

# Sensitivity of Transportation Performance Measures to Changes in Reference Speed

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## Motivation

### Reference Speed

- Benchmark for transportation system mobility and reliability
- Denominator for delay, mobility, and reliability statistics
- Term used by public agencies and third-party speed data providers to identify a common comparison standard

### Data-Driven Approach to Define Reference Speed

- Several agencies use fixed proxies for reference speed such as Posted Speed Limit (PSL) or speed limit plus five (PSL+5)
- Recorded travel-time data can be more reflective of current operational conditions; thus a data-driven approach to derive reference speed can be superior
- Table 1 outlines key recommendations from previous research for determining reference speed from a travel speed database

**Table 1. Recommended Procedure for Deriving Reference Speed from Recorded Travel-Time Data**

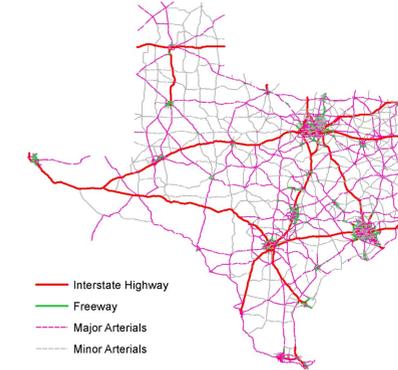
Data Availability during 9 PM–6 AM Time Window	Recommended Reference Travel-Time Window	Recommended Reference Speed Percentile	Notes
≥ 50 percent	9 PM–6 AM weekdays (Mon–Fri)	85 <sup>th</sup> percentile of average speeds within chosen time window	Consistent, less variable data; conformity to normal distribution
< 50 percent	9 PM–6 AM weekdays (Mon–Fri) + 11 AM–4 PM weekdays (Mon–Fri)		Left skew in speed distribution; low data availability and high variability during nighttime period

### Research Objective

- Examine performance measure sensitivity to changes in reference speed on freeways and arterial street facilities
- Measures examined: Travel delay, Travel Time Index (TTI), 80<sup>th</sup> percentile Planning Time Index (PTI<sub>80</sub>), and 95<sup>th</sup> percentile Planning Time Index (PTI<sub>95</sub>)

## Data

- INRIX XD™ (Traffic Message Channel) database
- All urban areas in Texas
- Segments typically ≤ 1 mile long
- 10,584 freeway segments and 17,057 arterial segments
- Annual average travel times for each 15-minute interval of each day of the week

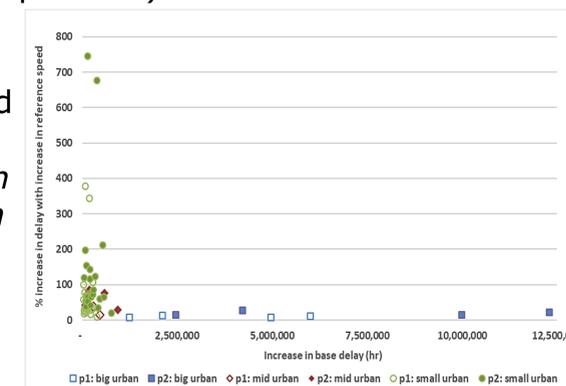


## Methodology and Results

- Calculate percent changes in performance measures with 1 mph and 2 mph increase or decrease in base reference speed (base reference speed is derived using procedures outlined in Table 1)
- Calculate performance measure values at the speed-limit reference
- All sensitivity values represent percent changes in the value of the performance measure for these incremental changes

### Overall

- Performance measure sensitivity to changes in reference speed depends on facility type (freeway vs. arterial street) and size of urban area (represented by population)
- *Delay is more sensitive to changes in reference speed than any index (TTI, PTI<sub>80</sub> and PTI<sub>95</sub>)*
- *Delay sensitivity decreased on freeway facilities as the urban area size increased (any changes in reference speed affected freeway delay values more in smaller urban areas)*



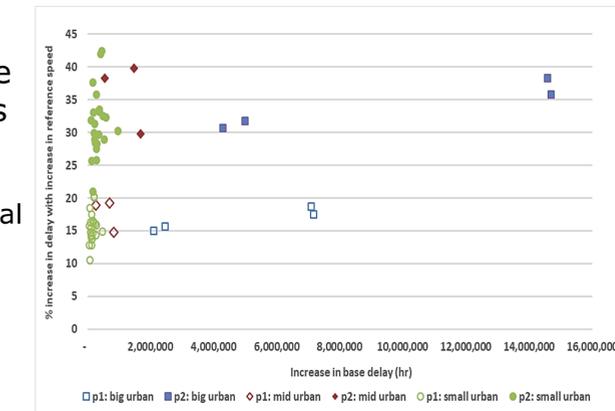
## Methodology and Results

- Arterial street delay remained largely unaffected by the size of urban area
- For the same urban area, delay sensitivity as a whole is higher on arterial streets than freeways

- For a given change in reference speed, delay accrual is faster at lower operating speeds (higher travel rate in minutes per mile)

- For a given facility, sensitivity is higher for upward (positive) changes in reference speed

- Delay increases non-linearly with increments in reference speed
- TTI, PTI<sub>80</sub> & PTI<sub>95</sub> show low sensitivity to changing urban area size
- For the same urban area or urban area type, any index sensitivity is higher on arterial streets than freeways



## Conclusions

- On interstates and freeways, delay becomes less sensitive to reference speed change as the urban area size increases
- Arterial street delay sensitivity is not significantly affected by urban area size because of some “base amount” of delay
- For any urban area, arterial streets are more sensitive to changes in reference speeds than interstates and freeways
- Speed-limit values are 2–3 mph lower than data-derived reference speeds; widely reported delay measures may typically remain *under-reported* on freeway facilities when using *posted speed limit* as reference speed, and *over-reported* when using *posted speed limit plus five* as reference speed