Abstract

Volume 1 covers the basic information needed to obtain and interpret the results of a traffic forecast.
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### Volume 1: Traffic Forecasting Background

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Glossary of Terms

8th Highest Hour: The 8th highest hour of the day factor, expressed as a percentage. Used for traffic signal warrants.

Annual Average Daily Traffic (AADT): The average number of vehicles that travel through a segment of roadway in one day, calculated over a duration of one year.

Average Daily Traffic (ADT): The average number of vehicles that travel through a segment of roadway in one day, calculated over a duration of at least 24 hours but less than one year.

B & C Commercial Vehicles (B&C): “Trucks”; all other vehicles that are not P&A, including single unit trucks, tractor with semi-trailers, trucks with trailers, recreational vehicles, and school and commercial buses. FHWA “Scheme F” Classes 4-13.

Daily Truck Factor (T24): The percentage of AADT that is comprised of heavy and commercial trucks (B&C commercial vehicles).

Design Hour: The selected hour that traffic forecasts, and subsequently design calculations, are based on.

Design Hour Truck Percentage (TD): The percentage of the design hour volume that is comprised of heavy and commercial vehicles (B&C commercial vehicles).

Design Hour Volume (DHV): The number of vehicles that travel along a segment of roadway during the design hour.

Directional Design Hour Volume (DDHV): The amount of traffic moving in the peak direction during the design hour.

Directional Factor (D): The proportion of traffic moving in the peak direction during the design hour; the ratio of DDHV to DHV.

Design Traffic: A finalized traffic forecast that is based on preliminary forecast estimates and growth trends, and has been subjected to rigorous adjustments and checking.

Design Year: The selected year in the future for which traffic forecasts, and subsequently design calculations, are based on. Typically 20 years beyond the Opening Year.

Equivalent Single Axle Load (ESAL): Truck traffic loading expressed as the number of equivalent 18,000 lb (80 kN) single axle loads.

High Risk Projects: More complex transportation projects that change the highway network, are located in oversaturated areas, or otherwise experience shifts in traffic patterns that do not follow historic trends.

High Risk (Certified) Design Traffic: Design traffic certified for use in roadway design. Prepared for High Risk Projects and requires extensive coordination, data collection, TDF modeling, and post-processing efforts. Must be either prepared or reviewed by the ODOT Division of Planning, Office of Statewide Planning & Research, Modeling & Forecasting section.

K-Factor (K): The proportion of traffic occurring during the design hour; the ratio of DHV to AADT.
**Low Risk Projects**: Simple transportation projects that do not change the highway network, are not located in oversaturated areas, and have relatively stable and predictable traffic volume trends.

**Low Risk Design Traffic**: Design traffic that is prepared for Low Risk Projects through simpler methods such as use of SHIFT or applying a growth rate to existing traffic volumes to estimate future traffic.

**Model of Record (MOR)**: Model that is used as the basis for the latest long-range plan/transportation improvement program analysis. The default set of raw model output that is referenced when project level modeling is unavailable.

**Model Results/Output**: Data generated from a travel demand forecasting model, such as traffic assignments, that can be used in the traffic forecasting process.

**Opening Year**: The selected year in the future that the project and any associated development is anticipated to be completed.

**Passenger & A Commercial Vehicles (P&A)**: “Cars”; includes motorcycles, passenger cars, panel (4-tire) and pick-up trucks. FHWA “Scheme F” Classes 1-3.

**Simplified Highway Forecasting Tool (SHIFT)**: A front-end software application for reporting simplified traffic forecasts for highway design purposes; used to prepare Low Risk Design Traffic for projects on State highways or to check other forecasts.

**Traffic Forecast**: An estimation of traffic volumes for any future year.

**Traffic Impact Study (TIS)**: A study performed to assess the impact of a future development on traffic operations of the supporting road network.

**Transportation Improvement Plan (TIP)**: A short-term capital improvement plan developed by local and state transportation agencies.

**Travel Demand Forecasting (TDF) Model**: A computer-based model used to estimate travel patterns at a future time using road network, land-use, and socioeconomic data.
Chapter 1. Introduction

The Ohio Traffic Forecasting Manual is intended to support and document the process managed by the Ohio Department of Transportation’s Office of Statewide Planning & Research, Modeling & Forecasting Section (ODOT M&F). The Manual documents the policies and procedures for Ohio traffic forecasts and serves as guidelines for other entities producing traffic forecasts.

Traffic forecasting dates back to the 1930s when the United States Bureau of Public Roads (later the Federal Highway Administration or FHWA) first started the federal financing of highway projects. From the very beginning, traffic counts were collected and growth rates were applied to produce a travel demand forecast used for planning and design purposes. Over 70 years later, the fundamental process is very similar although it has grown significantly more complex.

Throughout this document the following symbols are used to indicate:

- Items that are required or suggested for documentation
- Times that are required or suggested for coordination with ODOT M&F

1.1 Manual Structure

The purpose of this manual is to provide information and guidance on preparing traffic forecasts. The intended audience includes project managers, the end users of the traffic forecasts (traffic analysts and designers), developers of forecasts and travel demand forecasting modelers. The manual contents are developed based on both ODOT M&F’s policies and on other industry-wide methodologies and practices. The manual has been divided into three volumes:

1. Traffic Forecasting Background
2. Traffic Forecasting Methodologies
3. Travel Demand Forecast Modeling
Volume 1: Traffic Forecasting Background

Volume 1 summarizes the entire process for the forecast user, covering the basic information needed to obtain and interpret the results of a traffic forecast. Forecast users apply the forecast volumes for analysis, design, or decision-making, but do not develop the forecasts. This volume begins with background information on traffic forecasting, including an overview of the components of a traffic forecast and guidelines for understanding forecast results. ODOT M&F policies and procedures are then covered, allowing the reader to understand how state transportation projects are classified and the type of forecast that is required. Lastly, the reader is provided with the administrative process to obtain Certified Design Traffic. This volume does not provide the technical detail required to develop a traffic forecast.

Volume 2: Traffic Forecasting Methodologies

Volume 2 is intended for the traffic forecaster. This volume provides the procedures and technical detail required to develop a traffic forecast following ODOT M&F’s Design Traffic methodologies. Examples are provided on the derivation of forecast parameters, intersection balancing techniques, trend line analysis, and NCHRP 255/765 model adjustments.

Volume 3: Travel Demand Forecasting Models

The final volume of the manual is written for the modeler and details the checks and adjustments made to Travel Demand Forecasting (TDF) models to produce various types of preliminary forecasts. This volume assumes that the reader already has knowledge of TDF models and explains the ODOT specific procedures used to prepare traffic forecasts for state roadway construction projects.

1.2 Purpose of Traffic Forecasting

The purpose of traffic forecasting is to produce future estimates of annual average daily traffic (AADT), design hour volumes (DHV), and truck percentages (TD and T24) for use in planning and design.

Some examples of ways that traffic forecasts may be used by design engineers include:

- Determining the number of lanes needed for a project;
- Determining the need for, the length of, and the number of turning lanes; and
- Providing pavement design inputs.

Planners use traffic forecasts primarily to determine the purpose and need for a project or to determine the proper location of alternatives. In both cases, traffic forecasts are critical to making an informed decision.
1.3 Design Traffic and Certified Design Traffic

Traffic forecast is a general term that refers to an estimation of traffic volumes for any future year, regardless of the method used to develop the forecasts. Design Traffic is a finalized traffic forecast that is based on preliminary forecast estimates and growth trends, and has been subjected to rigorous adjustments and checking. Forecasts developed following the procedures set forth in Volume 2 of this manual are suitable for use as Design Traffic.

Section 102 of the Location and Design Manual (revised Jan. 2017) states, “All forecasted traffic data used shall be developed following state traffic forecasting guidelines provided by Division of Planning, Office of Statewide Planning & Research, Modeling & Forecasting section.” As defined in Section 550 of the Location and Design Manual, “certified” design traffic is an Ohio-specific term that is short-hand for “design traffic certified for use in roadway design”. It is a subset of design traffic that has been explicitly certified (either directly prepared or approved) by ODOT M&F. Design traffic is also referenced in the following ODOT documents:

- Traffic Engineering Manual (July 15, 2016) - Section 402-2 - Traffic Volumes

Projects that are subject to certification include those that are administered by ODOT, are on the State System, and/or have federal funding. More detailed information on what types of projects require Certified Design Traffic is available in Chapter 4. Certified Design Traffic forecasts must adhere to the parameters and procedures set forth in this manual and must be submitted to ODOT M&F for review and approval. The relationship between a traffic forecast, Design Traffic, and Certified Design Traffic is illustrated in Exhibit 1-1.

Traffic Forecast
Any estimate of future traffic volumes.

Design Traffic
A finalized traffic forecast that has been subjected to rigorous checks and adjustments. Suitable for use in roadway design.

Certified Design Traffic
Design Traffic that has been explicitly certified (either directly prepared or approved) by ODOT M&F.
1.4 Resources

1.4.1 References

- ODOT Location and Design Manual, Volume 1, Roadway Design
- ODOT Access Management Manual
- Studies: IJS/IMS/IOS
- Project Development Process Manual
- Pavement Design Manual
- National Cooperative Highway Research Program (NCHRP) Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design
- National Cooperative Highway Research Program (NCHRP) Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design
- Institute of Transportation Engineers (ITE) Trip Generation Manual

1.4.2 Contacts

State design traffic forecasts are coordinated through or completed by the District. ODOT M&F maintains a list of Design Traffic District Contacts for projects where a district contact is not otherwise involved, particularly in the case of Traffic Impact Studies (TIS). If there is a District Project Manager or other district contact, the request should be forwarded through that individual unless directed otherwise by the district.

1.4.3 Training

Training opportunities are available through online courses and in-person workshops held periodically.
Chapter 2. Fundamentals

2.1 Traffic Forecasting Toolbox

Developing traffic forecasts requires the use of a wide range of information. The major factors that influence preparing a traffic forecast are traffic counts, existing and future land use patterns, road network capacities and connectivity, and population and employment estimates.

A new traffic pattern is developed from this data and is used to estimate traffic volumes at a point in the future. The primary tools used to identify growth patterns and estimate future traffic volumes are defined in NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design. An overview of these tools is provided in the sections below.

2.1.1 Trend Line Analysis

Trend line analysis, most commonly with linear regression, is used to estimate future traffic volumes and truck percentages when a TDF model is not available and changes to land use and road network are minimal. An average annual growth rate is calculated from historical data and is applied to existing traffic volumes.

2.1.2 Travel Demand Forecast Models

TDF models are used to estimate future traffic volumes when the interaction between land use, road network, and socioeconomic factors is complex. Model traffic assignments are adjusted in relation to existing count data to estimate future traffic patterns.

2.1.3 Trip Generation

Manual adjustments for trip generation may be necessary whether or not a TDF model is used for the forecast. New developments or minor changes in land use can be estimated using the procedures outlined within the ITE Trip Generation Manual. A typical application is for the preparation of traffic impact studies.
2.1.4 Other Adjustments

Minor changes to the highway network that do not significantly affect the overall traffic patterns are typically not reflected in TDF modeling; in these cases, traffic volumes can be logically reassigned to reflect new patterns. An example of this would be restricting or relocating relatively minor movements, extending turn lanes, or minor intersection realignments.

2.2 Types of Forecasts

TDF model results may be used for projects of varying complexity, but the level of refinement and adjustment to the model input varies. The user should be aware of which level of modeling effort is warranted for the project in question as this will significantly impact the project timeline. Projects that are large enough to require specific model work usually proceed through a more complex traffic forecasting process that involves the production of preliminary forecasts based upon more limited information and less manual refinement of the results. The users of traffic forecasts need to understand that raw TDF model output are not final design traffic and should not be used for analysis.

Traffic forecasts can generally be placed into one of the following four levels: 1) Raw Model Output; 2) Planning Level Traffic; 3) Refined Alternative Level Traffic; and 4) Design Traffic. The level of refinement is non-existent at the first level and increases with each increase in level. Exhibit 2-1 illustrates the relationship between the forecast types based on the level of effort and expected accuracy.

Exhibit 2-1. Forecast Type by Level of Effort and Accuracy
- **Raw Model Output** is defined as model results that have not been subjected to any of the checking/adjusting/refining procedures as documented in Volume 3. Growth rates are often calculated by comparing the base year and forecast year raw model volumes for use in less complex projects. Raw model outputs are also sometimes used for making system-wide or gross corridor level decisions. Unless otherwise directed by ODOT M&F, raw model results should not be used for reporting actual location specific volumes.

- **Planning Level Traffic** includes traffic forecasts that have been subjected to various checks and adjustments as documented in Volume 3. However, planning level traffic has not necessarily been refined to produce reasonable values at all locations within a study area. Planning level traffic is designed to answer questions on the order of magnitude of the addition of a general purpose travel lane in a certain location. It is generally only available as daily roadway segment volumes, and not at the sub-daily (such as hourly) or turning movement level. If more detailed decisions such as location and length of turn lanes, auxiliary lanes, traffic control devices, etc. are being made, then refined alternative level or design traffic is required.

- **Refined Alternative Level Traffic** uses matrix estimation or other techniques to refine travel demand results for traffic operations simulation. This level of refinement results in forecasts that are suitable for use in operational level models such as Synchro or TransModeler. The unique methods used to generate it allow it to be delivered as both turning movement volumes as well as point to point origins/destinations. The process to obtain refined alternative level traffic is labor intensive, and it is generally only produced for certain large, major projects that involve highly complex traffic operations such as occurs with major changes in the central business district of an urban area or major changes to freeway interchange configurations.

- **Design Traffic** consists of the final traffic forecasts and related information (including turn volumes, direction factors, truck fractions, and 30th highest hour factors) needed to inform the final detailed design of a project.

### 2.3 Design Forecast Parameters

Design traffic can provide estimates for a number of parameters based upon the requirements of the project. It is therefore important that the requestor be familiar with the parameters that can be requested.

More detailed information on the derivation of these parameters is contained in Volume 2.

- **Annual Average Daily Traffic (AADT):** The AADT is the number of vehicles that travel through a segment of roadway in one day, averaged over a duration of one year. Daily traffic is the most basic unit of traffic monitoring and is essential for developing traffic forecasts.

- **Average Daily Traffic (ADT):** The ADT is the number of vehicles that travel through a segment of roadway in one day, averaged over a duration of at least 24 hours but less than one year. Daily traffic is the most basic unit of traffic monitoring and is essential for developing traffic forecasts. The ADT can be seasonally adjusted, including day of week and/or month of year, to estimate AADT.
- **K-factor (K):** The K-factor represents the proportion of traffic occurring during the design hour (usually the 30th highest hour of the year, as defined by AASHTO’s Policy on Geometric Design of Highways and Streets).
- **Directional factor (D):** The D-factor represents the proportion of traffic moving in the peak direction during the design hour. The design hourly distribution of traffic on most roads is not evenly split during the design hour. Highway design is based on the proportion of traffic in the peak direction during the design hour, i.e., the D-factor.
- **Design Hourly Volume (DHV):** The DHV is the number of vehicles that travel along a segment of roadway during the design hour. The DHV is the volume unit which is used for making roadway, structural, and capacity design decisions. The DHV is related to ADT by the following equation:
  \[ DHV = K \times AADT \]

- **Directional Design Hour Volume (DDHV):** The DDHV is the amount of traffic moving in the peak direction during the design hour. As mentioned above, the critical design volume has a directional component. The DDHV is related to DHV and ADT by the following equation:
  \[ DDHV = D \times K \times AADT = D \times DHV \]

- **Daily Truck Percentage (T24):** T24 represents the percentage of AADT that is comprised of heavy and commercial trucks (B&C commercial classes), and is another important factor in highway design and transportation planning. Since trucks take up more physical space and are heavier vehicles than passenger cars, the most common purpose of T24 is in the design of pavement thickness in highway design projects.
- **Design Hour Truck Percentage (TD):** The design hour truck percentage or TD represents the percentage of the DHV that is comprised of heavy and commercial vehicles (B&C commercial classes).
- **8th Highest Hour:** The 8th highest hour of the day factor, expressed as a percentage, is used for traffic signal warrants. This factor is calculated as the ratio of the 8th highest hourly traffic volume to the total traffic volume counted over a 24 hour duration. As such, a 24 hour count is needed to calculate the factor, although it can be estimated from the Hourly Percent by Vehicle Type Report for low risk projects. The percentage can be multiplied by any design traffic AADT as needed for analysis. If an analysis year other than the provided Opening or Design Year is needed, linear interpolation between volumes is acceptable. For proposed development traffic, a factor should be estimated by either counting traffic volumes at a driveway that serves similar land uses, or by using data for the Local Road classification in the Hourly Percent by Vehicle Type Report (low risk projects only).
2.4 Understanding Forecasts

2.4.1 Presentation of Forecast Parameters

Forecast parameters will be presented in one of two formats: (1) traffic volume plates, or (2) summary tables. Plates are diagrams or drawings (not to scale) that graphically show the requested traffic forecast parameters by location. Forecast volumes will usually be displayed on plates in the form of link volumes and intersection turning movement volumes as applicable. Plates can include a combination of volume sets (e.g. AM and PM, or Opening Year and Design Year). If TD and T24 are requested at the turning movement level, these values may be displayed on plates as well. A sample Certified Design Traffic plate is shown in Exhibit 2-2.

2.4.2 Growth Rate Limitations

Generally, no negative growth rates are used in the preparation of ODOT design traffic forecasts. The volume of traffic on individual links may decrease if traffic diversion is expected with the project build alternative. However, the aggregate volume of traffic entering the study area as predicted by the traffic forecast should not be less than existing. This policy has been put in place to ensure that traffic operations do not fail at the project opening. Oftentimes operational analysis and overall roadway design decisions are based on Design Year traffic forecasts only (typically Opening Year plus 20 years). ODOT M+F does not have a set policy on maximum growth rates for traffic forecasts. However, linear annual growth rates of 3% or more (beyond the impact of traffic diversion expected from the project itself) should be given further consideration in the forecasting process. A thorough review of the process that yielded this outcome should be conducted. If necessary, additional data collection and coordination may be done to verify high growth rates. Forecasts exceeding this threshold will be flagged as discussed below.
2.4.3 Rounding Rules

Design traffic forecasts, or otherwise estimated traffic volumes, should be rounded to at least the nearest 10 to communicate the level of precision in traffic forecasts. It is recommended that AADT and design hour link volumes be rounded to the nearest 10, while AADT and design hour turning movement forecasts be rounded to the nearest 10 and are a minimum of 30 for AADT and 10 for design hour.

2.4.4 Uncertainty

A traffic forecast is an estimate of future travel patterns and is based on many assumptions; uncertainty is therefore inherent in all traffic forecasts. Less uncertainty is expected when there is ample information available. Ample information includes existing and historic traffic count data, as well as existing and future land use and roadway plans surrounding the roadway(s) under study/consideration.

Forecasts that are prepared with limited data will have a higher uncertainty rate. In such cases, a qualifying statement indicating uncertainty will be placed on the traffic plates. ODOT M&F has created standardized notes relating to the two main sources of forecast uncertainty: uncertainty due to lack of long term count data and uncertainty in future development. The applicable note(s) should be placed on design traffic plates to indicate a higher degree of uncertainty to the forecast user. Table 2-1 contains simplified and detailed text for each standardized uncertainty note.

<table>
<thead>
<tr>
<th>Uncertainty Type</th>
<th>Note Type</th>
<th>Note Text</th>
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<tr>
<td>Lack of Long Term Count Data</td>
<td>Simplified</td>
<td>Design traffic conducted without the benefit of long term counts, numbers should be considered within ±15%.</td>
</tr>
<tr>
<td></td>
<td>Detailed</td>
<td>Design must use design traffic values. However, if 85% of design traffic (or current volume, whichever is greater) eliminates the need for costly design options, design team may ask District design traffic coordinator to request additional counts and re-evaluation of forecasts (must provide locations and reasons for the request). A meeting between the stakeholders (design team, OSPR, District) will be required to determine if additional count data might mitigate the problem and whether the project time line can accommodate the time required to collect the data.</td>
</tr>
<tr>
<td>Uncertain Future Development*</td>
<td>Simplified</td>
<td>Design traffic in high growth area, includes growth exceeding 3% per year on indicated links.</td>
</tr>
<tr>
<td></td>
<td>Detailed</td>
<td>Design must use design traffic values. However, if opening year traffic at an indicated location (including peak hour or turn movement volumes associated with the same link) eliminates the need for costly design options, design team may ask District design traffic coordinator to request additional coordination on development assumptions and re-evaluation of forecasts (must provide locations and reasons for the request). A meeting between the stakeholders (design team, OSPR, MPO, District) will be required to evaluate development assumptions.</td>
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*Place on AADT Plates Only
When these notes are present on design traffic plates, the designer should consider a range of volumes as described in Table 2-1 to ensure that the project is not being over- or under-designed. If the range of forecast volumes results in a costly design change, such as a four-lane road becoming a six-lane road, additional data collection or coordination may be needed to reduce uncertainties in the forecast.

Even with sufficient information, forecasts should not be treated as a precise value because there are other uncertainties that may not be captured. For example, unpredictable parameters in travel behaviors, vehicle occupancies, and the economics of nearby cities and states will have a considerable influence on traffic forecasts. Thus, forecast volumes and their impacts to design projects should not be indiscriminately accepted, even if the forecast have been certified by ODOT M&F. Designers should be cognizant of this uncertainty when interpreting and applying forecast volumes and should recognize when the forecast volumes are very close to design parameter boundaries that would result in a significant project cost differential.
Chapter 3. Traffic Monitoring Data

High quality, current traffic monitoring data is required to prepare accurate traffic forecasting parameters. ODOT M&F has compiled **Guidelines for Traffic Counts Used for Forecasts Certified for Roadway Design** for facilitating the preparation of traffic forecasts for roadway construction planning and design. These guidelines are intended to reduce delays in preparing accurate traffic forecasts caused by poor data. An example of these guidelines is found in the Appendix; the most recent version is maintained on the ODOT M&F’s **Certified Traffic Webpage**.

Traffic monitoring data collection guidelines are summarized by count type in **Table 3-1**.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Continuous</th>
<th>Short-Term</th>
<th>Intersection Turning Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location(s)</td>
<td>Permanently installed or temporarily placed upon request; provide the annual traffic data at their location</td>
<td>Obtained using portable machine counters; typically installed for a continuous 24 to 48 hour period</td>
<td>Collected at intersections to determine turning movements; typically conducted on a single day surrounding the peak commute periods</td>
</tr>
<tr>
<td>Source(s)</td>
<td>ODOT TMMS/MS2 (if available)</td>
<td>ODOT TMMS/MS2, MPO, Project count program</td>
<td>ODOT TMMS/MS2, MPO, Project count program</td>
</tr>
<tr>
<td>Features</td>
<td>N/A</td>
<td>Hourly intervals, directional, classified</td>
<td>15-min intervals, classified</td>
</tr>
<tr>
<td>Duration</td>
<td>N/A</td>
<td>Minimum 24 hours, preferred 48 hours</td>
<td>Minimum of eight (8) hours; twelve (12) hours if midday peak</td>
</tr>
</tbody>
</table>

The following sections describe the types of data used and additional information related to these guidelines.

3.1 Sources

3.1.1 ODOT Traffic Monitoring Section

The ODOT **Office of Technical Services, Traffic Monitoring Section** is responsible for programming, collecting, analyzing, and reporting traffic monitoring data for interstate, US and state routes in Ohio. Traffic monitoring data includes vehicle volume, vehicle classification and weigh-in-motion. Data is collected using manual, portable (road tube) counters, permanent Automatic Traffic Recorders (ATR), and Intelligent Transportation Systems (ITS) methods. The **Traffic Monitoring Management System** (TMMS or MS2) is the web application tool that stores and delivers traffic monitoring data. This portal replaces the traffic count data that was previously available on the Traffic Monitoring Section’s website. However, it does not replace seasonal adjustment factors, hourly traffic profiles, K&D factors by location, or vehicle functional classifications. Additionally, the **Transportation Information Mapping System** (TIMS)
is a web-mapping portal that can be used to access other useful information such as planned project locations, car and truck growth rates, and AADT data.

3.1.2 Metropolitan Planning Organization

Metropolitan Planning Organizations (MPO) collect and store historical traffic data. If the project is located within an MPO boundary, supplemental short-term traffic count data on local roads and intersection turning movement counts may be available through the MPO. The Office of Statewide Planning & Research maintains the Statewide Planning MPO Maps and Contacts page which can be accessed for additional information.

3.2 Roadway Functional Classification

The functional classification of a road is used to establish design criteria for various roadway features. The ODOT Traffic Monitoring Section maintains data reports that represent Statewide averages by functional classification. These reports are used in the traffic forecasting process as described in Volume 2 and include seasonal adjustment factors, hourly traffic profiles, and K&D factors.

Functional classification defines the role a particular roadway segment plays in serving the flow of traffic. Roadways are assigned to one of the seven (7) classifications within a hierarchy, as shown in Table 3-2, according to the character of travel service each roadway provides. Functional classifications are further defined by denoting whether the road is in a rural or urban area.

Table 3-2. Functional Classification of Roads

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Interstate</td>
</tr>
<tr>
<td>02</td>
<td>Freeway/Expressway</td>
</tr>
<tr>
<td>03</td>
<td>Other Principal Arterial</td>
</tr>
<tr>
<td>04</td>
<td>Minor Arterial</td>
</tr>
<tr>
<td>05</td>
<td>Major Collector</td>
</tr>
<tr>
<td>06</td>
<td>Minor Collector</td>
</tr>
<tr>
<td>07</td>
<td>Local</td>
</tr>
</tbody>
</table>
3.3 Types

3.3.1 Continuous Counts

Continuous count stations are permanently installed, providing a 100% sample of hourly and daily traffic data for the entire year. With the entire years’ worth of data, the actual AADT value can be calculated (as opposed to estimated). In addition, the 30th highest hour can be explicitly determined from this data and used to calculate K and D factors. This data is also used to identify the seasonal variation in traffic volumes, which in turn can be used to estimate AADT from ADT data obtained at other short-term count locations.

The Traffic Monitoring Section maintains over 200 permanent (continuous) count stations throughout the state; these stations are located on roads of varying functional classification in both rural and urban areas. The data may be accessed through TMMS/MS2. Project-specific continuous count data is typically not available or required for most project limits.

3.3.2 Short-Term Counts

Short-term counts are obtained using portable machine counters (usually pneumatic tube counters) installed at a location for a continuous 24 to 48 hour period. These counts provide a one- or two-day ADT that can be adjusted using seasonal factors from permanent counts to estimate AADT.

The Traffic Monitoring Section collects short-term count data at 30,000 locations, rotating counted locations each year. The data is collected using manual, portable (machine) counters and can be accessed through TMMS/MS2. Supplemental short-term count data may also be available on local roads through the MPO. Availability, quality, and age of count data will dictate whether count data collection is required to develop a forecast.

3.3.3 Project Specific Long-Term Counts

The existing continuous count stations maintained by the Office of Technical Services are generally sufficient for most forecasting projects. For PDP Path 4 and 5 projects, longer-term count data may be needed to estimate design factors in locations where no automatic traffic recorder (ATR) exists. The need for a longer term count will be determined at the Early Coordination Meeting with ODOT M&F or before. About two months of lead time is required to install this equipment, and ideally, one year of data would be collected; early action by the Project Manager is vital to facilitate this.

3.3.4 Intersection Turning Movement Counts

Traffic counts are collected at intersections (either manually or with video collection software) in order to determine turning movements. They are typically conducted on a single day surrounding the peak commute periods. It is important to have recent manual turning movement counts (within the past 3 years); intersections are typically the capacity chokepoint on most highways, and turning movement forecasts are used to determine the design of the intersection including turn lane requirements and the length of storage.
A limited number of intersection turning movement counts are available through TMMS/MS2 along state-operated routes. If the project is located within a Metropolitan Planning Organization (MPO) boundary, intersection turning movement counts may be available at additional locations. Intersection turning movement counts will generally need to be collected to develop new traffic forecasts.

3.3.5 Queue Counts

Traffic count data provides the number of vehicles that physically cross a point, or pass through an intersection, within an interval of time. In oversaturated conditions, it is likely that traffic count data does not reflect the true demand. In such cases, queue counts can be used to supplement traffic count data. Queue counts provide the number of vehicles within the queue upstream of the count location, which equates to the unmet demand over a certain time interval. Traffic counts at the intersection are then increased to account for the demand that has not been serviced.

An effort should be made to identify the cause of the unmet demand, whether it be demand-based or operational-based. The latter is generally the result of cycle failure and can be remedied by adjusting the cycle length at the intersection. If the facility simply cannot accommodate the demand, this will have implications on the design of a roadway.

Queue counts are a special data request for Certified Design Traffic projects. The methodology for collecting queue count data will vary by project, although a typical approach is to measure the queue size at the end of every 15-minute interval at the beginning of the downstream traffic signal’s red phase as shown in more detail in Volume 2.

The need for queue count data, and the methodology used to obtain it, will be determined at the Early Coordination Meeting (see Chapter 4).

3.4 Features

3.4.1 Volume

Volume data is the simplest form of traffic data --- a count of the number of vehicles, of any classification, that traverses a location within a period of time. Link volumes refer to the number of vehicles that pass a point on the roadway while turning movement volumes identify the number of vehicles that pass through an intersection.

3.4.2 Classification

Classified volume counts contain information on the number of vehicles of a certain classification that traverse a location within a period of time. ODOT utilizes FHWA Vehicle Classification Scheme F pictured in Exhibit 3-1. This is a detailed classification scheme that identifies 13 classes of vehicles including motorcycles, passenger cars, buses, and trucks with varying axle and trailer configurations.

At a minimum, all traffic count data should be classified into “cars” and “trucks” for traffic forecasting purposes, as the daily and seasonal volumes vary greatly between these types of vehicles. “Cars” includes motorcycles, passenger cars, panel (four-tire) trucks and pick-up trucks (i.e. Passenger & A Commercial, or P&A). “Trucks” then includes all other vehicles such...
as single-unit trucks, tractors with semi-trailers, trucks with trailers, recreational vehicles, and school and commercial buses (i.e. B & C Commercial, or B&C).

The relationship between the FHWA Scheme F classification number and the minimum recommended classification is shown in Table 3-3. Depending on the source of the data, counts may be classified using a system that is different than, but related to, the FHWA Scheme F classification. Table 3-3 provides equivalencies for the Ohio Turnpike’s classification system as well as vehicle length.

Exhibit 3-1. FHWA Classification Scheme F
### Table 3-3. Minimum Classification for Traffic Monitoring Data

<table>
<thead>
<tr>
<th>FHWA Scheme F Classification</th>
<th>Description</th>
<th>Minimum Classification</th>
<th>Equivalencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motorcycles</td>
<td>Passenger Cars</td>
<td>0 - 22' (Short)</td>
</tr>
<tr>
<td>2</td>
<td>Passenger Cars</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Other Two-Axle, Four-Tire, Single Unit Vehicles</td>
<td>A Commercial</td>
<td>22.1 - 40' (Medium)</td>
</tr>
<tr>
<td>4</td>
<td>Buses</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Two-Axle, Six-Tire, Single Unit Trucks</td>
<td>C Commercial</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Three-Axle Single Unit Trucks</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Four or More Axle Single Unit Trucks</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Four or Less Axle Single Trailer Trucks</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>Five-Axle Single Trailer Trucks</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>Six or More Axle Single Trailer Trucks</td>
<td>B Commercial</td>
<td>&gt;40.1' (Long)</td>
</tr>
<tr>
<td>11</td>
<td>Five or Less Axle Multi-Trailer Trucks</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>Six-Axle Multi-Trailer Trucks</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>13</td>
<td>Seven or More Axle Multi-Trailer Trucks</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

#### 3.4.3 Data Summary

Volume data should be summarized in 15-minute intervals for intersection turning movement counts. If truck design factors are also requested, the classified data should be provided in 15-minute intervals. It is also preferred that short-term counts be summarized in 15-minute intervals, but at a minimum, the volumes and vehicle classifications should be in hourly intervals.

#### 3.5 Age of Data

The age of the existing traffic count data is a key consideration. The collection of new traffic count data is encouraged for use in the traffic certification process. However, recent count data collected in the project study area may be used. A general rule is that data collected beyond 3 years should not be used in the certification process and instead, new traffic count data should be collected. The acceptable age of the count data is dependent upon the area. Using older count data may be acceptable in areas that have not undergone notable changes in recent years. In areas where recent

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Monitoring data used to develop design traffic should be no more than 3 years old at the time of the forecast.
development or travel pattern changes have occurred, collecting new data may be required even if it was recently counted.

Data older than 5 years is not considered acceptable for use in the traffic certification process, and thus should be avoided unless special circumstances exist. ODOT M&F should be consulted to determine if data collected prior to the origination of the project is acceptable for use.

Also, the anticipated length of the project process should also be considered when determining whether or not to use previously collected data. For example, if a study is expected to require 24 months to complete and the data used is 4 years old at the time of project initiation, the data used in the project may be 6 years old at the time of study completion. Depending on the project and study area, this may be considered unacceptable.

### 3.6 Time Periods

Conducting traffic operational and capacity analyses typically require peak hour volumes. Peak hour volumes represent the highest hourly traffic volumes during a 24-hour period, usually during the morning and evening commuter peaks (AM Peak Hour and PM Peak Hour). Intersection turning movement counts should therefore be obtained for a minimum of 8 hours and capture the peak hour (4 hours during each peak, typically 7-11 AM and 2-6 PM). Where the traffic peak is midday, 12-hour turn movement counts are recommended, typically 6 AM-6 PM.

Forty-eight (48) hour machine counts are also recommended, one (1) on each of the intersecting roads wherever a turning movement count is performed. This helps ensure the turning movement count captures the applicable peak periods and allows that count to be expanded to ADT values. As an example, a four-legged intersection would have up to two machine counters to capture the mainline and cross street. This guideline may be waived for routes that are estimated to carry less than 1,000 vehicles per day.

Counts should be conducted during typical weekdays (usually Tuesday-Thursday) unless designing to accommodate unique, area-specific conditions such as weekend or amusement park traffic. Unless otherwise approved for purposes of accommodating unique traffic patterns (recreational route, tourist attraction, etc.), special event traffic dates must be avoided. Examples of events or dates to avoid:

- Holiday travel days
- The weeks before and after Christmas
- The week of Thanksgiving
- The day of a snowstorm
- Roadway construction
- Designated construction detour route
- Dates affected by County or State Fair traffic

Additionally, other activities that may disrupt typical travel patterns or levels of traffic should be considered. Usually the goal of the count program is to collect data on a day that is representative of typical operations. Data collection should be avoided when construction is underway where either signed detours exist or driver behavior changes could be expected. Both local and regional construction should be considered and avoided during the count program if possible.
For projects or studies involving multiple intersections, it is highly recommended that all of the intersection turn movements are recorded on the same dates. Short-term counts should also encompass the time of the intersection turning movement counts so that the data may be verified. However, when same day counts are impractical, counts within the same week are preferred.

Traffic count data should be verified by comparing data between adjacent intersections to avoid any unreasonable increases or decreases. If inconsistencies exist, issues with the data should be investigated and recounted if necessary. Traffic count data is the basis for all forecasts. Inaccurate traffic count data will significantly affect the quality of the traffic forecast.
Chapter 4. Selecting a Traffic Forecasting Method

4.1 Risk-Based Traffic Forecasting

It is ODOT policy to follow a risk-based traffic forecasting approach, meaning that the recommended forecasting procedure varies by the project’s relative risk level. This policy ensures that the appropriate amount of effort is expended on traffic forecasts given the size and complexity of the project. Projects are classified as either low risk or high risk based on the project administrator (local or state/ODOT), project type, and for ODOT projects, the Project Development Process (PDP) path.

Traffic forecasts for relatively minor projects that do not significantly change the highway network are considered low risk. These projects may be completed by public agency staff, consultants, or District staff without involving the ODOT M&F. Such projects typically do not require project-specific TDF modeling efforts, and design traffic is estimated by applying a growth rate to existing traffic volumes or by using the Simplified Highway Forecasting Tool (Chapter 7). This process requires significantly less time and effort.

Traffic forecasts for more complex projects that change the highway network, add capacity, and/or alter traffic patterns are considered high risk. These projects will require TDF modeling as a basis for the traffic forecast because past trends and/or the Model of Record are unlikely to be valid. In this case, design traffic is obtained through a more labor-intensive post-processing effort. Certified Design Traffic is required if the project is administered by ODOT, on the State System, and/or has federal funding. Sections 4.3 and 4.4 provide preliminary guidance on when Certified Design Traffic is required.

Exhibit 4-1 provides an overview of the ODOT Design Traffic forecasting process. The technical process used to produce the forecast is detailed in Volume 2.

4.2 Traffic Forecasting Methods

4.2.1 Design Traffic Forecasting Procedures

There are two main procedures for developing design traffic as accepted by ODOT:

- **Low Risk Design Traffic:** Forecast is prepared using a simpler process that requires significantly less time than the High Risk Design Traffic process. The following methods fall under Low Risk Design Traffic:
  - **Simplified Highway Forecasting Tool (SHIFT):** A front-end software application for reporting simplified traffic forecasts for highway design purposes (Chapter 7). This tool is available for use on State highway projects only.
  - **MPO Growth Rate:** If the project is located within an MPO boundary, the MPO can be contacted to obtain a growth rate for the project, oftentimes by road. The provided growth rate is applied to base counts to estimate future year volumes. In this case, the MPO may apply any, all, or none of the methods provided in these manuals as agreed upon by the project sponsor and the MPO.
  - **Other Growth Rate:** Calculating a growth rate from historic traffic count data (linear regression) or Model of Record results, or estimating a growth rate using area growth trends. For State highways, SHIFT can also be used to “borrow” a
growth rate from a nearby road on the State System. The chosen growth rate is applied to base counts to estimate future year volumes.

- **High Risk (Certified) Design Traffic:** This method requires TDF modeling as a basis. Due to the nature of these projects, the existing Model of Record is typically not applicable and thus detailed, project-specific TDF modeling work is required. The required coordination, data collection, modeling, and post-processing efforts significantly increase the timeline of High Risk Traffic forecasts over Low Risk Design Traffic forecasts. High risk projects by definition are the only ones that can have separate forecasts for multiple alternatives, and design traffic forecasts are developed for the conceptual alternatives. If alternatives are numerous enough, Planning Level or Refined Alternative Level traffic forecasts (Section 2.2) may be used to narrow down preliminary alternatives before developing detailed design traffic forecasts for a subset of alternatives. It is expected that Certified High Risk Design Traffic (or simply Certified Design Traffic) will go through an Early Coordination Meeting with ODOT M&F staff to determine necessary aspects for obtaining the forecast. It is at this meeting that it will also be determined if ODOT M&F staff will be generating the traffic forecast or reviewing one submitted by a consultant.

Table 4-1 provides the major differences between the design traffic procedures.

<table>
<thead>
<tr>
<th>Low Risk Design Traffic</th>
<th>High Risk (Certified) Design Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple transportation projects only</td>
<td>Complex transportation projects only</td>
</tr>
<tr>
<td>Growth rate from trend line analysis</td>
<td>Detailed TDF modeling</td>
</tr>
<tr>
<td>Uses Model of Record, if available</td>
<td>Reviewed or prepared by ODOT M&amp;F</td>
</tr>
<tr>
<td>No involvement from ODOT M&amp;F</td>
<td>Data collection is required</td>
</tr>
<tr>
<td>No/minimal coordination</td>
<td>Coordination is required</td>
</tr>
<tr>
<td>Short timeline</td>
<td>Minimum timeline is a month, but typically longer</td>
</tr>
</tbody>
</table>

4.2.2 Application-Specific Traffic Forecasting Procedures

The following procedures are also used in Ohio and result in forecasts that are suitable only for their specifically intended purposes:

- **Simplified State Highway Access Management Manual (SHAMM) Methods:** Three methods as detailed in Chapter 7.0 of the State Highway Access Management Manual. They apply only for traffic impact studies with developments that generate less than 500 trips (entering and exiting vehicles) during the highest peak hour.

- **Non-Interstate Bridge Replacement:** This method applies to bridge replacements on US highways, state routes, county routes, township routes or local streets only. Default factors are paired with actual traffic volume/vehicle classification data to estimate future
year volumes. The *Non-Interstate Bridge Replacement Form* is used to develop these traffic forecasts and is included in the Appendix.

- **Planning Level Traffic:** Planning level traffic is generated following the initial steps of the High Risk Design Traffic Process without the final manual refinements necessary to produce design hourly and/or turn movement level forecasts. It can also be generated without the need for project specific traffic count data. It is used to make high-level decisions such as the number of general purpose travel lanes required during preliminary planning studies, or to narrow numerous alternatives down during feasibility studies. More detail on Planning Level Traffic is found in Volume 3 of this manual.

- **Forecasting for Resurfacing Projects:** Forecasting Equivalent Single Axel Loads (ESALs) for pavement design is covered in Section 200 of the ODOT *Pavement Design Manual*. These projects are usually Low Risk and follow the appropriate methods documented in this manual for establishing growth rates.

### 4.3 Project Development Process

ODOT M&F’s traffic forecasting policies are aligned with the Project Development Process (PDP). The PDP is a project management and transportation decision-making tool that outlines project development from concept through completion.

#### 4.3.1 PDP Paths

Depending on the size, complexity, and/or potential impact to the environment, ODOT transportation projects are categorized as following one of five paths (Path 1-5). Certified Design Traffic is not required for all PDP Paths.

PDP Paths 1 and 2 are simple transportation improvement projects that do not significantly change the highway network and rarely require Certified Design Traffic. Examples of such projects that do not require Certified Design Traffic include:

- Routine maintenance
- Resurfacing
- Minor widening
- Culvert replacement
Exhibit 4-1. ODOT Design Traffic Process

*Processes detailed in Volumes 2 and 3
**Other methods summarized in Section 4.2
Path 3 projects involve a higher level of difficulty than projects in Path 1 or 2, with moderate roadway and/or structure work that may include capacity additions. As such, some Path 3 projects will require Certified Design Traffic while others will not. Examples of Path 3 projects that do not change the highway network and therefore do not require Certified Design Traffic are:

- Changing an interchange type but not the available movements (unless part of an IMS)
- Relocating ramp terminals (unless part of an IMS)
- Turn lanes additions and/or modifications
- Two way left turn lanes
- Auxiliary freeway lanes
- Changing lane use

Example Path 1-3 projects that can change the highway network and therefore do require Certified Design Traffic are:

- A new interchange (Interchange Justification Study)
- Interchange Modification Study (IMS) alternatives that change the number of access points (adding a new ramp to provide a movement that formerly wasn’t available) or significantly affects operations (i.e. adding C-D roads)
- Addition/removal of continuous through lanes (freeway or local)
- Construction of new roadways (or closure of existing roadways)

Path 1-3 projects that are necessary to support major development projects that will act as a new major traffic generator/sink or that are located in or serve rapidly growing areas should also follow the Certified Design Traffic procedure. At a minimum, developments creating 500 additional peak hour trips in the area served by the roadway would be considered major.

PDP Paths 4 and 5 are complex transportation improvement projects which include roadway and structure work that adds capacity and therefore require Certified Design Traffic. Such projects typically have multiple alternatives to be considered and always require Certified Design Traffic.

For additional information on ODOT’s PDP Paths, refer to ODOT’s Project Development Process Manual.

4.3.2 PDP Phases

All State transportation projects must advance through five sequential phases: Planning, Preliminary Engineering, Environmental Engineering, Final Engineering/ROW, and Construction. The following discussion highlights what type of traffic forecast is generally needed.

Planning

Planning is the first phase of the PDP. The purpose of the Planning Phase is to utilize a multi-disciplinary approach to identify transportation problems, assess existing and future conditions, identify stakeholders, develop goals and objectives, define the purpose and need and determine the scope, schedule and budget for the project.

If required, a Purpose and Need (P&N) study will be performed during the planning phase or even prior to entering the formal PDP process. The P&N study is used to justify the need
for a project, use of taxpayer dollars, and impacts to environmental resources. It is also used as a tool to evaluate whether any feasible “Build” alternatives can be eliminated early in the process. While the P&N study requires traffic forecasts as a basis, those forecasts will not be Certified Design Traffic.

Additionally, single alternative projects that do not significantly alter traffic volumes can have their final design traffic forecasts developed in the planning phase. However, these projects are by definition “low risk” and do not require Certified Design Traffic. For “high risk” projects, the design traffic process can be completed for existing and future “No Build” conditions during the planning phase.

Exhibit 4-2 shows a portion of the PDP task list from ODOT’s Scope and Fee (SAFe) system. For projects that will require Certified Design Traffic, the project Early Coordination Meeting will take place during Task 1.3.C.C. This meeting can be held in conjunction with the project start-up meeting from Task 1.1.C. Design traffic preparation begins in Task 1.3.D.

Exhibit 4-2. Certified Traffic in PDP Planning Phase

Preliminary Engineering

Preliminary Engineering is the second phase of the PDP. The purpose of Preliminary Engineering is to begin the process of collecting more detailed information by conducting field investigations, other technical studies, and engineering. This work builds upon and refines the information and analyses produced during the Planning Phase and many tasks can be performed concurrently.

Preliminary traffic forecast estimates and design traffic are prepared for all feasible Build alternatives during this phase as shown in Exhibit 4-3.
Detailed Design

The purpose of the detailed design phases (Phases 3-5) is to perform the final (Stage 3) detailed engineering design of the preferred alternative and finalize right-of-way acquisition for the project. This work builds upon and refines the information and analyses produced during the Preliminary Engineering Phase.

4.4 Other Types of Studies

4.4.1 Traffic Impact Studies

A traffic impact study (TIS) is performed to assess the impact of a future development on traffic operations of the supporting road network. Traffic impact studies are classified into levels based on the total number of trip ends (entering and exiting) that are generated by the development in the highest hour. As defined in Section 9.41 of the State Highway Access Management Manual:

- **TIS Level 1**: 200 - 499 trip ends
- **TIS Level 2**: 500+ trip ends

Traffic impact studies generally do not proceed through the PDP and do not require Certified Design Traffic. However, the recommended traffic forecasting method for Level 2 traffic impact studies is equivalent to that of Certified Design Traffic, without the additional coordination and approval steps.

4.4.2 Interchange Studies

Interchange studies include the following three types of studies:

- **Interchange Operations Study (IOS)**: Request for minor revised access to the Interstate System; altering the number and/or type of lanes at a ramp terminal (e.g. turn lane additions)
- **Interchange Modification Study (IMS)**: Request for major revised access to the Interstate System; reconfiguration of existing interchange (e.g. Diamond to Full Cloverleaf)
- **Interchange Justification Study (IJS)**: Request for new access to the Interstate System; new interchange where one does not currently exist.
Certified Design Traffic is required for Interchange Modification and Interchange Justification Studies. Interchange Operations Studies will be considered on a case-by-case basis. Interchange studies have different requirements than most other study types, particularly in relation to the size of the study area. More information on interchange studies and their requirements can be found on the Office of Roadway Engineering’s webpage Studies: IJS/IMS/IOS. The requirements found on this webpage supersede the guidance found in this manual.

4.5 Definition of High Risk Projects
Projects are defined as high risk if they meet at least one of the following criteria:

- Classified as PDP Path 4 or 5
- Project adds or removes through lanes on roadways
- Project adds or removes a road
- Project adds or removes interchange or ramp connections
- Project requires an IMS/IJS
- Project involves land use changes that would meet the criteria for a Level 2 TIS per the SHAMM
- Any project involving tolling, managed lanes or ITS/connected vehicle technology

All other projects may be classified as low risk. Such projects include turn lane modifications, traffic control changes, and minor lane widening. Most Path 1-3 projects will be classified as low risk.

4.6 Project Location
For the purpose of selecting a traffic forecasting method, projects that are on the State System are those that:

- Improve a State Route (SR), US Route (US), or Interstate Route (IR)
- Intersect a State System route
- Involve a Level 2 TIS whose study area includes or intersects a State System route
### 4.7 Selection Criteria

Table 4-2 summarizes the criteria used to select from one of the traffic forecasting procedures described in the previous section. The methodology used to produce forecasts is detailed in Volume 2.

<table>
<thead>
<tr>
<th>Case</th>
<th>Risk Level</th>
<th>Applicable Method(s)</th>
<th>Traffic Forecaster</th>
<th>Certification Required</th>
<th>District Approval Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIS</td>
<td>Low (Level 1)</td>
<td>A</td>
<td>Project sponsor or their consultant</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>High (Level 2)</td>
<td>F</td>
<td>Project sponsor or their consultant</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Planning Study</td>
<td>Not Applicable</td>
<td>B</td>
<td>Project sponsor or their consultant</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Locally Administered, Not on State System, and No Federal Funding</td>
<td>Not Applicable</td>
<td>D, E, F</td>
<td>Project sponsor or their consultant</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Locally Administered, Not on State System, with Federal Funding</td>
<td>Low</td>
<td>D, E</td>
<td>Project sponsor or their consultant</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>F</td>
<td>Project sponsor or their consultant</td>
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<td>No</td>
</tr>
<tr>
<td>ODOT Administered or on State System</td>
<td>Low</td>
<td>C (State Routes), D, E</td>
<td>District or their consultant</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>F</td>
<td>ODOT M&amp;F or project consultant</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Where
- A = Simplified State Highway Access Management Manual (SHAMM) Methods
- B = Planning Level Traffic
- C = Simplified Highway Forecasting Tool (SHIFT)
- D = MPO Growth Rate
- E = Other Growth Rate
- F = High Risk (Certified) Design Traffic Process
Chapter 5. Certified Design Traffic Workflow

The Certified Design Traffic workflow pictured in Exhibit 5-1 provides an overview of the phases of developing a Certified Design Traffic forecast, and the expected documentation or milestones throughout the process. These steps pertain to forecasts that are prepared externally by an on-call consultant (see Section 5.3); Certified Design Traffic that is prepared in-house by ODOT M&F will follow a slightly different workflow that is not covered in this manual. Additional technical detail describing the methodology used to prepare Certified Design Traffic is contained in Volume 2.

5.1 Project Initiation

Project initiation will occur once the need for Certified Design Traffic is verified. Chapter 4 provides more detail on the types of projects that require Certified Design Traffic. If any portion of a project meets the criteria for Certified Design Traffic, the entire project should be submitted for Certified Design Traffic. ODOT M&F may be contacted for questions regarding project requirements for traffic forecasts.

If the project meets any of the described criteria, the District Representative should be contacted to notify ODOT M&F of the upcoming request.

5.2 Scope Development

Projects that require Certified Design Traffic are complex and involve multiple parties. Oftentimes an Early Coordination Meeting is held to ensure that all parties agree on the forecast scope, helping to avoid delays at later phases in the project. The participants of this meeting will include, at a minimum, representatives from ODOT M&F and the District representative.

The Early Coordination Meeting Checklist will be distributed to all meeting participants at least a week prior to the meeting. An example of this checklist is found in the Appendix; the most recent version is maintained on the ODOT M&F’s Certified Traffic Webpage.

Table 5-1 summarizes the required information/documents that should be prepared and brought to the meeting for reference. This meeting is meant to cover very specific questions that impact the production of the traffic forecast.

Several items will be defined at this stage:

- Study Area
- Analysis Year(s)
- Analysis Time Periods (i.e. AM, PM)
- Project Alternatives
- Existing count data availability
- Need for new count data and data collection guidelines
- Model availability and applicability
- Need for project level modeling
- Other considerations, such as previous forecast attempts or studies
- Forecast Assignment
- Project Schedule
Exhibit 5-1. Design Traffic Phases and Documentation

**Project Initiation**
- Identify Project PDP Path
- Assemble Count Data
- Select Forecasting Tool(s)
- Define Study Area
- Define Analysis Year and Periods
- Identify Alternatives
- Set Schedule

**Scope Development**
- Identify Deficiencies and Inconsistencies

**Forecast Assignment**
- Forecaster is assigned to the project based on the results of Table 4-2 and discussions at the Early Coordination Meeting

**Count Evaluation**
- Collect New Count Data
- Identify Deficiencies and Inconsistencies

**Growth Evaluation**
- Evaluate travel demand models
- Evaluate historic count data
- Consider land use and trip generation

**Project Level Modeling**
- Land use and road network adjustments
- Multiple alternatives

**Draft Design Traffic**
- NCHRP 255/765 adjustments
- Turning movements
- Smoothing/balancing
- Consistency checks
- Design designations

**Certified Design Traffic**

**Brief Technical Memo:**
- Sources
- Dates
- Gaps
- Proposed K-Factors
- Existing Volume Plates with DHV and AADT

**Brief Technical Memo:**
- Growth rates and potential issues
- Whether or not project level modeling is required

**Technical Report:**
- References
- Exhibits
- Design Traffic Plates with DHV and AADT
- Design Designations

**Transmittal Letter**

**Early Coordination Meeting**
- Required Coordination
- Required Documentation
- Possible Required Documentation; To Be Determined at Early Coordination Meeting
The scope is the foundation for the entire traffic forecast. It is vital that each of these parameters is identified as best as possible in the early stages so that the forecasting process does not delay the entire project further down the line. A more detailed discussion of how each of these parameters should be defined is covered in Chapter 6.

### 5.3 Forecast Assignment

When the scope has been clearly defined, a forecaster will be assigned based upon the results of Table 4-2 and the Early Coordination Meeting. This forecaster may be from ODOT M&F, the project sponsor, a consultant an MPO or other entity.

### 5.4 Count Evaluation

The Early Coordination Meeting will identify the need for additional data collection to fulfill the forecast requirements. When all count data is compiled, the traffic forecaster should perform a review of the existing count data set to identify inconsistencies in the available information. Some projects will require a formal Count Evaluation Memo, as determined at the Early Coordination Meeting. The Count Evaluation Memo will be a brief technical summary of the sources and dates of all counts, as well as gaps and conflicts in the data. It is at this time that any special data collection efforts will be identified. If required, the Count Evaluation Memo will be submitted to ODOT M&F for review and approval of the existing count data set prior to proceeding with the next phase.

### 5.5 Growth Rate Evaluation

When the existing count data has been collected and approved (if necessary), the forecaster will assemble and compare growth trends from all available sources. These sources include but are not limited to TDF models, historic count data, previously developed forecasts, population growth, and development activity. If agreed upon at the Early Coordination Meeting, the forecaster will prepare another short technical memorandum summarizing these growth patterns and recommending the need for project level modeling. If produced, the memorandum will be submitted to ODOT M&F for review and approval of the proposed growth rates, or acknowledgement of project level modeling tasks.

### 5.6 Project Level Modeling

If required, project level modeling will be coordinated or performed by ODOT M&F. This stage involves project-specific land use and road network changes, in addition to what is contained in the model of record. Modeling will be provided as needed for each of the project alternatives.

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<table>
<thead>
<tr>
<th>District</th>
<th>Central Office (M&amp;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maps of study area showing limits, impacted roadways</td>
<td></td>
</tr>
<tr>
<td>• Description of alternatives to the extent known</td>
<td></td>
</tr>
<tr>
<td>• Description of proposed developments</td>
<td></td>
</tr>
<tr>
<td>• Previously completed studies</td>
<td></td>
</tr>
<tr>
<td>• Available count data</td>
<td></td>
</tr>
<tr>
<td>• List of future projects</td>
<td></td>
</tr>
<tr>
<td>• TAZ Maps with model variables</td>
<td></td>
</tr>
<tr>
<td>• Previous traffic forecasts</td>
<td></td>
</tr>
<tr>
<td>• Map/list of continuous count stations near project</td>
<td></td>
</tr>
<tr>
<td>• Map showing projects accounted for in long-range plan</td>
<td></td>
</tr>
<tr>
<td>• Other information relating to forecast parameters (K, D, etc.)</td>
<td></td>
</tr>
</tbody>
</table>
For complex projects, the model runs may have been completed during earlier planning steps to aid in the selection of one or more alternatives to progress to the next phase.

5.7 Draft Design Traffic

Draft design traffic is developed for all feasible alternatives. TDF model results are adjusted using the NCHRP 255/765 processes discussed in Volume 2. The adjusted volumes are checked and subjected to further manual adjustments as necessary to obtain a reasonable forecast. Once the forecast is complete, a technical report will be prepared to describe all assumptions and adjustments made in the development of the design traffic. This report will contain the Count Evaluation and Growth Rate Evaluation Memos as an Appendix if they were required, as well as references and supporting exhibits. Traffic plates and other forecast parameters (e.g. TD and T24) will be produced for each time period and analysis year. The draft design traffic forecast is submitted to the ODOT District along with the supporting documentation.

ODOT District staff will review and submit the Certified Traffic Request Form with the draft design traffic and documentation to ODOT M&F if they concur that the project should receive ODOT design traffic certification. The Appendix to this manual contains an example of the request form, and the most recent version is maintained on the ODOT M&F’s Certified Traffic Webpage.

5.8 Certified Design Traffic

When ODOT M&F has reviewed the documentation and deems the traffic forecast as acceptable, an inter-office communication (IOC) will be sent to the requestor including any update traffic volume plates and summary tables.

5.9 Forecast Tracking

ODOT’s Traffic Tracker database is an internal documentation tool with the purpose of tracking the progress of Certified Design Traffic requests. Requests are logged into the database at certain milestones in the project:

- After Early Coordination Meeting
- Modeling is requested from ODOT M&F
- Design traffic is submitted to ODOT M&F for certification

Additionally, ODOT M&F has published Google Earth Pro .KML maps which display information about prior requests complete with links to transmitted requests. The maps are currently available to internal employees only are and published on the ODOT O: drive.

The .KML maps were developed to address problems with conflicting forecasts on adjacent projects produced a few years apart. Maps are summarized by District and include those forecasts that were requested within 5 years of the date the map was created (Certified and Low Risk Design Traffic Forecasts). An example of the map format for District 6 is shown in Exhibit 5-2. Each pin may be selected to reveal additional information about the forecast, as in Exhibit 5-3.
Exhibit 5-2. Example Google Earth .KML Map, District 6

Exhibit 5-3. Example Google Earth .KML Traffic Forecast Pop-Up, SR-270 in Franklin County, OH
Chapter 6. Certified Design Traffic Forecast Scope

Once the District has notified ODOT M&F of the upcoming project (Project Initiation), the next step in the design traffic process is to define the forecast scope. This chapter specifically refers to Certified Design Traffic. The scope guidance may be loosely applied to other projects on a case-by-case basis.

The sections below discuss the primary scope aspects for design traffic forecasts. These sections are written in relation to Certified Design Traffic requirements as items to be addressed during the Early Coordination Meeting.

6.1 Boilerplate Scope Language

The requirement for Certified Design Traffic will have an impact on the scope, schedule and cost of a design project. ODOT has therefore prepared boilerplate language to be added to the scope of the project to help assist in this effort. This language, contained in the Appendix to this manual, provides a basis for services requested, completion time, and final products.

6.2 Basic Forecast Parameters

6.2.1 Study Area

The study area to be encompassed by a Certified Design Traffic forecast is the larger of the traffic analysis study area and the project study area.

The traffic analysis study area includes all areas whose traffic will be significantly impacted by any of the project alternatives. At a minimum, the traffic analysis study area should include:

- The next parallel facility to either side of the project facility
- Two intersections or interchanges before and after the last one physically impacted by the project and one beyond parallel facilities on cross routes
- All of the remaining network facilities connected to and bounded by these

The project study area, on the other hand, will most likely have been based on other factors such as environmental impacts. If the project study area is larger than the traffic analysis study area, Certified Design Traffic should be developed for the entire project study area.

As a comparison, the study area for design traffic forecasts that are not certified will encompass a much smaller area, usually only the specific location of the project.

6.2.2 Alternatives

A No Build alternative is generally required for projects for which Certified Design Traffic is prepared. The need for a No Build alternative will be evaluated on a case-by-case basis. If required, the No Build alternative should be defined at the Early Coordination Meeting. It may or may not include committed future developments and/or roadway connections.

Projects requiring Certified Design Traffic will have at least one Build alternative, if not multiple alternatives. Alternatives are generally distinguished by variations in road network, land use, or intersection configurations/traffic control. If they are numerous, the set of potential Build alternatives should be filtered using Planning Level or Refined Alternative Level traffic. Certified Design Traffic will then be developed for only a subset of Build alternative(s).
6.2.3 Analysis Years

The Section 102.2 of the ODOT Location and Design Manual (rev. Jan 2017) identifies the projected design year for various project types. Certified Design Traffic (and all design traffic) forecasts are typically developed for an anticipated opening year and a 20-year design horizon. Intermediate analysis years may also be required if the project will be completed in phases. Model results will be provided for a base year (i.e. 2010) and a future year (i.e. 2040), which are usually not consistent with the project analysis years. Model years can typically be interpolated/extrapolated to an opening/design year within 5 years unless project and/or development phasing suggests otherwise.

6.2.4 Analysis Periods

Certified Design Traffic volumes are typically reported as average daily traffic volume, AM design hour volume, and PM design hour volume. However, heavily commercialized areas may have midday peaks that are of similar magnitude or higher than the AM and PM peaks. Prior knowledge of the study area and the land uses contributing to traffic patterns will inform the selection of analysis periods.

6.3 Data Collection Guidelines

The most current version of the Guidelines for Traffic Counts Used for Forecasts Certified for Roadway Design is maintained on the ODOT M&F’s Certified Traffic Webpage and should be consulted for data collection guidance, answers to common questions, and additional detail to the information provided here.

The count data that is available through existing sources such as the ODOT TMMS/MS2 or the local MPO will be brought to the Early Coordination Meeting and compared against these guidelines. Any new data that is required to fulfill the guidelines to the extent necessary will be identified at the Early Coordination Meeting and considered in the scope.

6.4 Travel Demand Forecasting Models

6.4.1 Model Selection

Model selection guidelines are summarized in Table 6-1. For project study areas that are located completely within an MPO area, the MPO model should be used as they typically contain more detailed inputs. Models are available for all of Ohio’s 17 MPOs. These MPOs are listed in Volume 3 along with their contact information and a map of their study areas.

For project study areas that are not located completely within an MPO area, the Ohio statewide TDF model is available for use. This model is primarily used for corridor studies and regional analysis. Additionally, the Statewide model should be used if freight impacts are the central driver of the project, regardless of the location of the project. As of the time of this publication, the Statewide model and some of the MPO models are not

<table>
<thead>
<tr>
<th>Location</th>
<th>Significant Freight Impacts</th>
<th>Model</th>
</tr>
</thead>
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<td>MPO</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Statewide</td>
</tr>
<tr>
<td>Not Completely Within An MPO Area</td>
<td>No/Yes</td>
<td>Statewide</td>
</tr>
</tbody>
</table>
particularly portable and usually must be run by ODOT, the MPO, or someone with access to the ODOT model servers.

6.4.2 Model Version

Base year model results will include the existing development patterns, socioeconomic factors, and road network. The future model, on the other hand, will typically represent long-range plans, including not only existing but also committed developments and network modifications. The variables for impacted traffic analysis zones (TAZs) should be checked for changes in population and employment as well as land use assignments to verify that they are consistent with the assumed project alternatives.

Verify that population, employment, land use, development model assumptions are consistent with project assumptions.

If a development is associated with the project, it is important to note whether or not this development is contingent upon the build alternative. Other future projects that are related to or influenced by the subject project should be verified as well.

6.4.3 Previous Studies and Forecasts

Previously completed and future known studies within the vicinity of the project, including safety studies, traffic impact studies, and design traffic or modeling should be identified at the Early Coordination Meeting. It will then be determined whether or not the project should account for or be consistent with these studies.
Chapter 7. SHIFT

Simplified Highway Forecasting Tool (SHIFT) is a front-end software application for reporting simplified traffic forecasts for highway design purposes. This tool is used to prepare Low Risk Design Traffic for projects on State highways. It may also be used to check forecasts that are prepared following the High Risk Design Traffic procedure. SHIFT generates design designations using a Microsoft Access database file which was created by adding functionality to the ODOT M&F congestion management forecasting tool and thus is consistent with Ohio’s Congestion Management and Ohio’s statewide TDF model. The database is updated annually.

7.1 Uses, Limitations, and Availability

SHIFT forecasts are only suitable for roadway design projects which are low risk projects, or projects where the design is relatively insensitive to forecasted traffic, such as with most resurfacing projects. SHIFT has not been designed for use with high risk projects which may result in changes to travel patterns, such as those that involve the addition of new roads, lanes, ramps, or interchanges.

Certain limitations need to be considered when using the SHIFT software application:

1) Forecasts are created independently; there is no attempt to provide any consistency between the forecasts on adjacent segments.
2) There is no attempt to provide any consistency with known developments or projects occurring in the vicinity of the segment.
3) The SHIFT software application only provides forecasts on state mainline road segments.
4) Turning movement forecasts are simplistic as the forecasts utilize iterative proportional fitting rather than logical changes in paths due to the land use changes or shortest path.

SHIFT is currently available for ODOT internal use only, although a web application version of this software is in the early development stages. The SHIFT software application and user guide may be obtained by contacting ODOT M&F. Review of the user guide is highly encouraged when using SHIFT. Additionally, any questions regarding the use of the software applications or whether, or not SHIFT is appropriate for use on a specific project, may be directed to ODOT M&F as needed.

7.2 Methodology

SHIFT calculates growth rates on State roadways from its database using historic trend line analysis, Model of Record results, or a combination of both. Growth rates are capped at 3% per year for cars and 4% per year for trucks, and negative growth rates are not used. The resulting growth rate is applied to the most recent count data available to estimate the forecasted volume. Additional information contained within the database is used to develop design designations such as K, D, T24 and TD. Count data is not a required input to obtain SHIFT link forecasts but can be provided if a newer count is available than what is contained in the database. However, turning movement count data is required if turning movement forecasts are needed.
7.3 Output

SHIFT generates reports that contain all design designations as well as a summary of the data used to complete the forecast. Exhibit 7-1 shows an example report for a link segment forecast report while Exhibit 7-2 contains an example intersection turning movement forecast report.
Chapter 8. Traffic Impact Studies

Level 2 traffic impact studies will require a full TIS as detailed in Chapter 9 of the SHAMM. Additional considerations with respect to the traffic forecasts used in those studies are provided here. Developments not meeting the requirements of a Level 2 TIS use simplified procedures as detailed in the SHAMM but might benefit from some of these recommendations.

Per the SHAMM:

- Any development generating between 200 and 500 trips in the peak hour requires a Level 1 TIS, while any development generating over 500 trips requires a Level 2 TIS.
- Either level of TIS might also be required by ODOT District Office if the location has been identified as a safety problem area or a congested traffic area.
- The TIS must analyze two Build conditions (existing roadway and proposed roadway with background traffic plus site traffic) and No Build (existing roadway with background traffic) in the Design Year, which is Opening Year + 10 years for Level 1 and Opening Year + 20 years for Level 2.
- Typically must use weekday AM peak and PM peak hour traffic volumes but can use weekend and/or midday volumes when agreed upon.
- Study area for a Level 2 TIS is agreed to by the District but at a minimum includes adjacent and nearby significant intersections including ramp intersections.

Peak Hour volumes used in traffic impact studies should be based on traffic counts that fit one of the following criteria:

- A 24-hour machine count should be performed to determine AM, Midday (if needed), and PM Peak Hours. As an alternative, the peak hours may be determined from existing count data available through TMMS or the local MPO. If TMMS or MPO counts are to be used in lieu of project specific 24-hour counts, the counts must contain hourly breakdowns, be less than 3 years old, and not have any major generators/cross streets located between it and the project site. When consulting TMMS, the K-factors listed there should generally not be used; these are not usually (except at permanent ATR sites) the 30th highest hour K but rather the counted day K.
- Manual turning movement classification counts should be conducted based on the determined peak hours, gathering a minimum of four (4) hours of data, making every reasonable attempt to capture the peak. If the project involves multiple intersections, the same period of data collection should be used for all of the intersections, ensuring that the individual peaks are captured.
- Or, eight (8) hours of manual turning movement classification counts should be collected (typically 7-11 AM and 2-6 PM), unless a midday retail peak is expected, then hours should be adjusted accordingly.
- Unless a special circumstance exists, traffic counts should be conducted on a Tuesday, Wednesday, or Thursday, and should not occur the week preceding or following a major holiday. Saturday counts should be considered in areas where retail traffic patterns are expected to exceed weekday.
All traffic counts should be checked for consistency with one another to ensure there are no unexplained inconsistencies between counts at adjacent intersections.

Traffic forecasts should be created following the methods in this manual. Some additional points related specifically to TIS’s include:

- Background traffic forecasts are converted to DHV per the methods shown in Volume 2.
- Site traffic is not converted to DHV.
- Site traffic for the peak hour of the adjacent street (the street directly serving the development site) as defined in the ITE Trip Generation Manual is added to DHV background traffic for the Build condition. For sites with multiple adjacent streets, the one with the highest volume is used to determine the hour of analysis.
- Site traffic for the peak hour of generator should also be analyzed. The appropriate background traffic in this case is for the hour of the generator’s peak, however, it is still adjusted with the DHV factor to be conservative.
- If TDF model results will form the basis of the background traffic growth rate, it is imperative to determine whether a representation of the development under study in the TIS was included in the model. If so, it must be removed to generate the No Build conditions.

The latest version of the ITE Trip Generation Manual should then be used to estimate site-generated trips. Specific recommendations for estimating trip generation are:

- Choose the most appropriate land use code. Avoid non-specific land uses when possible.
- When possible, multi-use sites should be built up from individual development types and employ the internal capture procedures (a spreadsheet for this is available upon request) rather than employing broad categories such as Office Park.
- Proprietary trip generation rates must include good documentation of the data sources and methods to derive those rates. Undocumented trip generation rates will be discarded by ODOT during any subsequent design traffic certification.
- Use the appropriate method (rate vs. equation) to generate the trips following guidance provided in the ITE Trip Generation Handbook.
- For site traffic generated during peak hours, the time period that should be analyzed is the time period in which the combination of site-generated traffic and adjacent street traffic is the greatest. Typically, the Peak Hour of Adjacent Street Traffic provides a higher total traffic volume than the Peak Hour of Generator.
- Pass-by and diverted link trips should be incorporated, if appropriate, based on recommendations provided in the ITE Trip Generation Handbook.
- Trip distribution assumptions should be reasonable and well-documented. Typically the analyst will need to study the broader expected travel shed of the development to determine where the primary generated traffic will go while pass-by and diverted link distributions will depend upon background traffic distributions.
All assumptions and calculations should be thoroughly and clearly documented so that they can be verified by the ODOT M&F if Certified Design Traffic is later required. While certification of the TIS forecasts themselves is not required, submissions to the ODOT M&F for review (either at the time of the TIS or to support subsequent development of certified design traffic) should include the following:

- Location map
- Site Plan
- Original raw traffic counts
- Growth rate documentation or calculations
- Existing Background Peak Hour Volume Plates (For each analysis period)
- Design Year Background (No Build) Volume Plates (For each analysis period)
- Plates showing redistributions, if applicable
- Trip Generation worksheets or table
- Site Generated Volume Plates (with Primary, Pass-by and Diverted Link Trips delineated, for each analysis period)
- Design Year Final (Build) Volume Plates (For each analysis period)
- Documented assumptions including detailed sources and computations behind any proprietary trip generation rates.