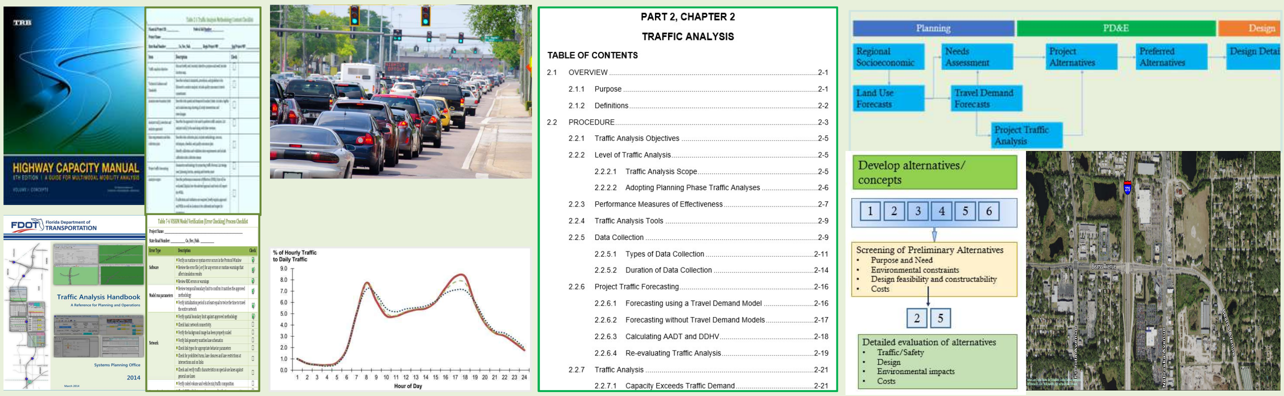


TRAFFIC ANALYSIS FOR PD&E STUDIES

JANUARY – APRIL 2019

This course provides information regarding traffic analysis which is performed to support PD&E Studies for Florida Department of Transportation (FDOT). The course covers scoping the level of analysis effort, analysis methods—including the process and tools used to analyze traffic, performance measures of effectiveness, data collection, alternatives evaluation and documentation of traffic analysis effort.

Office of Environmental Management

FDOT

Traffic Analysis for PD&E Studies

Victor Muchuruza, PhD, PE, PTOE

Offered January - April 2019

Course Agenda

- Module 1: Introduction to Traffic Analysis
- Module 2: Traffic Analysis Methodology
- Module 3: Performance Measures of Effectiveness
- Module 4: Traffic Analysis Tools
- Module 5: Data Collection
- Module 6: Travel Demand and Project Traffic Forecasting
- Module 7: Traffic Analysis and Alternatives Evaluation
- Module 8: Traffic Analysis Documentation

2

Expected Learning Outcomes

- Gain insight on how traffic analysis fits into the PD&E process
- Determine the level of detail required for PD&E traffic analysis
- Understand key requirements of the traffic analysis and documentation in your projects

Module 1

Introduction to Traffic Analysis Procedure

Traffic Analysis Defined

Evaluate the effect of demand and supply on the performance and function of a transportation facility

Demand is the amount of traffic load that intends to use the facility

Supply is the capacity of the facility to handle the demand

Results of traffic analysis can evaluate the performance of the design with respect to traffic operations (mobility & accessibility) and safety

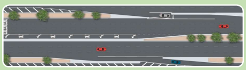
Traffic Analysis Defined

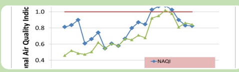
Traffic Forecasting	Estimate future travel demand on the facility
Operational Analysis	Estimate the performance of current and future conditions
Safety Analysis	Identify safety issues and countermeasures

Traffic Analysis Defined


Evaluates transportation needs


Essential in decision making—evaluation of plans, programs,


Evaluates impacts of improvements/design


Produces data needed for noise and air impact analyses

Traffic analysis is applied in a broad spectrum of project ranging from spot-improvement to corridor level, network level, to regional and statewide transportation projects

Traffic Analysis and Scope of Work

- Traffic analysis is one of the critical activities for a project development and can impact the project schedule;
- The Project Manager must understand the effort associated with traffic data collection, forecasting, analysis, documentation and quality

Making decision about project alternatives requires an understanding of the **balance** between operations (i.e. accessibility and mobility) and potential environmental impacts

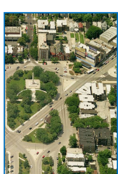
FDOT Pre-construction Process

The objectives of the traffic analysis may vary by Phase of the project development process

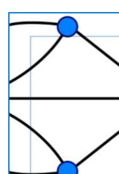
Planning	PD&E	Design
Regional Socioeconomic → Land Use Forecasts → Needs Assessment / Travel Demand Forecasts → Needs Assessment; Travel Demand Forecasts → Project Traffic Analysis	Needs Assessment → Project Alternatives → Preferred Alternative; Project Traffic Analysis → Project Alternatives	Preferred Alternative → Detail Design
Identify demand to be served	Provide data to support prelim. design	Support const. plans prep.

Planning Phase

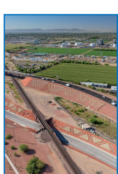
Various planning studies, analyses and reports



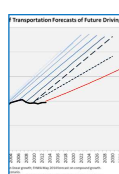
Existing conditions



Purpose and need



Alternatives screening



Future conditions forecasts—land use & travel demand

PD&E Phase

- Transportation projects are evaluated to address Purpose and Need
- Decision makers require justification to support both funding and clearance [environmental impacts] of the project
- Purpose and need explains WHY the project is implemented

Purpose explains the problem

Need includes data to substantiate why there's a problem

PD&E Phase

Alternatives are evaluated in detail and compared

Traffic analysis is a primary component of the alternatives development and evaluation

Analysis results are communicated to decisionmakers, stakeholders and public

PD&E Phase

Preliminary engineering analysis tasks

- Project purpose and need
- Design controls and criteria
- Existing conditions analysis
- Alternatives development and evaluation
- Documentation

Supported by Traffic Analysis

Typical Tasks for a PD&E Traffic Analysis

a. Develop traffic analysis objectives
b. Select performance measures
c. Determine analysis approach and select analysis tools
d. Identify data needed for the analyses
e. Specify collection methods and documentation
f. Perform traffic operational analysis and safety analysis
g. Document analysis results and assumptions

Traffic Analysis in PD&E Scope of Services

Design Phase

The objective of project design is usually to ensure that the facility is sized to handle demand

Most of traffic analysis are completed during PD&E

Design phase should use the same traffic data for detail design and operational purposes such as designing turn lanes, signal timing, or traffic control plans

MOEs sensitive to detail design of project elements (segments, intersections, merge, diverge, etc.) are critical in this Phase

PD&E Traffic Analysis Procedure

PD&E Manual Part 2, Chapter 2
Traffic Analysis

The purpose of Chapter 2 is to provide guidance on traffic analysis procedure—methodology, appropriate tools, analysis, and documentation to support NEPA analyses for the FDOT projects

PART 2, CHAPTER 2

TRAFFIC ANALYSIS

TABLE OF CONTENTS

PD&E Traffic Analysis Procedure

Reference Guidelines

FDOT resources
- Traffic Analysis Handbook
- Project Traffic Forecasting
- Traffic Engineering Manual (TEM)
- Manual of Uniform Traffic Studies (MUTS)

National guidance
- Highway Capacity Manual (HCM)
- FHWA's Traffic Analysis Toolbox

Users of the PD&E Traffic Analysis Chapter

Preparers of traffic analyses	Reviewers of the reports	Users of the results

Factors Affecting Scope of Traffic Analysis

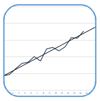
Scope and scale of the analysis depends on

- Project purpose, objectives/goals
- Land use context, rural vs. urban
- Prevailing operating conditions
- Functional classification
- Type of improvements & number of alternatives
- Analysis tools/software to use
- Availability of [existing] data
- Amount of documentation
- Number and effectiveness of project reviews

Similar projects may require different levels of effort because one or more of these reasons

Scope of Traffic Analysis

Work effort should be divided into three categories


Traffic forecasts


Traffic analysis


Safety Analysis

Methodology


Data


Analysis tools


Documentation

Methodology

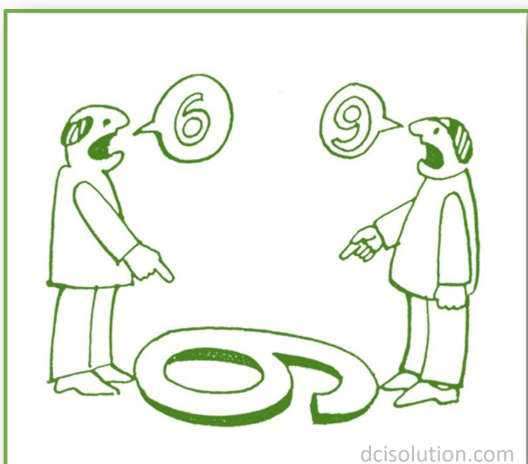
What is the **reasonable** tool to analyze traffic?

Do we have a **standard** methodology?

The Bottom Line… The answer is **It Depends…**

It depends on project scope & scale, goals &MOEs, time, resources and budget

Methodology



It Depends, so What??

Always seek agreement on the analysis approach…early on

Avoid misunderstanding between traffic analysts and reviewers

Methodology is So Important to Avoid…

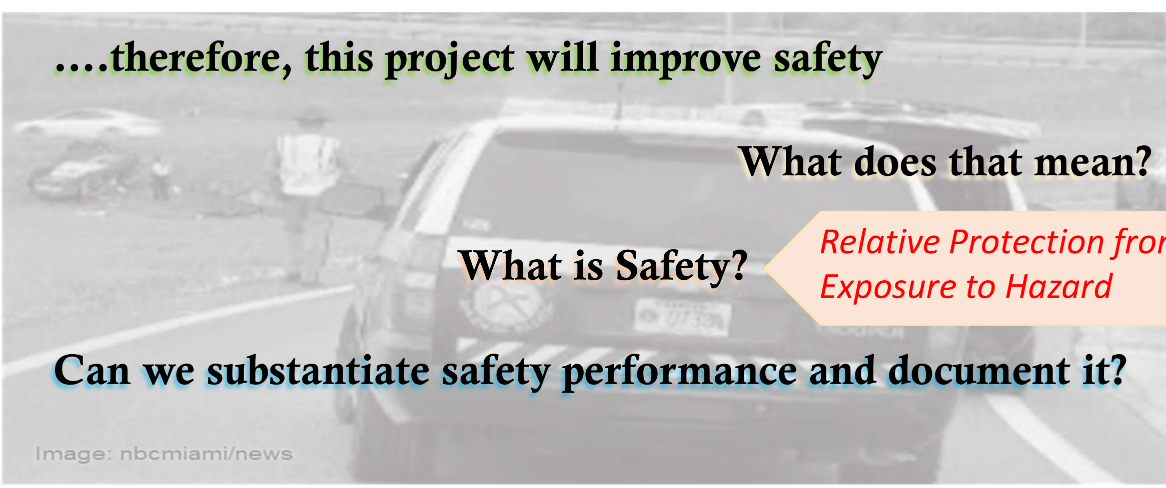
- Misunderstandings regarding the goals of the analysis effort

- Scope creep such as unplanned enlargement of the study area, etc.

- Misusing traffic analysis tools

- Inappropriate sequencing of activities such analyzing build conditions before calibration

Integrating Safety in Analysis



….therefore, this project will improve safety

What does that mean?

What is Safety?

Relative Protection from Exposure to Hazard

Can we substantiate safety performance and document it?

Image: nbcmiami/news

Integrating Safety in Analysis

Historical Crash Analysis

- Existing: Crash rate on a project Vs. the statewide average; crash patterns
- Future: How alternatives improve any existing or potential safety issues

Quantitative Safety Analysis

- ***HSM*** methods using safety performance and crash modification
- Support purpose and need & alternatives evaluation

Linking Planning and PD&E

- Planning decisions inform development of PD&E
- Integrate planning analysis and PD&E studies
- Streamline the project development process
- Must meet certain FHWA conditions (23 USC 168 and 23 CFR 450)
  - ✓Include a statement to adopt planning products in PD&E
  - ✓Make planning products available for public review during PD&E

Previously Completed Analyses

Review and consider previously completed planning analyses

- Corridor study, feasibility study or Interchange Access Request
- Methodology, data, decisions
- Additional data will be applied in the operational analysis

Do they meet 23 CFR Part 450 and ***23 U.S.C § 168 requirements?***

Previously Completed Analyses

- What is the forecast year used in the planning study?
- What method was used for forecasting traffic volumes?
- What were the data assumptions used in the transportation planning process related to land use, economic development, transportation costs, and network expansion?

- Are the planning assumptions and the corridor vision/purpose and need consistent with each other and with the LRTP? **Are the assumptions still valid?**

Documentation

Project Traffic Analysis Report

Preliminary Engineering Report

Project Traffic Forecasting Memo

Calibration Memo

IJR/IMR/IOAR

Alternatives Corridor Evaluation Report

Documentation

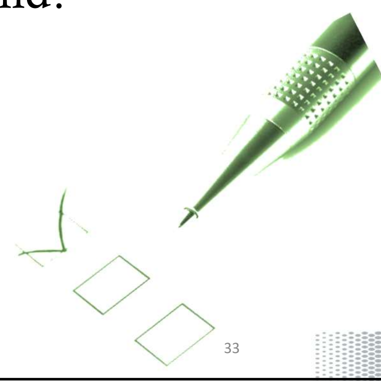
Why documentation is so important?

………….If it was not documented, it **did not** happen

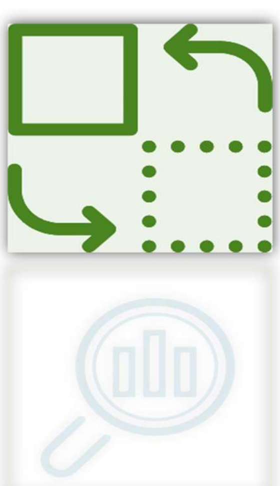
Documentation Review Question

In the report, an engineer stated that when demand exceeds road capacity, throughput would remain at maximum and would not decrease until the demand for capacity decreases. Is this claim valid?

- ❑ Yes
- ❑ No
- ❑ I don't know, give me more info



Re-evaluating Traffic Analysis

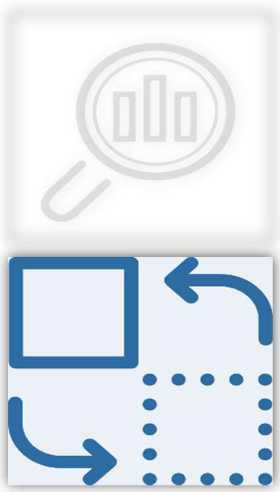


For projects which require a re-evaluation of PD&E

Verify validity of traffic forecast by assessing whether there have been **substantial** changes in

- Economy and driving habits
- Land use or economic growth
- Scope of work
- Transportation network
- Adopted regional travel demand model volumes

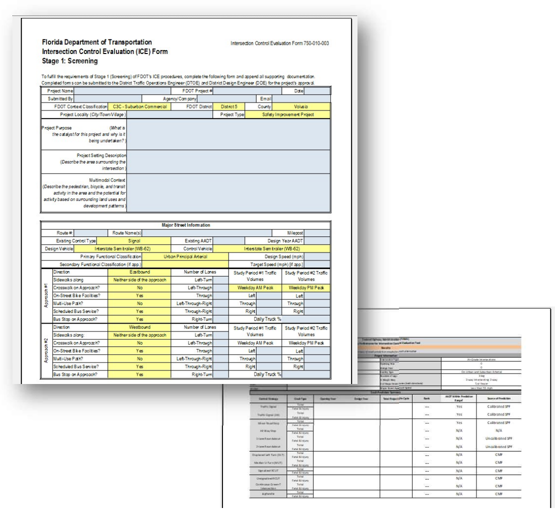
Re-evaluating Traffic Analysis



- What changes are deemed substantial?
  - Assess the effect of the magnitude of the changes in forecast to the prior project decisions
  - Focus on consistent conclusions from the analysis, rather than minor numerical differences.
- If there **is a substantial** change in the traffic, coordinate with District PLEMO and OEM to address the need for re-evaluating project traffic
- If changes are not substantial, document sensitivity analysis results in the project file

Intersection Control Evaluation (ICE)

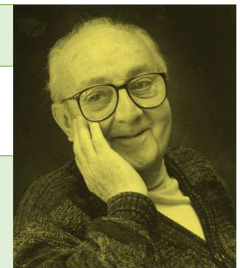
- Will replace three-step roundabout screening process (in 2020)
- Screening process for innovative intersection feasibility
  - SPICE and FDOT ICE tool
  - FDOT ICE forms (stage 1, 2, and 3)
- FDOT ICE process manual, tools, and forms:
  - http://www.fdot.gov/traffic/TrafficServices/Intersection_Operations.shtm



Perfecting the Analysis…

"Essentially, all models are wrong but some are useful"

*"Since all models are wrong the scientist cannot obtain a **correct** one by excessive elaboration"*



George Box
(1919 –2013)

Module 2

Traffic Analysis Methodology

Factors Affecting Level of Analysis

- Project and analysis goals
- Project location
- Analysis period
- Proposed improvements
- Project phasing

Project and Analysis Goals

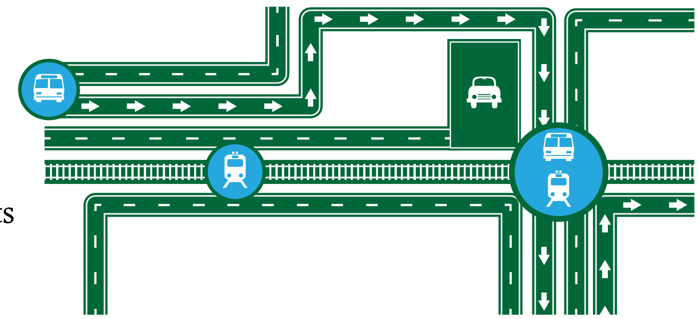
- Review Purpose and Need statement
- Review project description
- Determine analysis performance goals
  - Capacity & Demand
  - Mobility
  - Accessibility
  - Safety
  - Preservation
- Review previously completed studies

Each project is unique with its own set of issues

Location of the Project

Review the project location (aerial and field visit)

- Context classification
- Intersections (Isolated vs. close spaced)
- Rail crossings
- Transit and nearby stops
- Ped and bicycle facilities
- Major traffic generators
- Frontage and ancillary impacts



Analysis Study Area

- Project limits are not always the same as the study area limits
  - Study may extend beyond the area where work is proposed
  - Study limits should encompass all segments and intersections necessary to analyze all Alternatives being considered
  - Example projects with study area limits larger than project limits
    - New corridors
    - Coordinated networks
    - Lane repurposing
    - Transit component
- Adjacent intersections or bottlenecks may meter traffic entering the study limits
  - Study area must cover beyond the end of the full spatial extent of queues and congestion
- Prevailing Operating Conditions

Prevailing Operating Conditions

Traffic operating conditions that may affect study limits include:

- Oversaturated conditions (volume and speed)
- Vehicle mix (predominant vehicles)
- Bottleneck (congestion points)
- Crashes (or potential conflicts)
- Driving behavior (space and headway)
- Access density

Localized Bottlenecks

Common locations for localized bottlenecks

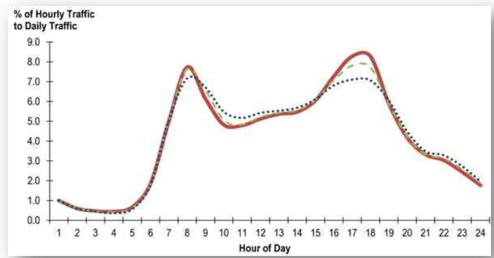
Lane Drops	Freeway Exit Ramps	Tunnels/Underpasses
Weaving Areas	Freeway-to-Freeway Interchanges	Narrow Lanes/Lack of Shoulders
Freeway On-Ramps	Changes in Highway Alignment	Traffic Control Devices

Source: FHWA, 2012

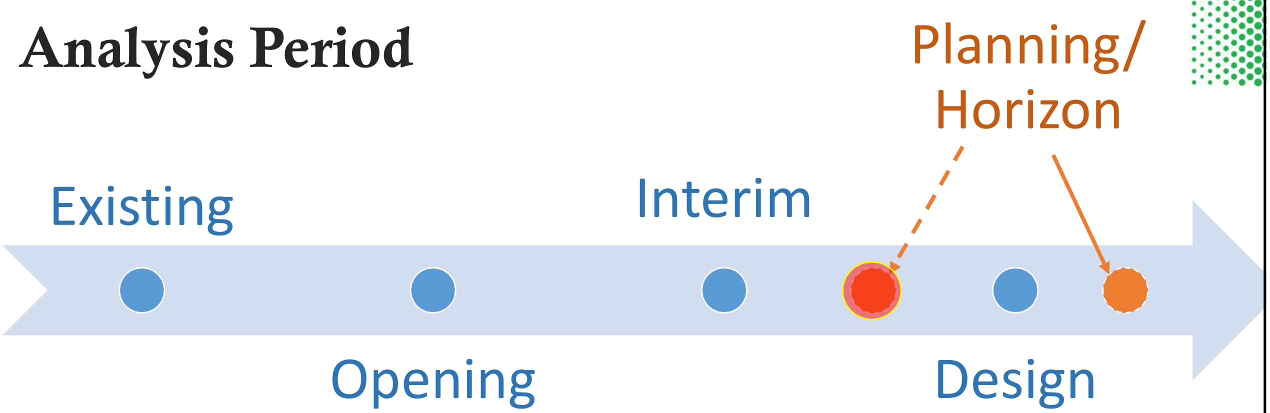
Analysis Period

Analysis time period of the project should be defined

- AM, PM, mid-day, off-peak
- One hour or multiple hours to cover full temporal extent of congestion
- Evaluate demand profiles



Analysis Period



Typical Analysis Years

Interim Year Analysis

Interim Year is needed when at least one of these exist

- Phased improvements are proposed
- Failure Year analysis is analyzed
- Major development/traffic generator will impact travel demand between opening and design year.

Interim Year is NOT arbitrarily chosen as half the analysis period.

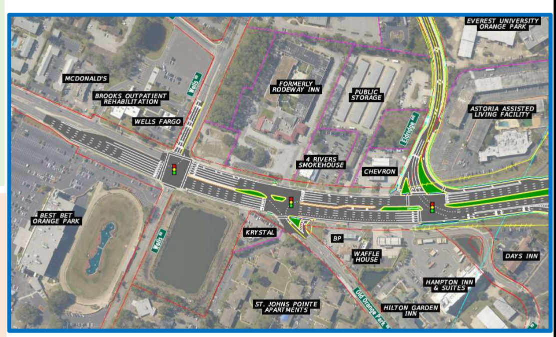
Proposed Improvements

Considerations

- What are possible geometric considerations that could impact the analyses?
- What are possible intersection control scenarios that could impact the results?
- What are signal timing issues?

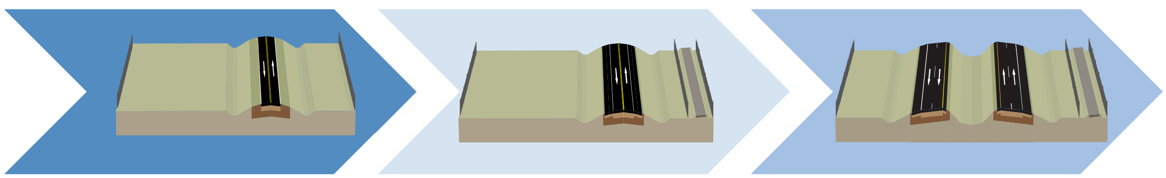
Number of alternatives and their composition

- Geometric and operational improvements
- Facility type and geographic context
- Presence of ITS
- Need for tolling/express lanes
- Other modes such as bus lanes and transit



Project Phasing

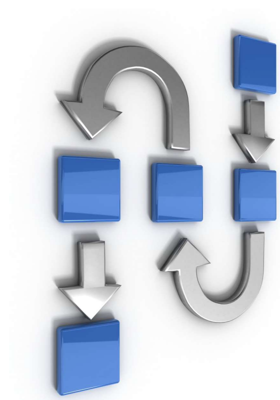
If the project will be phased (implemented in segments)
- How will the interim improvement vs. ultimate improvement be analyzed?
- Interim improvement may require interim year analysis



Existing Conditions | Interim Conditions | Full Built-out Conditions

Traffic Methodology Elements

- Project description
- Traffic analysis objective
- Analysis limits
- Analysis tools selection and approach
- Performance measures of effectiveness (MOEs)
- Data requirements and data collection plan
- Project traffic forecasting
- Project alternatives analysis
- Traffic analysis report and technical documentation
- Estimation of level of effort



See Traffic Analysis Handbook

Module 2 Exercise: Traffic Study Area Limits

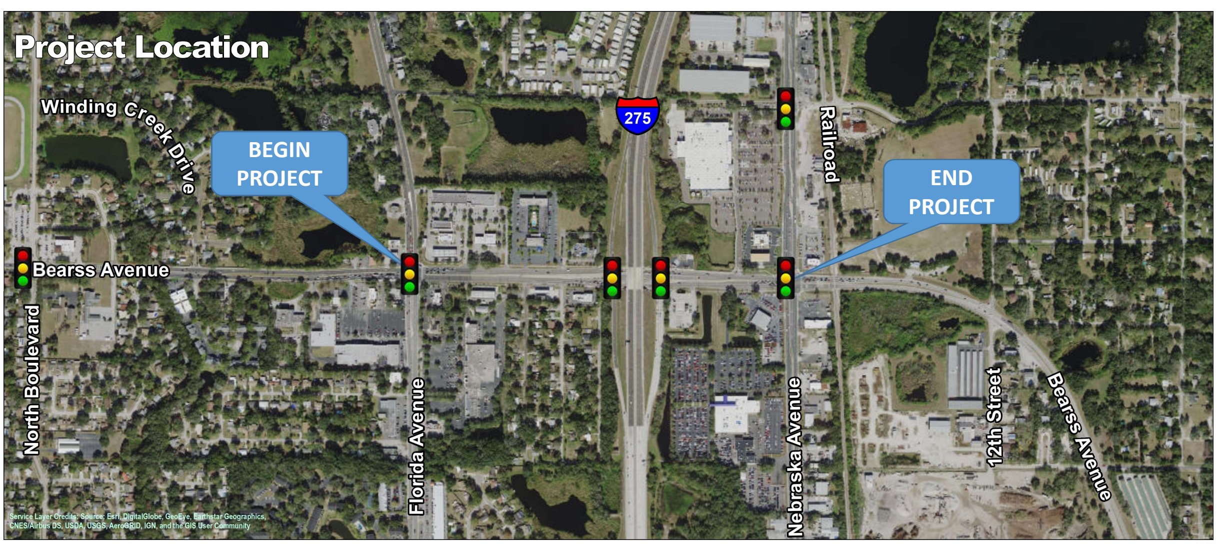
1.1 Project description and issue:
Bearss Avenue, a divided facility ranging from 4 to 6 through lanes, experiences congestion during peak hours from Florida Avenue to Nebraska Avenue. This segment is being widened and a PD&E study is underway

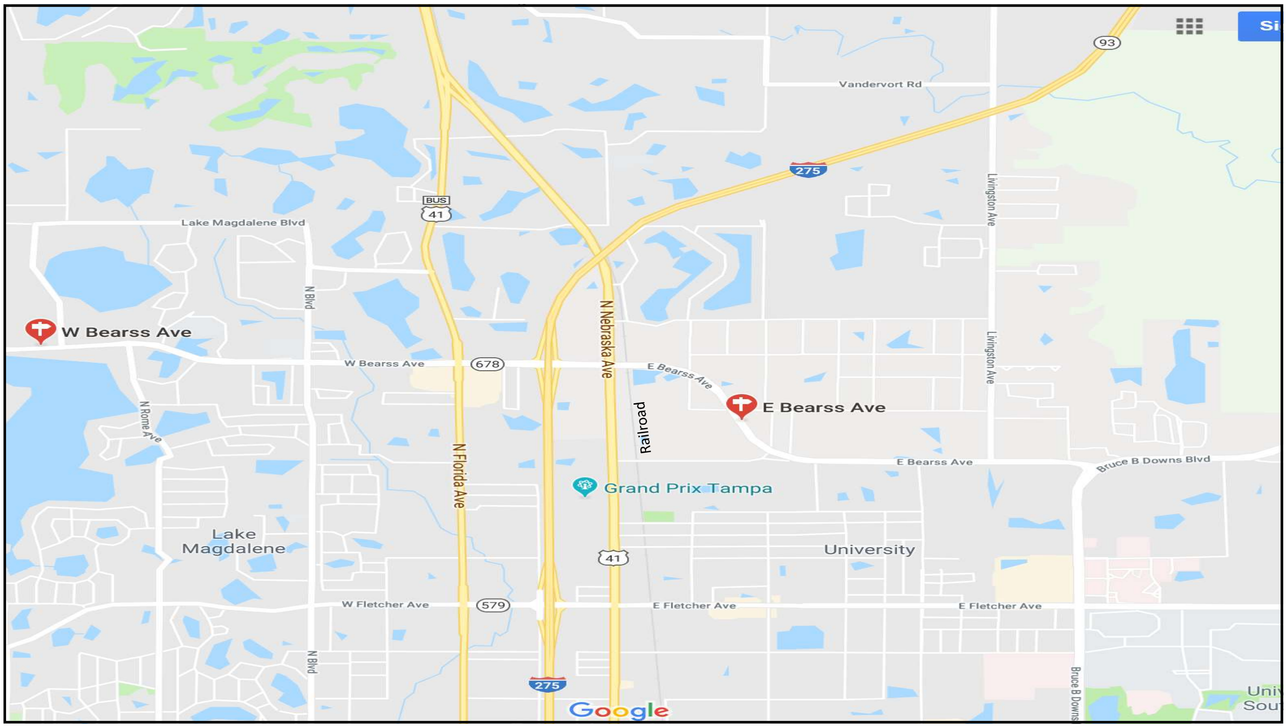
1.2 Traffic analysis objective:
Conduct corridor and intersection analysis to develop Alternatives to mitigate the congestion along Bears Avenue

1.3 Question:

What would you choose as the traffic study limits for this PD&E project?

Module 2 Exercise: Traffic Study Area Limits





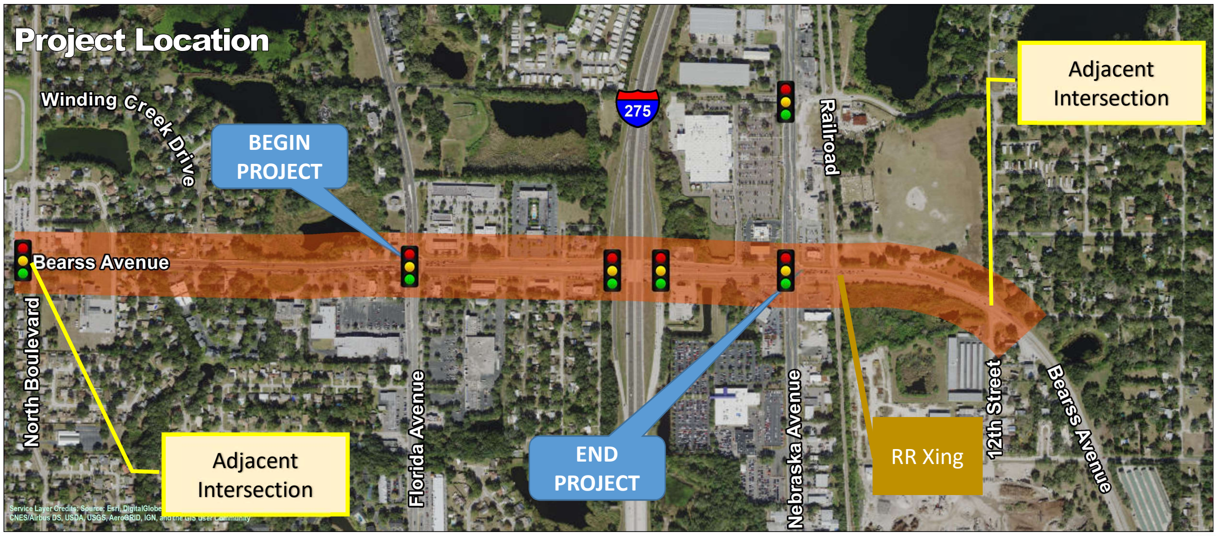
Before begin analysis analysis…

Make sure you understand the following key issues:

- Why are we analyzing Bearss Avenue?
- What is the regional significance of Bearss Avenue?
- What is the regional significance of roadways intersecting Bearss Avenue?
- Where is the traffic using Bearss Avenue going to/coming from?
- What additional information might be needed to scope analysis

FDOT 54 OEM Office of Environmental Management

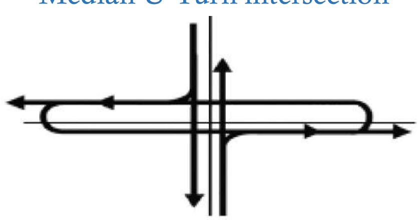
Module 2 Exercise: Traffic Study Area Limits



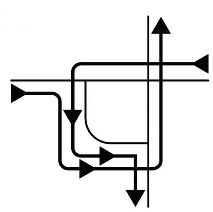
Module 2 Exercise: Other Scenarios

Scenario 1. If to mitigate adequately the traffic congestion at Bearss Avenue / Nebraska Avenue intersection, feasibility of quadrant road intersection at NE quadrant and median U-Turn (MUT) intersection alternatives are evaluated.

Median U-Turn intersection



Quadrant road intersection



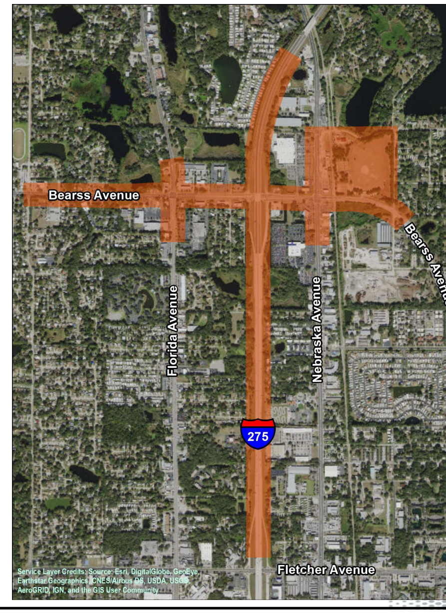
Study Area to Accommodate MUT and Quad

Module 2 Exercise: Other Scenarios

Scenario 2. If to mitigate adequately the traffic congestion at Bearss Avenue / Nebraska Avenue intersection, alternatives to improved operational performance of I-275 / Bearss Avenue interchange would need to be evaluated.

Interchange Study Area Limits = AOI

- What else would you include in the study limits for consideration of an improvement at the I-275 / Bearss Avenue interchange?
  - Need northbound on and southbound off ramps at Fletcher Avenue
    - Verify impacts to freeway such as weaving
    - Next interchange to the north is miles away at SR 56 (no expected impacts)
  - Need Bearss intersections at Florida and Nebraska
    - Close proximity to interchange
  - Need further coverage on each leg of Florida and Nebraska
    - Improvements at these intersections may be required for improvements to the interchange to show acceptable benefit
    - More coverage needed near Nebraska if decision has been made to consider a quadrant road intersection



Module 2 Wrap-up Points

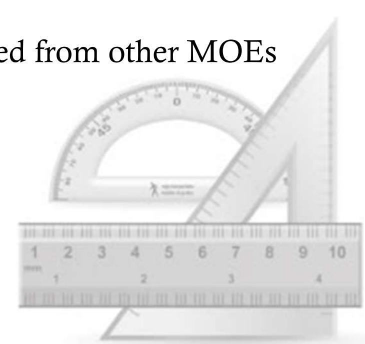
- Obtain and review previous (planning) studies
- Understand the main issues that need to be addressed
- Review aerials to familiarize with the location
- May need to visit the site to observe operations
- Available budget may affect the study efforts
- Each project is unique with its own set of issues

Module 3

Performance Measures of Effectiveness

Measures of Effectiveness (MOEs)

- Assess the performance of a facility
- Determine the degree to which the project meets its objectives.
- Selected based on the purpose and need/goal/objectives
- Can be field-measured, computed by traffic tools, or derived from other MOEs
- Existing operational MOEs
  - Establish a baseline
  - Establish and quantify the operational need/problem
- Future operational MOEs
  - Quantify expected performance
  - Compares improvement Alternatives



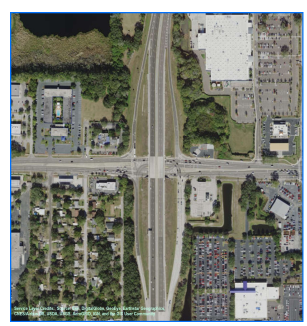
Determination of MOEs

- Decide what to measure based on the purpose and need
- Desired MOEs must be decided before the analysis tools and data requirements are set
  - Analysis tools have limitations on which MOEs they can compute and produce
  - Inadequate data can preclude some MOEs from being used
- Appropriate MOEs to use are affected by:
  - Prevailing operating characteristics
  - Facility type and complexity of alternatives
  - Modes being analyzed

Facility Type and MOEs

Different MOEs are used to best capture operations on

- Freeways
- Ramps
- Weaving segments
- Multi-lane highways
- Toll lanes
- Interchanges
- Intersections
- Arterials
- Special-use lanes



Automobile, bike, pedestrian, transit, and MOEs are captured differently

Common MOEs

- Level of Service (LOS)
- Volume-to-capacity ratio (v/c)
- Demand vs. simulated volume
- Delay
- Back of queue
- Speed
- Density
- Travel time

Analysis Objective	MOEs
Reduce recurrent and non-recurrent congestion	• Reduction in average peak period travel times • Improvement in average peak period speed • Improvement in level of service
Improve safety for motorists and maintenance workers	• Reduction in expected collision rate • Reduction in typical collision rate during construction

Level of Service

- Quantifies the drivers' perception of the level of congestion based on letter scale (A through F)
  - Automobile peak hour targets are LOS D for urbanized and LOS C outside urbanized
- Different performance measures are used to determine LOS for different facility types
- Not effective under oversaturated conditions
  - Difficult to compare alternatives if they are all LOS
  - Does not give information on the duration of the condition
  - Microsimulation deploys different methods than HCM

Delay

- Amount of time drivers are slowed/stopped for various reasons (traffic controls, high traffic volume, geometric features, incidents)
- Control delay is used to determine intersection LOS
- Total delay includes control delay and delay incurred from speed reductions due to high traffic volumes, geometric features (sharp curves), and incidents
- Pedestrian and bicyclist delay can be used to develop a perception score and LOS
- Treatment of incomplete trips or trips that have not started is an issue
- Free-flow speed against which delay is measured is an issue

Queue

- Excessive queue presence indicates an operations problem
- Distance the traffic is backed up for various reasons, mainly traffic controls or bottlenecks
- Useful for stop-controlled and signalized intersections
- Queue lengths are commonly arranged in a distribution from smallest to largest and checked at different intervals
- Difficult to report when queues extend beyond turn bay or link

Volume-to-Capacity Ratio

- Used to determine if the existing facility and proposed improvement (will) operate below capacity within the peak 15-minute period
- Capacity is the maximum number of vehicles that are able to pass through a point within a fixed time
- Difficult to measure in the field during oversaturated conditions, must add build up queue in the measured flow
- Microsimulation does not produce v/c as an output directly
- v/c>1.00 means the movement is over capacity and oversaturated

Demand vs. Simulated Volume

The number of vehicles that were trying to make it through (demand) vs. how many actually made it through (simulated)

	NB On Ramp	NB Off Ramp	SB On Ramp	SB Off Ramp
Demand	2000	6000	1000	500
Simulated	1500	5500	998	501
Proportion	1.333	1.091	1.002	0.998

Latent demand is a measure of the unsimulated demand

- Some microscopic tools can capture unsimulated demand through networkwide latent demand

Speed

- Used to evaluate performance of different alternatives
- Distance traveled over a period of time
- Most applicable to uninterrupted flow facilities or arterials
- Not a useful measure for segments of closely spaced and congested intersections
- Free-Flow Speed (FFS) is the speed under low volume conditions (LOS A)
- Average Travel Speed (ATS) is the actual speed that the drivers are able to achieve

Density

Used to compute LOS for uninterrupted flow facilities
- Freeways
- Ramp merge and diverge areas

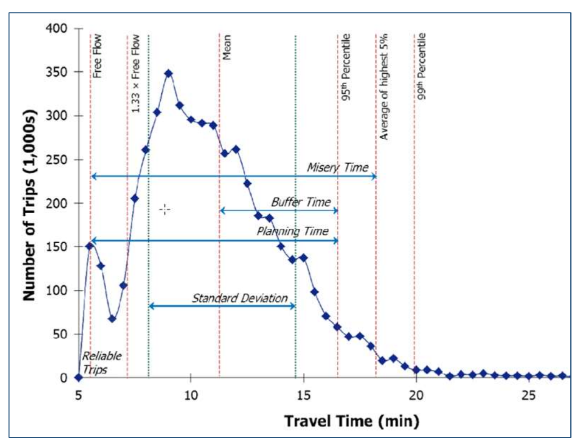
Density is the number of vehicles that occupy a set space
- Measured in passenger cars/mile/lane
- Not a useful measure for segments of closely spaced and congested intersections or arterials
- Does not help reach useful conclusions about the intersection's performance

Travel Time

- Used to evaluate and compare performance of different project alternatives
- Time it takes to traverse a segment with a defined start and end point
- May be computed by deterministic analysis tools
- Travel times of specific routes can be captured by some microscopic tools
- Networkwide total travel time

Travel Time Reliability Measures

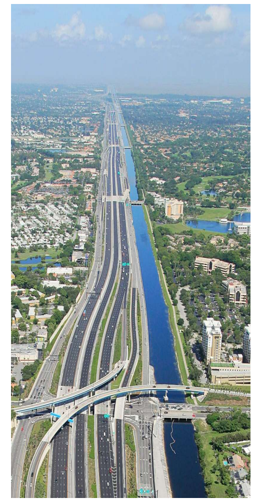
- Compares operations during a consistent baseline condition to possible variability in operations during a disrupting event
- May be used when peak periods are lasting longer
- Useful for express lanes since they must maintain acceptable travel times in exchange for the toll
- No method to measure this in alternatives analysis for arterials
- Planning time index, the ratio of extra time required to the off-peak free-flow travel time to ensure on time arrival.



Networkwide Measures

- Measure of overall system performance including all roadway segments and intersections within the study limits
  - ✓ Total travel time
  - ✓ Number of stops
  - ✓ Emissions
  - ✓ Latent demand
  - ✓ Average travel speed
- Valuable for discerning if proposed changes help the study area as a whole

  Example: retiming signals may cause some movements to have an increase in delay, but delay may be reduced for the system overall
- Useful in benefit-to-cost analyses



Module 3 Exercise: MOEs

1.1 **Project description and issue**:

Bearss Avenue, a divided facility ranging from 4 to 6 through lanes, experiences congestion during peak hours from Florida Avenue to Nebraska Avenue. This segment is being widened and a PD&E study is underway

1.2 **Traffic analysis objective:**

Conduct corridor and intersection analysis to develop Alternatives to mitigate the congestion along Bears Avenue

1.3 **Question:**

What MOEs would you use to meet the traffic analysis objectives for this project, assuming it was not over-congested?

Module 3 Exercise: MOEs

Module 3 Exercise Answer: MOEs

MOEs that could be selected for this PD&E project

Intersection-level

- Delay
- LOS
- v/c of each movement or approach
- Back of queue for each movement

Arterial-level

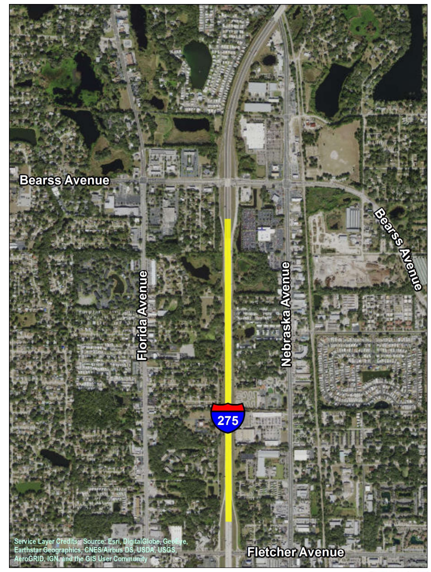
- Average travel speed
- Travel time
- LOS

Networkwide measures

- Total travel time
- Average travel speed
- Number of stops

Module 3 Scenario 1: MOEs

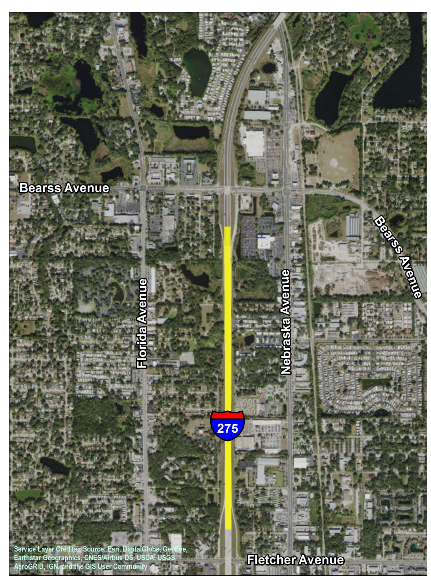
What MOEs would you use to analyze the freeway if the project involves widening I-275 from Fletcher Avenue to Bearss Avenue.



Module 3 Scenario 1: MOEs

MOEs you would use to analyze the freeway if the project includes widening I-275 from Fletcher Avenue to Bearss Avenue

- Density (also used for ramps areas and weaving segment)
- LOS (also used for ramps area and weaving segment)
- Speed (also used for weaving segment)
- v/c
- Travel time
- Networkwide measures



Module 3 Wrap-up Points

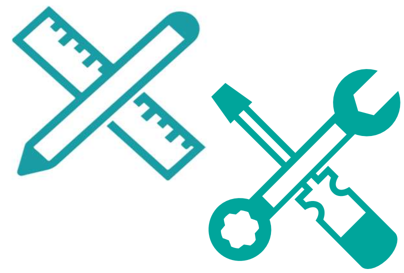
- MOEs should match the Project’s Purpose and Need
- Different intersection and facility types may need different MOEs
- Several MOEs are needed to fully evaluate alternatives and compare them to each other
- Know the limitations of the MOEs before using them
- LOS is widely known and used, but may not tell the full story when capacity is reached

Module 4

Traffic Analysis Tools

Categories of Traffic Analysis Tools

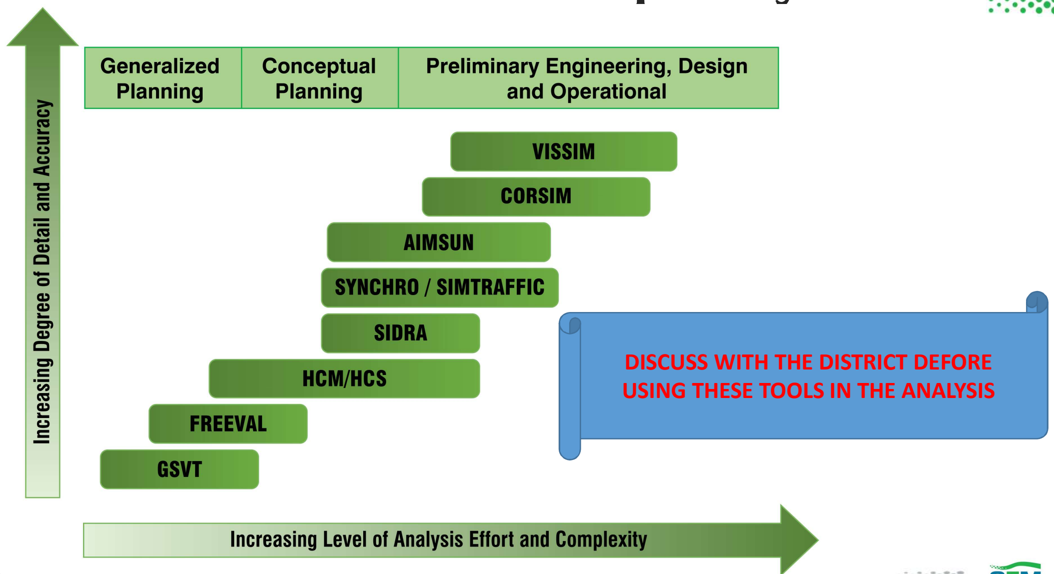
- Sketch-planning tools
  - ✓ General order-of-magnitude estimates of performance based on capacity constraints and operational control
- Travel demand models
  - ✓ Models forecast future travel demand based on current conditions, future land use, long-range plans
- Analytical/deterministic tools
- Traffic signal optimization tools
- Simulation models-Macro, Micro, Meso



Traffic Analysis Tools Examples

Sketch-Planning Tools	Analytical/ Deterministic Tools	Traffic Signal Optimization Tools	Travel Demand Models	Microscopic Simulation Models	Mesoscopic Simulation Models
Generalized Service Volume Tables	HCS, Synchro, SIDRA, Vistro, FREVAL, ELTOD, Spreadsheets	Synchro, Vistro, Transyt-7F	Cube Voyager, VISUM, Aimsun	Aimsun, CORSIM, Vissim, SimTraffic, Paramics	Aimsun, Vissim, Cube Avenue

Tools, Level of Details and Complexity



Traffic Analysis Tools and Concept Development

Deterministic analysis is the best way to start any concept development

- Spot check critical areas
- Test preliminary concepts
- Develop preliminary lane configurations

Microsimulation is required to test more complex concepts that have:

- Tightly spaced traffic elements such as signals or merges/diverges
- Lane utilization concerns caused by multiple decision points
- Platooning, queue spillback, signal interconnect issues that are critical to the function of the system

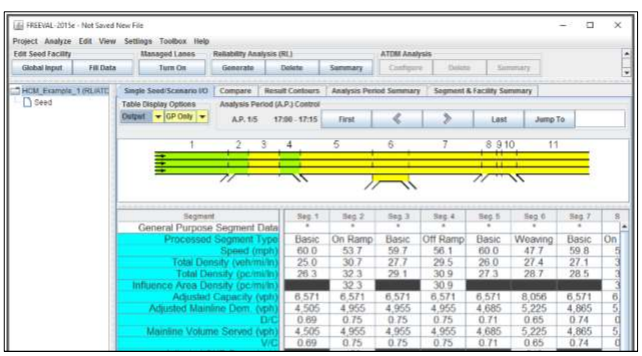
Generalized Service Volume Tables

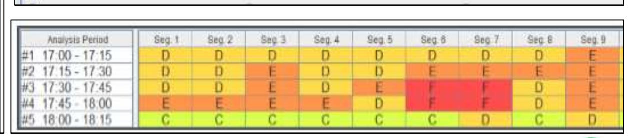
- An example of sketch-planning tools
- Provide estimates of capacity and LOS for various facility types
- Represent average roadway conditions
- Used for planning application or high-level screening of alternatives

Pros	Cons
Low cost	Limited in scope
Fast analysis	Limited MOEs
Limited data	
View of big picture	

FREEVAL

- Implement the operational analysis freeway facilities
- Analyze both saturated and unsaturated conditions
- Analyze both general purpose and managed lanes facilities





Travel Demand Models

- Mathematical models that predict travel demand by considering destination choice, mode choice, time-of-day travel choice, and route choice, and the highway network.
- Forecast future travel demand based on current conditions, and future projections of household and employment characteristics.
- Typically, used determine the benefits and impact of major highway improvements in metropolitan areas.
- Have limited capabilities to accurately estimate changes in operational characteristics (such as speed, delay, and queuing) resulting from ITS/operational strategies.
- Does not model dynamic nature of traffic on highways.

Cube Voyager

- Used to perform future travel demand forecasting
- Employs the gravity model and capacity restrained assignment
- Regional models are validated and maintained by MPO
  - Does not analyze operational performance of improvement

SIDRA

- Used to analyze signalized, unsignalized, and roundabout intersection operations
  - Most reliable for roundabout analysis
- Capable of performing lane-by-lane analysis at the intersection
- Used for isolated locations, without congestion

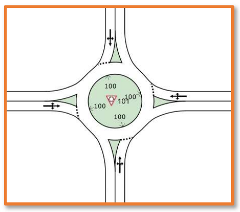
LANE SUMMARY

Site: Existing 2016 AM

Existing 2016 AM
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
SouthEast: US 98													
Lane 1[d]	250	0.0	1051	0.238	100	8.1	LOS A	1.2	30.3	Full	1600	0.0	0.0
Approach	250	0.0		0.238		8.1	LOS A	1.2	30.3				
NorthEast: Trilby Road													
Lane 1[d]	56	18.8	718	0.077	100	5.3	LOS A	0.3	9.5	Full	1600	0.0	0.0
Approach	56	18.8		0.077		5.3	LOS A	0.3	9.5				
NorthWest: US 98													
Lane 1[d]	372	6.0	1004	0.371	100	7.9	LOS A	2.1	56.2	Full	1600	0.0	0.0
Approach	372	6.0		0.371		7.9	LOS A	2.1	56.2				
SouthWest: Trilby Road													
Lane 1[d]	111	0.0	813	0.137	100	5.9	LOS A	0.6	16.0	Full	1600	0.0	0.0
Approach	111	0.0		0.137		5.9	LOS A	0.6	16.0				
Intersection	789	4.1		0.371		7.5	LOS A	2.1	56.2				



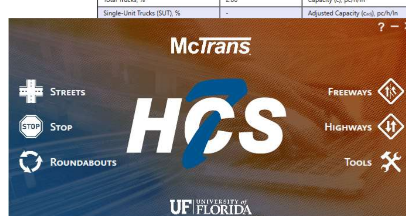
Highway Capacity Software (HCS)

- Utilizes Highway Capacity Manual (HCM) methodologies
- Analyzes capacity and LOS for interrupted and uninterrupted-flow facilities in planning, preliminary engineering, and operational applications
- Used for isolated locations, without congestion

HCS7 Basic Freeway Report

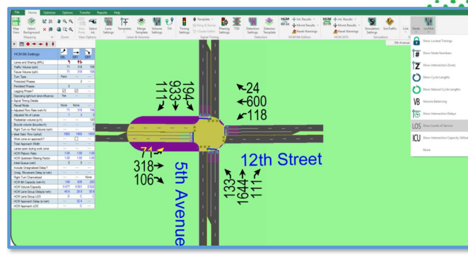
Project Information			
Analyst		Date	9/7/2017
Agency		Analysis Year	2017
Jurisdiction		Time Period Analyzed	
Project Description			
Geometric Data			
Number of Lanes (N), ln	4	Terrain Type	Level
Segment Length (L), ft	3000	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	50.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	50.0
Right-Side Lateral Clearance, ft	10		
Adjustment Factors			
Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000
Demand and Capacity			
Volume (V), veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	0.980
Peak Hour Factor (PHF)	0.95	Flow Rate (v_p), pc/h/ln	0
Total Trucks, %	2.00	Capacity (c), pc/h/ln	2200
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2200
			0.00
			50.0
			0.0
			A

Generated: 7/12/2018 6:31:15 PM



Synchro/SimTraffic

- Used for intersections and arterial segments
- Optimizes traffic signals for individual intersections or an arterial
- Most useful for uncongested areas



ICE Tools

- Screens of different intersection concepts
- Ranks intersection concepts based on v/c ratios
- Rank intersection based on safety performance

Capacity Analysis for Planning of Junctions

Results Worksheet

		Estimated Volume-to-Capacity Ratio			
Project Name:	Road A/Road B	Number of Configurations			
Project Number:		< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00
Location					
Date		2	0	0	0

Results for Non-roundabout Intersections

TYPE OF INTERSECTION	Sheet	Zone 1 (North)		Zone 2 (South)		Zone 3 (East)		Zone 4 (West)		Zone 5 (Center)		Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations	Transit Accommodations
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C				
Traffic Signal	FULL									438	0.25	0.25	Good	Good	Excellent
Two-Way Stop Control	N-S									--	0.17	0.17	Fair	Good	Excellent

Capacity Analysis for Planning of Junctions

Results Worksheet

Results for Roundabouts

TYPE OF ROUNDABOUT	Zone 1 (North)			Zone 3 (East)			Zone 2 (South)			Zone 4 (West)			Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations	Transit Accommodations
	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3				
1 X 1	0.20			0.11			0.36			0.00			0.36	Excellent	Excellent	Excellent

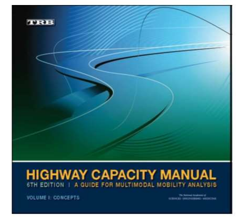
Characteristics of HCM Procedures

- Macroscopic

  input and output deal with average performance during a 15-minute or a 1-hour analytical period),
- Deterministic

  any given set of inputs will always yield the same answer
- Static

  they predict average operating conditions over a fixed time period



Good for analyzing the performance of isolated, uncongested or small-scale transportation facilities

Limitations of Deterministic Tools

- Limited ability to evaluate a system or network
- Limited ability to evaluate queues
- Cannot evaluate some specific roadway geometries
- Does not account well for impacts or metering of neighboring traffic controls/delays

Microsimulation

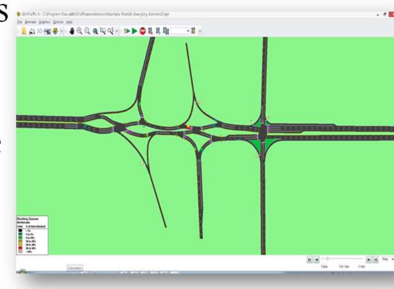
- Analyzes and models individual vehicle movements using car-following and lane-changing theories
- Randomness present to reflect real world conditions
- Able to analyze unconventional concepts or performance of an entire network
- Requires calibration to field conditions to model realistic driver behaviors
- Calibration is not required for visualizing models
- Used when an understanding of interactions between intersections, drivers, or systems is necessary
- Used when congested conditions are present

Microsimulation Limitations

- Modeling two-way left turn lanes
- Impacts of on-street parking, commercial vehicle loading, and double parking
- Modeling sharrows or interference with bicycles
- Modeling is conflict-free (100% safe driving)
- Modeling of road environment and driver behavior

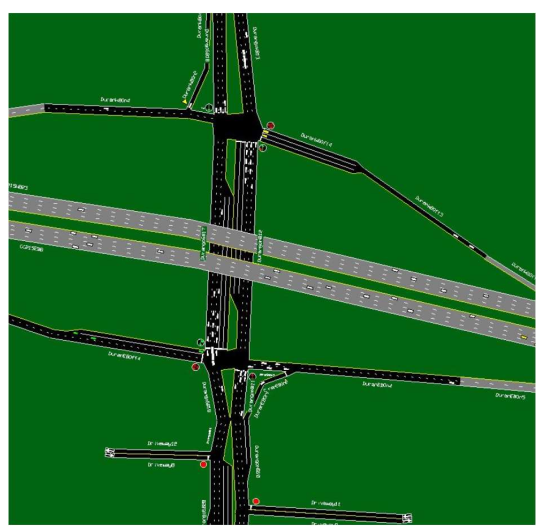
SimTraffic

- SimTraffic is only applicable for arterial analysis
- Used to observe driver behavior and conduct a "reality check" on Synchro outputs.
- Can report vehicle queues, especially when vehicles spill out of the turn lane and block through traffic.
- If the primary purpose of the SimTraffic model is to conduct "reality checks", calibration may not be necessary.
- If SimTraffic results are used to support critical design decisions, calibration is required



CORSIM

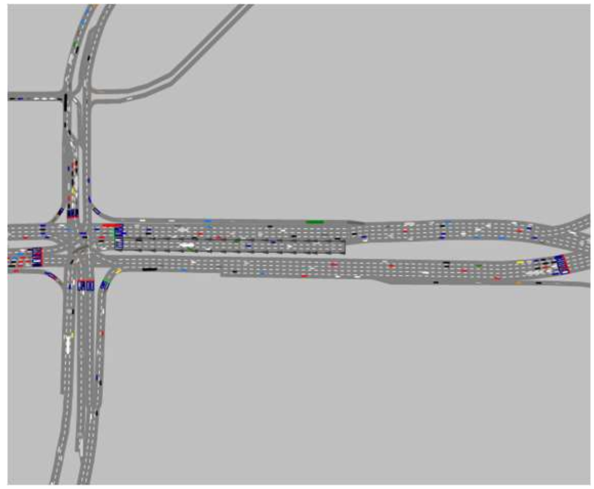
- Point to point coding (nodes and segments)
- Visualization for HCS



TRANSMODELER IS NOW A TOOL TO VISUALIZE HCS

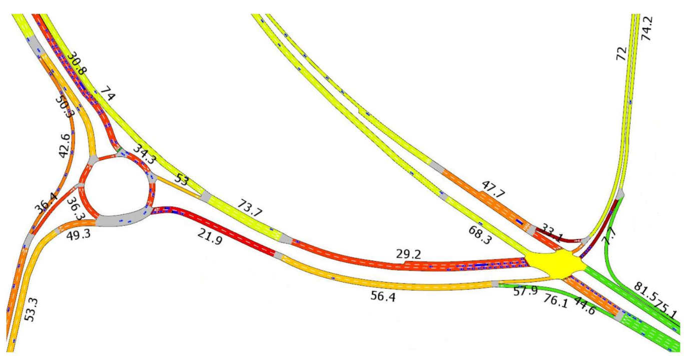
Vissim

- Includes microscopic and mesoscopic simulation
- Analyzes and models individual vehicle movements, transit, and pedestrian flows
- Link-based coding (links and connectors)
- Can record 3D simulation videos
- All features are highly customizable
- Custom scripts can be applied
- Easily compatible with other software programs



Aimsun

- Macroscopic, microscopic, and mesoscopic applications can be contained in one platform
- Point to point coding (nodes and segments)
- Can produce 3D animation



Deterministic Tools vs. Simulation Models

Deterministic	Simulation
Static approach (average operating conditions over a fixed time period; does not deal with transitions in operation)	Dynamic approach (analyze transitions between system states)
No vehicle-vehicle interaction (section-by-section basis)	Vehicle-vehicle interaction based on lane changing and car-following theories
Average MOEs over one hour	Predict MOEs over each time period (can exceed an hour)
Reports density as equivalent passenger cars	Reports density for actual vehicles
Traffic flow in terms of passenger-car equivalents	Traffic flow in terms of actual vehicles
Reports all delays caused by a bottleneck	Reports delay on the segment where vehicles are queued
Reports all queued vehicles from a given bottleneck	Reports queue on the segment where vehicles are queued

When is Deterministic Analysis Appropriate?

Conditions are not over-saturated

- Isolated intersection or segment
- Influence from adjacent segments or intersection is minimal

When is Microsimulation Appropriate?

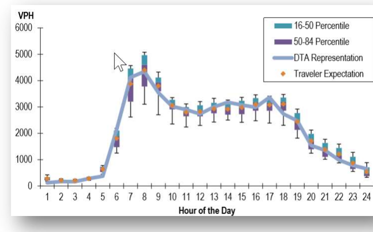
- Facility exhibits a high level of congestion
- Complex geometric configurations are proposed
- Traffic routing is necessary, excessive queuing or prolonged periods of congestion are observed
- Analysis requires evaluation of vehicle performance, user behavior, system-level impacts, or advanced improvement strategies
  - ✓Managed lanes
  - ✓Ramp metering
  - ✓Innovative intersection concepts with unconventional timing schemes required

Mesoscopic Simulation

- Combines properties of both microscopic and macroscopic models
  - Unit of traffic flow is the individual vehicle
  - Vehicle movement is governed by the average speed on the link
- Does not consider dynamic speed/volume relationships, simulation is on aggregate level
- Models and simulates large network with users ability to choose different (alternative) routes to get to their destination.
- Tools: Vissim, Aimsum, Transmodeller

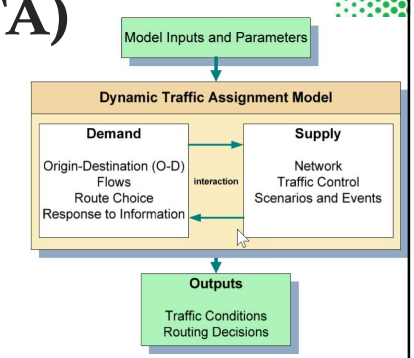
Dynamic Traffic Assignment (DTA)

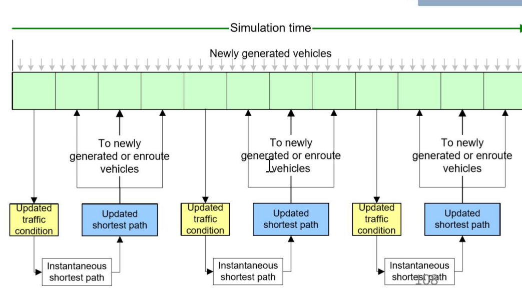
- Models different sizes and resolutions and to different contexts for analysis time frames
- Uses route choice—capability of analyzing different route choice behaviors based on congestion knowledge
- Usually incorporated in mesoscopic tools
- Can be applied in microscopic and hybrid tools



Dynamic Traffic Assignment (DTA)

- DTA methods require more effort than other modeling technique
- Scope of DTA analysis should include data needs, model building time, and calibration which could be significant!





Misusing Traffic Analysis Tools

Use of the Highway Capacity Manual for the operational analysis of projects on the NHS is not required if another traffic analysis method is determined [**by State DOT**]to be more appropriate to fully identify and evaluate the performance and impacts of the proposed project alternatives.

FHWA LOS Directives	Robert Mooney's Memo 05/06/2016 & Dwight Horne's Memo 08/31/2010

Misusing Traffic Analysis Tools

Tradeoff between resources vs. decisions

Default to HCM based tools

Understand capabilities of the tool.

The appropriate tools for traffic analyses should be discussed with, and reviewed, and approved by the District Project Manager

Considerations when Selecting Analysis Tools

WHICH TOOL IS MOST APPROPRIATE?

- Type of project and level of analysis
- Facility type and geographic context of the analysis
- Existing traffic operating conditions
- Presence of traffic management strategies and applications, ITS technologies
- Required performance MOEs
- Proposed improvements
- Assumptions and limitation of the available analytical tools
- Interoperability with other analysis software or traffic management strategies
- Software versions may have different capabilities
- Resources and budgetary constraints

Module 4 Exercise: Traffic Analysis Tools

1.1 **Project description and issue**:
Bearss Avenue, a divided facility ranging from 4 to 6 through lanes, experiences congestion during peak hours from Florida Avenue to Nebraska Avenue. This segment is being widened and a PD&E study is underway

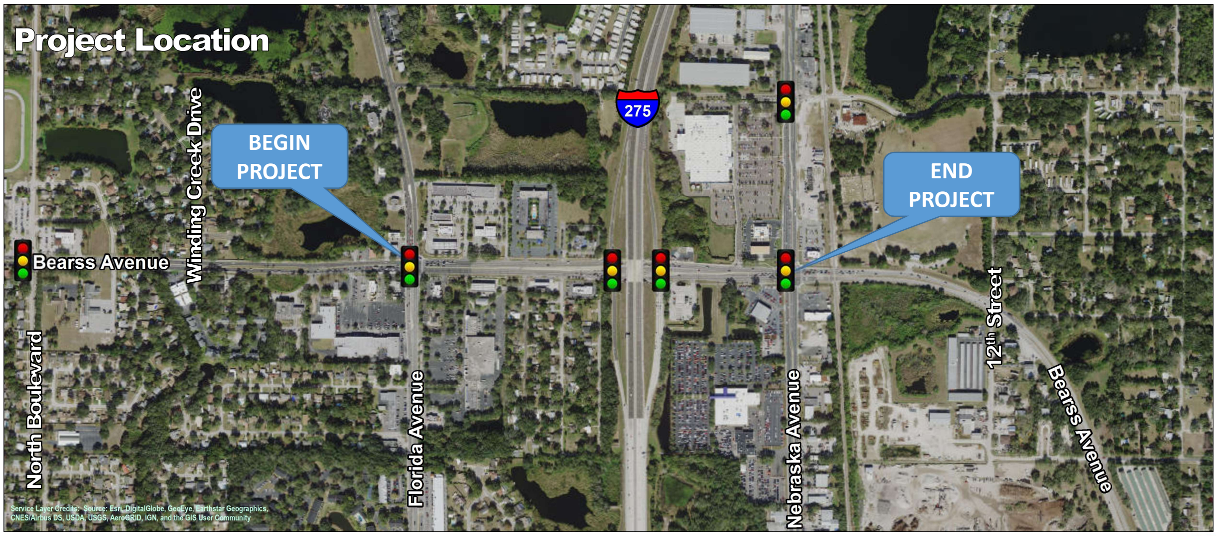
1.2 **Traffic analysis objective:**
Conduct corridor and intersection analysis to develop Alternatives to mitigate the congestion along Bears Avenue

1.3 **Question:**

What analysis tool(s) would you use to meet the traffic analysis objective, if

a) The corridor is not congested (not oversaturated)?
b) The corridor is congested (oversaturated)?

Module 4 Exercise A: Traffic Analysis Tools



Module 4 Exercise: Traffic Analysis Tools

a) If the corridor is not congested (not oversaturated)?

- Tools that deploy HCM methodology, most commonly Synchro and HCS should be used
- These tools produce the corridor-level MOEs that are needed to meet the goals of the traffic analysis objective by allowing Alternatives to be compared
- Possible MOEs
  - a) Average travel speed
  - b) Average running speed
  - c) Travel time
  - d) LOS

Module 4 Exercise: Traffic Analysis Tools

b) If the corridor is congested (oversaturated)?

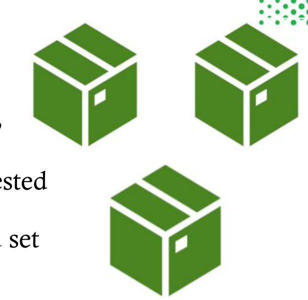
- Microsimulation tools such as CORSIM, Vissim, and Aimsun because:
  - Area is oversaturated
  - Involves multiple closely spaced signals that require close coordination

    Interaction between the intersections should be analyzed, Signal coordination and vehicle routing affect MOE results

- Synchro will be used to estimate lane geometry and signal timings schemes, including signal optimization

    Refinements should be made at the microsimulation level to meet the goals of the traffic analysis objectives and compare Alternatives

Module 4 Wrap-up Points



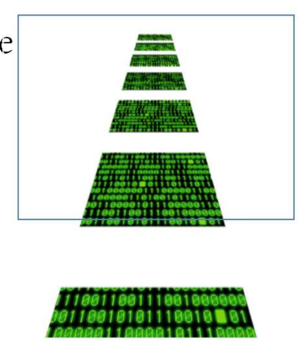
- Deterministic tools take less time to set up and complete and, therefore, have lower associated costs
  - There are limitations if the project involves complex designs or congested conditions
  - Must understand what the traffic analysis goals of the project are and set scope
- Microscopic simulation provides more substantive results, but take more time to develop
  - Can produce animation videos that are effective for communicating anticipated operations to a wide range of audiences and are valuable at public meetings/hearings
- Avoid misusing or misapplying traffic analysis tools
- Know limitation of the tools and their capabilities before selection

Module 5

Data Collection

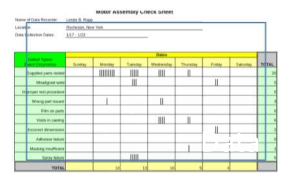
Determining Data Needs

- Consider
  - ✓project context, project limits, study area/area of influence, analysis method, and MOEs
  - ✓all modes that exist or are planned in the project area
  - ✓intersections and driveways that are critical to meeting the traffic analysis goals
  - ✓use of Default values v/s field-measured data
- Gather existing data from prior studies or databases
- Conduct field reviews to determine sufficiency of available data



Data Collection Plan

- Consider the following:
  - ✓Data required to meet objectives of analysis
  - ✓Desired level of accuracy dependent on the level of analysis
  - ✓Collection method and data sources
  - ✓Data storage
  - ✓Schedule and resource requirements
  - ✓Budget
  - ✓Quality control
- Traffic Analysis Handbook sections 5.4.1 (data collection checklist) and 5.4.2 (data collection resources) have useful guidance



Traffic Counts

- Typically collected Tuesdays, Wednesdays or Thursdays (not during summer or holidays)
- Vehicle approach counts
  - ✓Measures two-way vehicle traffic passing a point, typically over a 1-3 day period
  - ✓This is an Average Daily Traffic (ADT) measurement used to estimate AADT
    - AADT=ADT*seasonal factor (SF)*axle factor (AF)
- Vehicle classification (class) counts

AADT	Annual Average Daily Traffic • Total volume traveling on a segment over one year divided by the number of days in the year
ADT	Average Daily Traffic
SF	Seasonal Factor
AF	Axle Factor

Count as many intersections along the corridor as possible on the same day to reduce the potential for volume discrepancies

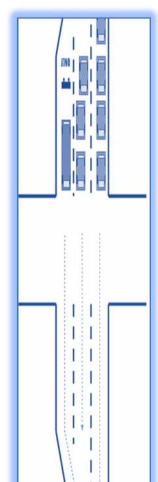
Traffic Counts

- Should be collected Tuesdays, Wednesdays or Thursdays (not during summer or holidays)
- Turning movement counts (TMCs)
  - ✓ Typically taken during AM and PM peak periods
  - ✓ May include truck, bicycle, and pedestrian movements
  - ✓ Vehicle approach and class counts can be used instead of turning movements for right-in right-out geometry only
  - ✓ Approach, class, and TMCs should be collected closely together

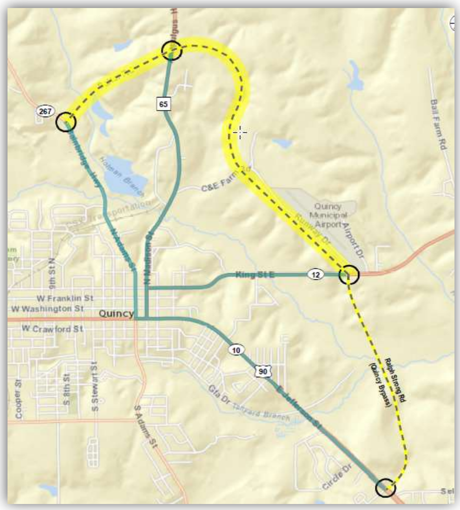
Calibration and Validation Data

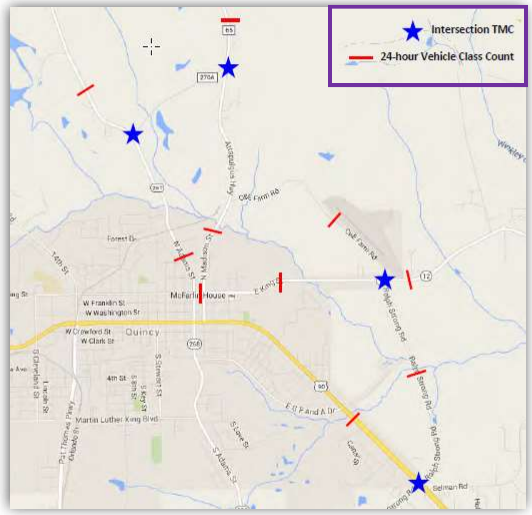
Collect calibration data simultaneously with count data

- Saturation flow rates
- Queue observed
- Travel times and delay
- Speed: Peak vs Off-peak
- Origin-destination (OD) data
- Weaving, lane-changing, lane utilization
- Signal timings



Data Collection Example





Roadway Data

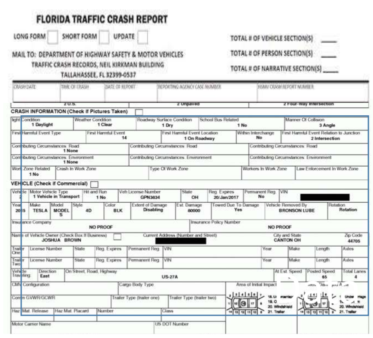
- Apparent existing right of way / property lines
- Typical section
- Utilities
- Topography
- Construction/development activity
- Drainage
- Pavement and curb conditions
- Roadside clear zone width
- Access density
- Major/special traffic generators
- On-street parking
- Signage
- Signal hardware features
- Lighting
- ITS or other roadway technology
- Social, cultural, or environmental observations
- Bridges
- Railroads
- School zones
- Transit stop locations and amenities
- Operational/safety observations
- Obstructions

Multimodal Data

- Bicycle/pedestrian counts
  - Bicyclists only,
  - Pedestrians only,
  - Pedestrians and bicyclists combined
- Transit ridership
  - Boardings and alightings
  - Average riders each day
- Transit data
  - Frequency/schedule
  - Dwell time
  - Trip length
  - Bus blockage

Crash Data

- Most recent 5 years is required
- Main categories of interest include:
  - Crash location
  - Severity
  - Crash type
  - Cause of crash



FLORIDA TRAFFIC CRASH REPORT

LONG FORM ☐ SHORT FORM ☐ UPDATE ☐

MAIL TO: DEPARTMENT OF HIGHWAY SAFETY & MOTOR VEHICLES
TRAFFIC CRASH RECORDS, NEIL KIRKMAN BUILDING
TALLAHASSEE, FL 32399-0537

TOTAL # OF VEHICLE SECTION(S) ____
TOTAL # OF PERSON SECTION(S) ____
TOTAL # OF NARRATIVE SECTION(S) ____

CRASH DATE | TIME OF CRASH | DATE OF REPORT | REPORTING AGENCY CASE NUMBER | HSMV CRASH REPORT NUMBER

2 U.S. | 2 Unpaved | 2 Four-Way Intersection

CRASH INFORMATION (Check if Pictures Taken) ☐

Light Condition: 1 Daylight | Weather Condition: 1 Clear | Roadway Surface Condition: 1 Dry | School Bus Related: 1 No | Manner Of Collision: 3 Angle

First Harmful Event Type | First Harmful Event: 14 | First Harmful Event Location: 1 On Roadway | Within Interchange: No | First Harmful Event Relation to Junction: 2 Intersection

Contributing Circumstances: Road: 1 None | Contributing Circumstances: Road | Contributing Circumstances: Road

Contributing Circumstances: Environment: 1 None | Contributing Circumstances: Environment | Contributing Circumstances: Environment

Work Zone Related: 1 No | Crash In Work Zone | Type Of Work Zone | Workers In Work Zone | Law Enforcement In Work Zone

VEHICLE (Check if Commercial) ☐

Vehicle: 2 | Motor Vehicle Type: 1 Vehicle in Transport | Hit and Run: 1 No | Veh License Number: GPN3834 | State: OH | Reg. Expires: 20/Jan/2017 | Permanent Reg.: No | VIN: [redacted]

Year: 2015 | Make: TESLA | Model: MODEL S | Style: 4D | Color: BLK | Extent of Damage: Disabling | Est. Damage: 80000 | Towed Due To Damage: Yes | Vehicle Removed By: BRONSON LUBE | Rotation: Rotation

Insurance Company: NO PROOF | Insurance Policy Number: NO PROOF

Name of Vehicle Owner (Check Box If Business) ☐: JOSHUA BROWN | Current Address (Number and Street): [redacted] | City and State: CANTON OH | Zip Code: 44705

Trailer One | License Number | State | Reg. Expires | Permanent Reg. | VIN | Year | Make | Length | Axles

Trailer Two | License Number | State | Reg. Expires | Permanent Reg. | VIN | Year | Make | Length | Axles

Vehicle Traveling | Direction: East | On Street, Road, Highway: US-27A | At Est. Speed | Posted Speed: 65 | Total Lanes: 4

CMV Configuration | Cargo Body Type | Area of Initial Impact

Comm GVWR/GCWR | Trailer Type (trailer one) | Trailer Type (trailer two)

Haz Mat. Release | Haz Mat. Placard | Number | Class

Motor Carrier Name | US DOT Number

Drag a column header and drop it here to group by that column

Crash#	Crash Date	Roadway Id	Location Mile Post	1st Harmful Event	Light Cond	Surface Cond	Junc
828485400	7/18/2012	49090000	3.25	Ditch			Non-
820516190	1/9/2012	49010000	1.65	Overturn/Rollover			Non-
820515410	8/28/2012	49010000	1.88	Tree (Standing)			Non-
820515550	12/3/2012	49010000	5.27	Motor Vehicle In Transpor			Inter Relat
819956420	3/2/2012	49010000	7.136	Motor Vehicle In Transpor			Inter
820642560	1/2/2012	49010000	8.879	Motor Vehicle In Transport	Dusk	Dry	Non-

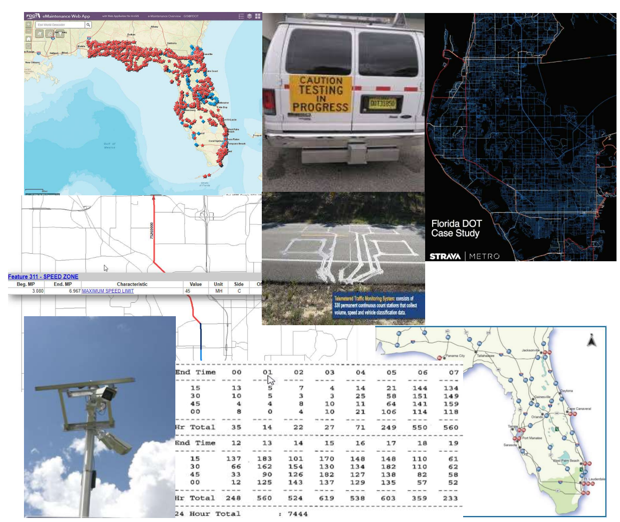
Data Collection Quality Control

- Analyze data collected descriptively
- Verify there are no equipment malfunctions or human error
- Check data collected for completeness, accuracy, and reasonableness
- Check and verify collected counts are balanced within the analysis area
- Check variation of data (space and time) for reasonableness
- Compare maximum count with capacity
- Data smoothing should be documented

Is the data collected reliable?

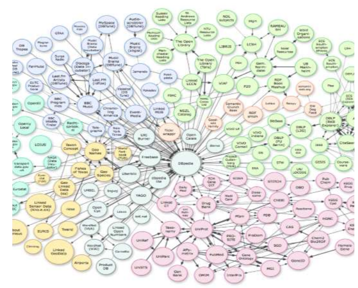
Data Collection Methods

- Permanent counts
- Roadway (pneumatic) tubes
- Turning movement counts
- Manual counts
- License tag matching for OD info
- Self-reported data
- Emerging technologies
  - Bluetooth
  - Blue Toad
  - Cellular/GPS
  - Video detection
  - Infrared



Data Collection Considerations

- Turning movements should be collected from all approaches (including driveways that act as an approach
- Include heavy vehicles, buses and pedestrians
- Include estimates of queue lengths in turning movement counts
  - Unmet traffic demand is not captured in turning movement counts
  - Can be time-consuming and there are time constraints for when data can be collected
- Resource and schedule



Data Collection Summary

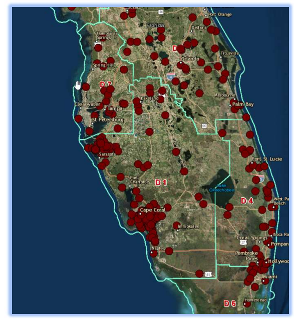
- Data collection summary should document:
  - Data needs
  - Collection methods and strategies
  - Data storage
  - Descriptive summaries
  - Quality assurance procedure

- Traffic analysis report should contain a narrative of the existing conditions as supported by the field observations and data

- Data collection summary must be presented in a manner that is easy to comprehend for ease of quality control

Sources for Existing Data

- Florida Traffic Online (Florida Traffic Information)
- Regional Integrated Transportation Information System (RITIS)
- FDOT and Local Governments
  - Signal timing sheets
  - Planned projects and other traffic studies
  - Counts (all types)
  - Crash databases
- FDOT Crash Analysis and Reporting (CARS)
- Signal Four Analytics
- Strava data
- Previous studies
- Roadway Characteristics Inventory (RCI)
- Straight-line diagrams (SLD)
- Local Jurisdiction GIS Databases
- Aerial imageries
- Transit Agencies



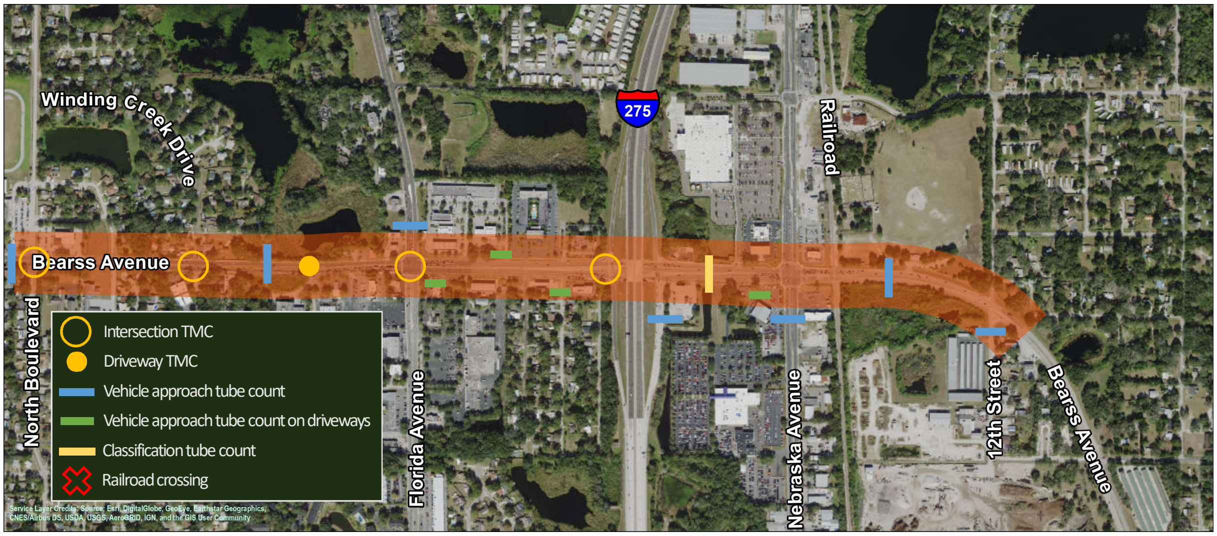
Module 5 Exercise: Data Collection

1.1 Project description and issue:
Bearss Avenue, a divided facility ranging from 4 to 6 through lanes, experiences congestion during peak hours from Florida Avenue to Nebraska Avenue. This segment is being widened and a PD&E study is underway

1.2 Traffic analysis objective:
Conduct corridor and intersection analysis to develop Alternatives to mitigate the congestion along Bears Avenue

1.3 Question:
What types of data are needed to meet the traffic analysis objectives? Identify data collection locations **along Bears Avenue only**.

Module 5 Exercise: Data Collection Location



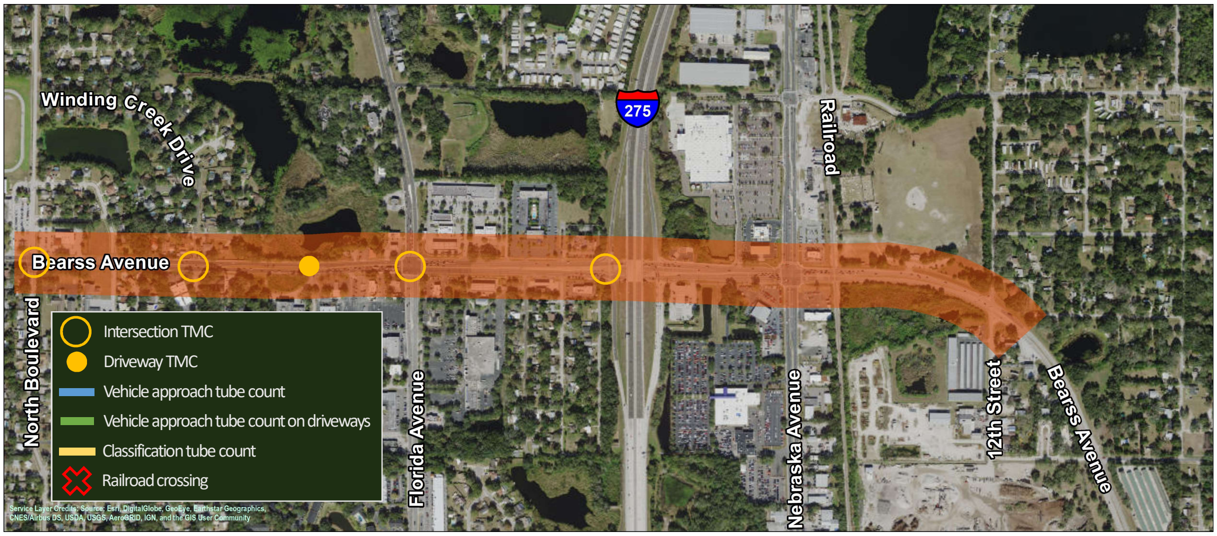
Module 5 Exercise: Data Types

Types of data needed to meet the traffic analysis objectives

Traffic	Roadway	Crash
Turning movement	Number of lanes	Type
Approach	Lane width	Severity
Classification	Lane storage	Contributing cause
Saturation flow	Grade	Pattern
Queue	Pavement condition	
Signal		
Rail Road		
Bike and Ped		

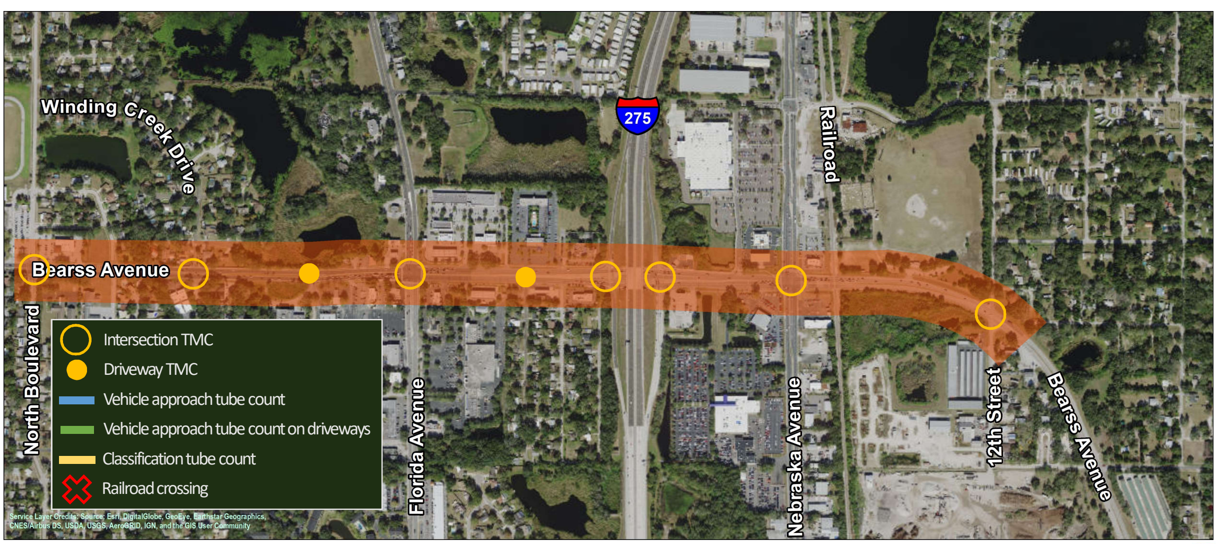
Calibration?
…

Module 5 Exercise: Data Collection Location



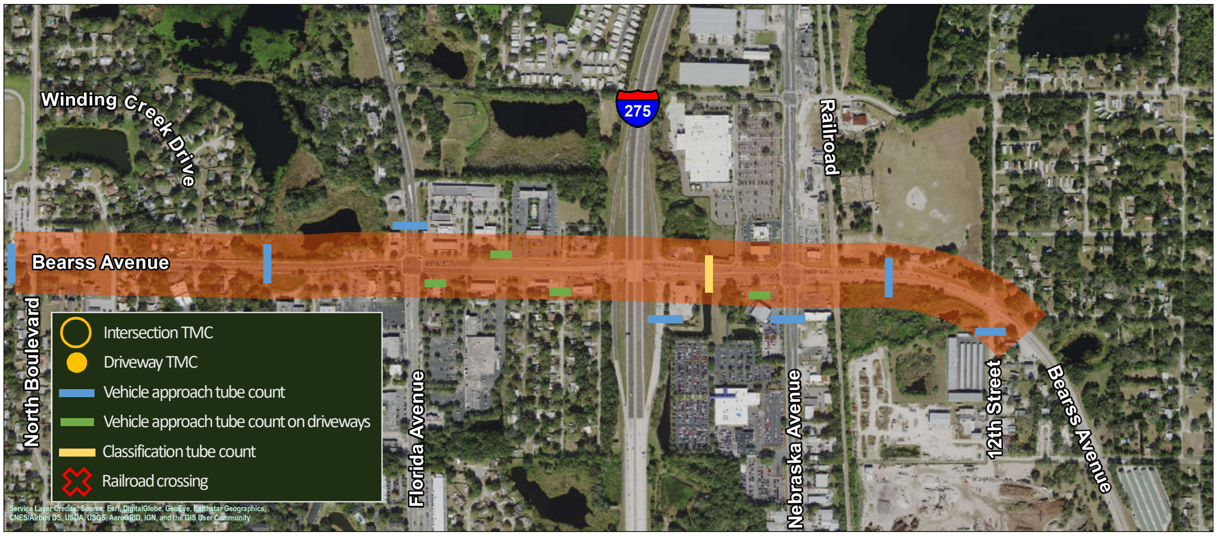
Module 5: Data Collection

Module 5 Exercise: Data Collection



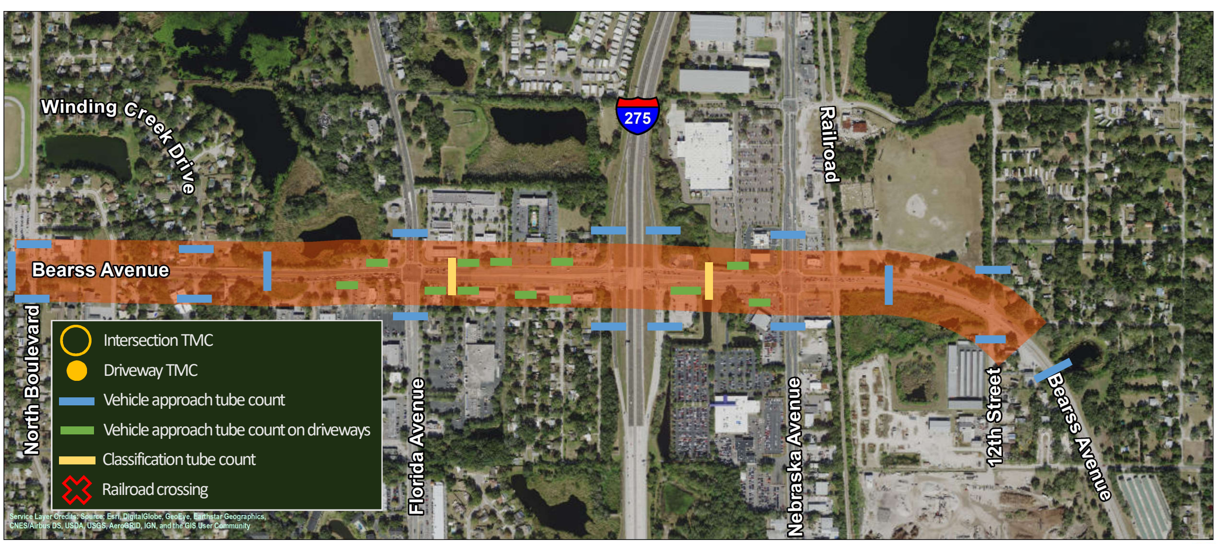
Module 5: Data Collection

Module 5 Exercise: Data Collection



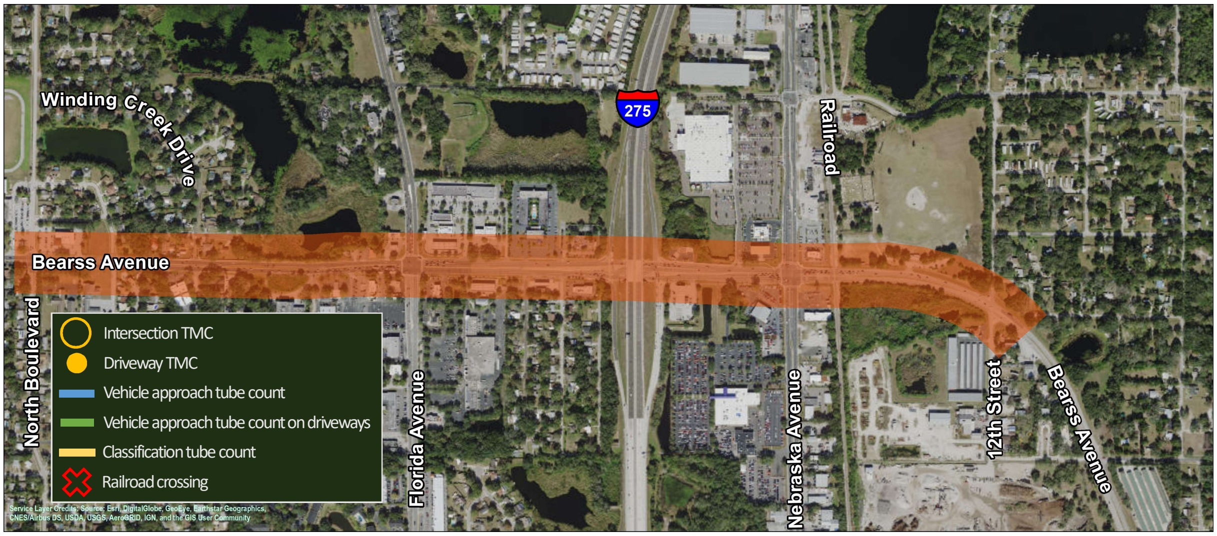
Module 5: Data Collection

Module 5 Exercise: Data Collection



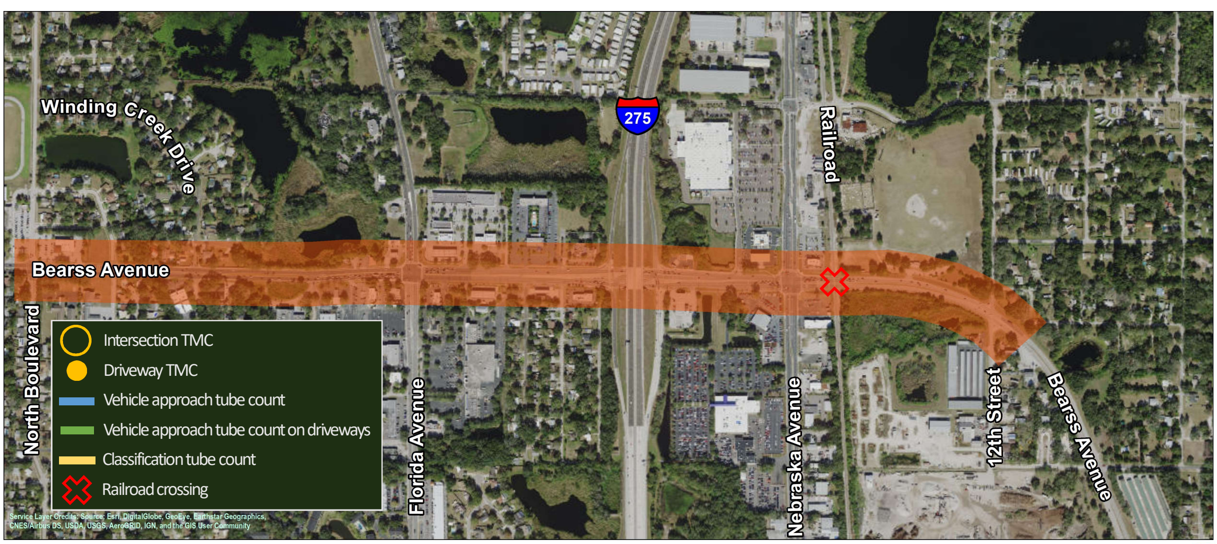
Module 5: Data Collection

Module 5 Exercise: Data Collection



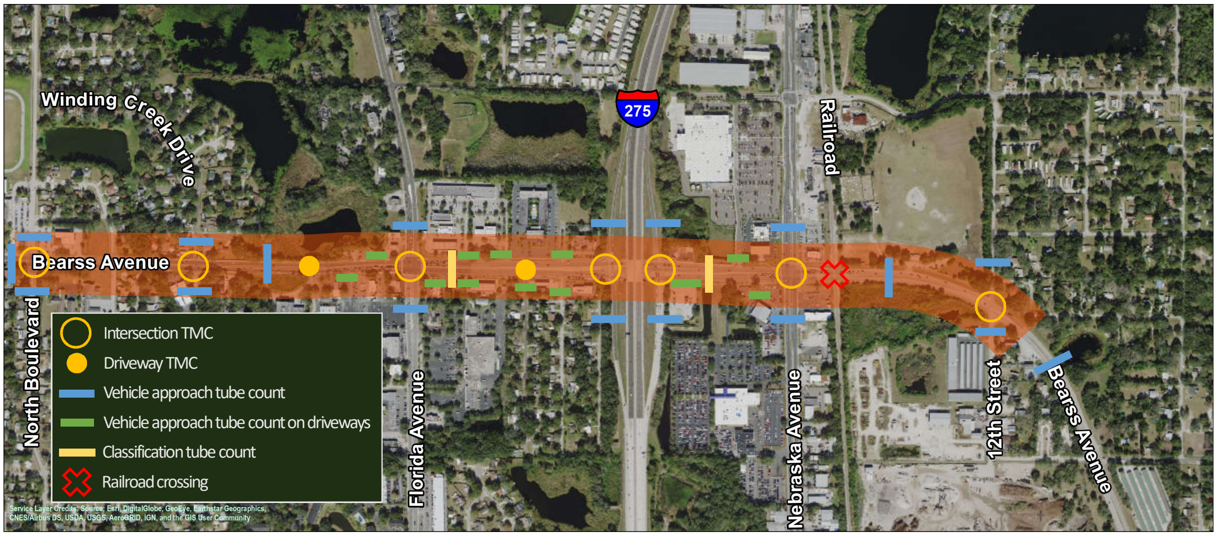
Module 5: Data Collection

Module 5 Exercise: Data Collection



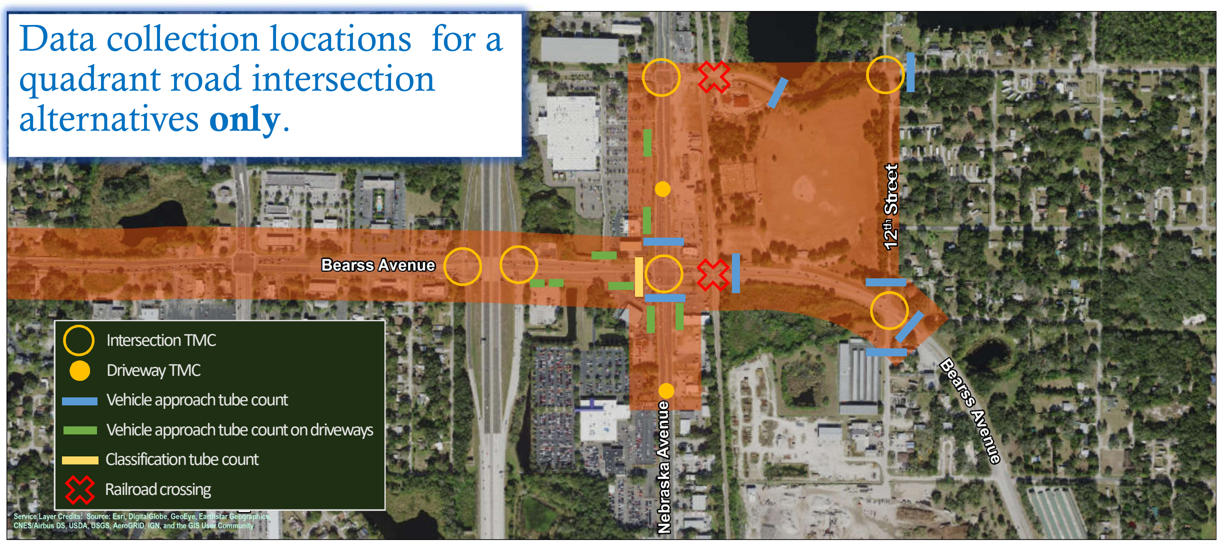
Module 5: Data Collection

Module 5 Exercise: Data Collection



Module 5 Scenario 1: Count Locations

Data collection locations for a quadrant road intersection alternatives **only**.



Module 5 Wrap-up Points

- Scope is based on the scale and complexity
- Understand the project purpose and need
- What information is required, what do we currently have?
- Know your budget and schedule limitations
- Plan before you collect data
- Multimodal data
- Data quality

Module 6

Project Traffic Forecasting

Project Traffic Forecast

Is a process of estimating the future year travel demand

Traffic forecasts are used to

- Evaluate LOS for improvement needs
- Determine appropriate number of lanes for a roadway
- Design pavement structure
- Analyze environmental issues—such as air quality
- Evaluate alternative transportation scenarios

Developing Project Traffic in PD&E

Is the same as Design Traffic

Purpose & Method → Existing Conditions → Future Conditions

Existing Conditions

- Existing land use, transportation system and demographics
- Existing traffic volume and traffic characteristics
- Base year travel demand model validation

Future Conditions

- Future land use, and demographics
- Existing system plus committed improvements
- Traffic trend projections
- Traffic demand forecasts
- Project traffic volumes & future conditions analysis

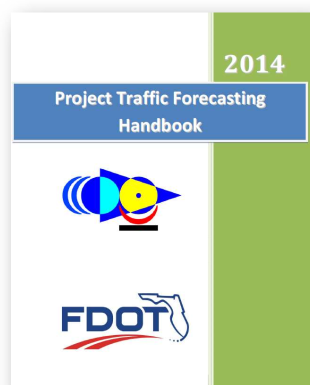
Developing Project Traffic in PD&E

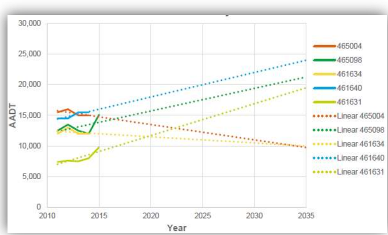
- Regional travel demand model
- Growth rates
- Trip generation for a site with a specific land use
- Utilizing information from previous studies

Discussions with the reviewing agency is encouraged for the selection of the travel demand model or method

Project Traffic Forecasting in PD&E

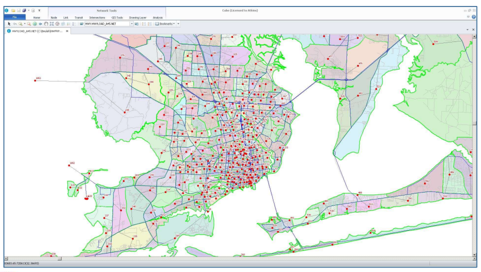
- FDOT's traffic forecasting methods
  - With a travel demand model
  - Without a travel demand model
- Documentation of traffic forecasts and analysis





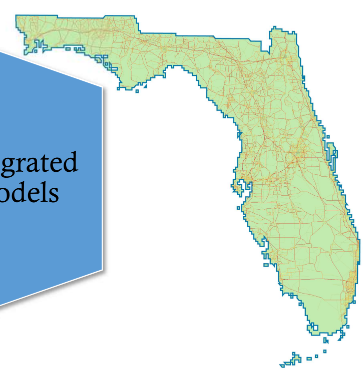
Forecasting with Travel Demand Models

- Travel demand forecasts produces regional traffic patterns based on population and employment across the region
- Only as good as the quality of inputs and robustness of validation
- Forecasting area typically larger than the project area



Travel Demand Models

- Four step models
- Activity-based models
- Statewide model
- Turnpike statewide model
- Integrated models



Concurrence from the District modeling coordinator should be obtained

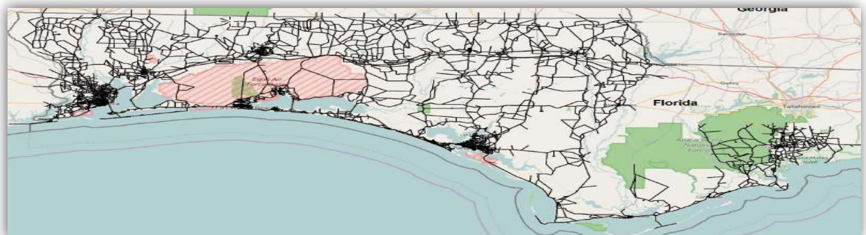
Travel Demand Models

Consider size, scope, and location

- Big changes may require more detailed use of a model
- Different areas of the State have different models

Prepared using the Florida Standard Urban Transportation Model Structure (FSUTMS)

- Cube Voyager is the software currently used in Florida
- Use the most recently adopted version of the Model



Model Calibration, Validation, Refinement

- Calibrated and validate using the latest assumptions of socioeconomic and network data
- User must determine if it meets the areawide validation standards
- Tradeoff confidence in the level of accuracy of the models and the cost of data collection and effort required to validate model

"Essentially, all models are wrong, but some are useful"

…the practical question is how wrong do they have to be to not be useful

…models need to be able to replicate observed conditions within reason before being used to produce future-year forecasts

Model Calibration, Validation and Refinement

- Reviewers should consider model's age and make reasonableness checks
- Validation of base year model
  - Does the model replicate existing conditions?
  - Will the model predict future behavior?
- Subarea validation is needed when the Model meets areawide validation standards, but fails on specific area or corridor under study

Table 3: 2010 FDOT Count Station AADT versus 2010 CRTPA AADT

Road Name and FDOT Count Station Location	2010 AADT	2010 CRTPA PSWADT	MOCF	2010 CRTPA AADT	CRTPA Volume Adjustment
SR 267 (Bainbridge Hwy/N Adams St)					
500011 (0.25 miles N of CR 272)	4,400	4,598	0.95	4,400	100.0%
501502 (400' S of CR 270A)	4,200	4,363	0.95	4,100	102.4%
CR 65 (Attapulgus Hwy/N Madison St)					

Post Processing Model Outputs

- Post processing of the model's outputs is required prior to its use in analysis
- The outputs should be post processed to develop traffic volumes
- Travel Demand Models produce PSWADT
- AADT obtained by applying Model Output Conversion Factor (MOCF)
  - AADT = PSWADT *MOCF

<u>Example:</u>
Model output 30052, MOCF = 0.96
AADT = 30,052 x 0.96 = 28,850 ~ 29,000

Design Hour Volumes

DHV=AADT*K	DDHV=AADT*K*D

- Design Hour Volume (DHV)
  - Two-way total volume traveling on a segment in the peak hour (design hour)
- Directional Design Hour Volume (DDHV)
  - Total volume traveling in the peak direction in the peak hour (design hour) of the design year

- Design-hour factor (K)
  - Proportion of daily traffic (AADT) traveling on a segment in the peak hour (design hour)
- Direction distribution factor (D)
  - Proportion of vehicles traveling in the peak direction on a two-way segment in the peak hour (design year)

Example:
AADT = 29,000   K = 0.10   D = 0.55
DHV = 29,000 *0.1 = 2900 and DDHV = 1600

Module 6: Travel Demand and Project Traffic Forecasting 155

Forecasting Considerations

- No Build vs. Build volumes
  - Socio-economic data may change with the build condition
  - Future year scenarios for No Build and Build
- Review generated volumes for logical traffic growth rates
- Where model results do not appear to be reasonable
  - Deviation must be documented and acceptable revisions to the network, land use, or socio-economic data need to be made.
- If the model results are not reasonable and cannot be corrected, then use the historical traffic forecasting
- Schedule sufficient time for preparation of traffic forecasts and validation

Module 6: Travel Demand and Project Traffic Forecasting 156

Forecasting without a Travel Demand Model

- Growth rate methods may be considered when:
  - MPO/TPO does not exist in project area
  - Travel demand model shows inadequate accuracy for project area
- Population and employment growth rates apply to areas that are experiencing substantial growth, construction of parallel facilities, and/or changes in land use
- Growth rate can be obtained from the Model and applied to the existing year
- Apply the growth rate to the specified base year for desired year estimate (linear, compound, etc.)

Study Segment	Trend Analysis		
	Design Year (2040) Trend	Trend R-Squared	TRENDS based Annual Historic Growth Rate
SR 85			
North of Cracker Barrel Rd (Site 571607)	68,800	53.42%	2.19%
South of Antioch Rd (Site 570088)	47,200	61.83%	1.57%
Side Streets			
PJ Adams Pkwy West of SR 85 (Site 570283)	28,600	72.25%	3.31%
Antioch Rd, West of SR 85 (Site 570284)	10,000	80.56%	15.56%
I-10			
WB on Ramp from SR 85 (Site 572605)	7,100	72.36%	2.27%
EB off Ramp to SR 85 (Site 572606)	9,200	68.57%	3.48%
WB off Ramp to SR 85 (Site 572607)	900	22.59%	-2.40%
EB on Ramp from SR 85 (Site 572608)	3,400	85.21%	1.74%

Note: Historical counts were obtained from the FDOT 2016 FTI DVD

Forecasting without Travel Demand Models

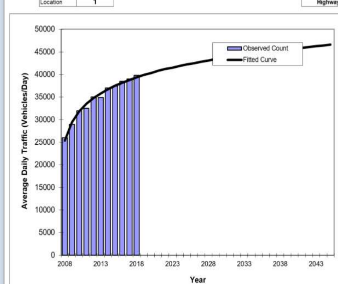
Historical trends analysis

- Uses historical traffic counts
- Historical count data can be obtained from FTO or other sources
- Traffic trends analysis tool (Excel worksheet)
- Most applicable in areas with stable land use
- Not sensitive to capacity constraints or new capacity

Traffic Trends - V03.a
MASON AVE. -- 79220000

FIN#	1234
Location	1

County:	Volusia (79)
Station #:	7046
Highway:	MASON AVE.



Year	Traffic (ADT/AADT) Count*	Trend**
2008	26000	25400
2009	29000	29400
2010	32000	31800
2011	32500	33500
2012	35000	34800
2013	34900	35800
2014	37000	36700
2015	37400	37500
2016	38500	38200
2017	39000	38800
2018	39800	39400
2025 Opening Year Trend		
2025	N/A	42200
2035 Mid-Year Trend		
2035	N/A	44800
2045 Design Year Trend		
2045	N/A	46600
TRANPLAN Forecasts/Trends		

Trend R-squared:	98.51%
Compounded Annual Historic Growth Rate:	4.49%
Compounded Growth Rate (2018 to Design Year):	0.62%
Printed:	27-Sep-18

Decaying Exponential Growth Option

*Axle-Adjusted

Forecasting without Travel Demand Models

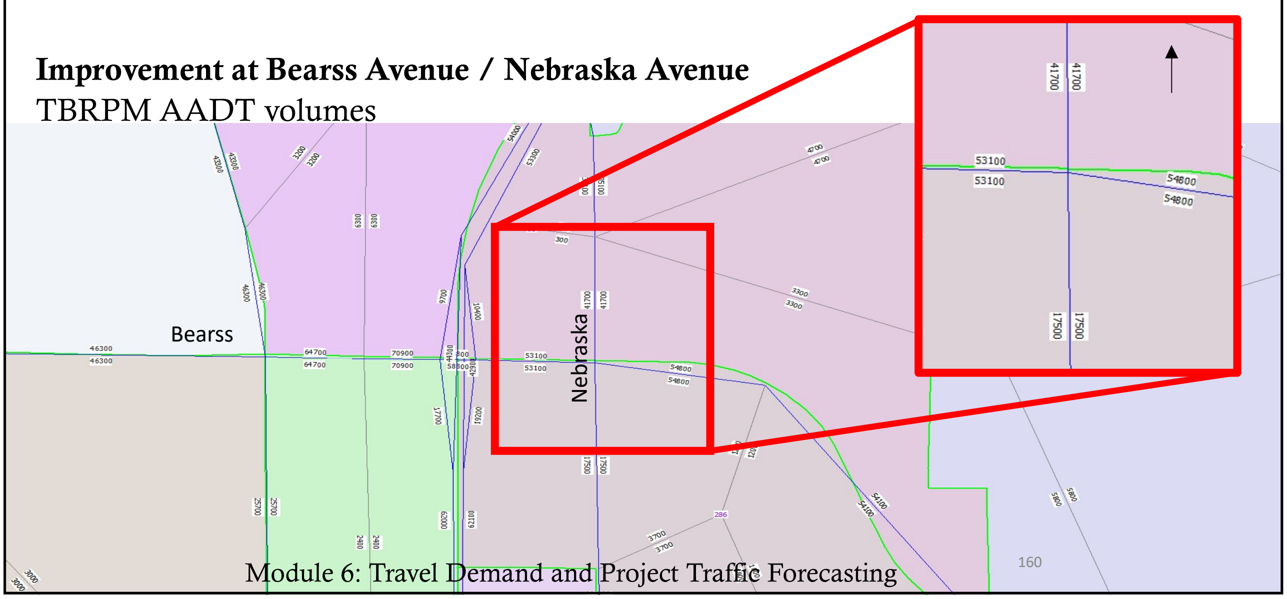
Historical Growth Rates Example

FDOT Traffic Count Station #	Facility	Location	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Annual Trend Historical Growth Rate (10 YR)	Regression Estimated Year 2015 2-way AADT	2015	Annual Trend Historical Growth Rate (10 YR)
46-0271	CR 388	CR 388 300' East of SR 79, West Bay	2,600	2,800	3,400	2,500	2,600	4,600	5,100	5,300	5,100	5,200	8.01%	5,900	6,300	9.43%
46-0128	CR 388	CR 388 300' West of SR 77	3,000	3,200	3,200	2,700	2,800	5,200	4,300	4,500	4,700	4,700	5.11%	5,100	5,400	5.99%
46-0104	CR 388	CR 388 500' East of SR 77	1,450	1,550	1,550	1,600	1,550	1,550	1,550	1,400	1,650	1,750	2.11%	1,600	1,850	1.99%
46-0138	SR 79	SR 79 300' North of CR 388	6,300	6,400	6,400	5,100	6,200	5,800	6,600	6,000	6,500	6,900	1.02%	6,500	7,700	2.08%
46-0118	SR 79	SR 79 1000' North of ICWW Bridge	7,700	8,000	8,000	6,200	6,900	8,400	9,500	8,800	9,400	10,700	3.72%	10,100	12,000	4.61%
46-0258	SR 79	SR 79 at North City Limits of PC Beach	8,000	8,000	7,900	6,500	7,800	8,000	9,000	8,700	11,900	9,600	2.05%	10,300	12,500	5.08%
46-0105	SR 77	SR 77 2400' North of CR 388 (West)	13,000	13,500	14,000	13,600	14,100	15,300	13,500	13,200	16,600	13,700	0.58%	14,900	16,500	2.25%
46-0005	SR 77	SR 77 500' South of CR 388 (West)	14,000	14,500	15,000	14,200	14,400	16,000	15,000	14,600	16,600	16,200	1.63%	16,300	18,400	2.68%
46-0003	SR 77	SR 77 1093' North of Nassau St., Southport	14,000	15,300	16,800	14,100	16,500	16,700	15,500	15,500	16,900	16,400	1.77%	16,800	18,100	1.88%
60-0270	US 98	SR 30 (US 98) 300' West of CR 30A (Walton County)	11,100	13,200	12,800	12,000	10,200	13,200	12,100	13,200	13,400	16,200	4.29%	14,500	19,100	4.19%
46-0284	US 98	SR 30 (US 98) 1265' E End of Phillip Inlet Bridge	17,600	19,000	19,200	15,300	16,800	17,500	18,000	18,700	20,400	21,000	1.98%	19,900	24,000	2.63%
46-0216	US 98	SR 30A (US 98) 660' East of Front Beach Rd	16,500	18,300	18,500	15,800	16,200	17,900	17,700	18,300	20,500	23,000	3.76%	20,900	23,000	2.57%
46-0276	US 98	SR 30A (US 98) 800' West of SR 79	29,000	30,000	30,000	30,500	27,500	31,000	29,500	30,000	31,500	34,000	1.78%	32,200	37,500	2.51%
46-0275	US 98	SR 30A (US 98) 450' West of Powell Adam Rd	36,000	37,000	37,000	34,500	31,500	38,000	38,500	40,000	39,000	45,500	2.64%	42,100	46,000	2.45%
TOTAL			180,250	190,750	193,750	174,600	175,050	199,150	195,850	198,200	214,150	224,850	2.49%	217,100	248,350	2.67%

Source: FDOT 2015 Traffic Count DVD, 2016

Module 6 Quiz: Design Hour Volumes

Improvement at Bearss Avenue / Nebraska Avenue
TBRPM AADT volumes



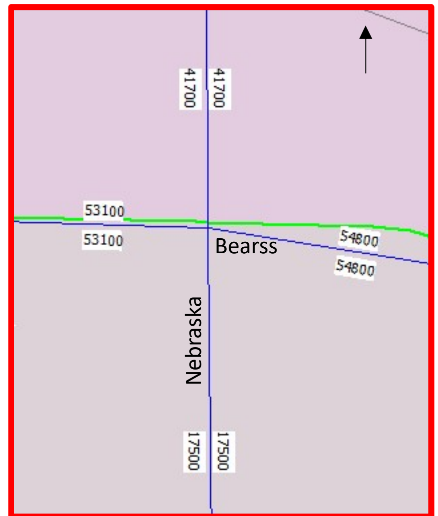
Module 6 Quiz: Volume Development

Improvement at Bearss Avenue/Nebraska Avenue
Given: K=0.09 and D=0.57

- What is the DHV along Bearss Avenue (west and east legs)?

- What is the DDHV along Bearss Avenue (west and east legs)?

  Assume peak direction is eastbound

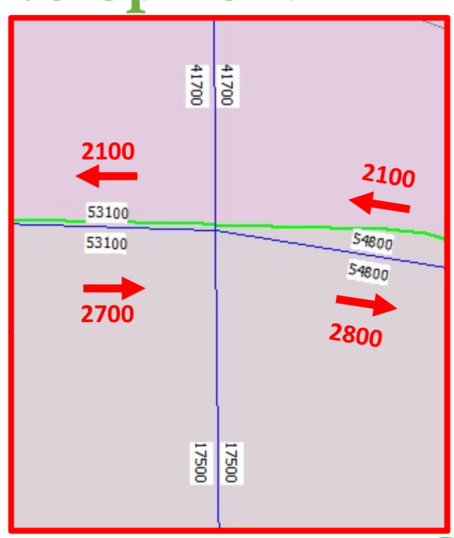


Module 6 Quiz: Volume Development

Improvement at Bearss Avenue / Nebraska Avenue
Given: K=0.09 and D=0.57

What is the DHV along Bearss Avenue (west and east legs)?
- West leg: 53100*0.09 = 4779 ~ 4800
- East leg: 54800*0.09 = 4932 ~ 4900

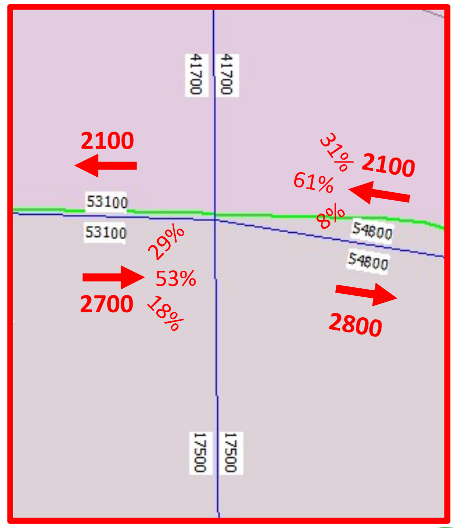
What is the DDHV along Bearss Avenue (west and east legs)?
- Assume peak direction is eastbound
- West leg:
  - 4800*0.57 = 2736 ~ 2700
  - 4800*0.43 = 2064 ~ 2100
- East leg:
  - 4900*0.57 = 2793 ~ 2800
  - 4930*0.43 = 2107 ~ 2100



Module 6 Scenario 1: Volume Development

Traffic counts at Bearss Avenue / Nebraska Avenue show the turning proportions on the figure

- What are the projected eastbound left, through, and right turn horizon year volumes along Bearss Avenue?

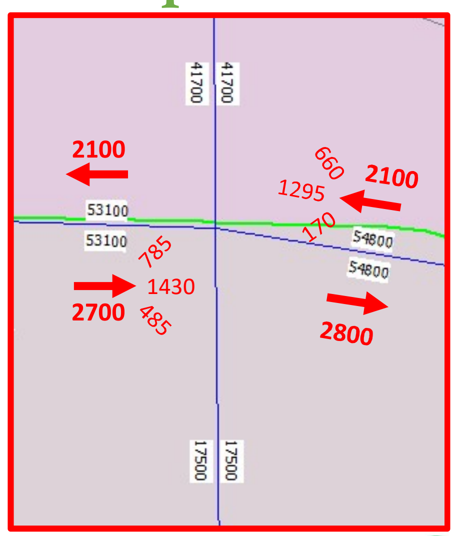


Module 6 Scenario 1: Volume Development

Projected eastbound left, through, and right turn horizon year volumes along Bearss Avenue based on [existing] traffic counts proportions

- Multiply percentage by hourly approach volume (rounded to nearest 5)

Left	Through	Right
29% * 2700	53% * 2700	18% * 2725
785	1430	485



K Factor

- It is the percentage of AADT occurring during the analysis hour.
- The K-factor is The Design Hour Factor
- Properties of K Factor
  - The *K*-factor decreases as the AADT on a highway increases;
  - The *K*-factor decreases as development density along a highway increases; and
  - The highest *K*-factors occur on recreational facilities, followed by rural, suburban, and urban facilities, in descending order (HCM 2016).
- The K-factors have been established statewide to represent typical conditions found around the state for area type and facility type during the weekday peak hour for areas with more than a population of 50,000.

FDOT 165 OEM Office of Environmental Management

Standard K Factors

- FDOT Standard K Factors replaced K_{30} factors

FDOT Standard K Factors

Area *(Population) [Examples]*	Facility Type	Standard K Factors* (%AADT)	Representative Time Period
Large Urbanized Areas with Core Freeways *(1,000,000+) [Jacksonville, Miami]*	Freeways	8.0 - 9.0 ***	Typical weekday peak period or hour
	Arterials & Highways	9.0**	Typical weekday peak hour
Other Urbanized Areas *(50,000+) [Tallahassee, Ft. Myers]*	Freeways	9.0 **	Typical weekday peak hour
	Arterials & Highways	9.0 **	Typical weekday peak hour
Transitioning to Urbanized Areas *(Uncertain) [Fringe Development Areas]*	Freeways	9.0	Typical weekday peak hour
	Arterials & Highways	9.0	Typical weekday peak hour
Urban *(5,000-50,000) [Lake City, Key West]*	Freeways	10.5	100th highest hour of the year
	Arterials & Highways	9.0 **	Typical weekday peak hour
Rural *(<5,000) [Chipley, Everglades]*	Freeways	10.5	100th highest hour of the year
	Arterials	9.5 **	100th highest hour of the year
	Highways	9.5	100th highest hour of the year

*	Some smoothing of values at area boundaries/edges would be desirable.
**	Value is 7.5% in approved Multimodal Transportation Districts where automobile movements are deemphasized. Essentially, this lower value represents an extensive multi-hour peak period rather than a peak hour.
***	Value is 8.0% for FDOT-designated urbanized core freeways and may be either be 8.5% or 9.0% for non-core freeways. Values less than 9% essentially represent a multi-hour peak period rather than a peak hour.

https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content/planning/systems/programs/sm/ptf/docs/ptf_handbook_2014.pdf?sfvrsn=a62d347d_0

FDOT 166 OEM Office of Environmental Management

Module 6 Wrap-up Points

- Project study area vs. forecasting area
- Verify that the entire "adopted" model has been validated prior to use
- Review base year land use data within the project area for accuracy and consistency with plans
- Compares volumes from the validated model to observed volumes on a link by link basis
- Refine and adjust network and socioeconomic data, and document changes
- Document assumptions used to develop (and calibrate) demand and design volumes

Module 7

Traffic Analysis and Alternatives Evaluation

Traffic Analysis and Alternatives Evaluation

Where Do We Start?

Traffic Analysis and Alternatives Evaluation

Where Do We Start?

A clear understanding of the purpose, needs and goals of the project is critical in determining the necessary level of traffic analysis.

An understanding of how both supply side (infrastructure/capacity) and demand-side (volumes) effects on the study area across all modes

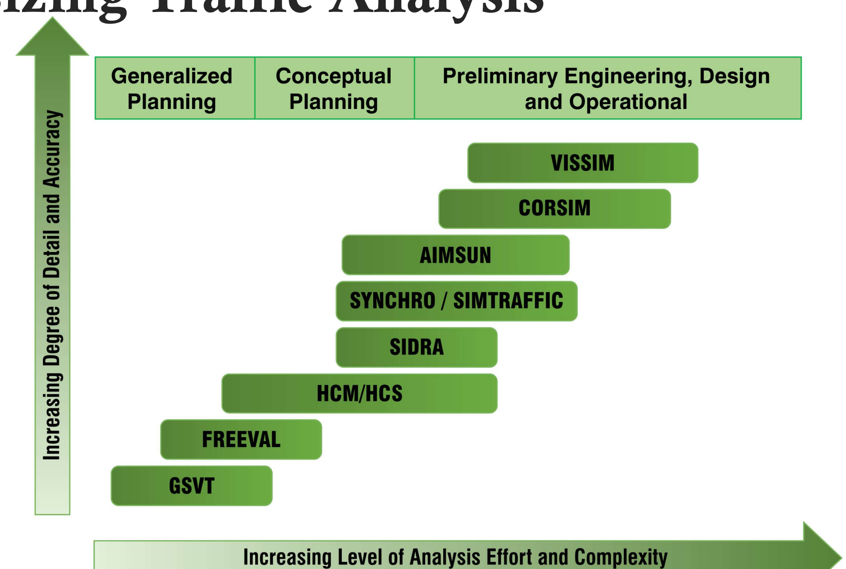
We analyze traffic to test the performance of alternatives. How does improvement alternatives compare with no-build alternatives

Traffic Analysis

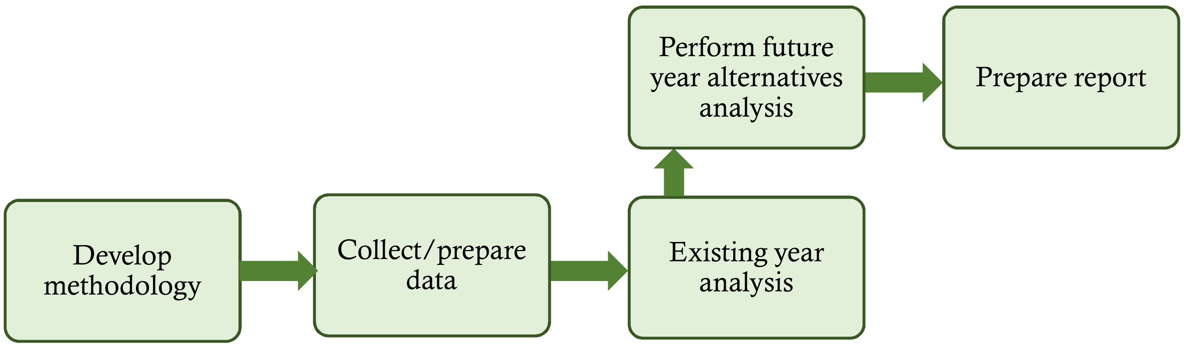
…Right-sizing the analysis

If the project goal is to provide a planning level assessment of the traffic operations…	If the project goal is to define project-specific design or operations requirements…
A higher-level analysis	A detailed analysis

Right-sizing Traffic Analysis



Traffic Analysis Steps



Special Considerations for the Analysis

- Significant queues occurring on a two-lane highway (violates assumption that the flow is uninterrupted).
- Backup from one intersection affecting the movement of traffic from another intersection.
- Overflow of a storage bay that inhibits the movement of through traffic.
- Short sections of a longer facility that have a different cross section than the main facility.
- Control features that are not covered by the HCM procedures (e.g., three-way stop at a four–legged intersection.
- Conditions that would suggest the use of traffic models that are more complex

Alternatives Evaluation Considerations

- Before analyzing build alternatives in detail
  - Develop alternatives that address the needs & analysis objectives
  - Screen out non-viable alternatives
- Analyze no-build alternative
- Include MOEs important in making a decision
- Present MOEs/results of analysis clearly

Alternatives development and evaluation process is typically an iterative process

PD&E Study's Alternatives Evaluation

How about this evaluation approach?

Existing Year Analysis

No Build

Interim Year Analyses

No Build

Alternative 1 → Alternative 1a

Alternative 2 → Alternative 2a

Alternative 3 → Alternative 3a

Alternative 4 → Alternative 4a

Design Year Analyses

No Build

Alternative 1a → Alternative 1b

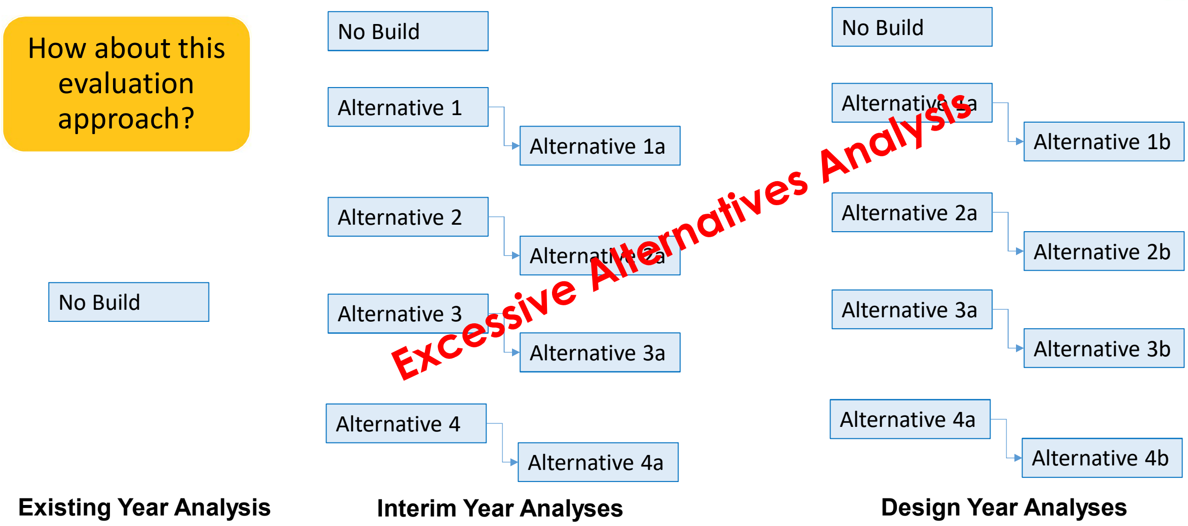
Alternative 2a → Alternative 2b

Alternative 3a → Alternative 3b

Alternative 4a → Alternative 4b

PD&E Study's Alternatives Evaluation

How about this evaluation approach?



PD&E Study's Alternatives Evaluation

How about this one?

PD&E Study's Alternatives Evaluation

How about this one?

Incomplete Alternatives Analysis

No Build

Alternative 1

Existing Year Analysis

Interim Year Analyses

Design Year Analyses

PD&E Study's Alternatives Evaluation

Develop alternatives/ concepts

1 2 3 4 5 6

Preliminary Alternatives/Concepts

(Simple projects do need this step)

A higher-level analysis
Use GSVT & HCM

Screening of Preliminary Alternatives
- Purpose and Need
- Environmental constraints
- Design feasibility and constructability
- Costs

2 5

1 – 3 Viable Alternatives & No-Build

Detailed evaluation of alternatives
- Traffic/Safety
- Design
- Environmental impacts
- Costs

A detailed analysis
Use HCM or Simulation tools

2

Preferred Alternative

PD&E Study's Alternatives Evaluation

No Build | No Build | No Build

Alternative 2a | Alternative 2a

Alternative 5 | Alternative 5

Existing Year Analysis **Opening Year Analyses** **Design Year Analyses**

PD&E Study's Alternatives Evaluation

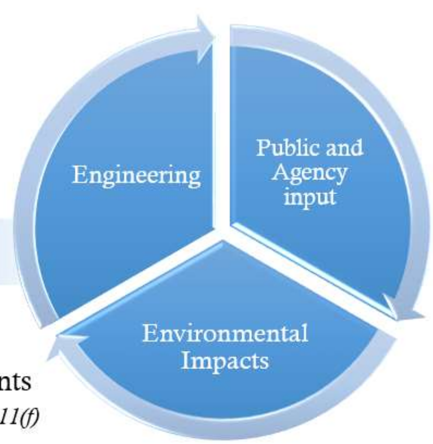
Purpose of Alternatives Evaluation

Balance of engineering design and impacts to environmental resources while considering public and agency input

Project Alternatives

- Connect logical termini
- Have independent utility or independent significance
- Not restrict consideration of alternatives for other improvements

23 CFR 771.111(f)



Alternatives Evaluation

Traffic is only one of the alternatives evaluation criteria, other criteria include:

- Cost
- Environmental impacts, including public
- Drainage
- Design and Constructability

An alternative performing better in terms of traffic operational or safety performance is not necessarily the Preferred Alternative

Detailed Traffic Analysis

Consider traffic characteristics, roadway conditions, and control conditions

Start by evaluating existing operation

Then modify existing traffic model to evaluate future conditions

Default input parameters can be changed to replicate observed conditions, or otherwise expected conditions.

Prepare the report summarizing assumptions and analysis results

Analytical Tools (HCM Based)

Peak Hour Factor	Free Flow Speed	Max Service Flows
• Use the field measured peak hour • Apply same PHF for all movements • If no measurements, 0.95 (freeways), 0.92 (others) • 1.0 for future year conditions	• Measured under low flow conditions • Estimated at 5 mph above posted speed	• Field measured values • Use Q/LOS handbook volumes • Need coordination or agreement on acceptable flow rates

Analytical Tools (HCM Based)

% Heavy Vehicles	Driver Population	Signal Parameters
• % HV in the peak hour is lower than in an avg. day • %HV on mainline come from forecast • Intersection counts have %HV	• Adjust capacity and speed due to driver unfamiliarity • 1.0 assumes commuter drivers • Lower factor should be justified by data	• Obtain from maintaining agencies • Field measure? • Use HCM quick estimation (planning analyses)

SIDRA

Geometric delay	Degree of Saturation	Environmental Factor
• Vehicles slowing down within roundabout • HCM doesn't consider this	• Max v/c ratio • 0.85 DOS is desired • Perform sensitive analysis if DOS is above 0.85	• Default is 1.2 • Lower values may be used is roundabouts are prevalent

- SIDRA analysis has two distinct modes: SIDRA Standard Mode or HCM Mode.
- Use HCM mode to be consistent with HCM 6 Methodology

Synchro

Nodes	Lane Utilization	Bends and Short links
• Number nodes in logical order	• Override default with field measurements • As demand approaches capacity, use LUF of 1	• Avoid excessive bends and short links • Use curved link as possible

Synchro

- Adjust lost time adjustment factors to field observed queues
- Extend all link terminals at least 1000 ft from last node
- Volume should be balanced between the nodes
- Check and correct coding errors before finalizing analysis
- Avoid custom signal phasing—>odd results and high delays

Synchro Reports with Footnotes (~, #, m)

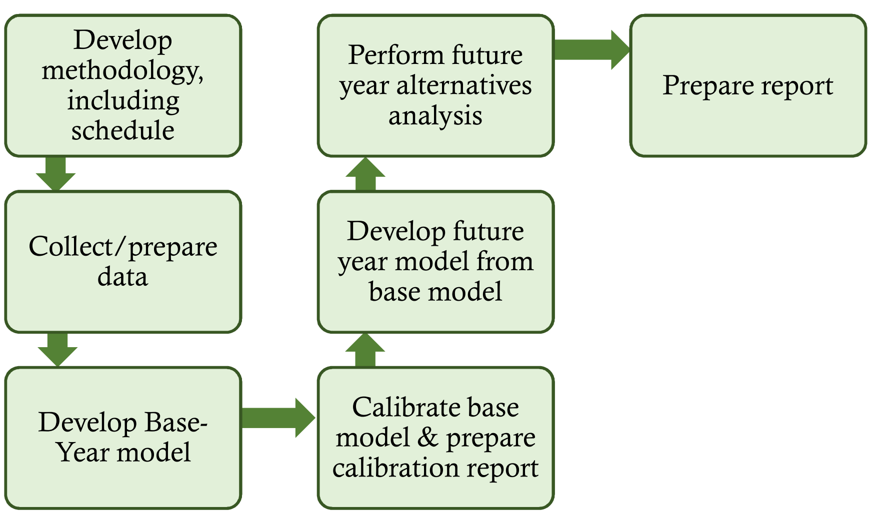
#	The volume for the 95th percentile cycle exceeds capacity
m	The volume for the 95th percentile queue is metered by an upstream signal
~	The approach is above capacity for the 50th percentile traffic and the queue length could be longer

Review Synchro printouts for movements with footnotes and document if it is determined that no adjustments will be made to Synchro

Before Micro simulating…

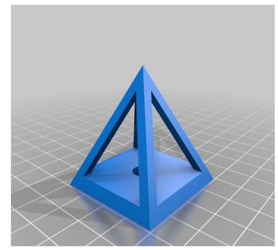
- Plan to collect data to build and calibrate (and validate) the model
- Secure sufficient expertise to develop and evaluate the model.
- Set a side sufficient time and resources to develop and calibrate the microsimulation model.
- Be ready to document the model development process, including assumptions and calibration results

Microsimulation Steps



Microsimulation Model Development

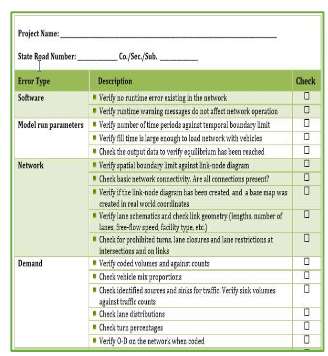
- Objective of this task is to develop a model that is verifiable, reproducible, and accurate.
- Default parameters are initial
  - Driver behavior, car following, lane changing characteristics
    - Start with default values
  - These parameters should be calibrated
    - Calibrate only few parameters
    - Document calibration
- Establish minimum number of model runs



Microsimulation Model Verification

Also known as error checking

- Perform various tests of the coded network and the demand data to identify input coding errors.
- Use a peer-reviewer to error-check the simulation model, use checklists



Project Name: ____________________

State Road Number: __________ Co./Sec./Sub. __________

Error Type	Description	Check
Software	Verify no runtime error existing in the network	☐
	Verify runtime warning messages do not affect network operation	☐
Model run parameters	Verify number of time periods against temporal boundary limit	☐
	Verify fill time is large enough to load network with vehicles	☐
	Check the output data to verify equilibrium has been reached	☐
Network	Verify spatial boundary limit against link-node diagram	☐
	Check basic network connectivity. Are all connections present?	☐
	Verify if the link-node diagram has been created, and a base map was created in real world coordinates	☐
	Verify lane schematics and check link geometry (lengths, number of lanes, free-flow speed, facility type, etc.)	☐
	Check for prohibited turns, lane closures and lane restrictions at intersections and on links	☐
Demand	Verify coded volumes and against counts	☐
	Check vehicle mix proportions	☐
	Check identified sources and sinks for traffic. Verify sink volumes against traffic counts	☐
	Check lane distributions	☐
	Check turn percentages	☐
	Verify O-D on the network when coded	☐

Presence of coding errors may significantly affect model calibration task

Microsimulation Calibration

Involves adjusting model parameters iteratively until simulated MOEs match field MOEs

- Default values are starting point and may not represent analysis area characteristics
- First step, examine the output visually
- Simulation and field measurement data collection points should match

Microsimulation Calibration Process

- Define calibration objective
- Select appropriate calibration parameters
- Establish a strategy to achieve the objective
- Determine the minimum number of simulation runs
- Perform calibration to obtain acceptable match at critical locations
- Visually inspect animations

Calibration Strategy

- Identify calibration targets
- Local parameters—capacity calibration
- Route choice parameters—reproduce current route patterns
- System performance parameters—fine tune model parameters to achieve systemwide MOEs

Microsimulation Calibration

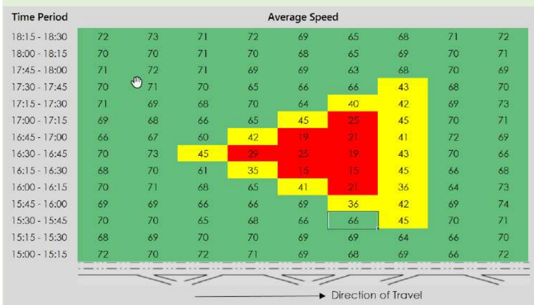
When is the model calibrated?

if the residual errors are within acceptable margins

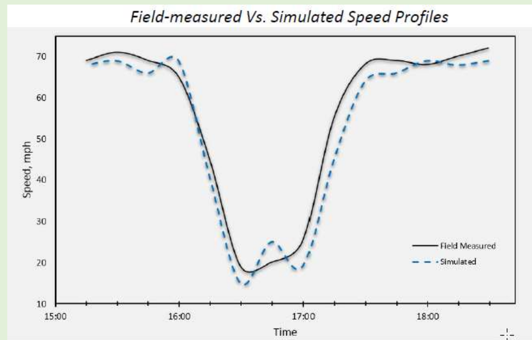
Table 7-7 Classical Model Calibration Targets

Calibration item	Calibration Target/Goal
Capacity	Simulated capacity to be within 10% of the field measurements.
Traffic Volume	Simulated and measured link volumes for more than 85% of links to be: ▪ Within 100 vph for volumes less than 700 vph ▪ Within 15% for volumes between 700 vph and 2700 vph ▪ Within 400 vph, for volumes greater than 2700 vph.
	Simulated and measured link volumes for more than 85% of links to have a GEH* statistic value of five (5) or lower.
	Sum of link volumes within calibration area to be within 5%.
	Sum of link volumes to have a GEH* statistic value of 5 or lower.
Travel Time (includes Transit)	Simulated travel time within ±1 minute for routes with observed travel times less than seven (7) minutes for all routes identified in the data collection plan.
	Simulated travel time within ±15% for routes with observed travel times greater than seven (7) minutes for all routes identified in the data collection plan.

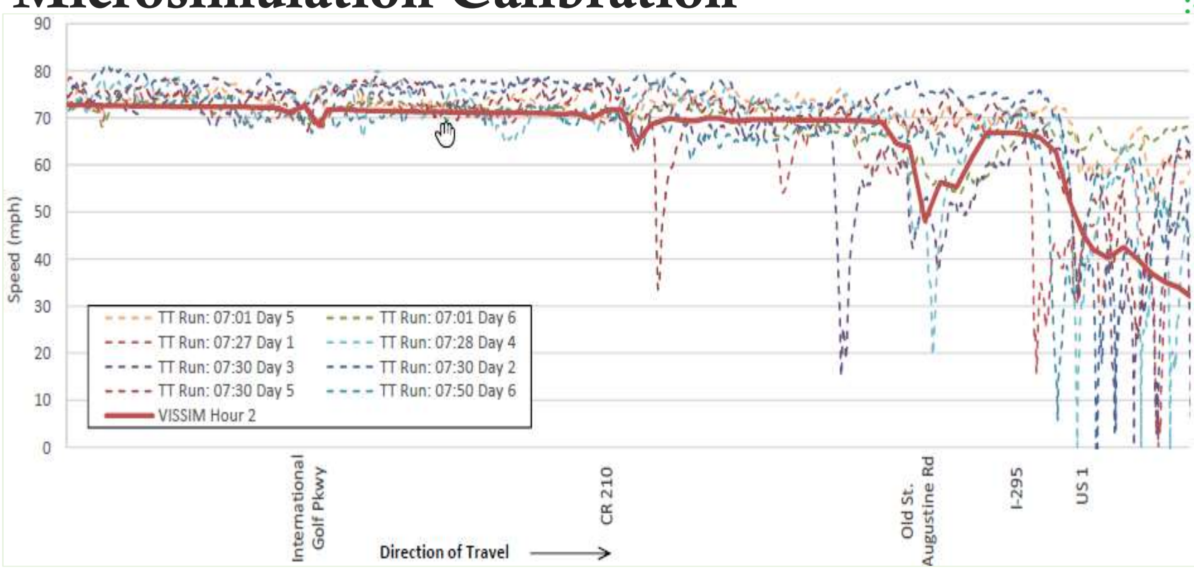
Microsimulation Calibration



Time Period	Average Speed								
18:15 - 18:30	72	73	71	72	69	65	68	71	72
18:00 - 18:15	70	70	71	70	68	65	69	70	71
17:45 - 18:00	71	72	71	69	69	63	68	70	69
17:30 - 17:45	70	71	70	65	66	66	43	68	70
17:15 - 17:30	71	69	68	70	64	40	42	69	73
17:00 - 17:15	69	68	66	65	45	25	45	70	71
16:45 - 17:00	66	67	60	42	19	21	41	72	69
16:30 - 16:45	70	73	45	29	25	19	43	70	66
16:15 - 16:30	68	70	61	35	15	15	45	66	68
16:00 - 16:15	70	71	68	65	41	21	36	64	73
15:45 - 16:00	69	69	66	66	69	36	42	69	74
15:30 - 15:45	70	70	65	68	66	66	45	70	71
15:15 - 15:30	68	69	70	70	69	69	64	66	70
15:00 - 15:15	72	70	72	71	69	68	69	66	72



Microsimulation Calibration



Microsimulation Validation

Validation is a test to confirm [using a different data set] that the model has been correctly calibrated and match existing conditions.

Is the calibrated model reliable?

Does not involve fine tuning of model parameters

Microsimulation Calibration

- WHAT if the base year model cannot be calibrated to reproduce the existing traffic conditions?

Microsimulation Calibration

- WHAT if the base year model cannot be calibrated to reproduce the existing traffic conditions?

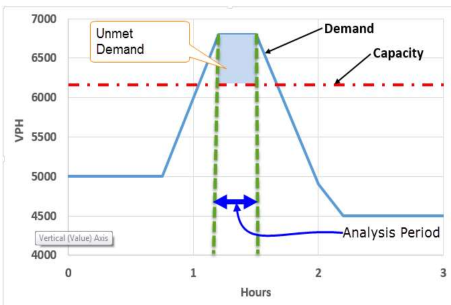
Then it has NO VALUE in predicting future conditions, the model would be useless.

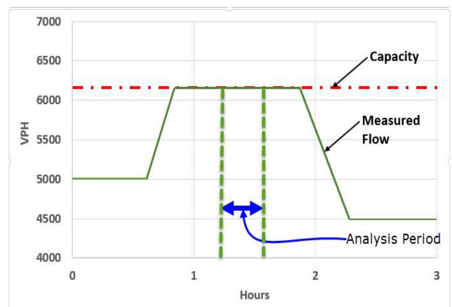
Microsimulation Considerations

- Bottlenecks will make comparisons more complicated
  - Check presence of bottlenecks
  - Upstream bottlenecks may prevent from reaching the desired flow rate
  - Downstream bottlenecks may create queue back
  - Check how the system is expected to work in reality since adjacent bottlenecks do exist
- Future year models are not calibrated, only checked for errors and reasonableness
- Build Alternatives should be evaluated using the same total volume entering the system
- Unmet demand?

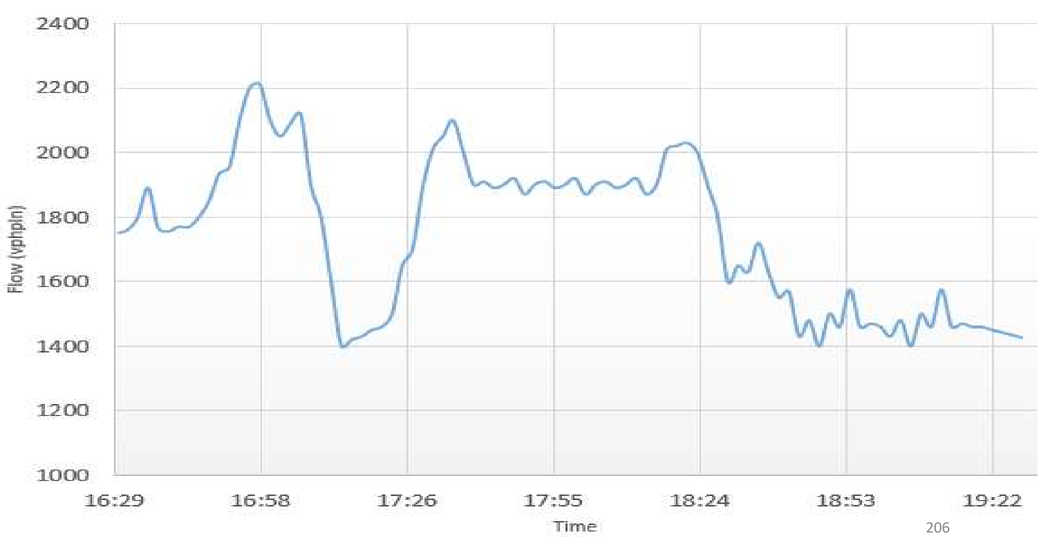
Unmet Demand in Microsimulation

- Demand that cannot be served during the analysis period may produce erroneous results
- Queue should build up in the middle time period and dissipated before the time expires





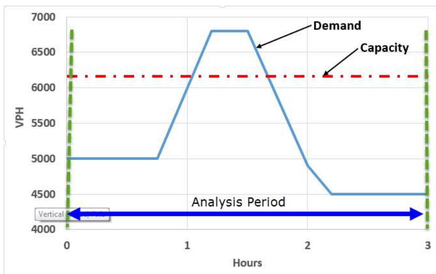
Capacity, Demand & Measured Flow Rate

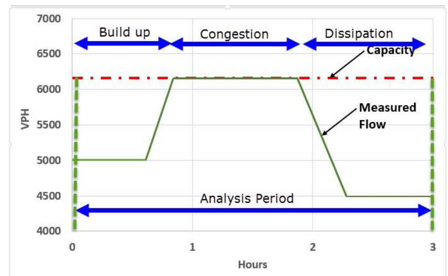


Unmet Demand in Microsimulation

Address unmet demand by:

- Extend the model time and spatial boundary (limitation of the software)
- Adjust the model results to account for the unreported congestion





Alternatives Analysis Quiz—True or False

Q1. Simulation models cannot be applied to a specific facility without calibration of those parameters to actual field conditions.

Q2. If the existing model is not properly calibrated, any flaws in the model will be magnified in future models.

Q3. Calibration is not necessary if it is expected that the microsimulation model will be accurate for existing conditions.

Alternatives Analysis Quiz

First Avenue, a four-lane divided highway is experiencing unpredictable delays at certain times of day. To address excessive and unpredictable delays and make trips more reliable along First Avenue, a highway agency commissioned a PD&E study to evaluate various capacity improvements(e.g., freeway interchange, intersection, signal timing coordination, and widening to six lanes) at known bottlenecks. A consultant hired by the highway agency performed detail evaluation of two build alternatives against a no-build alternative. Build Alternative 1 would widen First Avenue from four lanes to six lanes with bicycle lanes and pedestrian sidewalks. Build Alternative 2 would change configurations of intersections of First Avenue with B Street, D Street, both ramp terminals, M Street and N Street by adding new turn lanes at some intersections, and restricting left turn lanes by proposing superstreet segments at various locations.

Traffic analysis results showed that in the design year, Build Alternative 1 will reduce delay by 34%, while Build Alternative 2 will reduce delay by 21%, as compared to the no-build alternative.

Which alternative should the highway agency select (as a preferred alternative) to address the needs?

Module 8

Traffic Analysis Documentation

Documentation

Clear and concise writing

- Tell Story
- Keep it Brief
- Control Quality

Traffic Analysis Documentation

Documentation is required for changes of initial input parameters

Help reviewer understand the intent of the analyst

Supports decisions regarding project actions

- Document model development and calibration
- Document the results of the traffic analysis
- Summarize methodology, findings and conclusions

Clarification in Documentation

Example

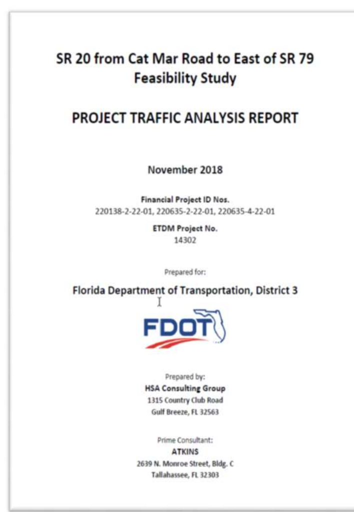
- Sometimes, analysis may consider reduced LOS operations for specific intersection movements during the design year to determine the most practical design and operation.

In this example, the report should describe the rationale for justifying and accepting the lower LOS for these intersection movements.

FDOT 213 OEM Office of Environmental Management

Project Traffic Analysis Report

- Documents the assumptions, methods, traffic forecasts, and traffic operational and safety analyses of alternatives
  - Review should consider reasonableness and completeness of results
- Supports decisions regarding project actions
  - Information should be presented in a way that can be readily understood by a variety of audiences
    - No difficulty with seeing text size on figures
    - No uncertainty of project issues, conclusions, or recommendations
    - No need to perform their own calculations to make sense of tables or figures
  - Discussion should avoid unnecessary information and highly detailed information should go in the appendices
- Traffic analyses conducted prior to the PD&E phase may be incorporated, which could reduce scope



SR 20 from Cat Mar Road to East of SR 79
Feasibility Study

PROJECT TRAFFIC ANALYSIS REPORT

November 2018

Financial Project ID Nos.
220138-2-22-01, 220635-2-22-01, 220635-4-22-01

ETDM Project No.
14302

Prepared for:
Florida Department of Transportation, District 3

FDOT

Prepared by:
HSA Consulting Group
1315 Country Club Road
Gulf Breeze, FL 32563

Prime Consultant:
ATKINS
2639 N. Monroe Street, Bldg. C
Tallahassee, FL 32303

FDOT Module 8: Traffic Analysis Documentation 214 OEM Office of Environmental Management

Project Traffic Analysis Assumptions

Traffic forecast for the project was developed using:	
☐ Travel Demand Model	☐ Growth Rates
Type of Travel Demand Model Used: ☐ Metropolitan Planning Model ☐ Other Model ____________________	*Refer to appropriate section of Project Traffic Analysis Report that discusses growth rates*
Is the travel demand model based on the latest adopted Long Range Transportation Plan?	
☐ YES	☐ NO
________ Date when MPO adopted the latest Long Range Transportation Plan	Explain why?
________ Base Year of Travel Demand Model	
________ Horizon Year of Travel Demand Model	
Long Range Transportation Plan documentation is available at (provide web address): ____________________	
Traffic Data and Factors	
Standard K = ____________ D Factor = ____________ T_{Daily} = ____________	Data Collection Year = ________ Opening Year = ____________ Interim Year = ____________ Design Year = ____________
Discuss any changes in land use, economics, population and employment data since the model was built	
Traffic Analysis Assumptions	
Discuss study area, data calibration/validation parameters, analysis tools, analysis periods and MOEs	

- Study Area
- Key input parameters
- Calibration and validation parameters
- Analysis method and/or tools
- Performance MOEs

Project Traffic Analysis Report Outline

- Cover - Part 2, Chapter 2 Figure 2-1
- Executive Summary
- Traffic Analysis Assumptions
- Introduction
- Traffic Analysis Method
- Existing Conditions Analysis
- Development of Future Year Traffic
- Alternatives Analysis
- Summary of Analysis Results
- Appendix (inputs and outputs)

USE STANDARD COVER

Florida Department of Transportation
District X
Project Title
Limits of Project
County, Florida
Financial Management Number: XXXXX-X
ETDM Number: XXXXXX

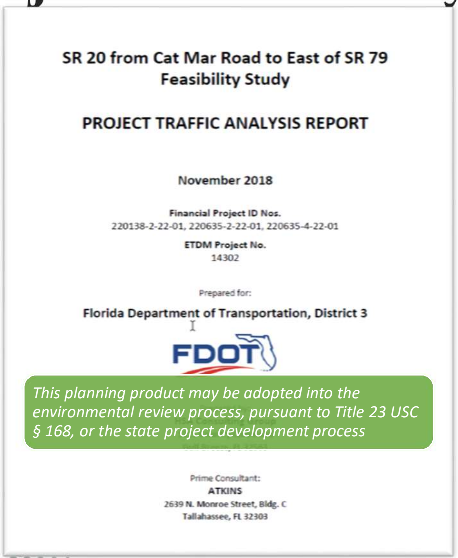
The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated December 14, 2016 and executed by FHWA and FDOT.

(Insert digital signature block)

JANE ANN SMITH
Date: 2013.10.09
16:40:48 - 4'00'

DO NOT SIGN AND SEAL DRAFT DOCUMENTS THAT ARE SENT OUT FOR REVIEW

Project Traffic Analysis Report Outline


SR 20 from Cat Mar Road to East of SR 79
Feasibility Study

PROJECT TRAFFIC ANALYSIS REPORT

November 2018

Financial Project ID Nos.
220138-2-22-01, 220635-2-22-01, 220635-4-22-01

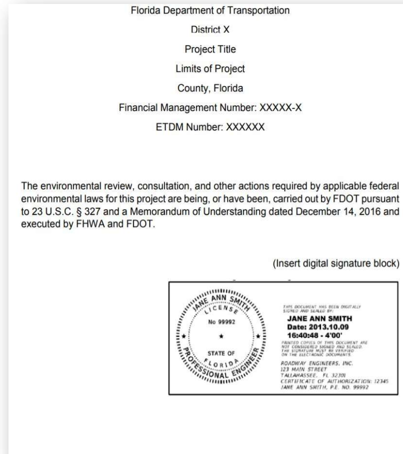
ETDM Project No.
14302

Prepared for:

Florida Department of Transportation, District 3

Prime Consultant:
ATKINS
2639 N. Monroe Street, Bldg. C
Tallahassee, FL 32303

This planning product may be adopted into the environmental review process, pursuant to Title 23 USC § 168, or the state project development process


Florida Department of Transportation
District X
Project Title
Limits of Project
County, Florida
Financial Management Number: XXXXX-X
ETDM Number: XXXXXX

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated December 14, 2016 and executed by FHWA and FDOT.

(Insert digital signature block)

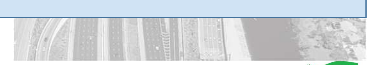
Interstate PD&E Studies

TWO FACTS

1. Interstate PD&E Studies have two approval decisions which require preparation of:
   i. Interchange access request (IAR) report (which is approved by FHWA) and
   ii. NEPA document (which is approved by FDOT under NEPA Assignment MOU)
2. Both documents (IAR and NEPA) require traffic analysis to support decision (approval).

QUESTION

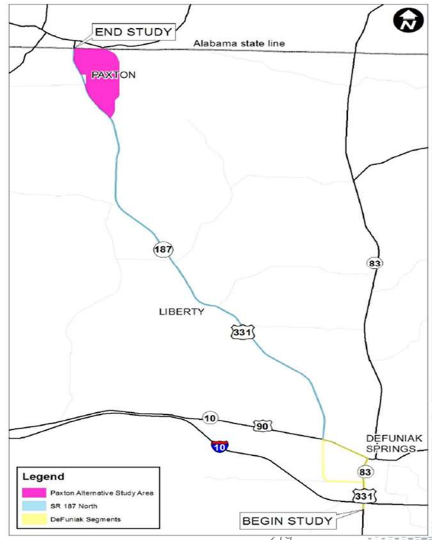
Does this mean we need two separate traffic analysis reports—for IAR and NEPA?



Interstate PD&E Studies

PD&E limits may be:

- The same as the IAR limits
- Larger than the IAR limits



Interstate PD&E Studies

PD&E limits may be:

- The same as the IAR limits
- Larger than the IAR limits

IAR document types

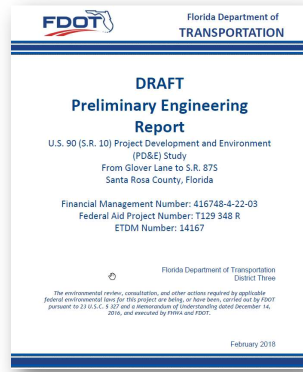
- Interchange Justification Report (IJR)
- Systems Interchange Modification Report (SIMR)
- Interchange Modification Report (IMR)
- Interchange Operational Analysis Report (IOAR)
- Non-IAR projects generally involve changes that favor the interstate or do not involve geometric changes

Project Traffic Analysis Report

- Not needed if PD&E is the same limits as the AOI for the IAR (IAR serves the purpose of PTAR)
- Needed in addition to IAR if PD&E limits exceed AOI

Preliminary Engineering Report (PER)

- Documents engineering analyses and decisions made during the PD&E study for:
  - Type 2 Categorical Exclusions (CEs)
  - Environmental Assessments (EAs)
  - Environmental Impact Statements (EISs)
  - State Environmental Impact Reports (SEIRs)
- References Traffic Analysis Report
- Summarizes alternatives analysis and findings from other PD&E report types
- Contains preliminary design plans and parameters that support advancing the project into the final Design phase


Florida Department of TRANSPORTATION

DRAFT
Preliminary Engineering Report
U.S. 90 (S.R. 10) Project Development and Environment (PD&E) Study
From Glover Lane to S.R. 87S
Santa Rosa County, Florida

Financial Management Number: 416748-4-22-03
Federal Aid Project Number: T129 348 R
ETDM Number: 14167

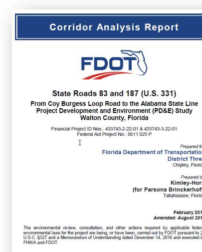
Florida Department of Transportation
District Three

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated December 14, 2016, and executed by FHWA and FDOT.

February 2018

PD&E Traffic Documentation

- Technical memorandums are interim reports at various stages of a project
  - Allows intermediate review of different stages before the final report is prepared
  - Helps prevent redoing subsequent steps by reaching concurrence on a stage early on
  - Need, and number depend on the type and complexity of the analysis
- Tech memos submitted before the traffic analysis report may include:
  - Existing Conditions Report
  - Calibration Report
  - Project Traffic Forecasting Memo
  - Alternatives Analysis Report
- The Traffic Analysis Report summarizes and reference of interim tech memos


Corridor Analysis Report

State Roads 83 and 187 (U.S. 331)
From Coy Burgess Loop Road to the Alabama State Line
Project Development and Environment (PD&E) Study
Walton County, Florida

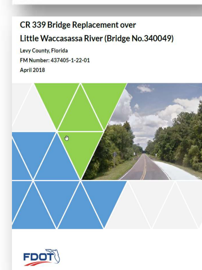
Financial Project ID Nos.: 433743-2-22-01 & 433743-3-22-01
Federal Aid Project No.: 0611 025 P

Prepared for:
Florida Department of Transportation
District Three
Chipley, Florida

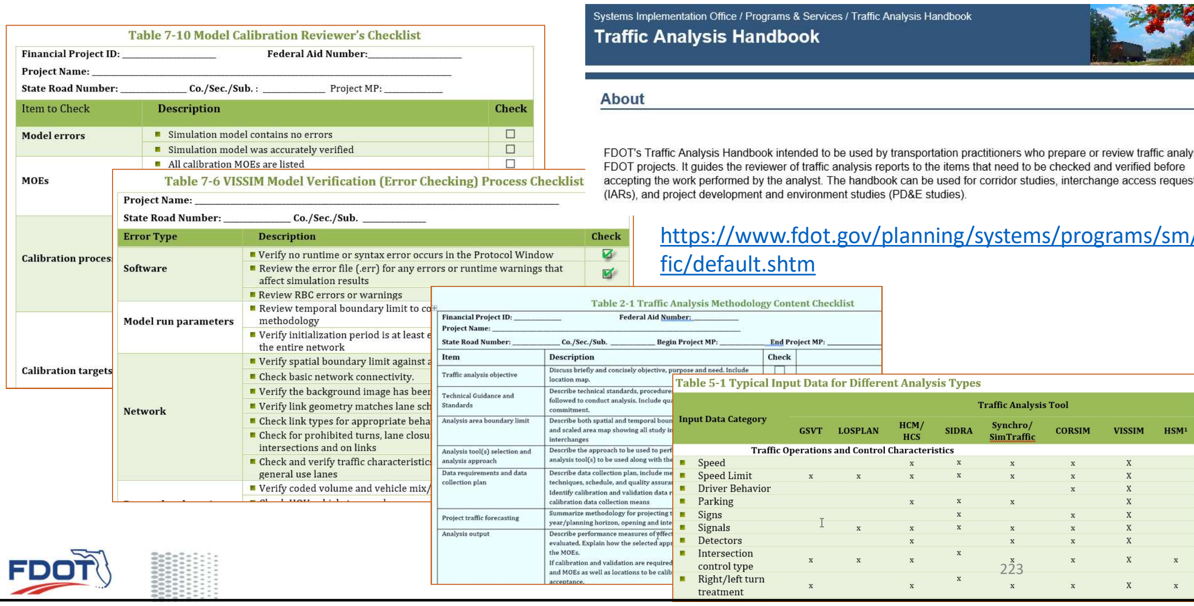
Prepared by:
Kimley-Horn
(for Parsons Brinckerhoff)
Tallahassee, Florida

February 2017
Amended: August 2017

The environmental review, consultation, and other actions required by applicable federal environmental laws for the project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. §327 and a Memorandum of Understanding dated December 14, 2016 and executed by FHWA and FDOT.


CR 339 Bridge Replacement over
Little Waccasassa River (Bridge No.340049)
Levy County, Florida
FM Number: 437405-1-22-01
April 2018

Quality Control Tools



Systems Implementation Office / Programs & Services / Traffic Analysis Handbook

Traffic Analysis Handbook

About

FDOT's Traffic Analysis Handbook intended to be used by transportation practitioners who prepare or review traffic analyses for FDOT projects. It guides the reviewer of traffic analysis reports to the items that need to be checked and verified before accepting the work performed by the analyst. The handbook can be used for corridor studies, interchange access requests (IARs), and project development and environment studies (PD&E studies).

https://www.fdot.gov/planning/systems/programs/sm/traffic/default.shtm

FDOT

OEM Office of Environmental Management

Quality Control Tools

TRAFFIC ANALYSIS			
Traffic analysis used the traffic methodology that was developed and agreed upon by the Department.			
Data for noise and air quality analyses have been obtained and transmitted to noise and air specialists.			
Planning phase traffic analysis results were incorporated by reference per the procedure outlined in Part 2, Chapter 2.			
Future demand traffic forecast for no-build and all feasible alternatives has been developed.			
Operational performance of viable or feasible alternative(s) for opening and design years and any interim years as appropriate has been analyzed per the agreed upon methodology.			
Future year operational analysis of each feasible alternative has been conducted and the results have been documented in the Project Traffic Analysis Report.			
Traffic Analysis Assumptions have been documented in the Project Traffic Analysis Report.			
Methods and assumptions used to develop the analysis, inputs, reasonableness of results, and completeness of the results have been reviewed.			
Preliminary System Engineering Management Plan been developed.			
SAFETY ANALYSIS			
Crash history was analyzed to assess high hazard locations, crash types, crash patterns, and contributing causes.			
Appropriate corrective actions or countermeasures were identified and incorporated in the alternatives.			
Safety analysis documented results of Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs) in accordance with agreed upon methodology.			

PD&E Study Quality Control Plan Template

Quality Control Plan template will assist consultants in preparation of Quality Control Plan for Project Development and Environment (PD&E) Studies. The template and associated checklists are based on the Department's project development procedure documented in the PD&E Manual. Links contain word files.

- Quality Control Plan Template
- Consultant Quality Control Certification
- Type 2 CE Checklist
- EA Checklist
- EIS Checklist
- SEIR Checklist
- PE Checklist

PE Checklist contains Traffic items

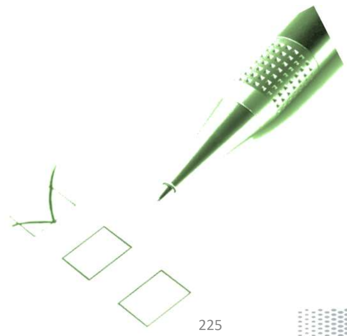
https://www.fdot.gov/environment/QC-Plan-Template.shtm

OEM Office of Environmental Management

Documentation Review Question

In the report, an engineer stated that when demand exceeds road capacity, throughput would remain at maximum and would not decrease until the demand for capacity decreases. Is this claim valid?

- ❑ Yes
- ❑ No
- ❑ I don't know, give me more info



Things we have not covered…