound Speed Differential: 0.4 mph
  - for 85% cumulative speed
  - Basically symmetrical but small reduction in speed inbound to village may be attributed to collective judgment or congestion.
  - A Speed differential greater than 0.2 mph is statistically significant with a 95% confidence
- Best conformance seen during morning commute (7am – 9am) where again congestion is likely the major factor
- Highest speeds seen in the early morning hours prior to the commute
- Weekday and Weekend volume stats suggest traffic largely dominated by northern Boston Post volumes
  - Other potential feeders such as Foundry St. or Church St. contribute mainly for the weekdays

Boston Post Rd S. of Main St. Data Set

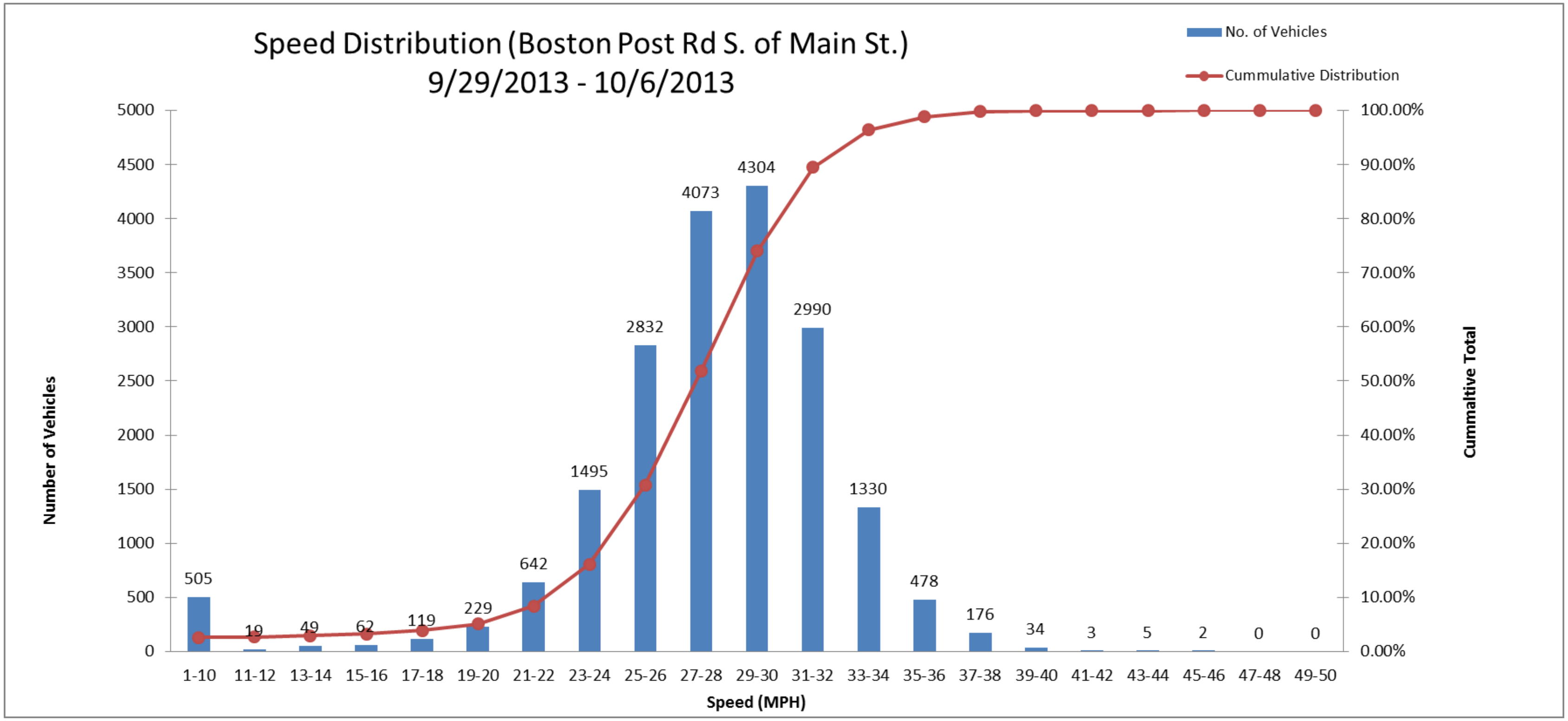
- Data Set Summary:
  - Site Code: 013545
  - 12:00pm on Sunday 9/29/2013 thru 8:00am on Sunday 10/6/2013
  - 39,501 speed and vehicle type observations (including northbound and southbound)

Northbound Stats



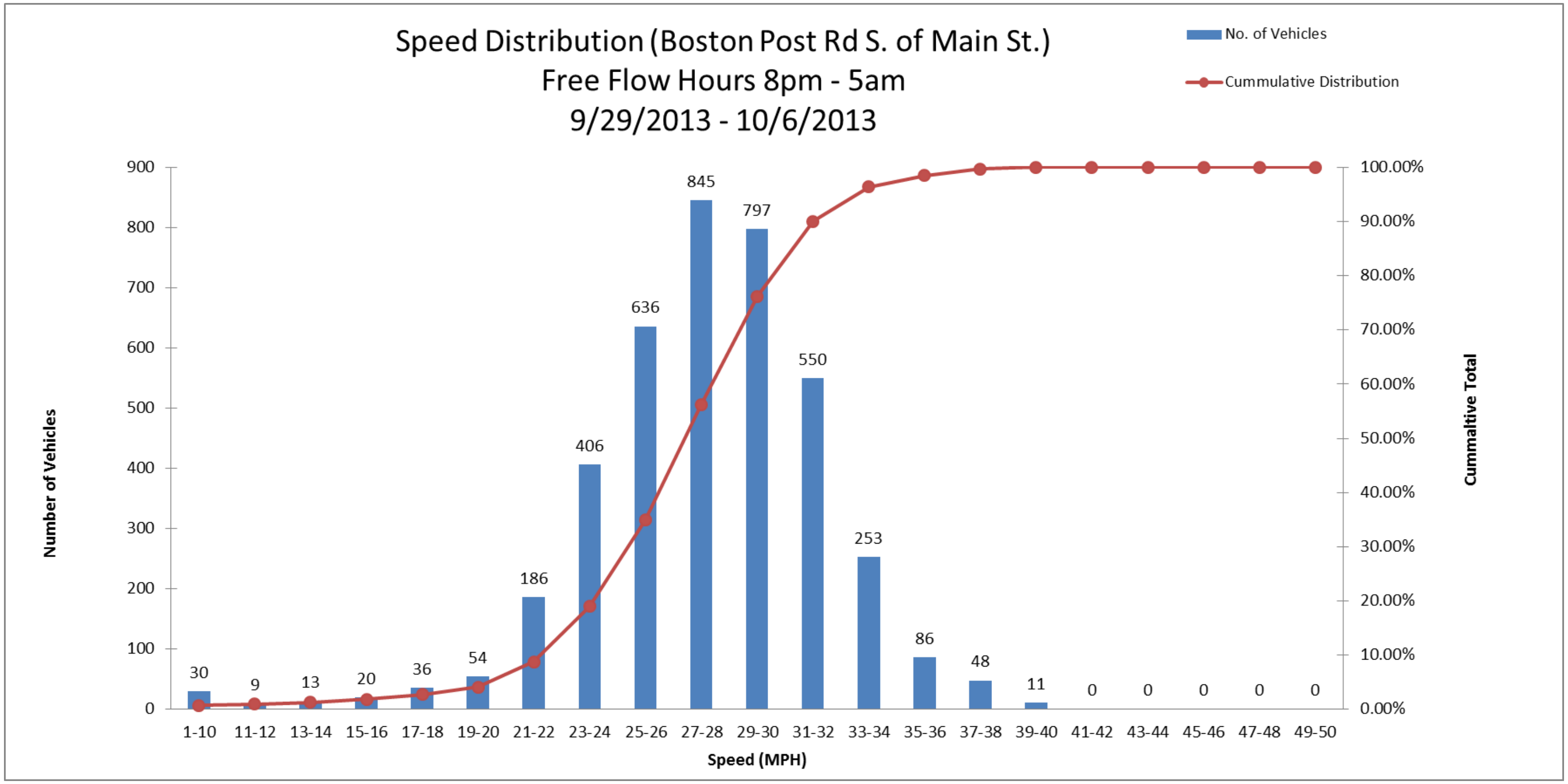
- 85% cumulative speed of 28.6 mph
- 10 mph pace of 21 mph - 30 mph containing 77.7% of the observed traffic
- Mean of 24.5 mph with a median of 24.7 mph (slightly skewed)
- Standard Deviation of 5.3 mph

Southbound Stats



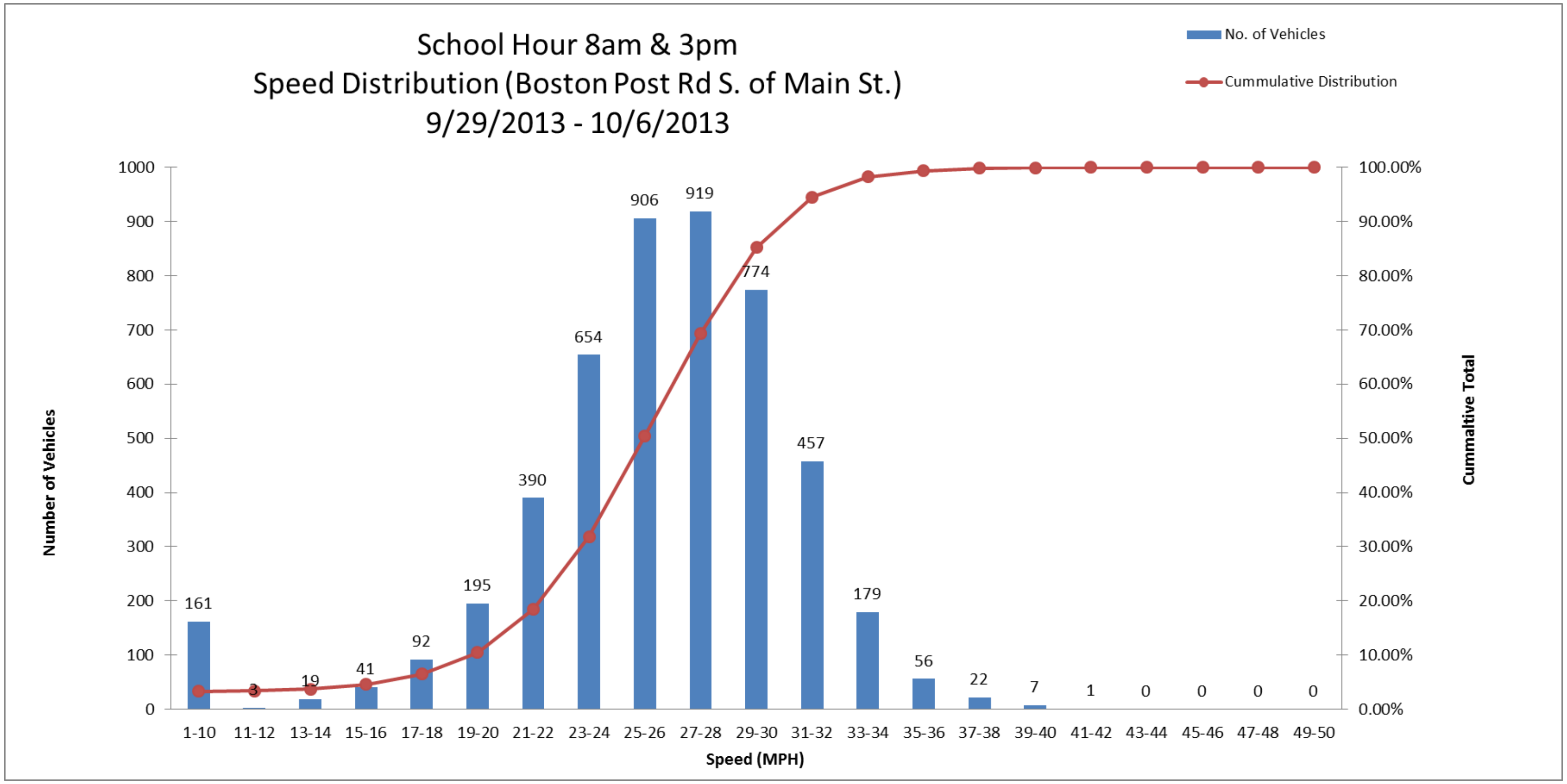
- 85% cumulative speed of 31.4 mph
- 10 mph pace of 23 mph - 32 mph containing 81.1% of the observed traffic
- Mean of 27.7 mph with a median of 27.8 mph (approx. normal)
- Standard Deviation of 5.2 mph

Free Flow Stats
Combined NB & SB



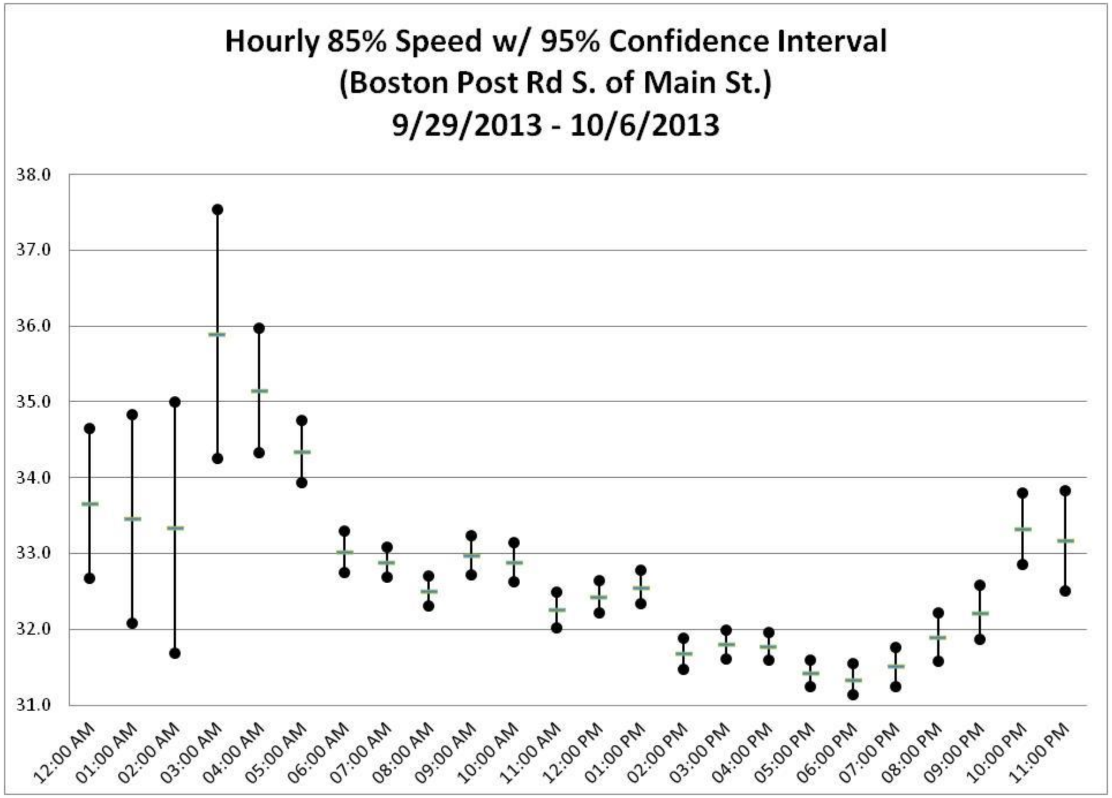
- 85% cumulative speed of 31.3 mph
- 10 mph pace of 23 mph - 32 mph containing 81.3% of the observed traffic
- Mean of 27.6 mph with a median of 27.4 mph (approx. normal)
- Standard Deviation of 4.4 mph

Stats School Hour NB & SB



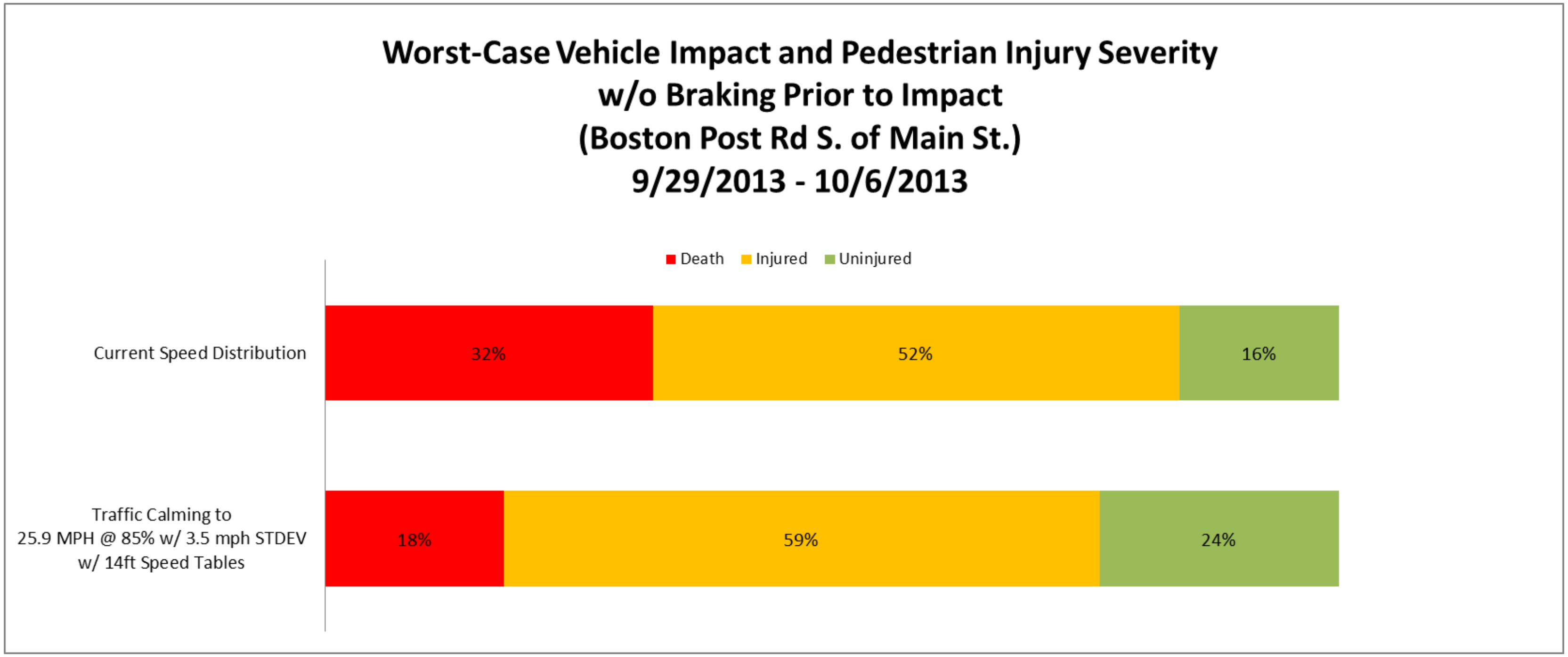
- 85% cumulative speed of 30.0 mph
- 10 mph pace of 23 mph - 32 mph containing 76.1% of the observed traffic
- Mean of 25.8 mph with a median of 25.9 mph (approx. normal)
- Standard Deviation of 5.5 mph

85% Cumulative Speed vs. Time of Day



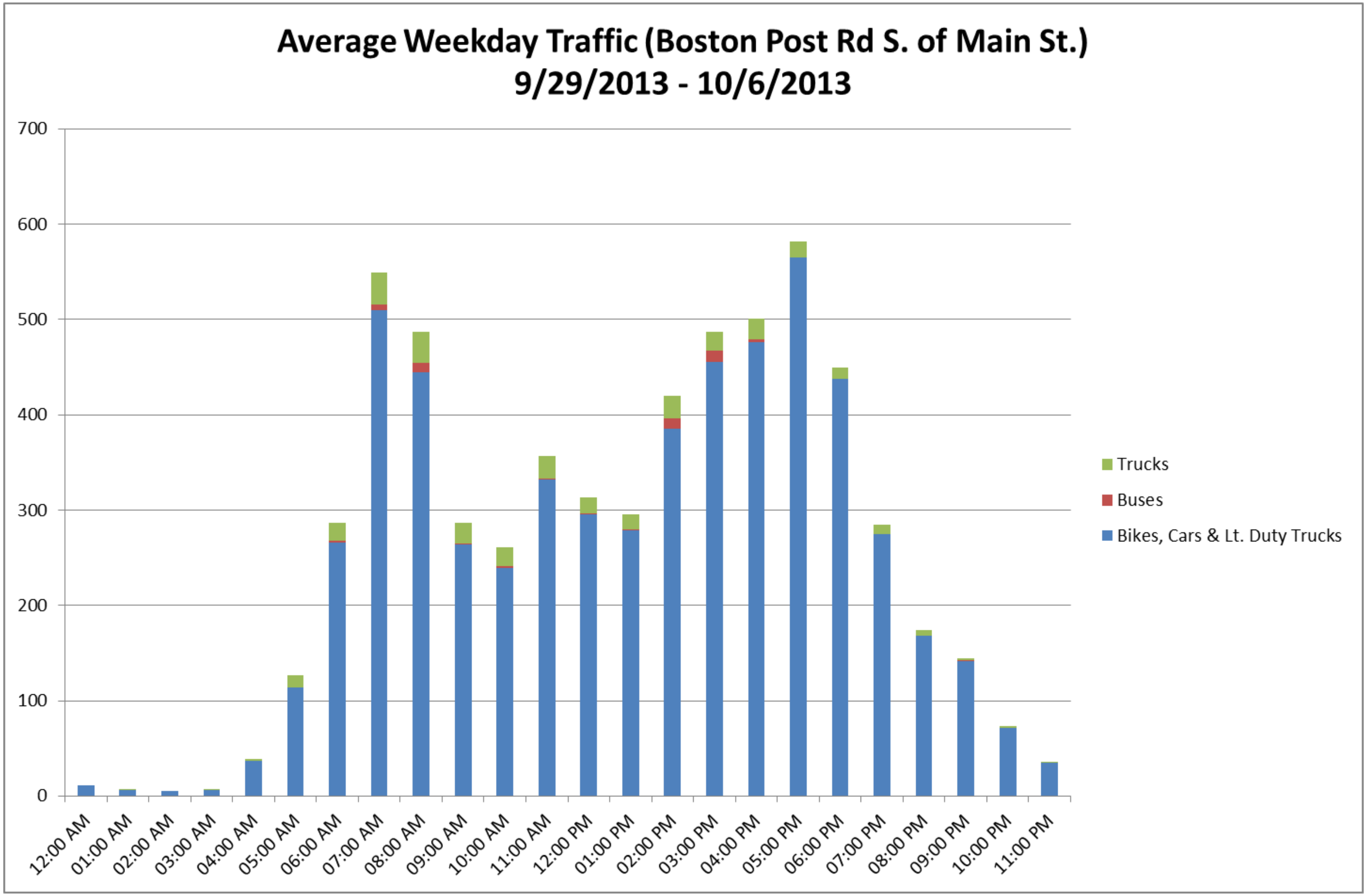
- Highest 85% speeds seen on off hours (late night & early morning)
  - Particularly very early in the morning 2am to 4am
- Lowest 85% speeds seen during morning school hour and around noon
  - both still well above posted speed limit

Application of DoT HS Stats

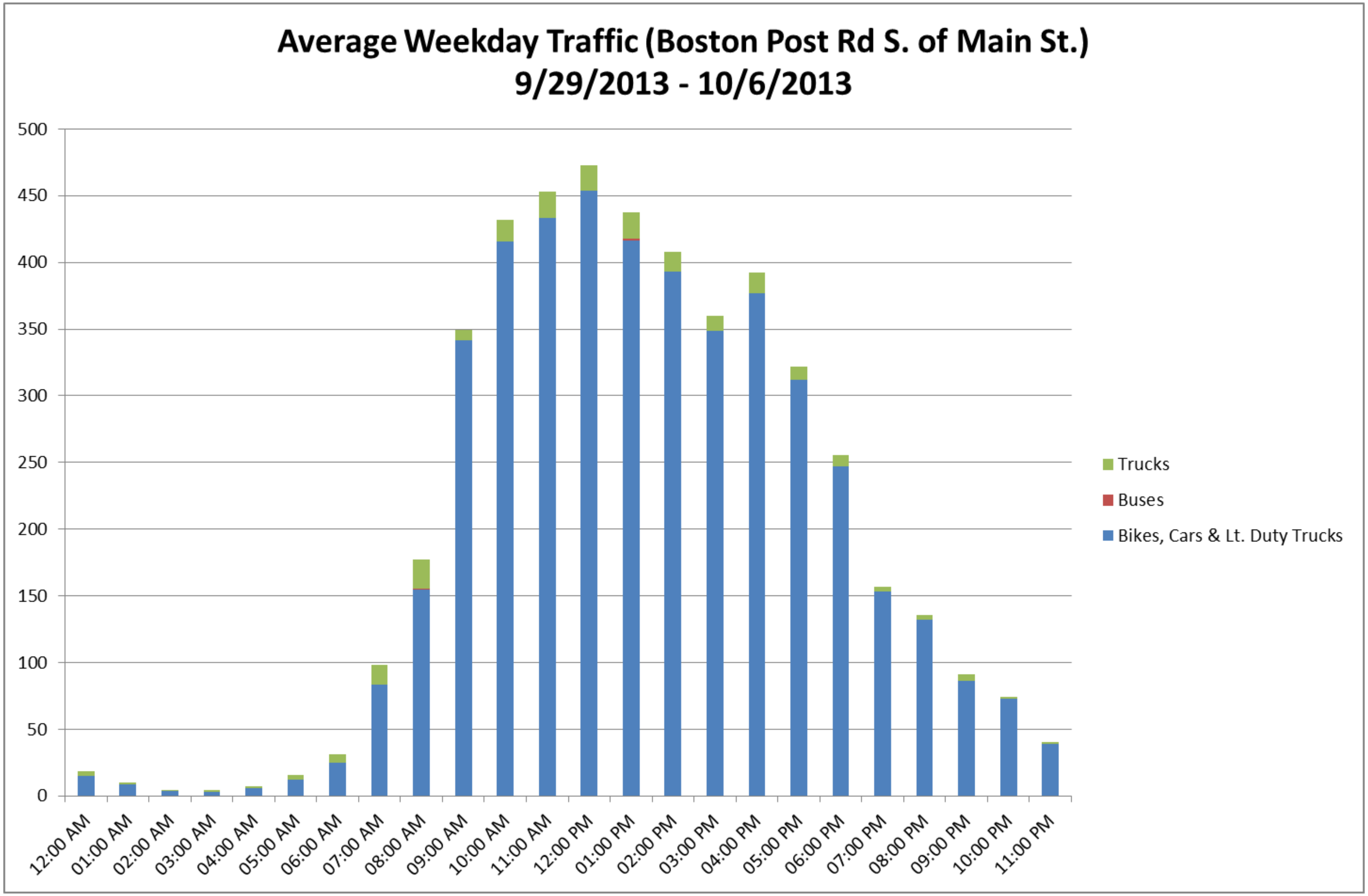


- **Caution must be used** when referencing the above graph as it represents absolute worse-case scenario
  - Assumes **zero** driver reaction/braking prior to impact
  - Traffic calmed pedestrian injury severity stats represent best case improvement localized near a traffic calming measure
  - Speed table used as an **example only**. The resultant speed distribution based on 2002 Minnesota DoT Investigative Report into effectiveness of traffic calming measures.
- It is however illustrative in depicting the dramatic improvements in safety for the worst-case scenario by having the overall population speed be essentially conforming to the posted speed limit

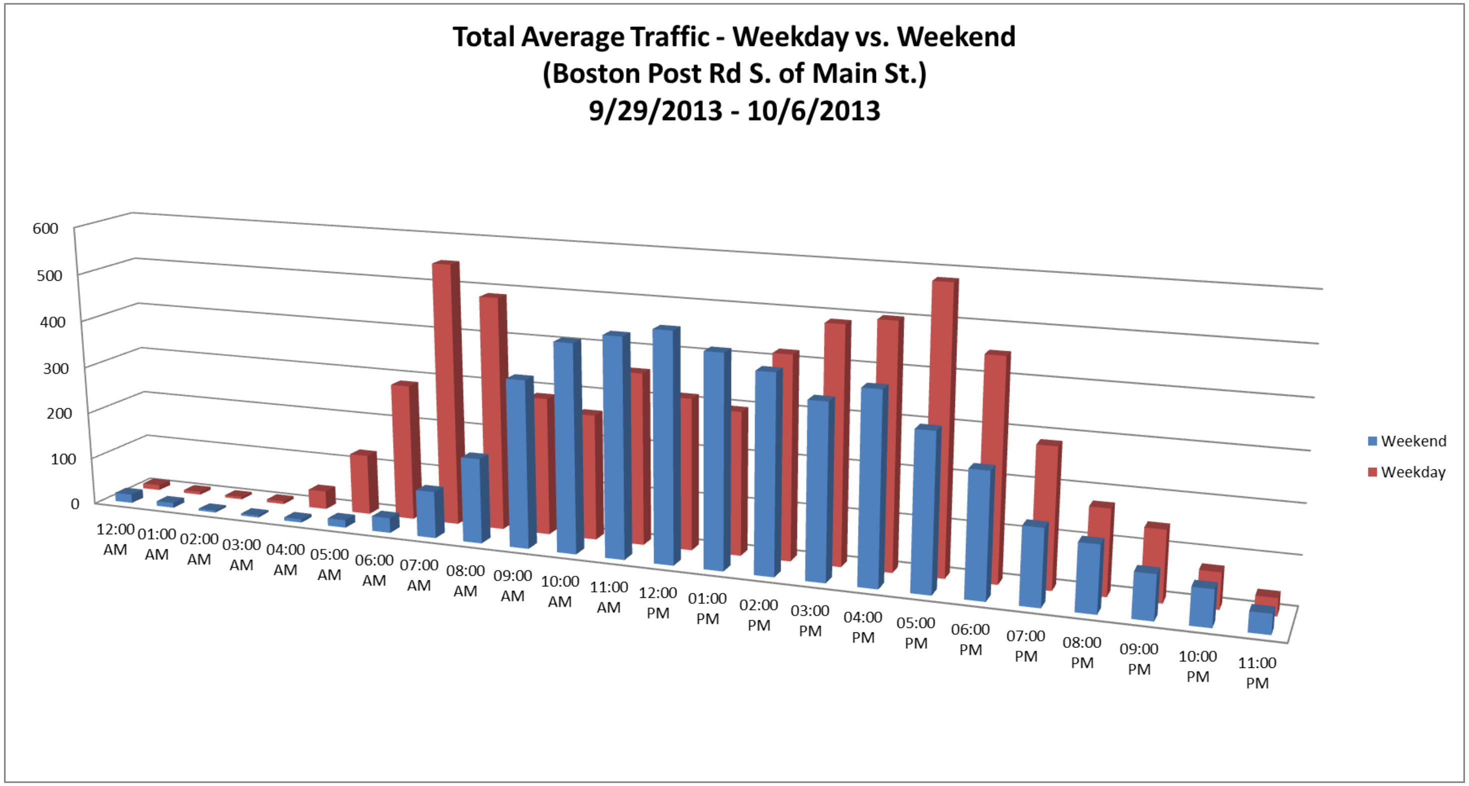
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Weekend volume stats which nearly identical to Boston Post Rd S. of Sunset Ave location suggest traffic largely dominated by northern Boston Post volumes during week-end
  - Not other potential feeders such as Foundry St. or Main St.
- Again comparing to traffic volumes of the Boston Post Rd S. of Sunset Ave location – approximately 80% weekday peak volumes are contributed from northern Boston Post Rd volumes
  - The remaining 20% is due to other feeders such as Foundry St. or Main St.

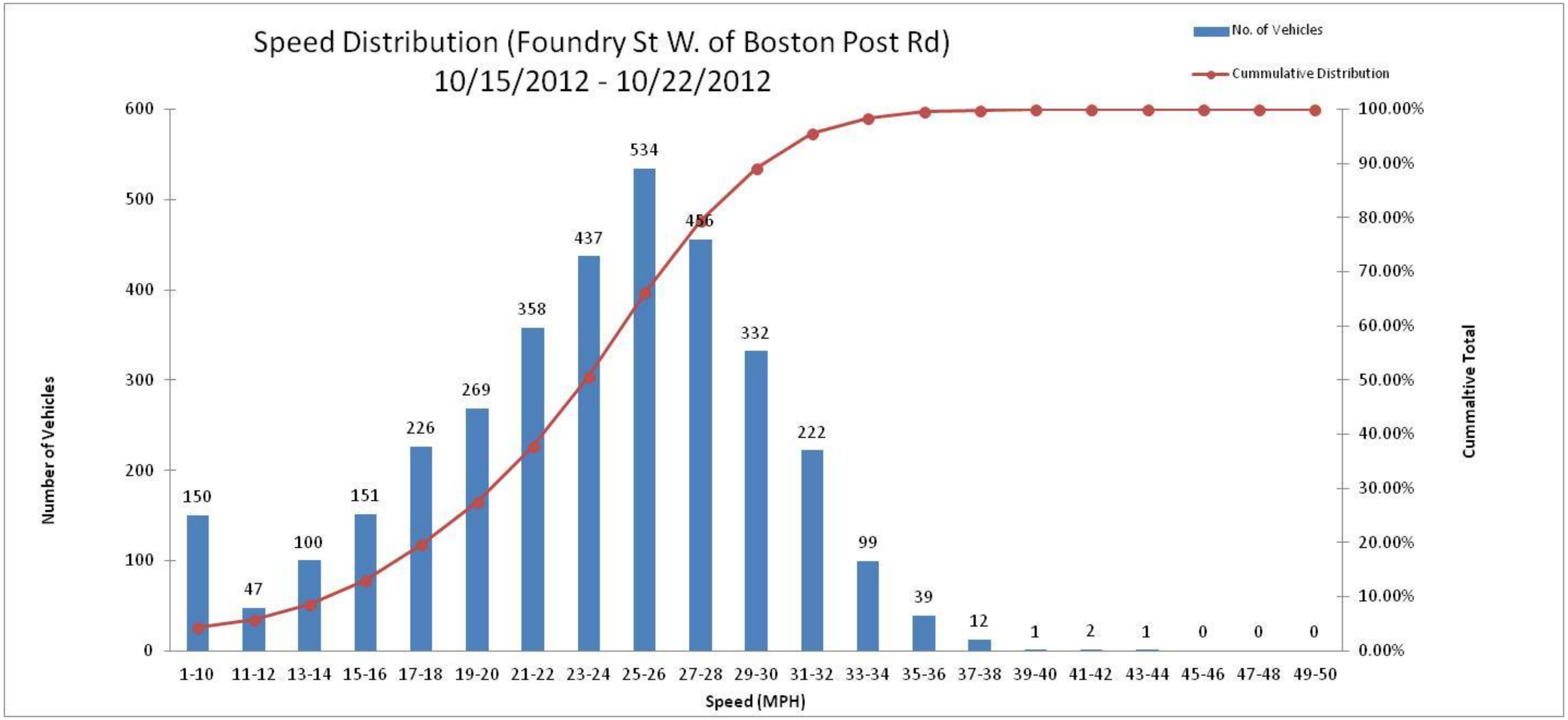
Preliminary Observations
Boston Post Rd S. of Main St.

- Effective Speed Limit: 30 mph
- Posted Speed Limit: 25 mph
- Northbound and Southbound Speed Differential: -2.8 mph
  - for 85% cumulative speed
  - Most likely due to southbound drivers trying to time the light.
  - A Speed differential greater than 0.2 mph is statistically significant with a 95% confidence
- Best conformance seen during evening commute (5pm – 7pm) where again congestion is likely the major factor
- Highest speeds seen in the early morning hours prior to the commute
- Weekday and Weekend volume stats suggest traffic largely dominated by northern Boston Post volumes
  - Other potential feeders such as Foundry St. or Main St. contribute mainly for the weekdays

Foundry St W. of Boston Post Rd. Data Set

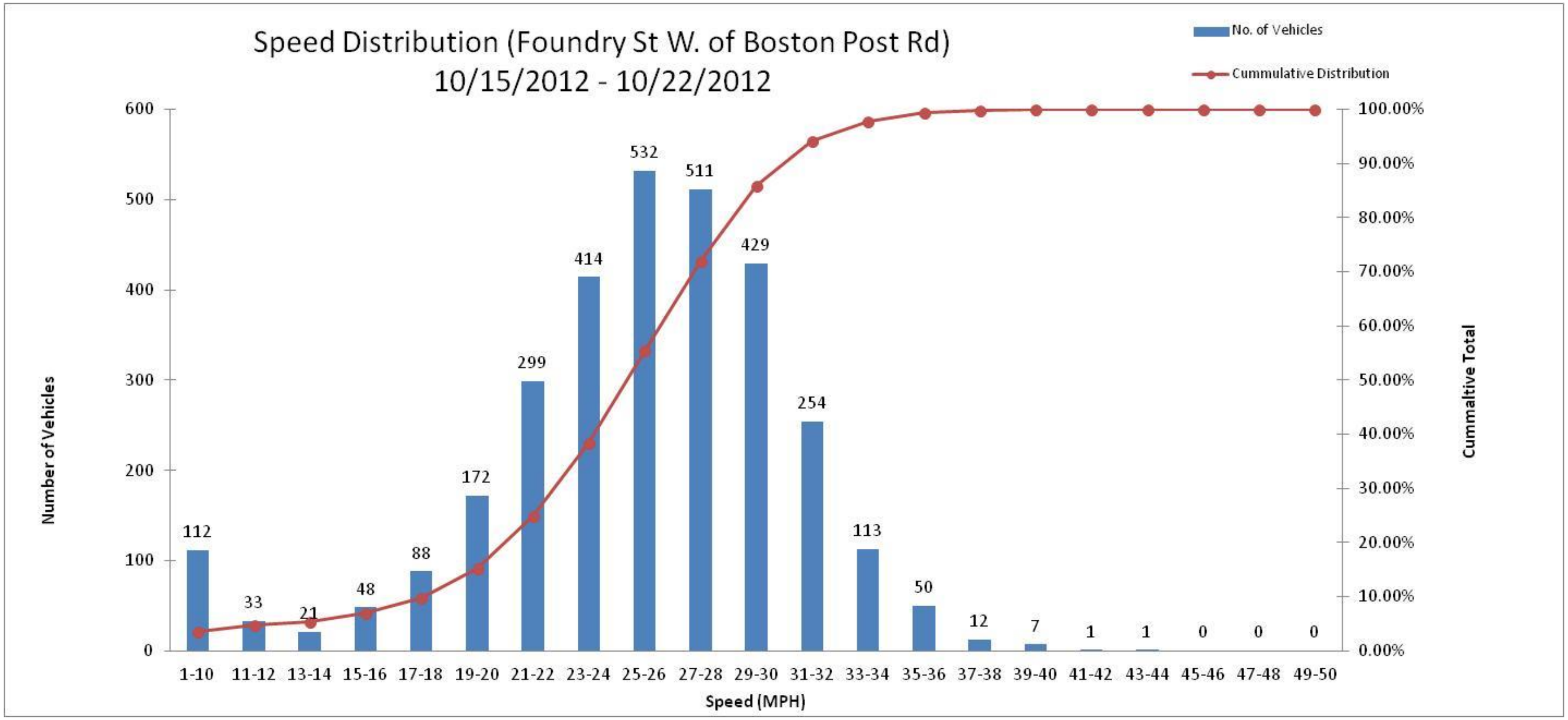
- Data Set Summary:
  - Site Code: AMHERST0FONDRY
  - 1:00pm on Monday 10/15/2012 thru 11:00am on Monday 10/22/2012
  - 6,533 speed and vehicle type observations (including northbound and southbound)

Eastbound Stats



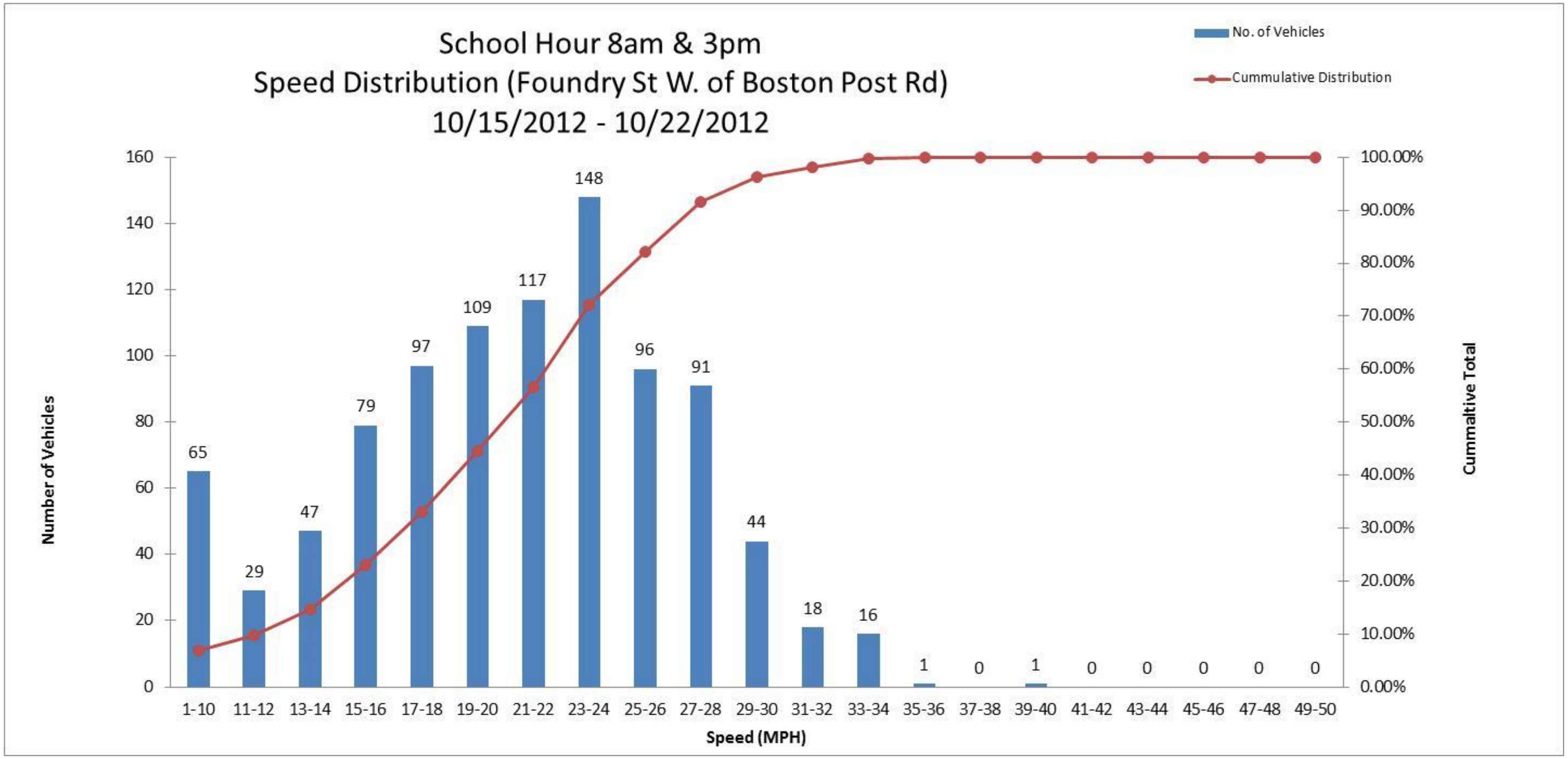
- 85% cumulative speed of 29.2 mph
- 10 mph pace of 21 mph - 30 mph containing 61.6% of the observed traffic
- Mean of 23.4 mph with a median of 23.9 mph (skewed)
- Standard Deviation of 6.5 mph

Westbound Stats



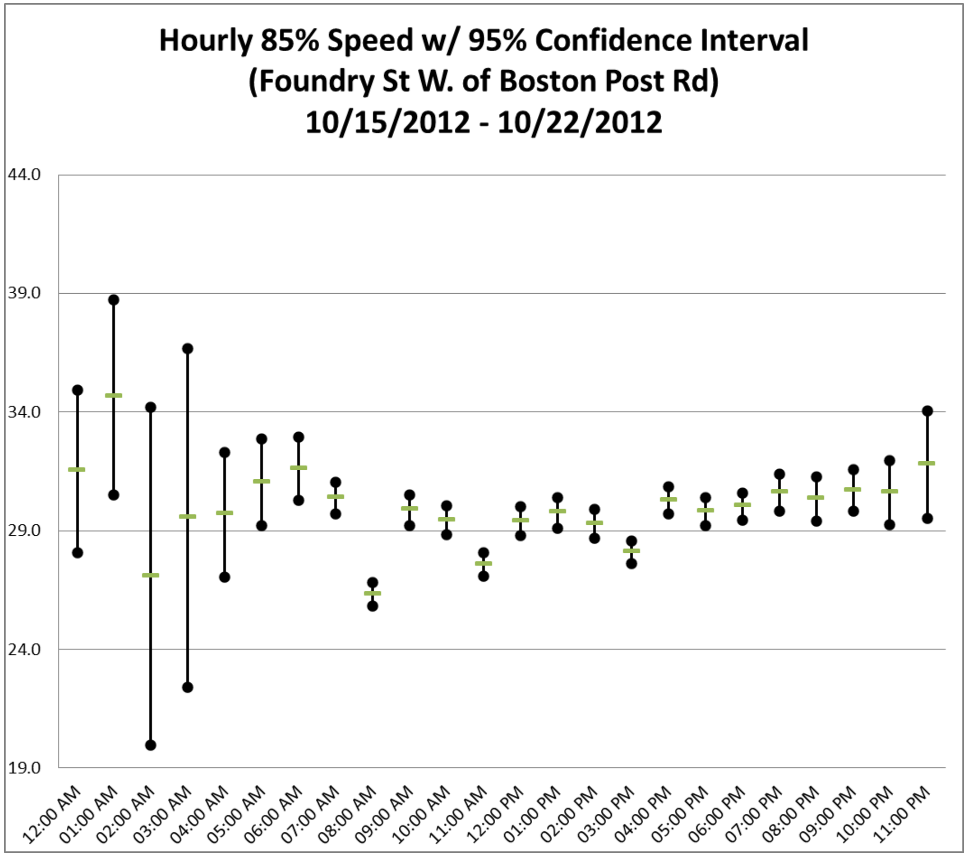
- 85% cumulative speed of 31.8 mph
- 10 mph pace of 21 mph - 30 mph containing 70.6% of the observed traffic
- Mean of 25.1 mph with a median of 27.4 mph (skewed)
- Standard Deviation of 6.0 mph

Stats School Hour NB & SB



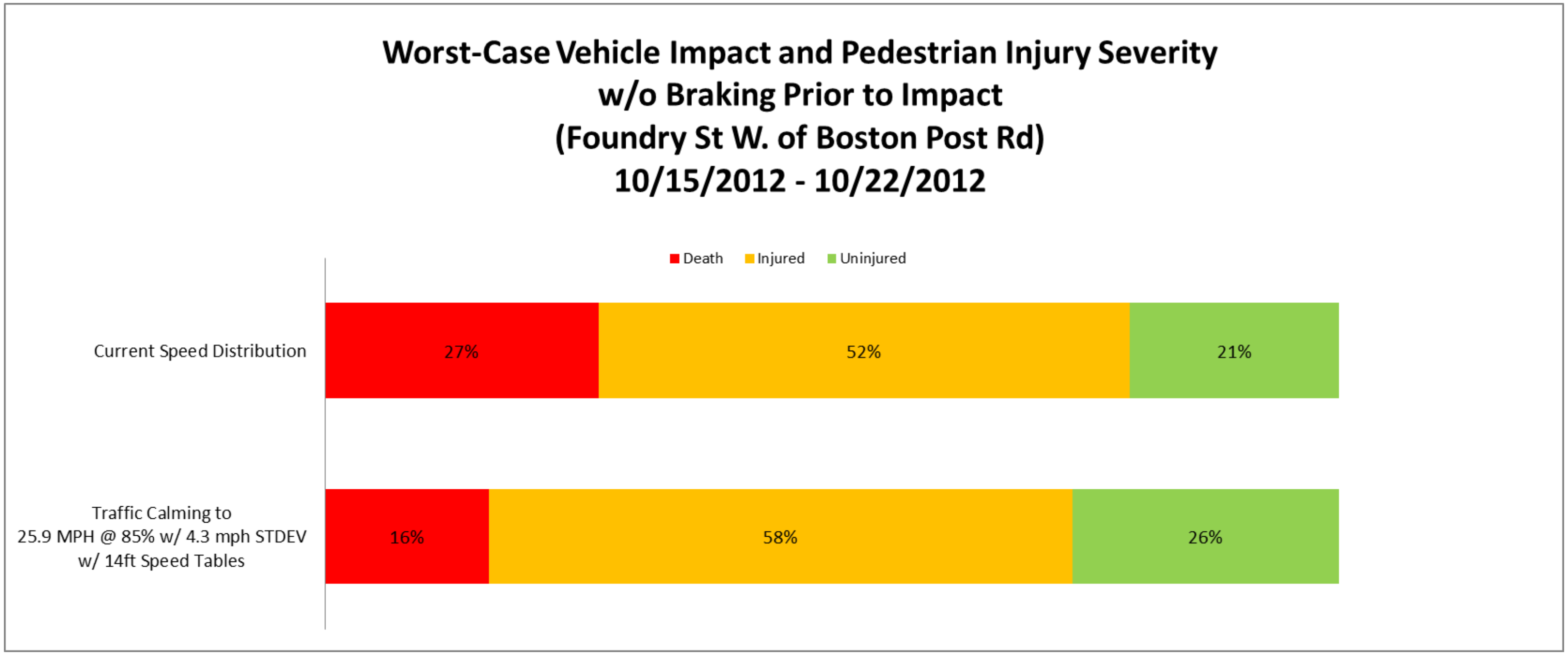
- 85% cumulative speed of 26.6 mph
- 10 mph pace of 17 mph - 26 mph containing 59.2% of the observed traffic
- Mean of 20.7 mph with a median of 20.9 mph (only slightly skewed)
- Standard Deviation of 6.4 mph

85% Cumulative Speed vs. Time of Day



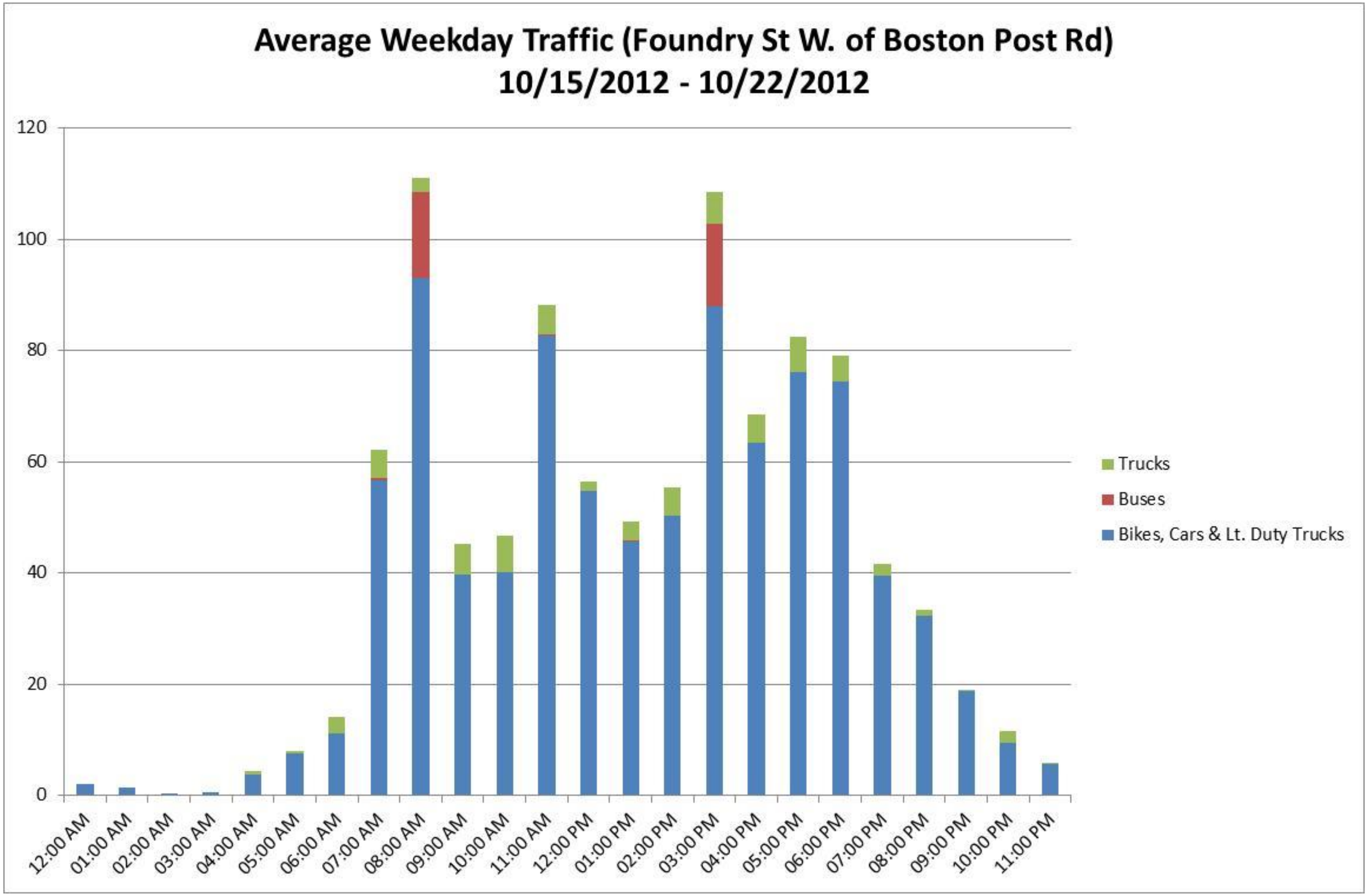
- Highest 85% speeds seen on off hours
  - Particularly very early in the morning but confidence interval is large due to small number of observations
- Lowest 85% speeds seen during 8am, 11 am, and 3 pm school hours
  - Again changes are likely due to congestion rather than changes in collective judgment

Application of DoT HS Stats

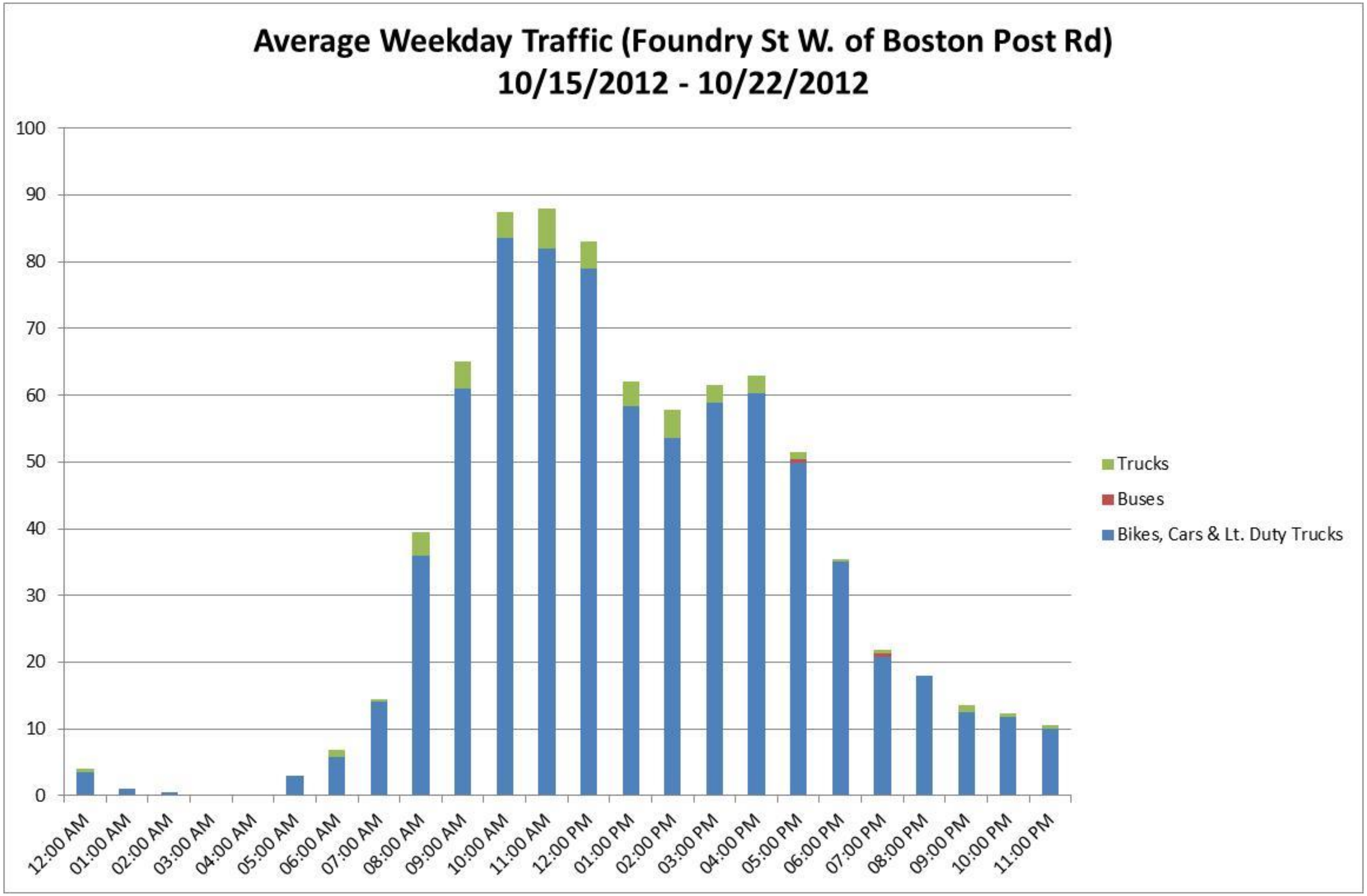


- **<u>Caution must be used</u>** when referencing the above graph as it represents absolute worse-case scenario
  - Assumes **<u>zero</u>** driver reaction/braking prior to impact
  - Traffic calmed pedestrian injury severity stats represent best case improvement localized near a traffic calming measure
  - Speed table used as an **<u>example only</u>**. The resultant speed distribution based on 2002 Minnesota DoT Investigative Report into effectiveness of traffic calming measures.
- It is however illustrative in there are some gains in safety to be found in the worst-case scenario through traffic calming measures
  - The success criteria may be higher than other roads due to the location of school on it

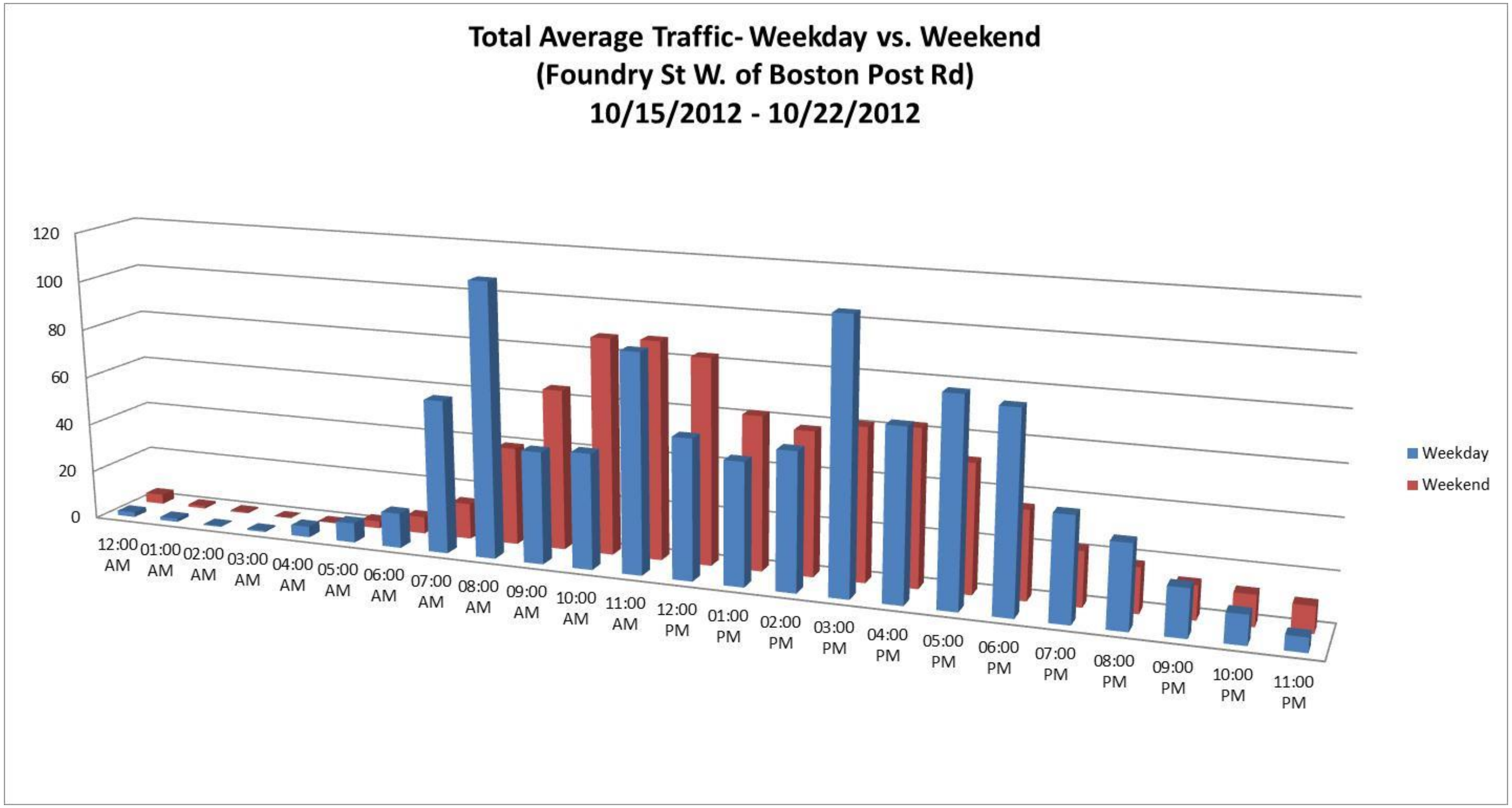
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Peak hours are the school hours during the week
- Generally volume below 100 vehicles/hour

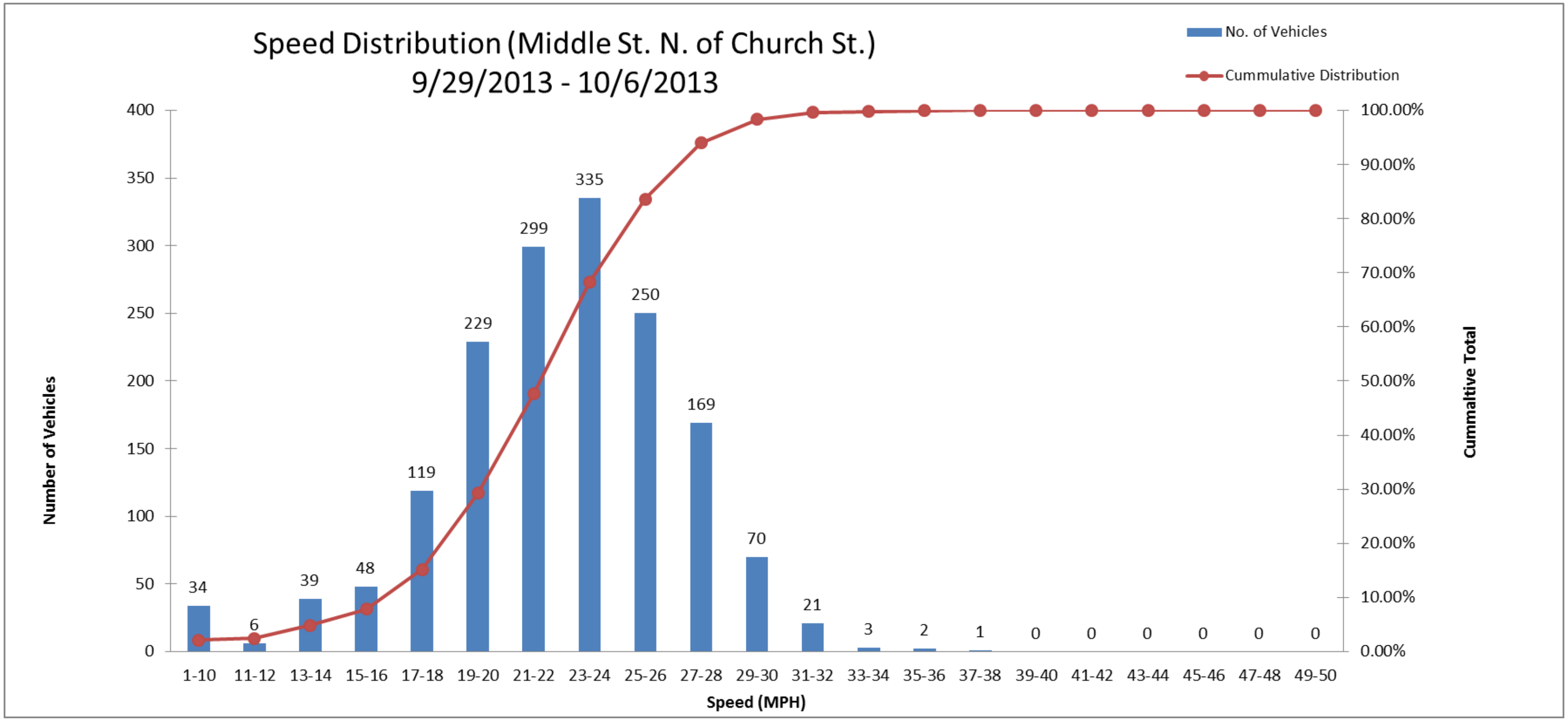
Preliminary Observations
Foundry St W. of Boston Post Rd.

- Effective Speed Limit: 30 mph
- Posted Speed Limit: 25 mph
- Eastbound and Westbound Speed Differential: -2.6 mph
  - for 85% cumulative speed
  - Descending hill prior to entering village area may be contributing factor
  - A speed differential greater than 0.4 mph is statistically significant with a 95% confidence
- Best conformance seen during three school hours where again congestion is likely the major factor in improved conformance
- Highest speeds seen late in the evening and very early morning hours

Middle St. N. of Church St. Data Set

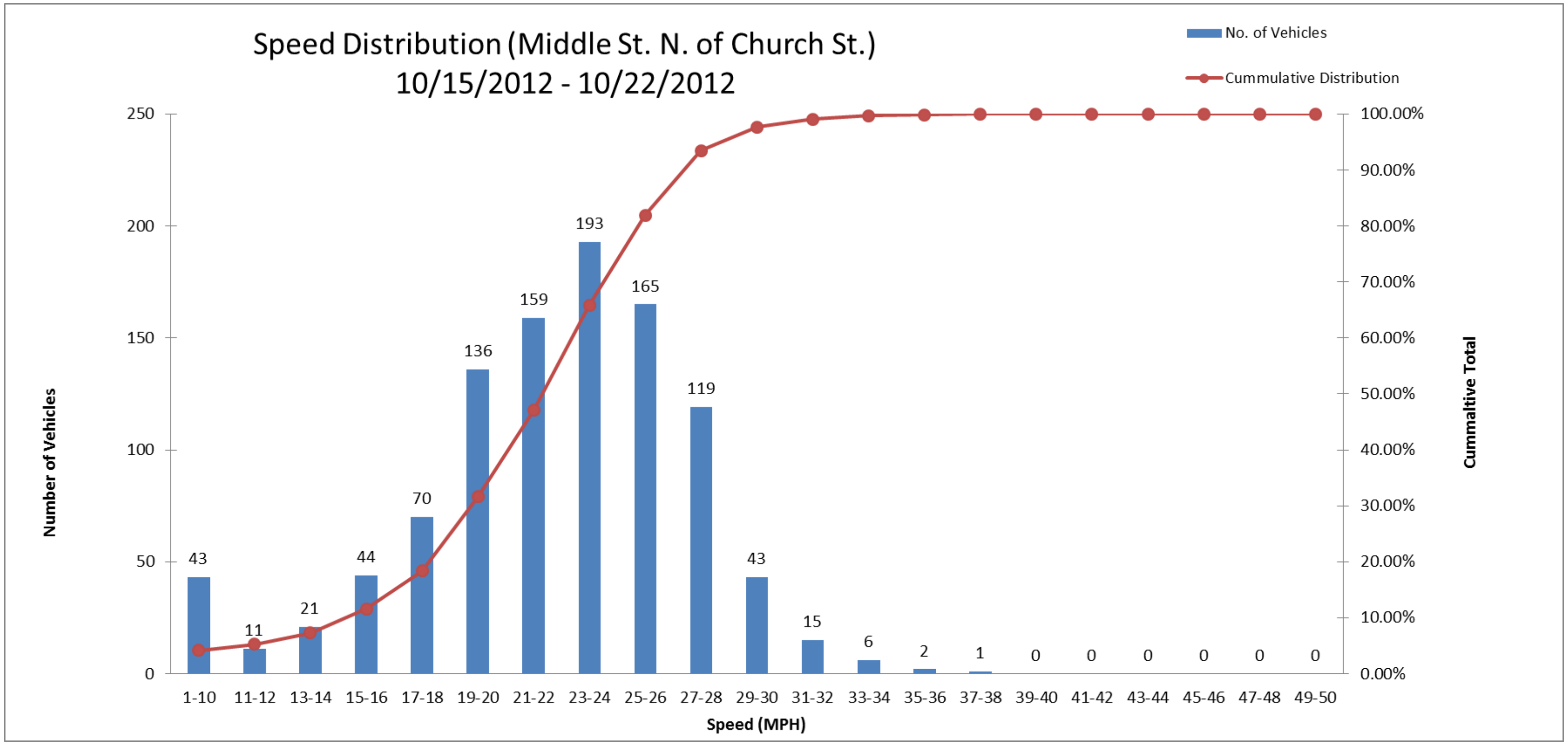
- Data Set Summary:
  - Site Code: 13539
  - 1:00pm on Monday 9/29/2013 thru 8:00am on Monday 10/6/2013
  - 2,576 speed and vehicle type observations (including northbound and southbound)

Northbound Stats



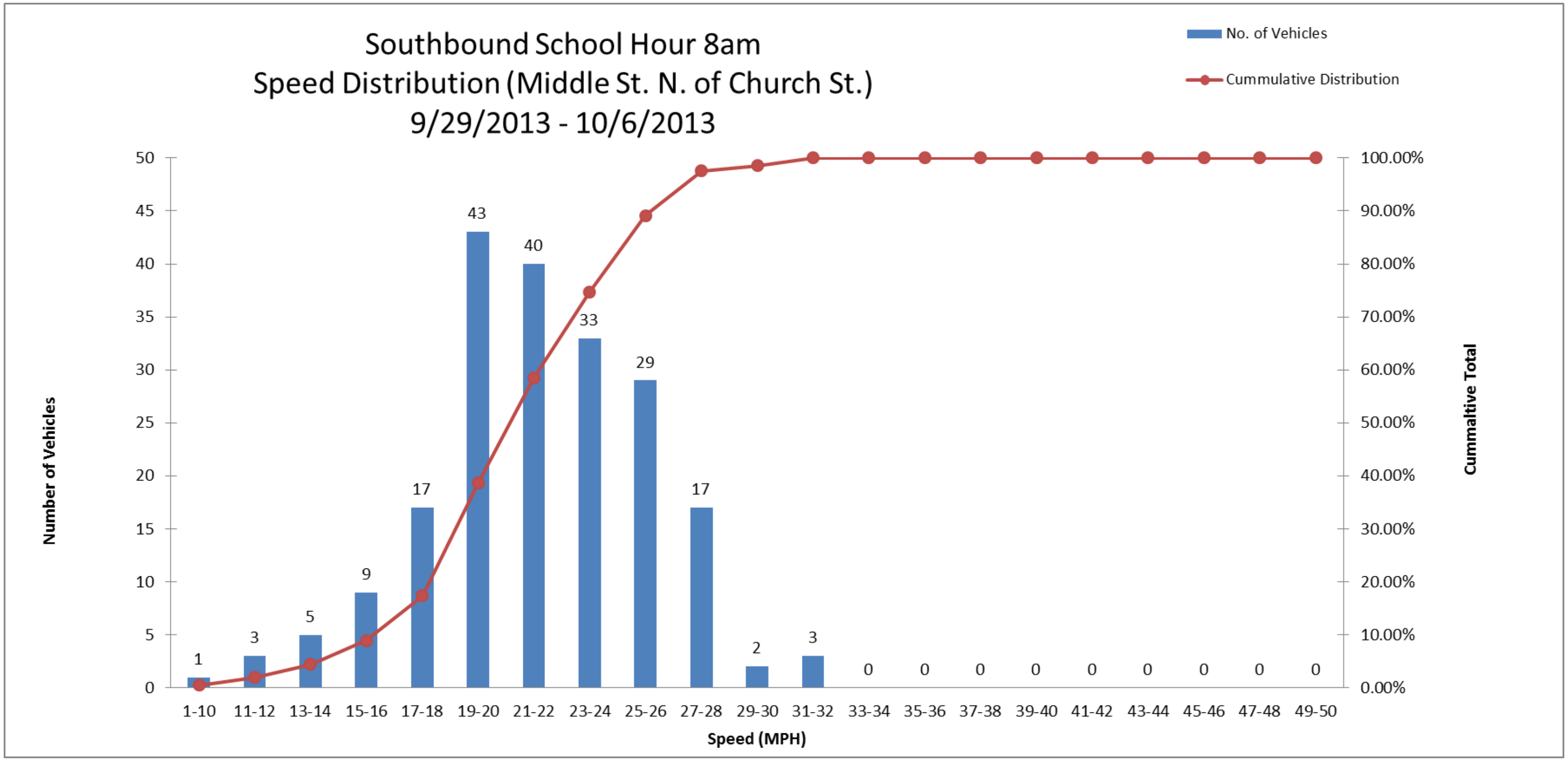
- 85% cumulative speed of 26.3 mph
- 10 mph pace of 19 mph - 28 mph containing 78.9% of the observed traffic
- Mean of 22.4 mph with a median of 22.2 mph (essentially normal)
- Standard Deviation of 4.9 mph

Southbound Stats



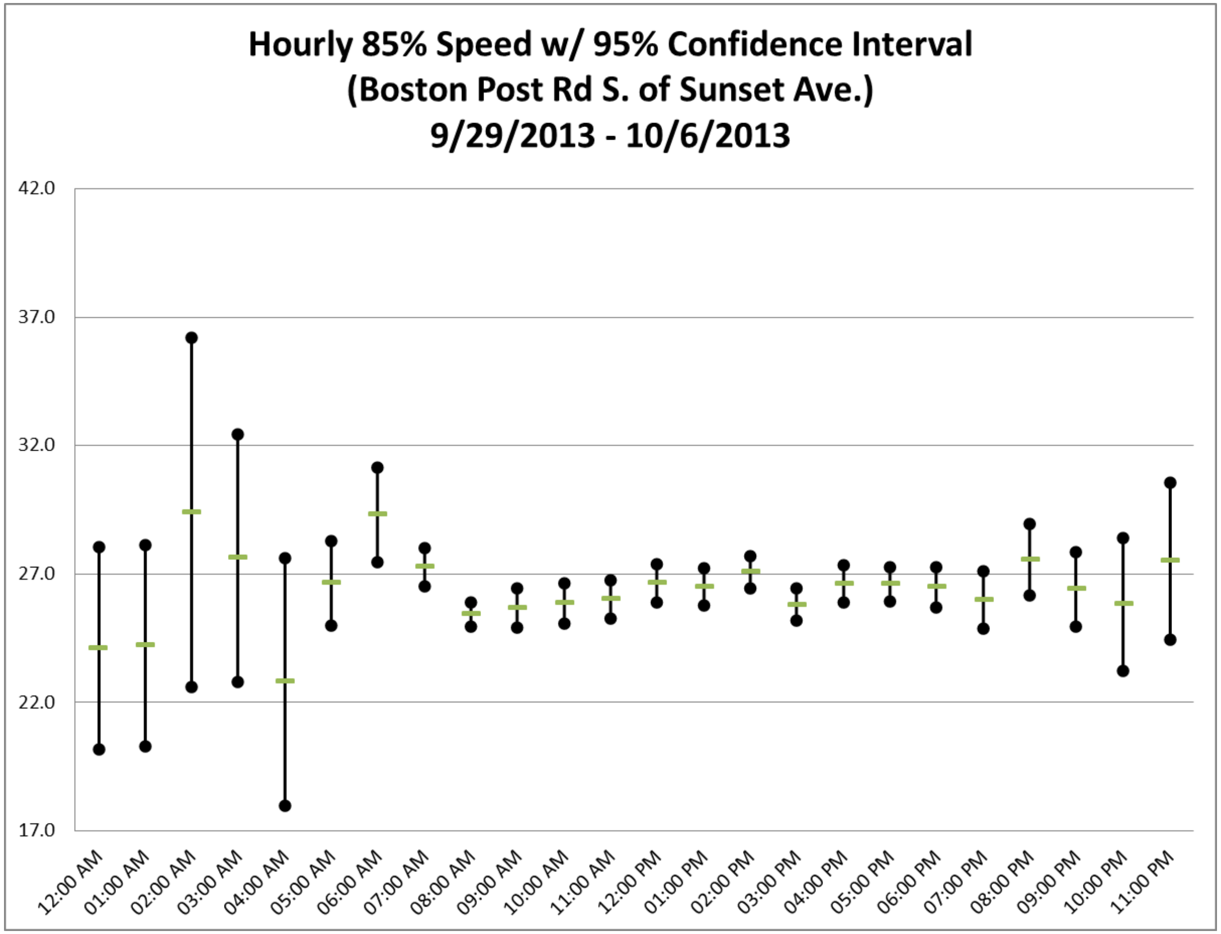
- 85% cumulative speed of 26.5 mph
- 10 mph pace of 19 mph - 28 mph containing 75.1% of the observed traffic
- Mean of 22.1 mph with a median of 22.3 mph (essentially normal)
- Standard Deviation of 5.4 mph

Stats Southbound 8am School Hour



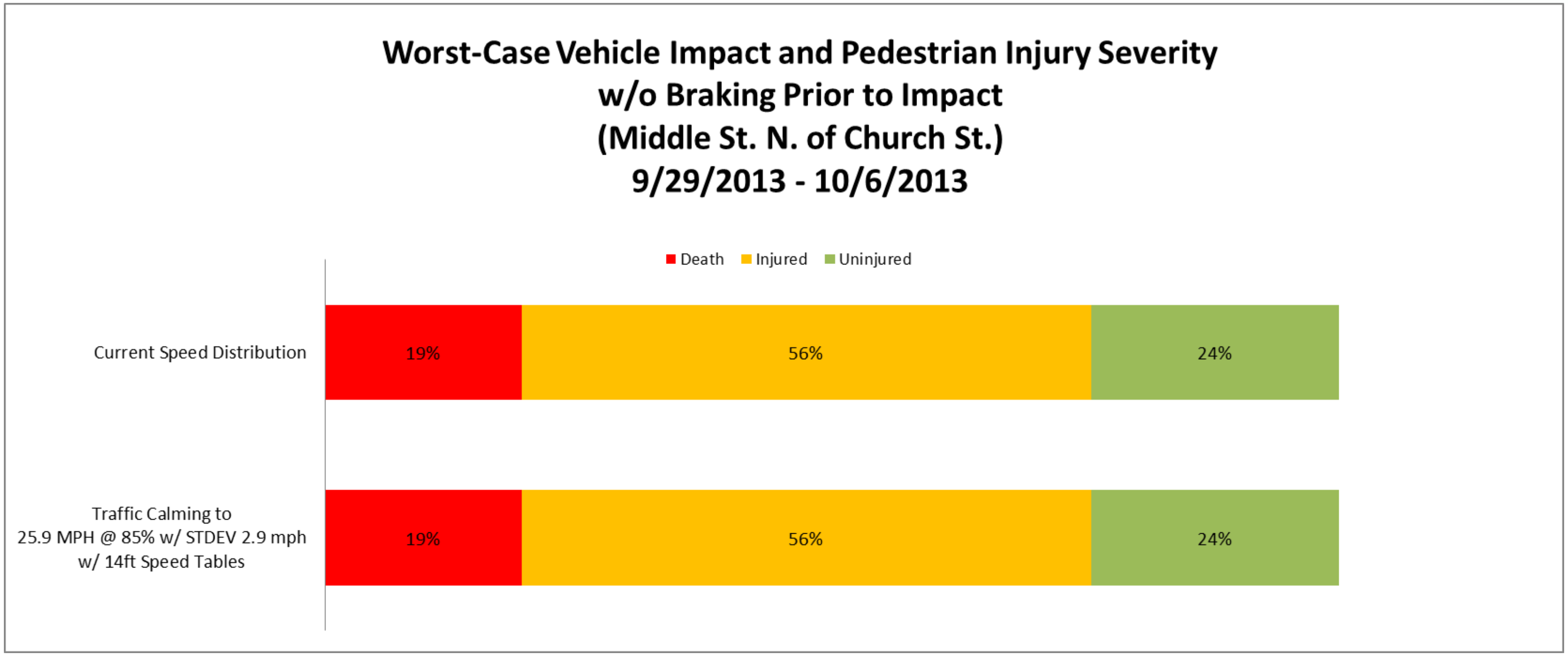
- 85% cumulative speed of 25.4 mph
- 10 mph pace of 19 mph - 28 mph containing 80.2% of the observed traffic
- Mean of 21.7 mph with a median of 21.2 mph
- Standard Deviation of 4.0 mph

85% Cumulative Speed vs. Time of Day



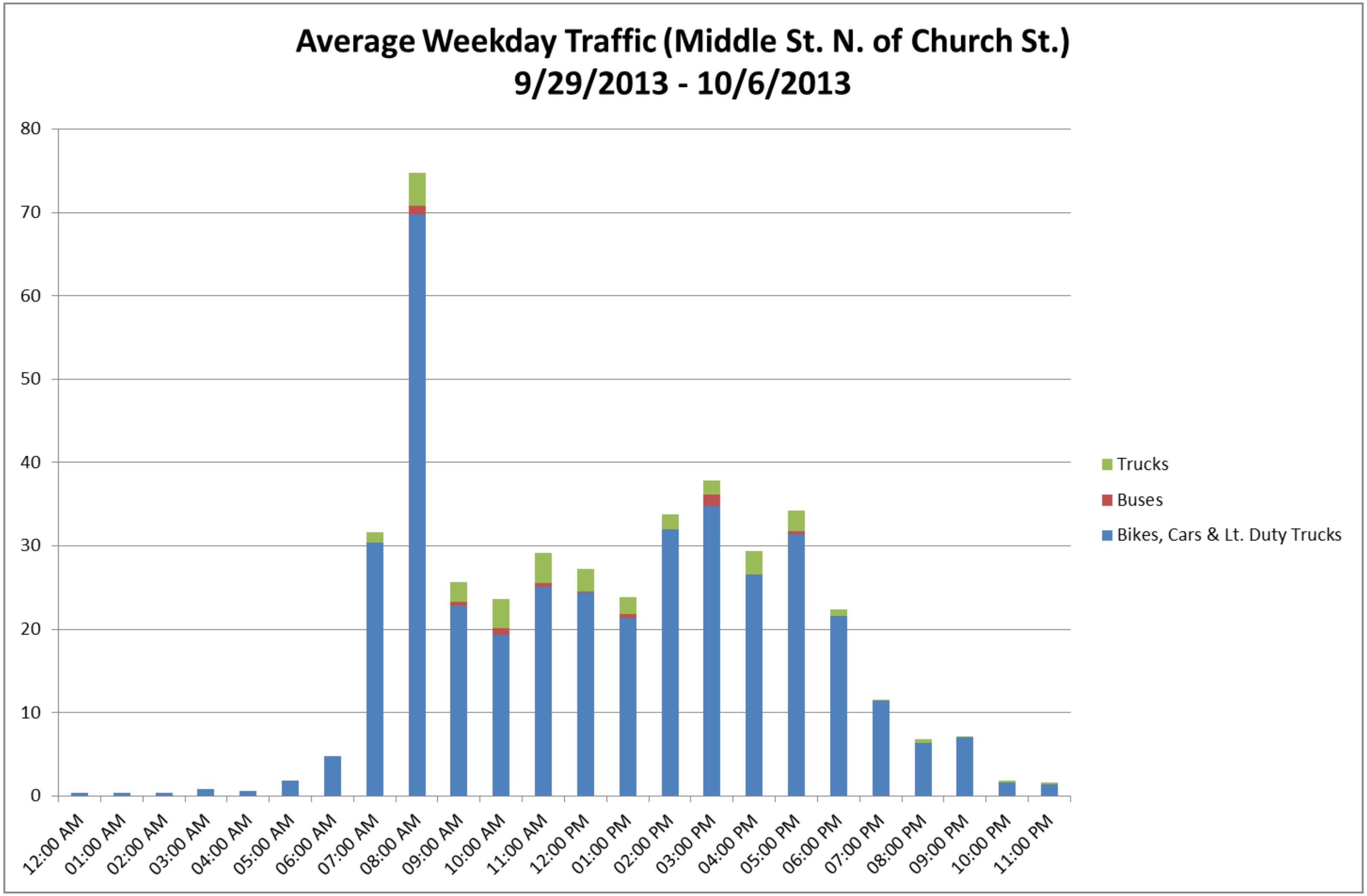
- 85% speeds fairly consistent
- Highest 85% speeds seen in the morning hours just prior to the commute

Application of DoT HS Stats

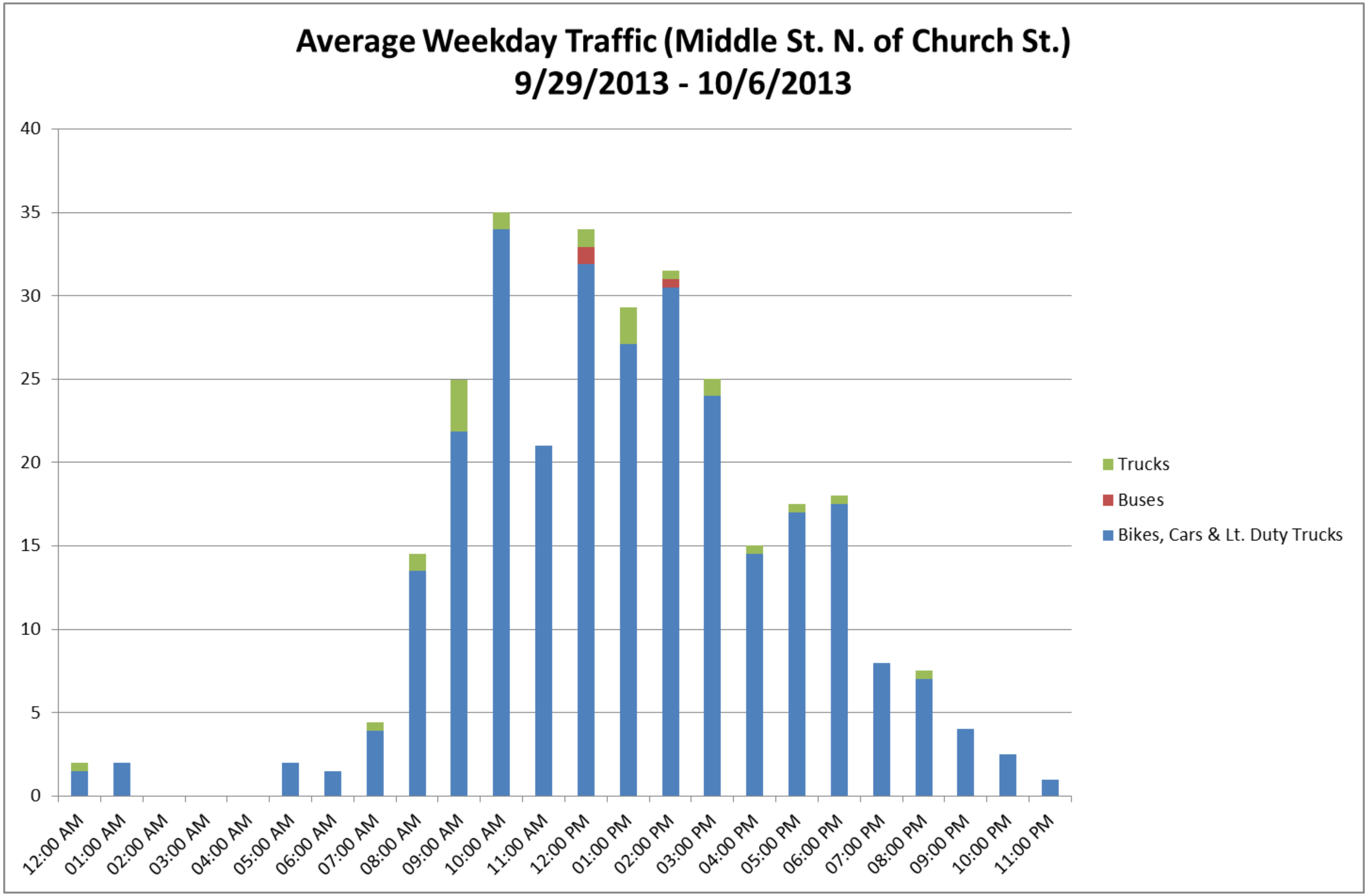


- **<u>Caution must be used</u>** when referencing the above graph as it represents absolute worse-case scenario
  - Assumes **<u>zero</u>** driver reaction/braking prior to impact
  - Traffic calmed pedestrian injury severity stats represent best case improvement localized near a traffic calming measure
  - Speed table used as an **<u>example only</u>**. The resultant speed distribution based on 2002 Minnesota DoT Investigative Report into effectiveness of traffic calming measures.
- It is however illustrative in depicting possible gains in safety to be found in the worst-case scenario through traffic calming measures
  - Here you can see there is negligible gains in safety

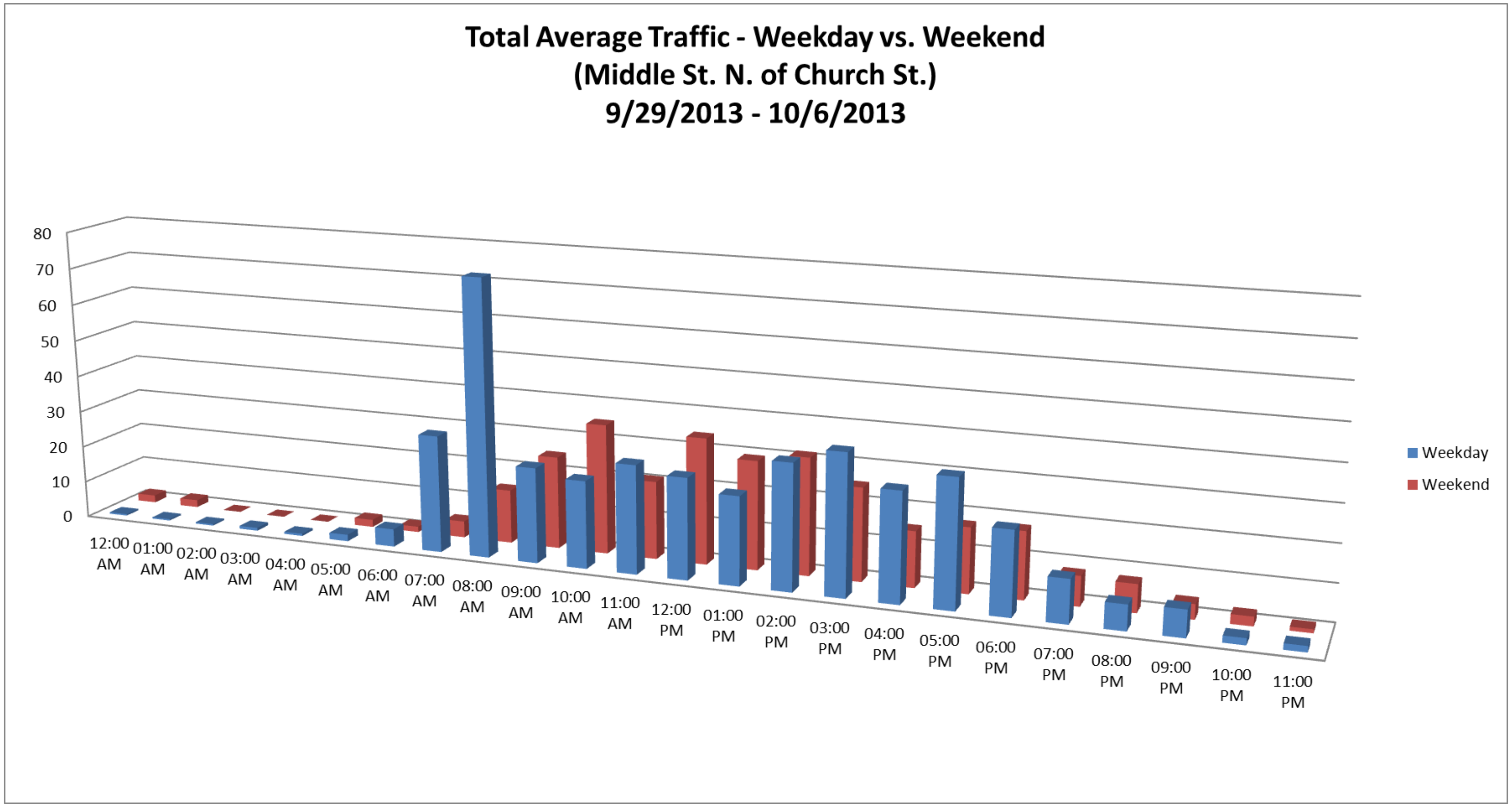
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Peak hour is the morning school where the volume effectively double
- Generally volume below 35 vehicles/hour

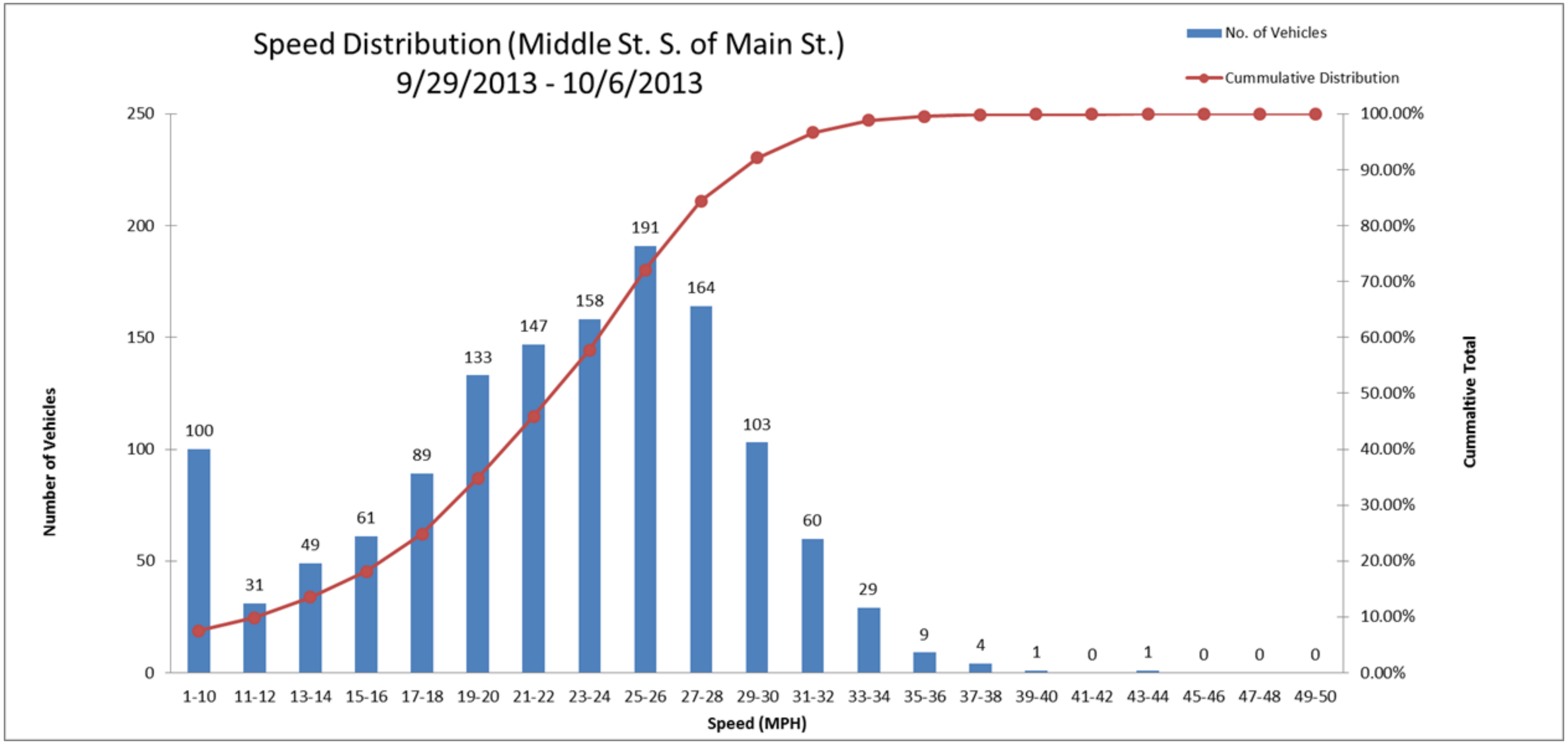
Preliminary Observations Middle St. N. of Church St.

- Effective Speed Limit: 26.4 mph
- Posted Speed Limit: 25 mph
- Northbound and Southbound Speed Differential: -0.2 mph
  - for 85% cumulative speed
  - A speed differential greater than 0.5 mph is needed to be statistically significant with a 95% confidence
    - 85% cumulative speed essentially symmetric with any level of statistical confidence
- No corresponding spike in 85% cumulative speed seen with spike in southbound traffic during 8am school hour
- Highest speeds seen late in the couple of hours prior to the morning commute
  - Other off-hour 85% cumulative speeds indetermistic due to low sample size and large confidence interval

Middle St. S. of Main St. Data Set

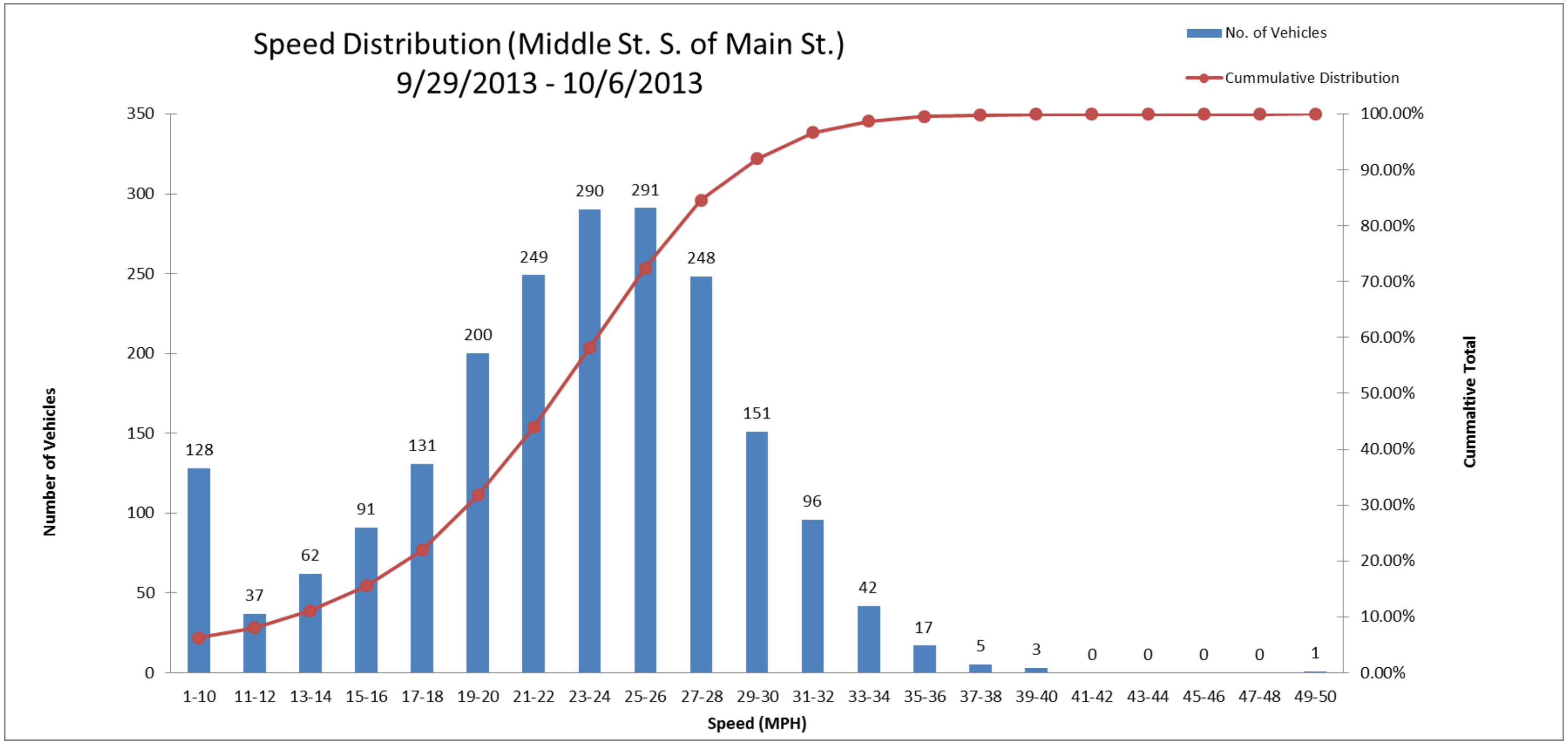
- Data Set Summary:
  - Site Code: 013542
  - 1:00pm on Monday 9/29/2013 thru 8:00am on Monday 10/6/2013
  - 2,576 speed and vehicle type observations (including northbound and southbound)

Northbound Stats



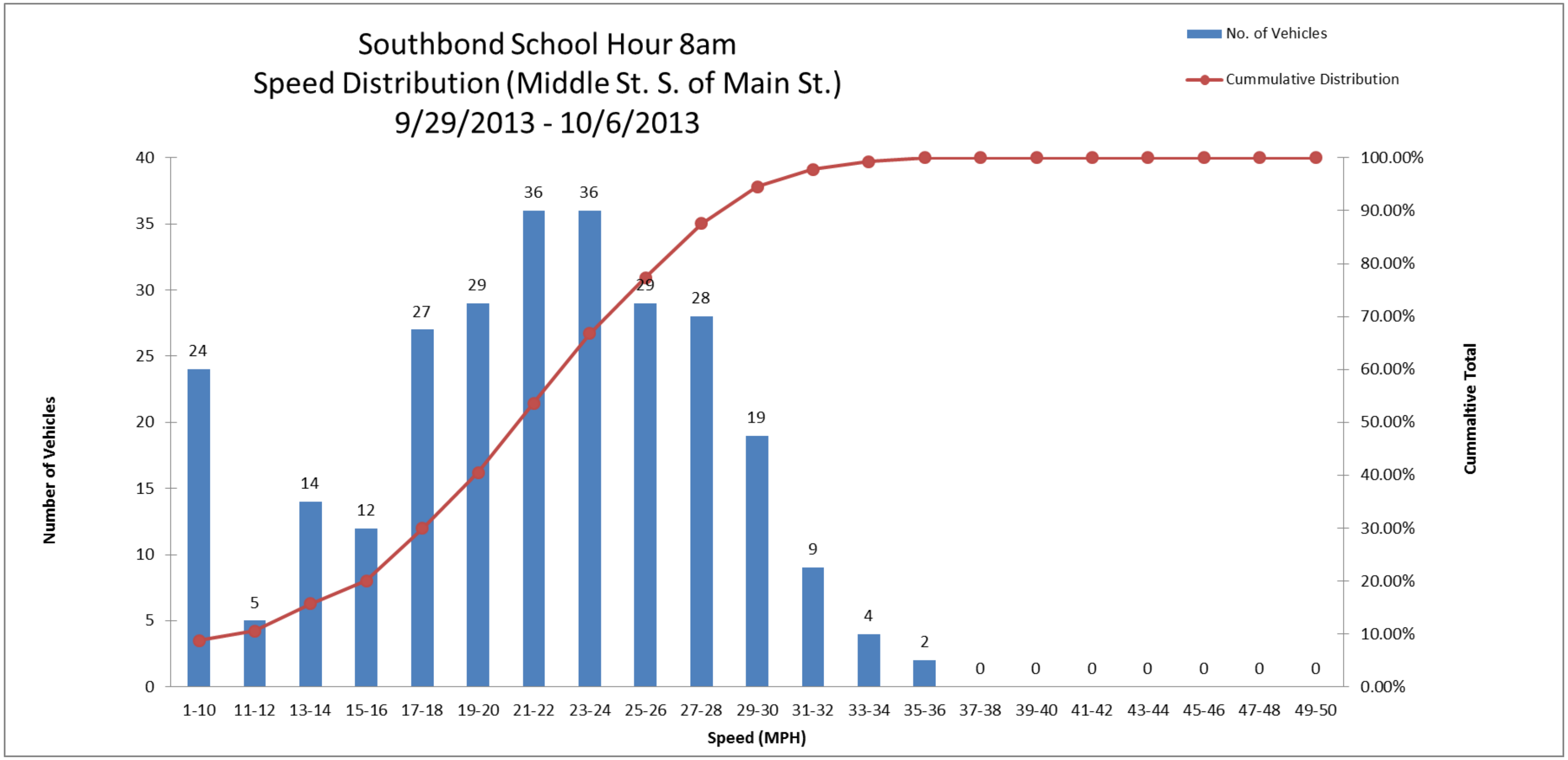
- 85% cumulative speed of 28.1 mph
- 10 mph pace of 19 mph - 28 mph containing 59.6% of the observed traffic
- Mean of 22.1 mph with a median of 22.7 mph (heavily skewed)
- Standard Deviation of 7.0 mph

Southbound Stats



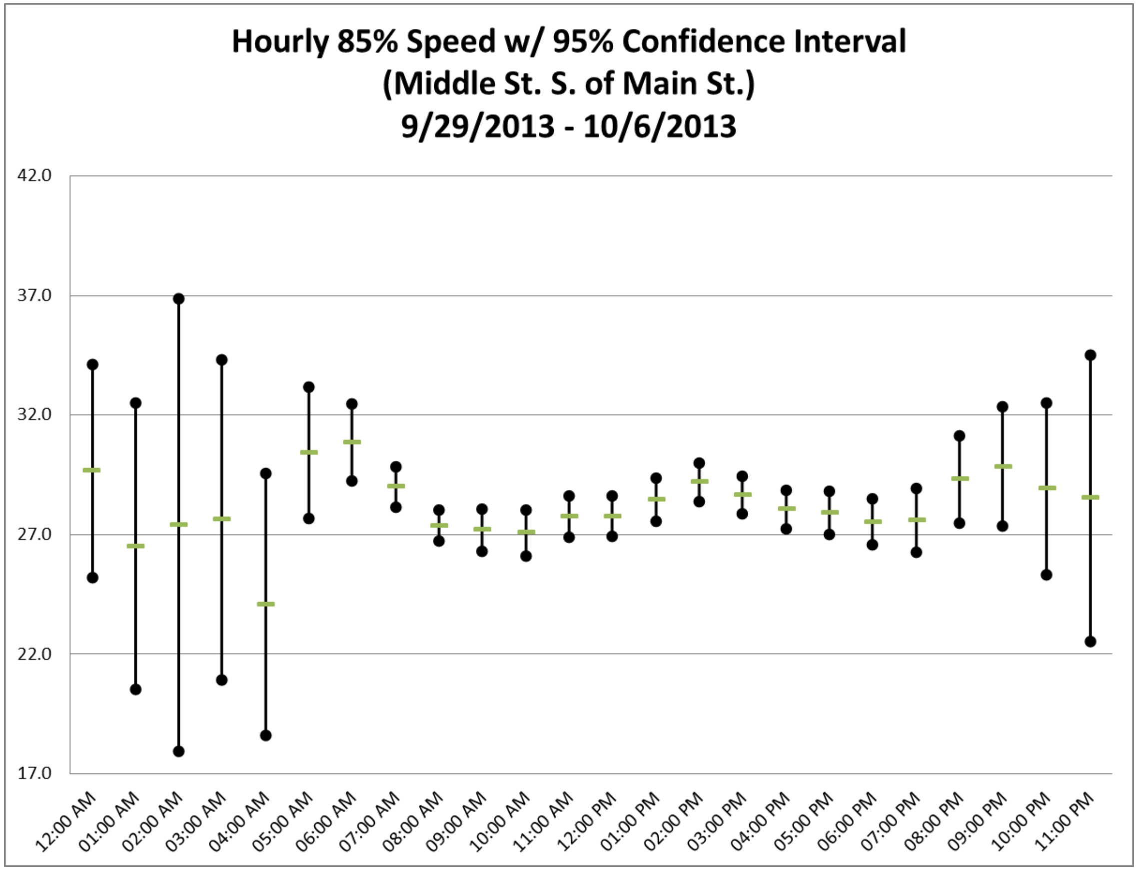
- 85% cumulative speed of 28.1 mph
- 10 mph pace of 19 mph - 28 mph containing 62.6% of the observed traffic
- Mean of 22.4 mph with a median of 22.8 mph (skewed)
- Standard Deviation of 6.7 mph

Stats Southbound 8am School Hour



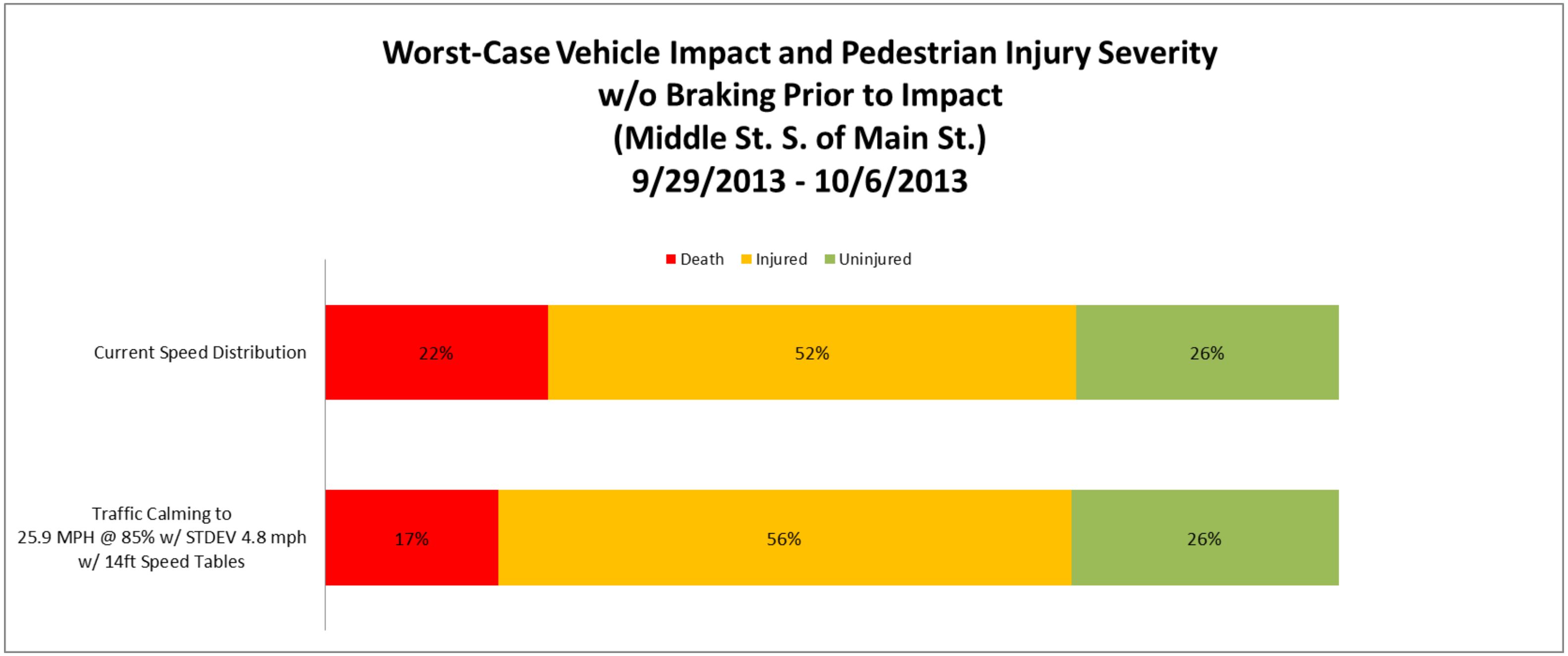
- 85% cumulative speed of 27.5 mph
- 10 mph pace of 19 mph - 28 mph containing 57.7% of the observed traffic
- Mean of 22.1 mph with a median of 22.4 mph
- Standard Deviation of 6.9 mph

85% Cumulative Speed vs. Time of Day



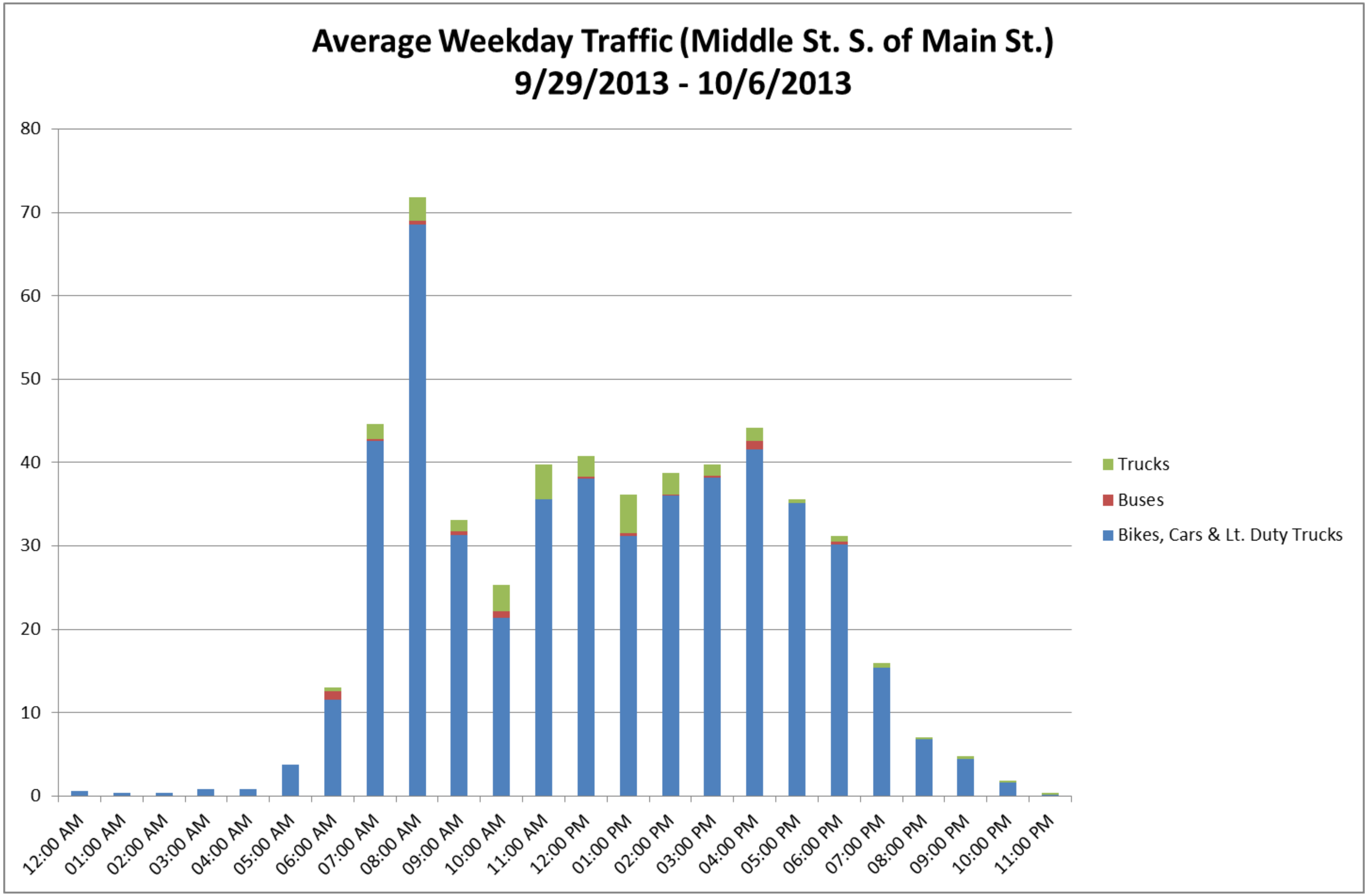
- Highest 85% speeds seen on off hours
  - Particularly the morning prior to the commute but confidence interval is larger due to small number of observations
- During the daytime hours the 85% speed if fairly consistent

Application of DoT HS Stats

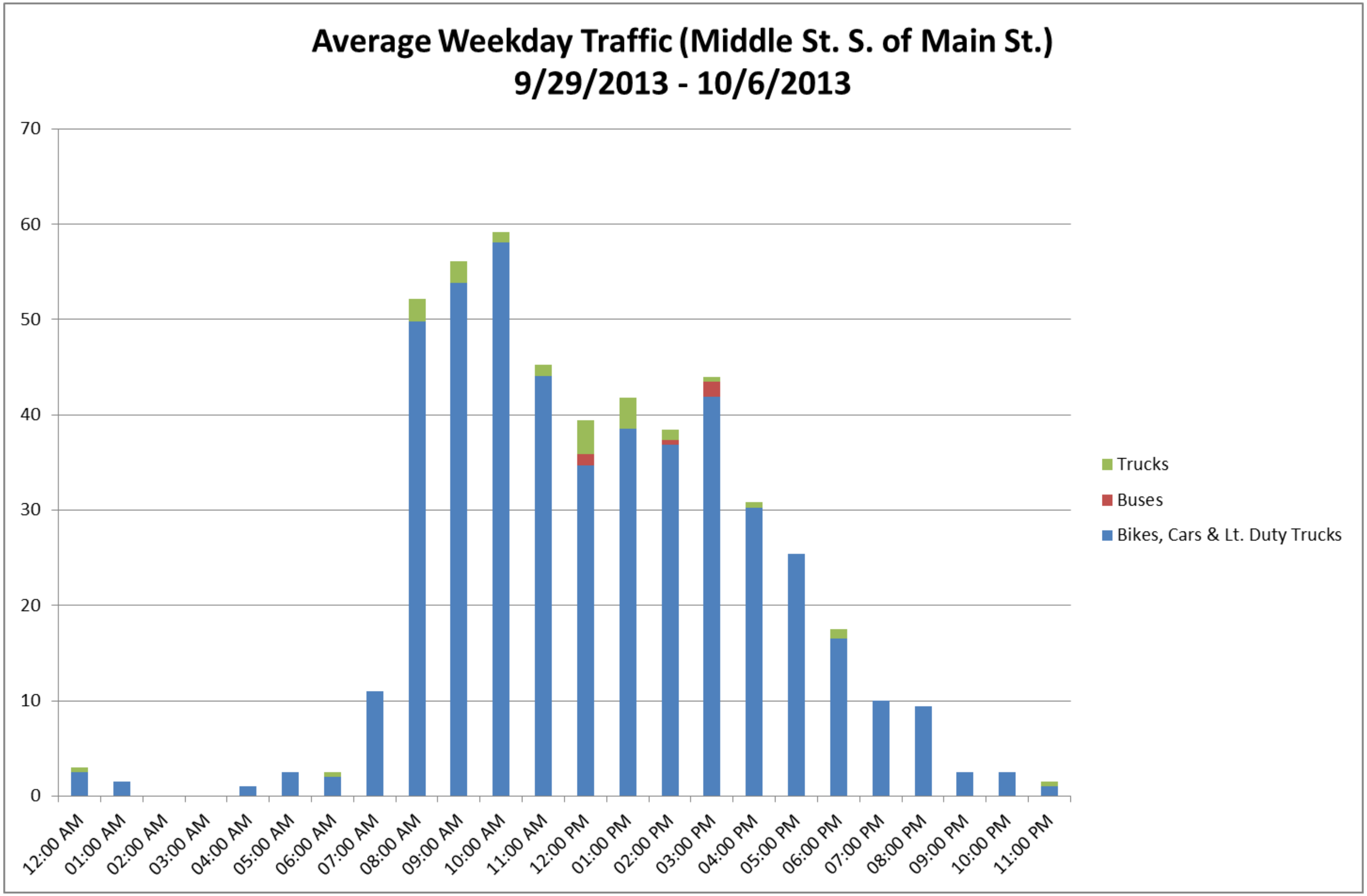


- **Caution must be used** when referencing the above graph as it represents absolute worse-case scenario
  - Assumes **zero** driver reaction/braking prior to impact
  - Traffic calmed pedestrian injury severity stats represent best case improvement localized near a traffic calming measure
  - Speed table used as an **example only**. The resultant speed distribution based on 2002 Minnesota DoT Investigative Report into effectiveness of traffic calming measures.
- It is however illustrative in depicting possible gains in safety to be found in the worst-case scenario through traffic calming measures
  - Here you can have some small gains in safety through traffic calming
  - Again amount of school aged pedestrian traffic may play a role in determining what is considered sufficient

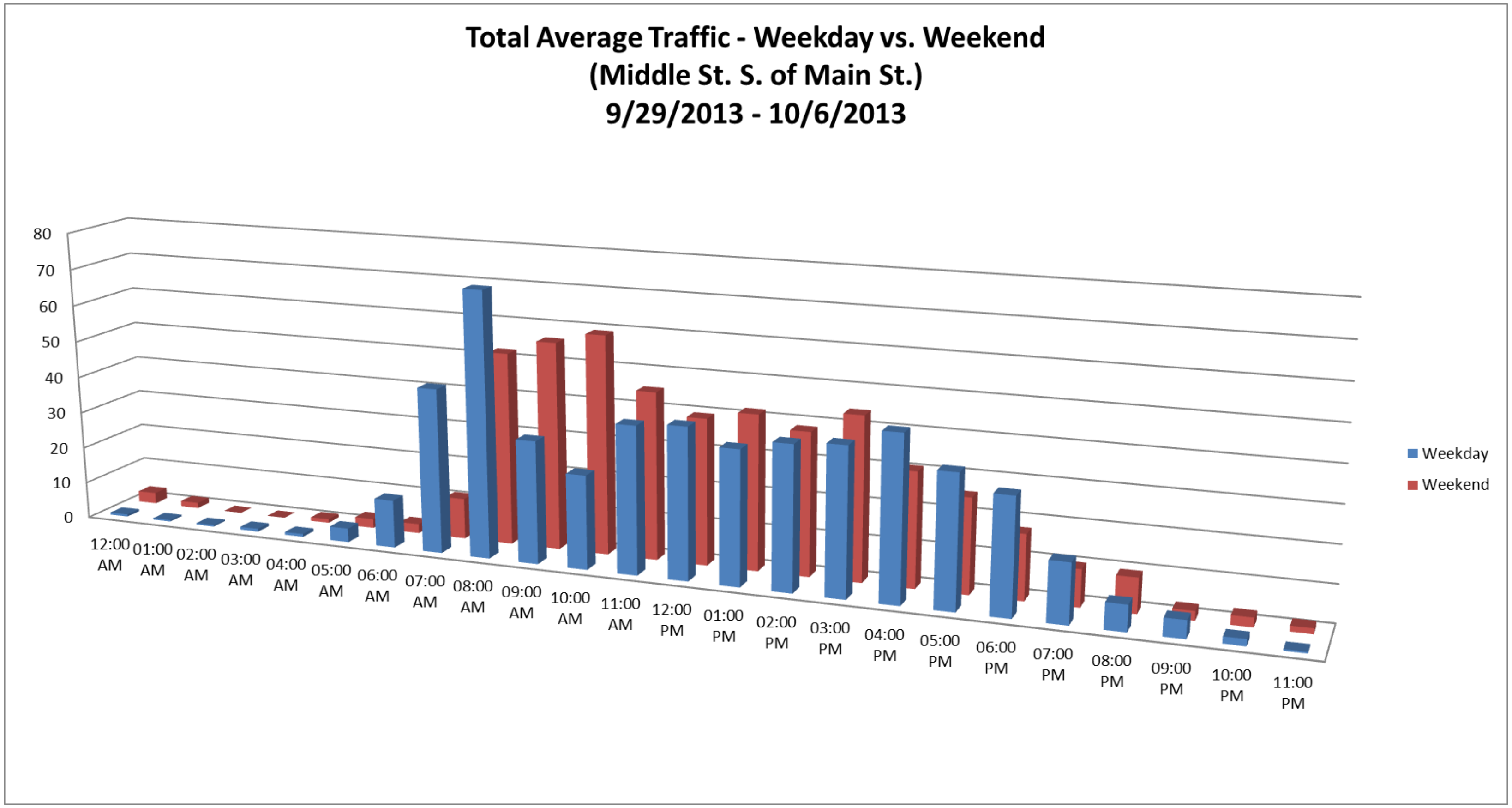
Weekday Traffic Volume



Weekend Traffic Volume



Weekday/Weekend Traffic Volume Comparison



- Peak hour is the morning school where the volume nearly doubles
  - Other pear hours seen between 8:00am – 11:00am during the weekend
- Generally volume below 40 vehicles/hour

Preliminary Observations
Middle St. S. of Main St.

- Effective Speed Limit: 28.1 mph
- Posted Speed Limit: 25 mph
- Northbound and Southbound Speed Differential: -0.0 mph
  - for 85% cumulative speed
  - 85% cumulative Northbound and Southbound speed essentially symmetric with any level of statistical confidence
- No corresponding spike in 85% cumulative speed seen with spike in southbound traffic during 8am school hour
  - From earlier data traffic originates from the intersection of Middle and Boston Post Rd by drivers trying to avoid the school hour congestion with school crossing
- Highest speeds seen late in the couple of hours prior to the morning commute
  - Other off-hour 85% cumulative speeds indetermistic due to low sample size and large confidence interval

Submitted by Chris Buchanan

Traffic & Stop Signs in Amherst

A Political Quagmire with a Surprising Solution

When it comes to the important question of "what to do about traffic in the village?" there are some very opinionated groups that seem to have formed in town. One group is concerned about the safety of pedestrians in the village, one is concerned about the inefficient and seemingly-arbitrary application of traffic systems, another wants the town to be a place of community and gathering, while another group wants to do anything to improve and preserve the historic and aesthetic environment.

With so many deeply passionate and differing groups, it may seem as though *any* proposed solutions or modifications to the village will accomplish little in the eyes of most. Acting on behalf of a particular group may seem to neglect the other groups in town; while finding some middle-ground compromise would leave all groups unhappy.

Surprisingly though, there is a solution that will uncompromisingly accomplish all major goals of *every* one of these groups.

A comprehensive solution to the village traffic situation that:

- Uses proven methods to increase safety in the village for drivers, cyclists, and pedestrians
- Increases efficiency of traffic driving through town
- Creates a comfortable, safe, social community in the village that is welcoming to all, including pedestrians
- Aesthetically restores the village to an historic environment, restoring the village to our nationally-recognized historic atmosphere

The answer: Shared Space.

"Shared space" is a street or place designed to improve pedestrian movement and comfort by reducing the dominance of motor vehicles and enabling all users to share the space rather than follow the clearly defined rules implied by more conventional designs. It is a concept that minimizes the demarcations that separate vehicles, pedestrians, and cyclists. Shared Space has proven to increase safety while simultaneously improving traffic efficiency and restoring the social world to the village square.

Shared space revolves around the counterintuitive but proven philosophy that by blurring the lines of rite of way and by creating uncertainty, drivers naturally drive more slowly, become more alert, more cautious, and therefore safer. This is based on the psychological concept known as "risk compensation," roughly concluding that people will adjust their behavior in response to the perceived level of risk, becoming more careful where they sense greater risk and less careful if they feel more protected. In short, if drivers *perceive* less safety, they drive more safely.

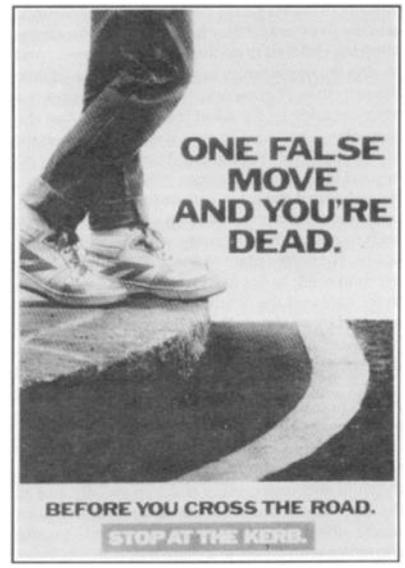
"Shared space" also goes by other names: "Naked Streets," "Living roads," "Shared Places" and the Dutch word "Woonerf"

Why (More) Signs, Lights, Bumps, and Lines Fail

High speeds and traffic safety issues in villages have been a persistent problem globally since the advent of the personal vehicle. Over time, three main concepts were adopted by traffic engineers to help with this persistent issue:

- Transplanting highway systems (traffic regulation, markings, wider roads, and signage) from highways into villages
- Segregation of motor vehicles from the rest of the village, including all other kinds of traffic (pedestrian, cyclists, etc.)
- Traffic calming techniques (warning signs, increased speed enforcement, speed bumps, etc.)

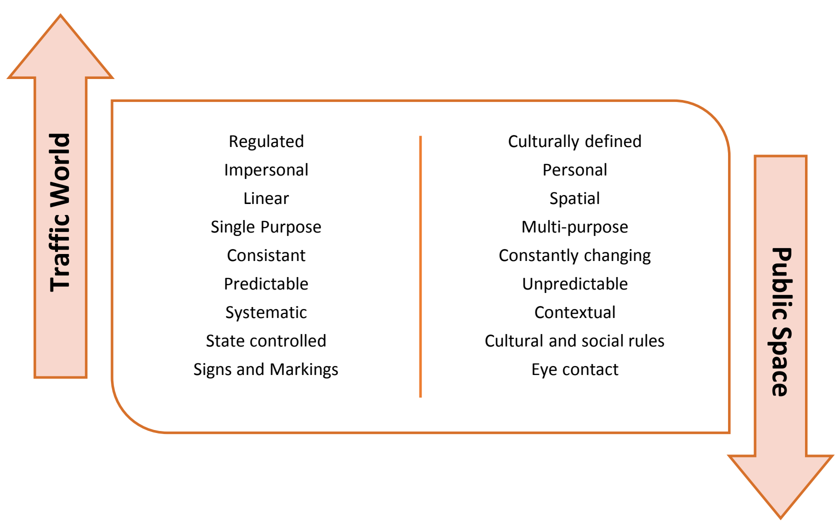
Although these three strategies were never evaluated much for their effectiveness, they appeared to be common-sense solutions and were also the seen as the only logical options to combat the issue of safety on rural roads. The results however, were unimpressive. Despite villages being gradually filled with segregated roads designed to separate cars from pedestrians, pedestrians were still being hit and killed. Despite lower speed limits, the installation of speed bumps, and higher traffic enforcement, motorists continued to drive too fast. Why were these common-sense safety solutions failing to make villages safer?



An example of a 1967 campaign to spread awareness regarding traffic segregation in the U.K.

Simply put: highway systems, vehicle segregation, and traffic control devices do not belong in villages. Through the well-intentioned efforts of transplanting these systems into villages and rural roads, traffic engineers were licensing motorists to drive as though they would on highways. **When a road looks and feels like a highway, people will drive on it like it's a highway, no matter what a sign says.** This can include a range of behaviors from speeding to not expecting pedestrians, or even not expecting other cars coming from different directions. Specifically, these efforts to make the roads “safer” had four major effects on drivers:

- Drivers were more comfortable with the uniform highway-like driving experience, allowing them to feel as though they didn’t have to pay attention to the environment, much like one would on a high-speed road.
- Speeds on these roads increased, as the roads looked and felt as though they were major roads with wide shoulders and a wide margin for error, drivers felt as though they were able to drive quickly without major and immediate ramifications. By bringing signage and lines from highways into small towns, drivers no longer recognized the need to reduce speeds in a village. Village roads resembled more and more the major roads which connected them, but with a confounding “20 MPH Speed Limit” sign which conflicted with the messages of a “forgiving” road.
- Drivers developed a sense of “territory” over the road, and any pedestrians or cyclists who impinged on that space ran the risk of being hit, as that was perceived to be “car territory”
- Most importantly, drivers no longer felt as though they had to pay attention to their job. Drivers, when told exactly how to drive, when to stop, and how to act, ceased to concentrate on driving and their environment. This is extremely dangerous, and has a major effect on driving behavior in rural environments. (The same sort of result can be seen when drivers have a tendency to fall asleep while driving on highways)



Characteristis of the "Traffic World" vs. Public Spaces

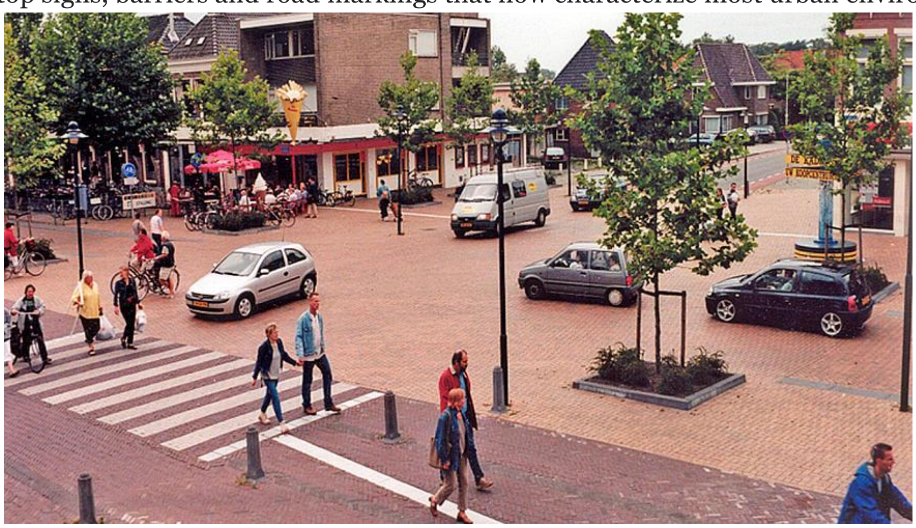
To quote world-renowned traffic engineer Hans Monderman, “A wide road with a lot of signs is... saying, go ahead, don’t worry, go as fast as you want, there’s no need to pay attention to your surroundings. And that’s a very dangerous message.”

Traffic engineers and social psychologists from the 1960s-1980's began to look at these conventional methods of traffic calming in villages, and they began to question their effectiveness. By using psychological research, specifically that surrounding the concept of "risk compensation," they developed some counter-intuitive but compelling explanations for the failure of classical traffic engineering on rural roads. The culmination of decades of this research would be the creation of "shared space."

Shared Space and how it Remedies Village Traffic Woes

When traffic engineers such as Hans Monderman noticed the major flaws in the high-traffic-regulation approach to rural roads, he sought to turn the "risk compensation" based research into reality: a village environment devoid of the safety failures, inefficiencies, and ugliness of the "traffic world." But could such a thing really be done? For traditional highway engineers his idea was anathema. Since the advent of the car they have planned on the assumption that car drivers are "selfish, stupid, but obedient automatons" who had to be protected from their own stupidity, and that pedestrians and cyclists were "vulnerable, stupid, obedient automatons" who had to be protected from cars – and their own stupidity. Hence the ideal street was one in which the "selfish-stupid" were completely segregated from the "vulnerable-stupid," as on the American freeway or European motorway where pedestrians and cyclists and pedestrians are forbidden. Where segregation was not possible, in residential suburbs and older urban areas, their compromise solution was the ugly jumble of electronic signals, stop signs, barriers and road markings that now characterize most urban environments.

Shared Space in London



Shared Space Downtown Intersection/Square, Netherlands

Monderman observed those using the streets for which he was responsible and concluded that they were not stupid, but nor did they obey all the rules and barriers that assumed that they were, and nor, on the whole, did they behave selfishly. Pedestrians, he noticed, were nature's Pythagoreans – always preferring the hypotenuse to the other two sides of the triangle. Given half a chance they did not march to the designated crossing point and cross at right angles to the traffic; if they spotted a gap in the traffic they opted for the diagonal route of least effort.

And motorists did not selfishly insist on their right of way at the cost of mowing down lots of pedestrians. Monderman decided that those for whom he was planning were vigilant, responsive and responsible. He deliberately injected uncertainty into the street environment about who had the right of way. The results were transformative. Additionally, traditional highway engineers have never been concerned with aesthetics. Their job was to move traffic safely and efficiently. They dealt not with people but PCUs (passenger car units). The removal of the signals, signs and barriers that were the tools of their trade not only greatly improved the appearance of the streetscape but, by elevating the status of the pedestrian and cyclist relative to that of the motorist, made them safer as well.

Claes Tingvall, who is credited with being the architect of Sweden's Shared Space initiative "Vision Zero," said in an interview "Vision Zero ... is a shift in philosophy. Normal traffic policy is a balancing act between mobility benefits and safety problems. The Vision Zero policy refuses to use human life and health as part of that balancing act; they are non-negotiable. ... Part of the Vision Zero strategy is to improve the demand for safety."

How has this initiate panned out? The results were clear. In shared space projects, speeds were consistently lowered dramatically, motorists fundamentally changed their driving behavior, the number of accidents, especially fatal accidents have all but vanished completely, and pedestrians/cyclists have tended to feel a greater sense of comfort, mobility, and community (Please see the listed references and videos below for numerous examples of this). In these places, the driver becomes a citizen. Eye contact and human interaction replaces signs and rules. No longer were drivers afforded the comfort of being told what lines to drive between, when to stop, or where pedestrians may be. The result was not death and chaos as one might predict, but rather the opposite: drivers were compelled to drive more slowly, cautiously reading the environment through which they navigated. No longer did they have the capacity to speed, change the song on the radio, or text.

One may think that this is a crazy, modern concept that might only be permissible in small towns in the Netherlands, but in reality, Shared Space was the status quo of roads everywhere until the dawn on traffic control devices in the 1920's. Since its inception, shared space has become a commonly accepted means of urban development. It has been implemented in modern traffic systems in many countries across Europe, but also in United States and Canada with consistent results. The concept has long been familiar in Italy's historic towns. It has been introduced, at the last count, in 3,500 zones in Germany and the Netherlands, 300 in Japan, 600 in Israel, and in cities as widespread as Lyon, Barcelona, Copenhagen, Melbourne and Portland, Oregon. All have experienced a drop in accidents, and most a drop in journey times. At the now celebrated lights-and-sign-free Laweiplein intersection in Drachten in the Netherlands, the chief danger is from crowds of foreign experts watching incredulously as traffic merges with pedestrians and separates, unaided by robots or colored pieces of metal.

Conclusion

There is no need to take my word for any of this, as traffic engineering has a vast supply of resources to confirm the assertions I am making. I humbly encourage you to research shared space, as well as the traffic engineering concepts that show the ineffectiveness of signage on traffic safety. I have included many resources on this matter, please feel free to consider them.

Furthermore, there is *compelling evidence* that the overuse of signage, especially stop signs, as can be found in the Amherst village, is shown to make roads *more dangerous*. I understand that this concept may superficially appear nonsensical, but when researched, the reasoning for this is conclusive and logical.

The roads in the town of Amherst have gradually become more and more highway-like. With the now ubiquitous double-yellow and white lines, wide roads, stop signs, and warning signs, our roads no longer convey a message that they are village lanes. No longer do they look and feel like drivers must use social cues and eye contact to govern their calm visit to town. No, now drivers are licensed to drive like they would on high speed streets, "protected from error" by lines, curbs, wide roads, and the like.

The testimony of town residents complaining of dangerous traffic is supported by the science behind traffic engineering: drivers in town, licensed by the well-intentioned safety measures installed for our protection, are driving more dangerously. It's time we look at a solution to this problem, rather than perpetuating or worsening it by doubling-down on a failed traffic model. The solution to traffic woes in the village can be found in shared space.

Shared Space: Watch it in Action
http://youtu.be/RLfasxqhBNU?list=PL83763C4BA5DB70B0
http://youtu.be/qgYzyGvMqjo

How would something like this be implemented in Amherst?
Here is a how-to guide for Town leaders on Shared Space Implementation http://www.hamilton-baillie.co.uk/_files/_publications/50-1.pdf

Is there a video that goes over all of this information?
Yes: http://youtu.be/sKvLvEs2VJc?t=17m

Best Resources

- **"Traffic" by Tom Vanderbilt**
  A comprehensive overview of modern traffic science, engineering, and the social psychology behind traffic systems.
  http://www.amazon.com/Traffic-Drive-What-Says-About/dp/0307277194
- **Traffic in Villages: A toolkit for communities**
  This handbook aims to summarize latest best practice and experience from rural communities attempting to engage positively with their highway authorities to tackle the impact of traffic and speed in rural areas. It builds a set of approaches that avoids the use of standardized signs, lines, cameras, barriers and invasive traffic engineering. The handbook is written for town mayors and selectmen and local communities.
  http://www.hamilton-baillie.co.uk/_files/_publications/50-1.pdf
- **Lecture at the Buffalo, NY: Ben Hamilton-Baillie, the lessons of Shared Space and possible implementation for America**
  For a detailed overview of the concept of shared space. http://youtu.be/sKvLvEs2VJc?t=17m
- **Risk" by Professor John Adams**
  A book about how **risk compensation** postulates that everyone has a "risk thermostat" and that safety measures that *do not* affect the setting of the thermostat will be circumvented by behavior that re-establishes the level of risk with which people were originally comfortable. It explains why, for example, motorists drive faster after a bend in the road is straightened. http://www.amazon.com/Risk-John-Adams/dp/1857280687

- **The Project for Public Places**
  Project for Public Spaces (PPS) is the central hub of the global Placemaking movement PPS is a nonprofit planning, design and educational organization dedicated to helping people create and sustain public spaces that build stronger communities. Their pioneering "Placemaking" approach utilizes shared space and helps citizens transform their public spaces into vital places that highlight local assets, spur rejuvenation and serve common needs. http://www.pps.org/

Shared Space Videos

Shared Space report by CBS News
    http://vimeo.com/6449097
Removing The Traffic Lights
    https://www.youtube.com/watch?v=gVW-YAQCSVs
Why America Has Too Many Traffic Signs
    https://www.youtube.com/watch?v=b-wrtbs6_QM
"Traffic control - the road to nowhere?" by Martin Cassini
    http://youtu.be/ZeryaK22ntw
No code on German roads
    https://www.youtube.com/watch?v=Sf-O5o4aqcs
Shared space roundabout Drachten, The Netherlands https://www.youtube.com/watch?v=B88ZVrKtWm4
Introduction to shared space
    https://www.youtube.com/watch?v=RLfasxqhBNU
    part 2 https://www.youtube.com/watch?v=wuxMuMrXUJk
"Roads Fit for People" by Martin Cassini
    http://youtu.be/vi0meiActlU
"The Space Between Buildings" by Roshan Samarasinghe and Annabel Slater http://vimeo.com/10913301
Makkinga, Netherlands: A village with no traffic signs whatsoever. https://www.youtube.com/watch?v=5SaLhbbtmlE
Seems crazy?
    https://www.youtube.com/watch?v=ThaQjDLLJWA
Poynton Regenerated
    https://www.youtube.com/watch?feature=player_embedded&v=-vzDDMzq7d0

Shared Space Resources, Refrences

- "Rip out the traffic lights and railings" by Simon Jenkins
  - Simon Jenkins argues that drivers negotiating shared space with other street users reduces traffic and road accidents. Explains the key principles of "risk compensation", central to the research of Professor John Adams

- http://www.theguardian.com/commentisfree/2008/feb/29/guardiancolumnists
- “Challenging Assumptions” Urban Design Quarterly
  - This polemic for Urban Design Quarterly questions some of the familiar features of urban streets and ponders whether the clutter of signs, markings, barriers and signals are really necessary. It concludes with some simple, cost-saving recommendations for cash-strapped highway authorities
- “An international review of liveable street thinking and practice” Urban Design International. Volume 13, Number 2, Summer 2008
  - This peer-reviewed paper was published in Summer 2008, and outlines the background and principles behind shared space, describing some of the significant examples in the UK and mainland Europe. Special emphasis is given to exploring the links between street design and the quality of public space and the wider implications for health, well-being and economic activity.
  - http://www.hamilton-baillie.co.uk/_files/_publications/30-1.pdf
- Shared Space: Reconciling People, Places and Traffic by “Ben Hamilton-Baillie”
  - Under the label of ‘shared space’, a radically different approach to street design, traffic flow and road safety is rapidly emerging. Combining a greater understanding of behavioral psychology with a changing perception of risk and safety, shared space offers a set of principles that suggest new radically different possibilities for successfully combining movement with the other civic function of streets and urban spaces. Shared space has evolved most rapidly in the Denmark, Germany, Sweden and the northern part of Holland. However there is a growing range of examples in France, Spain, the UK and other European countries. The paper considers the potential for shared space principles to prompt a new approach to the design, management and maintenance of streets and public spaces in cities, towns and villages. Drawing on well-established examples from a variety of countries, the author examines the outcomes of schemes that deliberately integrate traffic into the social and cultural protocols that govern the rest of public life. The findings raise important implications for governments and local authorities, for professionals, for communities and for citizens.
  - http://www.hamilton-baillie.co.uk/_files/_publications/25-1.pdf
- Traffic in Villages: A toolkit for communities
  - This handbook aims to summarize latest best practice and experience from rural communities attempting to engage positively with their highway authorities to tackle the impact of traffic and speed in rural areas. It builds a set of approaches that avoids the use of standardized signs, lines, cameras, barriers and invasive traffic engineering. The handbook is written for town mayors and selectmen and local communities.
  - http://www.hamilton-baillie.co.uk/_files/_publications/50-1.pdf
- Lecture at the Buffalo, NY: Ben Hamilton-Baillie, the lessons of Shared Space and possible implementation for America
  - For a detailed overview of the concept of shared space
  - http://youtu.be/sKvLvEs2VJc?t=17m
- A collection of Shared Space Resources
  - http://www.hamilton-baillie.co.uk/index.php?do=publications
- Equality Streets
  - A campaign for traffic system reform that asserts the equal right of all road-users to co-exist in peace on roads free of vexatious traffic control.
- “Where ‘Share the Road’ Is Taken Literally” Paul Hockenos, New York Times 2013
  - http://www.nytimes.com/2013/04/28/automobiles/where-share-the-road-is-taken-literally.html
- Adams, John. "Managing transport risks: what works?" *Risk Theory Handbook*, November 25, 2010: 1-31.
- Hillman, Mayer, and John G.U. Adams. "One False Move and You're Dead." Children's Freedom and Safety. *Policy Studies Institute*. London, 1992.
- Jones, Phil. "Improving Traffic Behaviour and Safety Through Urban Design." *ice: Civil Engineering*, May 2005: 39-47.
- Southworth, Michael, and Eran Ben-Joseph. *Streets and the Shaping of Towns and Cities*. New York: McGraw-Hill, 1996.
- van den Boomen, T. "Het Nieuwe Woonerf-weg met de regels!" *NCR Handelsplat*, 2001: 7-8.