TRANSPORTATION

Section 6-1

TRAFFIC IMPACT ANALYSIS

The Town Of *Buckeye* Arizona

Engineering Design Standards

Section 6-1

Adopted December 2012

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STANDARD DETAILS

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Section 6-1 – Traffic Impact Analysis

This section provides policy and standards establishing design criteria for compiling a traffic impact analysis. The requirements of this section are set by the Town of Buckeye (Town) for all public and private streets. This standard provides guidance on the section and requirements for Traffic Impact Analysis.

The requirements of this section may be modified at anytime by the Town Engineer.

The Town Engineer may approve variances to the requirements of the design standard. Variance requests shall be submitted in writing and include a justification for the variance requested. A copy of the Town approved variance shall be included with the submittal of any plans or design reports to the Town that incorporate the variance.

The Town Engineer is required, pursuant to Chapter 23, Article 23-2, of the Town Code, to develop standards and detail regarding public improvements to be constructed within the Town. The standards, design criteria, and policy set forth in this section were developed and recommended by the Town Engineer pursuant to Chapter 23, Article 23-2 and adopted by Town Council in Resolution No. 141-12.

6-1 Traffic Impact Analysis

6-1.000 General Information:

6-1.001 Infrastructure Requirements:

A. It is the Town's responsibility to provide an interconnected transportation system to ensure the mobility of people and goods.

B. In order to achieve these objectives, traffic engineers determine whether the proposed improvements will satisfy future needs by comparing the forecast directional hourly volume with the traffic-handling capacity of an improved facility.

C. Project traffic forecasts and capacity are used to establish the number of through lanes, length of auxiliary lanes, signal timing, right of way needs, and other characteristics, so the facility can operate at an acceptable level of service through the design year.

D. This document provides guidance and general requirements for traffic analyses. Specific requirements for a traffic analysis depend on a variety of factors. These include:

1. The current transportation system and operational characteristics in the site vicinity.
2. The interface between the on-site circulation system and the adjacent circulation system.
3. The intensity and character of the development.
4. Trip generation.
5. Distribution and assignment estimates.
6. Impacts of the development on the existing and planned transportation systems.

E. Along with these factors, examine capacity and safety needs, determine development impacts, and identify mitigation requirements.

F. This section is to aid the engineer in developing a Traffic Impact Analysis to meet the Town minimum standards.

G. Traffic Impact Analyses provide the Developer, Town Council and Town staff with the information necessary to provide a balance between land use and transportation infrastructure.

H. Developers/Landowners are required, pursuant to the Town Code, including the Town Development Code, to provide a Traffic Impact Analysis to show the impact of the development on all streets within and adjacent to their sites.

I. Developers/Landowners shall install, at their expense, all requirements of the analysis necessary to serve their developments and mitigate offsite traffic issues caused by their development as required by the Town.

J. Developers/Landowners are requested to review this document. It is strongly recommended that Developers/Landowners meet with the Town engineering staff prior to the preparation of a Traffic Impact Analysis to discuss concerns unique to their development and to determine the scope of the study. By meeting with engineering staff, issues are addressed early resulting in a quicker approval process.

K. Approval of the Traffic Impact Analysis is required prior to any vesting on the property, approval of any Community Master Plan or amendment, preliminary plat, final plat, preliminary site plan, final site plan or any other document determining intensity, density or use.

L. The purpose of a Traffic Impact Analysis is to evaluate the impact of a proposed development on the surrounding transportation system. Based on the information provided in the Traffic Impact Analysis, the Town determines the adequacy of the existing or planned transportation improvements.

M. The Town will stipulate that certain items be the responsibility of the Developer as a condition of development approval. Such items include additional rights-of-way (ROW), street improvements, traffic signals, or transportation demand management programs that are necessary to mitigate transportation deficiencies adjacent to or on the proposed development site.

6-1.002 Definitions and Abbreviations:

A. 20-year horizon - This is assumed to be the project build-out year.

B. AASHTO - The American Association of State Highway and Transportation Officials

C. ADA - Americans with Disabilities Act

D. ADOT - Arizona Department of Transportation

E. Area of Significant Traffic Impact - The geographic area which includes the facilities significantly impacted by the site traffic.

F. A.R.S. - Arizona Revised Statutes

G. ASTM - American Society for Testing and Materials

H. Capacity - The maximum sustainable flow rate at which vehicles or persons can reasonably be expected to traverse a point or uniform segment of a lane or roadway during a specified time period under given roadway, geometric, traffic, environmental, and control conditions. Capacity is usually expressed as vehicles per hour (vph), passenger cars per hour (pcph), or persons per hour (pph).

I. CMP - Community Master Plan

J. Developer - Shall mean the individual or entity causing Development of land in the Town, including Development companies authorized to act on behalf of the Developer and the term Developer shall also mean a contractor ("Contractor") authorized to act on behalf of the Landowner or Developer. Developer shall also be interpreted to mean Landowner.

K. Development or development - Shall have the same meaning as defined in the Town Development Code.

L. DHV – Design hour volume.

M. Engineer or engineer - An engineer registered professionally in the State of Arizona pursuant to the provisions of A.R.S. §32-101; §§32-121-131; §§32-141-152, as amended.

N. HCM - Highway Capacity Manual

O. ICU - Intersection Capacity Utilization

P. Influence Area - The geographic area surrounding the site from which the development is likely to draw a high percentage (80% or more) of the total site traffic.

Q. ITE - Institute of Engineers

R. Landowner - Shall mean the owner of the land in the Town on which Development occurs. "Landowner" shall also be interpreted to mean Contractor and/or Developer, including Development companies authorized to act on behalf of the Developer/Landowner.

S. LOS - Level of service - A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed, travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. Six levels of service are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. Safety is not included in the measures that establish service levels.

T. MAG - Maricopa Association of Governments, Refers to the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction current edition

U. MCDOT - Maricopa County Department of Transportation

V. Median - A raised landscaped area down the middle of a roadway that adds aesthetics and prevents left-turns at unauthorized locations.

W. Mode Split - The estimation of the number of trips made by each mode (automobiles, pedestrian, transit, etc.)

X. MUTCD - Manual on Uniform Traffic Control Devices, as revised by the State of Arizona

Y. "Pass-by" trips - Intermediate stops between an origin and a primary trip destination; for example, home to work, home to shopping.

Z. Peak hour - The 60-minute interval that contains the largest volume of traffic during a given time period. If a traffic count covers consecutive days, the peak hour can be an average of the highest hour across all of the days. An a.m. peak is simply the highest hour from the a.m., and the p.m. peak is the highest from the p.m. The peak hour correlates to the DHV, but is not the same. However, it is close enough on items such as intersection plans for approval to be considered equivalent.

AA. Peak Hour of Generator - The single hour of highest volume of traffic entering and exiting a site.

BB. PHF – Peak Hour Factor

CC. Plan(s) or plan(s) - Design drawings that are 100% complete and sealed by a registered professional Engineer as defined above.

DD. Project - Activities directly undertaken by government, financed by government, or requiring a permit or other approval from government.

EE. PUE - Public Utility Easement

FF. Public Works Inspector - A Town employee or contracted consultant with a primary responsibility of monitoring the construction of improvements for conformance to Town requirements.

GG. ROW - Rights-of-Way

HH. TIA - Traffic Impact Analysis - It is a traffic engineering study which determines the potential traffic impacts of a proposed traffic generator. A complete analysis includes an estimation of future traffic with and without the proposed generator, analysis of the traffic impacts, and recommended roadway improvements which may be necessary to accommodate the expected traffic.

II. TOB - Town of Buckeye

JJ. Town - Town of Buckeye

KK. Town Engineer - The Town of Buckeye Town Engineer or designee.

LL. Traffic Impact - It is the effect of site traffic on highway operations and safety.

MM. Traffic Generator - A designated land use (residential, commercial, office, industrial, etc.) or change in land use that generates vehicular and/or pedestrian traffic to and from the site.

NN. Traffic Mitigation - It is the reduction of traffic impacts on roadways and/or intersections to an acceptable level of service by way of roadway construction improvements, the upgrade of existing traffic control devices, or the modification of the site plan.

OO. Traffic Generation - The estimation of the number of origins from and destinations to a site as a result from the land use activity on that site.

PP. TRB - Transportation Board

QQ. Trip Distribution - It is the allocation of the site-generated traffic among all possible approach and departure routes.

RR. Trip Assignment - It is the assignment of site plus non-site traffic to specific streets and highways.

6-1.003 Design Policy:

A. Developers/Landowners shall comply with the Town's requirements and perform a TIA in accordance with this design standard for all developments within the Town of Buckeye.

B. Town approval of plans and associated design reports are valid for one (1) year from the date of Town Engineer's signature.

C. All construction documents shall be prepared by a registered Professional Civil Engineer licensed and practicing in the State of Arizona pursuant to the provisions of A.R.S. §§32-101, 32-121 to 131; 32-141 to 152. Each sheet of the plans shall include the appropriate professional State of Arizona seal, signature, date and date of expiration below seal. The Town does not require original seals and or signatures (wet seal) on design documents during the review cycle.

6-1.004 Diligence:

A. Developers/Landowners shall verify the need and requirements for a TIA as well as roadway and paving improvements that are required to provide service to a site. It is the Developer's responsibility to become familiar with all of the existing site conditions. Available resources in which to find this information:

1. Obtain existing utility maps and as-built drawings.
2. Town's website – http://www.buckeyeaz.gov.
3. Contact the Town Engineer to confirm the need for any required conditions.

6-1.005 Implementation:

A. The implementation and enforcement of the design standards set forth in this section shall be effective the date of Town Council's adoption of the resolution approving the standards and requirements of this section and shall apply to the following:

1. All new plans and reports submitted to the Town following the effective date of Town Council's adoption of the resolution approving the standards and requirements of this section.

2. All plans and reports seeking a new Town Engineer's signature or a re-approval from the Town Engineer.
3. All expired plans and reports shall be brought into conformance with the design standards of this section.
4. All plans and reports produced under an approved CMP shall follow or be brought into conformance with the design standards of this section.
5. All current approved plans that have not been permitted shall comply with the requirements of this section. Prior to the issuance of the construction permit, the design engineer shall submit a written letter to the Town Engineer acknowledging the construction and materials shall be performed and supplied pursuant to the requirements of this section.
6. All expired or abandoned plans and reports as defined below.
    a. The Town will not hold or store plans and reports. Any plan set or report that has not been picked up from the Town within 90 days of the Towns first notification to the applicant that the plans are ready to be picked up will be deemed abandoned. The Developer/Landowner will be notified that the expired plan set or report will no longer be considered by the Town. If a plan or report is abandoned, the Developer/Landowner will be required to resubmit the abandoned plan or report and pay the Town all associated fees.
    b. If a construction permit for the plans has not been issued within 1 year from the date of approval noted on the cover sheet, the plans and reports will be required to be resubmitted to the Town for review and re-approval.
        i. In order to resubmit plans and reports, the design engineer shall bring the plans and reports into conformance of the Town's current standards and requirements.
        ii. All revised plans and reports will be subject to the Town's current fee schedule.
        iii. This resubmittal is required to go through a comprehensive review of the reports or all plan sheets.
    c. If plans and reports have not been resubmitted to the Town for review or permitting within 2 years from the date of the last Town action the plans and reports shall be considered expired. Once a plan or report has expired, the plan shall be resubmitted for first review and all associated fees shall be paid to the Town.
        i. In order to resubmit plans and reports, the design engineer shall bring the plans and reports into conformance of the Town's current standards and requirements.
        ii. All expired plans and reports being resubmitted will be subject to the Town's current fee schedule.
        iii. This new submittal is required to go through a comprehensive review of the reports or all plan sheets.

6-1.006 Private Streets:

A. All private streets shall be constructed to full Public Street standards, except equivalent construction materials or wider cross-sections may be approved by the Town.

B. No internal private streets shall be incorporated into the Town's public street system at a future date unless they are constructed, inspected, maintained and approved in conformance with the Town's street standards and approved by the Town Council.

C. Before issuance of any certificate of occupancy for the site, the Developer shall post the appropriate signage for private streets to identify that vehicles are entering a private street system.

D. All TIA requirements shall apply to all private streets.

6-1.007 Standards:

A. The following is a list of national, regional and local resources (the latest editions unless otherwise stated), which are referenced and used for the design of streets within the Town of Buckeye.

1. Resources, Standards and References:

a. *A Policy on Geometric Design for Highways and Streets*, AASHTO

b. *Access Management Manual*, TRB

c. ADOT Traffic Standards; http://www.azdot.gov/Highways/traffic/Standards.asp

d. American Public Works Association, www.apwa.net

e. American Society for Testing and Materials, ASTM

f. *Designing Sidewalks and Trails for Access* – Part 1 and 2, U.S. Department of Transportation

g. *Design Guideline Recommendations for the Arizona Parkway*, MCDOT

h. Federal Americans with Disabilities Act, ADA

i. *Freeway and Interchange Geometric Design Handbook*, ITE

j. *Guide for the Development of Bicycle Facilities*, AASHTO

k. *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, AASHTO

l. *Guidelines For Driveway Location & Design*, ITE

m. *Highway Capacity Manual*, TRB

n. *Highway Safety Manual*, All Volumes, AASHTO

o. *Intersection Design Guidelines*, FHWA

p. *Manual of Transportation Engineering Studies*, ITE

q. *MUTCD*, U.S. Department of Transportation, as revised by the State of Arizona

r. Revisions to the MUTCD, U.S. Department of Transportation, by the State of Arizona; *Arizona supplement to the Manual on Uniform Traffic Control Devices*; http://www.azdot.gov/Highways/traffic/standards/mutcd/MUTCD2009wAZSupp.pdf

s. *Roadside Design Guidelines*, AASHTO

t. *Signalized Intersections: Informational Guide*, FHWA

u. *Traffic Control Devices Handbook*, ITE

v. *Traffic Engineering Handbook*, ITE

w. *Traffic Signal Timing Manual*, FHWA

x. *Transportation and Land Development*, ITE

y. *Transportation Impact Analyses for Site Development*, ITE

z. *Transportation Planning Handbook*, ITE

aa. *Trip Generation Volumes 1 through 3*, ITE

bb. *Uniform Standard Details for Public Works Construction*, MAG

cc. *Uniform Standard Specifications for Public Works Construction*, MAG

6-1.008 TIA Preparation Process:

A. The TIA preparation process should include open discussions between the Developer/Landowner, Traffic Engineer, and Town staff. Therefore, project discussion should begin prior to a development plan and/or traffic study when the application for the development is initiated. This will ensure that the objectives of both the Landowner/Developer and the Town can be met.

B. At the Town's Pre-Application Meeting it will be determined if the project needs to produce a Trip Generation Letter or a full TIA. After the pre-application meeting, issues and process will be determined and discussed at a TIA preparation meeting with staff members from the Town's Planning and Engineering staff. If it was determined that a Trip Generation Letter is acceptable then that letter needs to be brought to the TIA meeting. Town staff will determine if any at-large issues are affected by the proposal. The Town will establish a general scope of the work and understanding of what is expected in the report.

C. After the TIA document is completed, it will be submitted to the Town for review. The document will be reviewed, and comments and redlines will be noted on the report. All redlines will be returned to the Developer/Landowner or its consultant for correction and resubmittal. Once the report has addressed all outstanding issues and no further comments exist, the project can move to the next phase of the development process.

D. TIA preparation meeting:

1. The procedures outlined herein present the minimum information required to determine what level of traffic analysis is required. The purpose of the TIA preparation meeting is to provide guidance and direction to the applicant concerning the nature and extent of the analysis.

2. Failure by the applicant to provide these items may result in delay in initiating the TIA process. At a minimum, the following items must be provided at the meeting:

   a. Vicinity map

   b. Current aerial map

   c. Summary of existing building or development on the site – examples: existing building area and land use, current zoning, approved site plan, previous zoning history, etc.

   d. Preliminary summary of proposed development by land use – examples: building area, number of employees, leasable tenant space, acreage, etc.

   e. Proposed site plan

   f. Market analysis, if available.

6-1.100 Trip Generation Letter:

6-1.101 Required Sections:

A. Cover Sheet:
   1. Project title
   2. Major cross streets
   3. Prepared for including: contact name, company name, address, telephone number, and email
   4. Prepared by including: contact name, company name, address, telephone number, and email
   5. Engineer's seal
   6. Town approval block (see Figure 1)
   7. All pages of the report shall have a page number

B. Introduction:
   1. Provide project name, size, description, land use and type of development
   2. Purpose of the report
   3. Explain the objectives of the report, defining requirements, satisfy regulatory requirements and evaluate the impact of the new development on the existing street systems.

C. Project Location:
   1. Vicinity Map
   2. Provide a map labeling all adjacent developments and street network.

D. Provide trip generation of the proposed project at build out.

E. Provide trip generation of the existing site traffic. For master planned sites or other areas that have an overall TIA the assumed traffic volumes from that report shall be included in addition to any existing traffic.

F. Provide a trip generation from the highest traffic generator at build out as allowed by the developing zoning category.

6-1.200 Traffic Impact Analysis / Report:

6-1.201 General Requirements:

A. The purpose of the TIA is to describe the layout and design of the proposed street network that will be owned, operated, and maintained by the Town. The description shall include the criteria and all assumptions used, the layout and sizing of the system, and provide all calculations and resources used. The proposed system shall meet the requirements of the Town.

B. The guidelines are important for ensuring that proper procedures and relevant details are included in the TIA resulting in an informative and useful study.

C. When the TIA is performed, the requirement will be that all intersections operate at "near capacity" or "under capacity" for ultimate build out.

6-1.202 Report Requirements:

A. All reports shall be sealed and signed on the cover by a registered Professional Civil Engineer in the State of Arizona.

B. Information from a previous report or other reports that is important to the design of the proposed project shall be included in the submitted report.

C. Reports should be letter size, bound with a hard cover.

D. Maps and exhibits should be folded in sleeves with a maximum size of 24 inches by 36 inches.

E. Provide the project title and submittal date on every page of the TIA.

F. All redline reports shall be returned with the submittal of the next report for review.

G. Cover Sheet:

1. Project title
2. Major cross streets
3. Prepared for including: contact name, company name, address, telephone number, and email
4. Prepared by including: contact name, company name, address, telephone number, and email
5. Engineer's seal
6. Town approval block (see Figure 1)
7. All pages of the report shall have a page number

Figure 1 Town Engineer Signature/Approval Block

DISCLAIMER:

THE TOWN APPROVES THIS REPORT FOR CONCEPT ONLY AND ACCEPTS NO LIABILITY FOR ERRORS OR OMISSIONS

BY: _____

BUCKEYE TOWN ENGINEER DATE

H. Table of Contents:

1. List all sections
2. Figures
3. Tables
4. Exhibits
5. Appendices

I. Executive Summary Paragraphs:

1. Criteria used
2. Criteria met
3. Project challenges
4. Overall observations

5. Principal findings
6. Conclusions
7. Recommendations

J. Introduction:

1. Provide project name, size, description, land use and type of development.
2. Purpose of the report
3. Explain the objectives of the report, defining requirements, satisfy regulatory requirements and evaluate the impact of the new development on the existing street systems.
4. Indicate if the proposed streets are public or private.

K. Project Location:

1. Township, Range and Section
2. Description of the major cross streets
3. Vicinity Map
4. Relationship to other developments
   a. Provide a map labeling all adjacent developments and street network.

L. Criteria:

1. All design criteria shall be per this design manual.
2. Summarize and include all design criteria used for this report, Town of Buckeye and other agency requirements and criteria.

M. Proposed Development:

1. Mention all available information such as location, land use, size, density, phasing, expected build-out year, access points, hours of operation, peak periods, and existing land use.
2. Off-Site development
3. Description of on-site development:
   a. Lane use and intensity
   b. Location
   c. Site plan
   d. Zoning
   e. Phasing

N. Area Conditions:

1. Study Area:
   a. The study intersections and streets should be listed in the report. The size of the study area is based on the number of peak hour trips generated by a proposed development. See Table 1 to determine the limits of the study area.
   b. Influence Area
   c. Area of significant traffic impact

2. Study Area Land Use:
    a. Mention the existing and proposed land uses surrounding the proposed development and any anticipated transportation connections between the developments.
    b. Existing land uses
    c. Existing zoning
    d. Anticipated future development
3. Site Accessibility:
    a. Area roadway system:
        i. Existing
        ii. Future
    b. Traffic volumes and conditions
    c. Transit service
    d. Existing relevant transportation system management

O. Existing Traffic Counts:
1. State when, where, and how counts were collected and include them in the Appendix.
2. All data shall be collected in accordance with latest edition of the ITE Manual of Traffic Engineering Studies or as directed by the Town.
3. The data used in the study should have been collected within the past 2 years.
4. Adjust counts for average conditions due to seasonal differences when necessary.
5. The directional split should be based on existing conditions. In the case where existing peak traffic is not available, a 60/40 split should be used.
6. The peak factor (k) should be based on existing conditions. If traffic data is not available, 7% of daily traffic should be used for the morning peak hour and 8% for the evening peak hour.

P. Projected Traffic:
1. Site traffic (each horizon year)
    a. Trip generation
    b. Trip distribution
    c. Modal split
    d. Trip assignment
2. Through Traffic (each horizon year):
    a. Method of projections
    b. Non-site traffic for anticipated development in study areas:
        i. Method of projections
        ii. Trip generation
        iii. Trip distribution

iv. Modal split

v. Trip assignment

c. Through traffic

d. Estimated volumes

3. Total Traffic (each horizon year)

4. Provide a trip generation from the highest traffic generator at build out as allowed by the developing zoning category.

Q. Traffic Analysis:

1. Site Access

2. Capacity and Level of Service

3. Traffic Safety

4. Traffic Signals

5. On-Site Circulation

R. Improvement Analysis:

1. Improvements to accommodate base traffic

2. Additional improvements to accommodate site traffic

3. Alternative improvements

4. Status of improvements already funded, programmed, or planned

5. Evaluation

S. Findings:

1. Site accessibility

2. Traffic impacts

3. Need for improvements

4. Compliance with Town of Buckeye codes

T. Recommendations:

1. Site access/circulation plan

2. Street/intersection/driveway geometrics and alignment

3. Auxiliary turn lanes

4. Traffic control devices-signalized or un-signalized

5. Traffic signal operation such as timing and coordination

6. Pedestrian and bicycle safety

7. Traffic mitigation measures

8. Roadway improvements:

a. On-site

b. Off-site

c. Phasing

9. Transportation System Management Actions:

a. On-site

b. Off-site

c. Phasing

10. Other

U. Conclusions:

1. Summarize the work that has been completed.
2. Summarize all recommendations.
3. List all reference documents.
4. State that all of the Town requirements as well as all other agencies have been satisfied.

V. Appendices:

1. Supporting calculations
2. Attach all relevant portions of external approved reports, including cover page, that validate the design of assumptions of this report.
3. All other supporting information

W. Required Figures:

1. Site Location – Area map showing site location and area of influence.
2. Conceptual Plan of Proposed Development – Detailed figure showing conceptual plan of proposed development including access points, circulation, and land use components.
3. Surrounding Transportation System – Include all major streets, minor streets adjacent to site, planned improvements not part of proposed development, and site boundary. Also show transit, bicycle, and major pedestrian routes, if applicable, along with ROW widths and signal locations.
4. Existing and Anticipated Area Development – Figure showing existing and future land uses in area.
5. Existing Traffic Volumes – Include daily traffic volumes and peak hour traffic volumes. Turning movements are required for the peak hours.
6. Distribution – Figure showing portion (by percentages) of site traffic approaching and departing proposed development.
7. Site Traffic – Include daily traffic volumes and peak hour traffic volumes for each horizon year (if separate phasing is expected). Turning movements are required for the peak hours. Show circled “blow-ups” of each study intersection on the same figure.
8. Off-site Future Traffic - Include daily traffic volumes and peak hour traffic volumes for each scenario (horizon year). Turning movements are required for the peak hours. Show circled “blow-ups” of each study intersection on the same figure.

9. Total Traffic - Include daily traffic volumes and peak hour traffic volumes for each scenario (horizon year). Turning movements are required for the peak hours. Show circled "blow-ups" of each study intersection on the same figure.
10. Recommend Improvements – Show recommended geometrics, cross sections and traffic control. Include phasing if applicable.

6-1.300 Traffic Analysis Scenarios:

6-1.301 TIA Plan Amendment/Update:

A. When only a plan amendment or update is being sought in a TIA, the following scenarios are required:

1. Existing Conditions - Current year traffic volumes and peak hour LOS analysis of affected state highway facilities.
2. Site Traffic, (entire project) only - Trip generation, distribution, and assignment in the year the project is anticipated to complete construction.
3. Background Traffic Only - Trip assignment and peak hour LOS analysis. Include current land uses and other pending plan amendments/anticipated developments.
4. Total Traffic (Site Traffic and Background Traffic) - Trip assignment and peak hour LOS analysis. Include proposed project and other pending plan amendments/anticipated developments..

6-1.302 TIA Specific Entitlements:

A. When a proposed project is seeking specific entitlements (such as site plans, conditional-use permits, preliminary plats, subdivisions, rezoning, and others), the following scenarios are required to be analyzed in the TIAs:

1. Existing Conditions - Current year traffic volumes and peak hour LOS analysis of affected state highway facilities.
2. Build Out Site Generated Traffic - Trip generation, distribution, and assignment in the year the project is anticipated to complete construction.
3. Background Traffic (Existing Conditions plus Other Approved and Pending Projects without Proposed Project) - Trip assignment and peak hour LOS analysis in the year the project is anticipated to complete construction.
4. Total Traffic (Existing Conditions plus Other Approved and Pending Projects plus Proposed Project) - Trip assignment and peak hour LOS analysis in the year the project is anticipated to complete construction.
5. A TIA or an update to an approved TIA is required for all phases of construction. An update may be required by the Town if the LOS degrades on a street or intersection prior to the projections in the approved TIA.

6-1.303 Inconsistent/Outdated Plan Elements:

A. In cases where the circulation element of the plan is not consistent with the land use element or the plan is outdated and not representative of current or future forecasted conditions, all scenarios will have to be updated to bring the TIA up to date.

6-1.304 Updating an Existing TIA:

A. A TIA may require updating the amount or character of traffic that is significantly different from an earlier analysis. Generally, a TIA requires updating every 2 years. A TIA might require updating sooner in rapidly developing areas and not as often in slowly developing areas.

6-1.400 Design Criteria:

6-1.401 Boundaries of Traffic Impact Analysis:

A. Boundaries of the TIA are all study area streets impacted in accordance with the criteria in Table 1. Traffic impacts of local streets and major streets can impact intersections on state highway facilities. In these cases, include an analysis of adjacent local facilities (i.e. driveways, intersections and interchanges) upstream and downstream of the intersections in the TIA.

6-1.402 Study Horizon Years:

A. The study horizon year is the future year that would be studied with the development. The existing background traffic shall be adjusted to provide a reasonable estimation of the traffic without the site in the horizon year. The horizon years are determined by the project type and size in accordance with the criteria in Table 1.

1. Assume full occupancy and build-out for single-phase developments. Multi-phase developments may require assessment of up to 3 horizon year's corresponding to key phases as directed by the Town.

2. An enlarged study area may be required when the minimum study areas identified in Table 1 do not provide sufficient information to meet the intent of the TIA guidelines.

B. All horizon years shall be rounded up to the next 5 year increment.

6-1.403 Trip Generation Thresholds:

A. Table 1 below provides a summary of criterion for starting point in determining when a traffic impact study is needed for new developments or additions to existing developments.

6-1.404 Trip Generations:

A. For trip generation forecasts, use the latest edition of the ITE publication, "Trip Generation." Other rates may be used with the prior approval of Town in cases where "Trip Generation" does not include trip rates for a specific land use category, or includes only limited data, or where local trip rates have shown to differ from the "Trip Generation" rates.

B. Each component of land use must be identified by the ITE land use code and variable (when applicable), size, and trip generation. The estimated trip generation must be shown for each analysis time period. Show trip reductions separately from the "raw" trip generation.

C. Trip Generation Rates:

1. When the land use has a limited number of studies to support the trip generation rates or when the Coefficient of Determination (R2) is below 0.75, consultation between the Town Engineer and those preparing the TIA are recommended.

D. Pass-by Trips:

1. Pass-by Trips are only considered for retail-oriented development. Reductions greater than 15% require consultation and acceptance by the Town Engineer. Include the justification for exceeding a 15% reduction in the TIA.

E. Captured Trips:

1. Captured trip reductions greater than 5% require consultation and acceptance by the Town Engineer. Include the justification for exceeding a 5% reduction in the TIA.

Table 1 Trip Generation Thresholds

Analysis Category	Development Characteristic	Study Horizons	Minimum Study Area
I	Small Development (100-499 peak hour trips)	1. Opening Year	1. Site Access drives 2. Adjacent signal controlled intersections within ¼ mile and/or major street intersections without signal control and driveways within 500 feet
II	Moderate Development (500-999 peak hour trips)	1. Opening Year 2. 5 years after opening	1. Site Access drives 2. Adjacent signal controlled intersections within ½ mile and/or major street intersections without signal control and driveways within ½ mile
III	Large Development (1000-1500 peak hour trips)	1. Opening Year 2. 20 years after opening	1. Site Access drives 2. Adjacent signal controlled intersections within 1 mile and/or major street intersections without signal control and driveways within 1 mile
IV	Regional Development (>1500 peak hour trips)	1. Opening Year 2. 20 years after opening	1. Site Access drives 2. Key signal controlled intersections and major street intersections without signal control within 3 miles

6-1.405 Trip Distribution and Assignment:

A. Projected trips shall be distributed and added to the projected non-site traffic on the roadway network.

B. Projected trips shall be distributed based upon a market area.

1. The market area is the area surrounding the site from which the project is likely to draw a high percentage (80% or more) of its trips.
2. The market area shall be established based upon a travel distance derived from travel time and travel speed.
3. The market area will be determined with the criteria in Table 2.
4. For development types not shown in Table 2, the market area will be determined based on the distance to similar competing developments.
5. The market area may be modified to account for similar commercial developments with concurrence of Town.
6. The specific assumptions and data sources used in driving trip distribution and assignment shall be documented in the report.

6-1.406 Capacity Analysis:

A. Level of service shall be computed for signal controlled and non-signal controlled intersections as identified in Table 1, in accordance with the latest edition of the Highway Capacity Manual.

B. For signal controlled intersections, operational analyses shall be performed for time horizons up to 5 years. Operational analyses shall also be performed for street sizing. The planning method will be acceptable for time horizons beyond 5 years and is also acceptable for Traffic Impact Analyses prepared at the Development Master Plan level, unless used for street sizing.

C. For urban roadways, and rural highways where signal controlled intersections are at or less than 1 mile apart, the capacity of the roadways is generally dominated by the capacity of the adjacent signal controlled intersections. Roadway levels of service need not be computed for these facilities.

D. For rural highways where the signal controlled intersections are more than 1 mile apart, the level of service on the highway shall be estimated in accordance with the latest edition of the Highway Capacity Manual.

E. PHF used for future conditions shall not exceed 0.90. The following PHF shall be used unless otherwise directed by the Town Engineer:

1. PHF = 0.80 for < 75 vph per lane
2. PHF = 0.85 for 75 – 300 vph per lane
3. PHF = 0.90 for > 300 vph per lane

Table 2 Market Area Criteria

Land Use Activity	Factors For Determining Market Area	Database Within The Market Area
Regional Shopping Center	1. Competing similar commercial developments 2. Travel time – usually a maximum of 30 minutes	Population Distribution* (sometimes weighted by projected spendable income in the proposed center)
Community Shopping Center	1. Competing similar commercial developments 2. Travel time – usually maximum of 20 minutes	Population Distribution* (sometimes weighted by projected spendable income in the proposed center)
Industrial park and office park	Travel time – usually maximum of 30 minutes or a distance of 10-15 miles is assumed	Population Distribution*
Stadium	Travel time – usually maximum of 40 minutes or more dependent on the size and character of the stadium	Population Distribution* (sometimes weighted by travel time, i.e. the longer travel time is weighted less)
Residential	Travel time – usually maximum of 30 minutes or a distance of 10 miles is assumed	Employment – opportunity distribution*

Source: Institute of Transportation Engineers. Transportation and Land Development Washington D.C. 1987
*MAG Population Projections should be used for the design year(s)

6-1.407 Traffic Counts:

A. Prior to field traffic counts, consultation between the Town Engineer and those preparing the TIA is recommended to determine the level of detail (location, signal timing, travel speeds, turning movement counts, and so forth) required at each traffic count site. All state highway facilities within the boundaries of the TIA are to be considered. Common rules for counting vehicular traffic include, but are not limited to, the following:

1. Conduct vehicle counts to include at least one contiguous 24-hour period on Tuesdays, Wednesdays, or Thursdays during weeks not containing a holiday and in favorable weather conditions.

2. Conduct counts during the appropriate peak hours (see peak hour discussion below).
3. Where appropriate, consider seasonal and weekend variations in traffic, such as recreational routes, tourist seasons, and the harvest season.

6-1.408 Peak Traffic Hours:

A. To eliminate unnecessary analysis, consultation between the Town Engineer and those preparing the TIA is recommended during the early planning stages of a project. In general, the TIA includes a morning (a.m.) and an evening (p.m.) peak hour analysis. Other peak hours (such as weekends and peaks caused by specific uses) might also be required to determine the significance of the traffic impacts generated by a project, as applicable.

6-1.409 Seasonal Adjustments:

A. The traffic volumes for the analysis hours should be adjusted for the peak season if appropriate. The use of seasonal adjustments factors requires the approval of the Town Engineer. The intent is not to assess maximum peak hourly volumes, such as the day after Christmas for a retail development, but to address peak seasonal volumes. If traffic counts were collected in a retirement community in July, and the peak traffic period occurs during the winter months, the counts shall be adjusted to winter months.

6-1.410 "K" – Value:

A. The k value for converting ADT to peak hour conversions shall range from 0.0833 to 0.10.

6-1.411 Data Collection Requirements:

A. All data shall be collected in accordance with the latest edition of the ITE, *Manual of Transportation Engineering Studies* or as directed by the Town Engineer.

B. Turning Movement Counts (TMC):

1. Turning movement counts shall be obtained for all exiting cross street intersections to be analyzed during the morning and afternoon peak periods and the peak hour of the generator. Turning movement counts may be required during other periods as directed by the Town Engineer.
2. Available turning movement counts may be extrapolated a maximum of two years with the concurrence of the Town Engineer.

C. Daily Traffic Volumes:

1. The current and projected daily traffic volumes shall be presented in the report. Available daily count data may be obtained from ADOT and extrapolated a maximum of two years with the concurrence of the Town Engineer.
2. Traffic volume estimates from other approved developments within the study area which are expected to occur during the study horizon years should be obtained from the Town and presented in the report.
3. Where daily count data is not available, mechanical counts may be required by the Town Engineer's.

D. Accident Data:

1. Crash History:

a. Traffic accident data shall be obtained from the Town or ADOT for the most current 3 year period available.

2. Collision Diagram:

a. A collision diagram illustrating the 3 year crash history at each location where the number of collisions at the location has been 15 or more in the last 3 years.

3. Collision Types and Locations:

a. The predominant collision types and their locations, any patterns, and an assessment of and mitigation for the development's traffic safety impacts. Also, include in the collision discussion:

i. Sight distance and any other pertinent roadway geometrics

ii. Driver expectancy and crash potential (if necessary)

iii. Special signing and illuminations needs (if necessary)

4. Roadway and Intersection Geometrics:

a. Roadway geometric information shall be obtained including roadway width, number of lanes, turning lanes, vertical grade, location nearby driveways, and lane configuration at intersections.

E. Traffic Control Devices:

1. The location and type of traffic control devices shall be identified.

6-1.412 Traffic Signal Needs:

A. A Traffic Signal Warrant Analysis shall be conducted for all arterial/arterial, arterial/collector and collector/collector intersections within the study area for the opening year. If the warrants are not met for the opening year, they should be evaluated for a 5 year horizon for Categories II, III and IV.

B. Traffic Signal Warrant Analysis shall be conducted per the Town Engineer's direction.

C. Traffic signals are only accepted when they are located to provide efficient progression.

D. Typical spacing is at ½ mile intervals. In rare situations, the Town may approve signals at ¼ mile spacing and possibly other spacing for unique situations.

E. Traffic signals may only be installed when they satisfy warrants in the MUTCD and are approved by the Town.

F. The applicant is responsible for the cost of traffic signal installations warranted by their development.

G. The following are the minimum warrants to be analyzed for all traffic signals: the 8 hour, 4 hour and peak hour warrants.

H. When traffic counts are not available refer to the ADOT Engineering Policies, Guidelines and Procedures Section 611 Figure 611-A for AADT hourly adjustment factors.

6-1.413 Traffic Impact Analysis Methodologies:

A. Typically, the traffic analysis methodologies for the facility types indicated below are used by the Town and will be accepted without prior consultations. When a state highway has saturated

flows, the use of a micro-simulation model is encouraged for the analysis; note, however, that the micro-simulation models must be calibrated and validated for reliable results. Other analysis methods may be accepted; however, consultation between the Town and those preparing the TIA is recommended to reach consensus on the data necessary for the analysis. The methodologies include:

1. Freeway Segments: HCM, operational analysis
2. Weaving Areas: HCM, operational analysis
3. Ramps and Ramp Junctions: HCM, operational analysis
4. Multilane Highways: HCM, operational analysis
5. Two Lane Highways: HCM, operational analysis
6. Signalized Intersections: HCM, operational analysis, Synchro
7. Un-signalized Intersections: HCM for capacity and MUTCD for signal warrants (if a signal is being considered)
8. Transit: HCM, operational analysis
9. Pedestrians: HCM
10. Bicycles: HCM

B. The procedures in the Highway Capacity Manual do not explicitly address operations of closely spaced signalized intersections. Under such conditions, several unique characteristics are to be considered, including:

1. Spill-back potential from the downstream intersection to the upstream intersection,
2. Effects of downstream queues on upstream saturation flow rates and
3. Unusual platoon dispersion or compression between intersections.

6-1.414 Mitigation Measures:

A. Consultation between the Town Engineer and those preparing the TIA is recommended to reach consensus on the mitigation measures and the responsible party. Mitigation measures must be included in the TIA to determine whether a project's impacts can be eliminated or reduced to a level of insignificance.

B. When the analyses indicate that a particular location is projected to operate at an acceptable level of service, no improvements are required. If, however, deficiencies are recognized, then improvements in access, geometry, or operations must be investigated. When reasonable improvements cannot sufficiently accommodate projected traffic, more detailed assessments of project size, land use, or development phasing may be required.

C. Many major projects necessitate improvements to the area's roadway infrastructure, both internally and externally. The nature of these improvements and their timing must be related to the anticipated phasing of the development, as well as the changes within the study area as a whole.

D. For re-development projects, mitigation alternatives will include transportation demand management measures, including, but not limited to, transit, bicycle, and pedestrian improvements.

6-1.415 Proposed Development - Mode Split:

A. If a mode other than vehicular travel is expected to be significant, the Town must approve assumptions and any reductions applied to vehicular traffic.

6-1.416 Level-of-Service (LOS) Analysis:

A. LOS analyses must be performed for the analysis time periods for each study intersection and site access in accordance with the latest edition of the Highway Capacity Manual.

B. Each analysis scenario (horizon year) should be analyzed with and without recommended improvements.

C. The level-of-service calculations must be included in the report appendix.

D. The Town requires the minimum of a LOS 'D' at both signalized and un-signalized intersections during the peak hours at build out.

E. LOS 'D' may be achieved by increasing intersection capacity and/or reducing vehicular traffic demand.

6-1.417 Turn Bays:

A. Based on anticipated traffic volumes, level-of-service, speed limits, and street cross sections, the need and size of right-turn and left-turn lanes at the site accesses and study intersections must be determined.

B. Recommended storage lengths shall be included in the report.

C. Right-turn lanes are required at all street intersections on major arterials and arterials. Right turn lanes are required at all commercial and industrial driveways. Right-turn lanes may be required by the Town on major collectors and collector street intersections.

D. Left-turn lanes are required at all arterial and collector street intersections and driveways.

E. Single Right Hand and Left Hand Turn Bays:

1. Design shall be per the AASHTO Method.
2. Maximum length of a single left turn lane is 300 feet.
    a. The following criteria is for un-signalized intersections:
        i. Average peak hour turning volume
        ii. 2 minute queue interval
        iii. Queue factor of two (2)
        iv. Design vehicle lengths
            1. All streets except commercial, industrial or truck routes – 25 feet.
            2. Commercial, industrial streets – 40 feet.
            3. Truck Routes determined by study but in no case less than 30 feet.
    b. The following criteria is for signalized intersections:
        i. Average peak hour turning volume
        ii. 120 second cycle length

iii. Queue factor of two (2)

iv. Design vehicle lengths

1. All streets except commercial, industrial or truck routes – 25 feet.
2. Commercial, industrial streets – 40 feet.
3. Truck Routes determined by study but in no case less than 30 feet.

F. Dual Right Hand and Left Hand Turn Bays:

1. Dual turn lanes are only allowed at signalized intersections.
2. Permissive dual left turn bays are prohibited.
3. Design shall be per the AASHTO Method.

a. The following criteria is for un-signalized intersections:

i. Average peak hour turning volume

ii. 2 minute queue interval

iii. Queue factor of two (2)

iv. Design vehicle lengths

1. All streets except commercial, industrial or truck routes – 25 feet.
2. Commercial, industrial streets – 40 feet.
3. Truck Routes determined by study but in no case less than 30 feet.

b. The following criteria is for signalized intersections:

i. Average peak hour turning volume

ii. 120 second cycle length

iii. Queue factor of two (2)

iv. Design vehicle lengths

1. All streets except commercial, industrial or truck routes – 25 feet.
2. Commercial, industrial streets – 40 feet.
3. Truck Routes determined by study but in no case less than 30 feet.

6-1.418 Improvement Analysis:

A. The anticipated results of any proposed or planned transportation improvements must be given in the study. The engineer may also recommend changes to planned improvements that may result in improved operating characteristics of the transportation system.

6-1.500 Traffic Analysis Software:

6-1.501 Trafficware – Synchro:

A. Synchro is a software application for optimizing traffic signal timing and performing capacity analyses. The software optimizes splits, offsets, and cycle lengths for individual intersections, an arterial, or a complete network. Synchro performs capacity analyses using both the ICU and HCM methods. Synchro can be used for creating data files for SimTraffic and other third-party

traffic software packages. SimTraffic models signalized and un-signalized intersections and freeway sections with cars, trucks, pedestrians, and buses.

B. Synchro capabilities other than signal timing programs include:

1. Lane-by-lane analysis
2. Direct CORSIM optimization
3. Multi-cycle and multi-period optimization
4. Detailed simulation of existing conditions
5. Detailed analysis of traffic-actuated control
6. Hill-climb and genetic algorithm optimization
7. Optimization based on a wide variety of objective functions
8. Optimization of cycle length, phasing sequence, splits, and spillover
9. Full flexibility in modeling unusual lane configurations and timing plans

C. A complete Synchro model will be required to be submitted with the TIA at the approval submittal.

6-1.600 Master Street Plans for CMPs:

6-1.601 General Information:

A. A Master Street Plan is required for all CMPs. The plan must show the proposed alignment for all arterial and collector streets within and adjacent to the CMP. The design of the streets will be based on the Street Classification Map, existing improvements and the approved Traffic Impact Analysis.

B. The Master Streets Plan shall be updated every 5 years. This includes showing all current conditions and complying with the Town's current design standards.

6-1.602 Required Sheets:

A. A complete Master Street Plan must have the following sheets:

1. Cover Sheet
2. Cross-section Sheet
3. Detail Sheet
4. Phasing Schedule

6-1.603 Required Information:

A. The following information must be included on all Master Street Plan submittals:

1. Use the Town Approved Cover Sheet including the second and subsequent sheet layouts (See "Design Standards - Section 1-2 Plan Submittal Requirements" General Construction Notes and Standard Sheets for Infrastructure Plan Submittals).
2. Also include on the cover sheet:
   a. Zoning case

B. Approval Block must include - Approval lines for (with date):
   1. Town Engineer
   2. Development Services Director
   3. Planning Manager

C. Legend - minimum required symbols:
   1. CMP boundary line
   2. ROW line
   3. PUE line
   4. Monument line
   5. Roadway center line
   6. Cross-section (ROW- traffic lanes - median width - traffic lanes)
   7. Traffic signal - existing and future (include Developer's percentage of participation)

D. Show the following on the plan view drawing:
   1. All arterial and collector streets
   2. ROW lines
   3. Roadway center lines
   4. Lane striping
   5. CMP boundary lines
   6. Street names
   7. Power poles – 69kv and larger
   8. Curb lines
   9. Sidewalks
   10. Median islands - openings only at arterial/collector intersections
   11. Intersection flares
   12. Island separated right turn lanes at signalized intersections
   13. Right turn lanes
   14. Bus bays
   15. Traffic signals - existing and future
   16. Dimensions - right-of-way, street width (face of curb to face of curb), median width, taper lengths, tangent and curve lengths, etc.
   17. All bearings and distances as well as all curve data.
   18. North arrow and scale (minimum scale should be 1” = 200’)

E. Include the following General Notes:
   1. ROW triangles at intersections will be per “Design Standards - Section 6-3 Street Planning and Design Criteria.”

2. Accessible ramps will be provided at all intersections including "T"s.
3. ROW for bus bays will be per City of Phoenix Supplement to the MAG Standard Details.
4. All dimensions are to face of curb.
5. All ROW necessary for the streets is shown on these plans including that for intersection flares and right turn bays.
6. Additional ROW and improvements beyond what is shown on this master street plan may be required for additional right-turn lanes and/or bus bays at the time specific development plans are reviewed by the Town.
7. Raised median island openings will normally be spaced no closer than 660 feet apart.
8. Any modifications to existing median islands will be subject to the approval of the Town and completed at the Developer's expense.
9. Conduit and pull boxes for future traffic signals will be installed at the time of initial street construction. Signal installation will only occur after warrants have been met as determined by the Town.
10. Safe Intersection Sight Distance lines, per Town and AASHTO standards, will be shown on individual improvement plans for all access points located on the inside of curved streets.

F. Disclosure Note – Include the following:

1. "I consent to the reproduction of this Master Plan for the purpose of future amendments provided that if modifications are made, the architects/engineers who make changes assume full responsibility and liability for the plan." Sign and date.

G. The Master Street Plan will be sealed and signed by a Professional Civil Engineer registered in the State of Arizona.

H. Cross-sections for arterial and collector streets - provide the following information:

1. Right-of-way width
2. Easement width
3. Sidewalk location and width
4. Type of curb
5. Pavement width
6. Median width
7. Roadway center line
8. Street name

I. Provide enlarged intersection details for clarity - provide the following information:

1. ROW widths
2. Easement widths
3. Pavement width
4. Median width
5. Roadway center line

6. Street name
7. Taper lengths
8. Pavement transitions from new construction to existing, ultimate design and between phases.
9. Bus bays
10. Curve data
11. North arrow and scale (minimum scale should be 1" = 20')

6-1.604 CMP Master Street Plan Review Notes:

A. Remember to read the zoning stipulations.

B. Review the plans for nearby developments for compatibility.

C. All street names shall be per the City of Phoenix street names for East - West Streets and Maricopa County numbering for the North - South Avenues.

D. Sight lines should be shown where needed.

E. Paving transition is needed between improvements and existing pavement or between improvements and improvements by others.

F. 5 feet is recommended between sidewalk and trail. The trail should be a minimum of 8 feet (10 feet desired) with 2 feet clearance.

G. Trails shown on the CMP cross-sections are preferred to be placed within an easement or tract, so that the TOB is not required to maintain them.

H. Cross-sections on CMP and Trails Master Plan must be consistent.

I. Show 404 washes and potential location of box culverts or multi barrel pipe crossings.

J. Minimum sidewalk width on collectors and arterials is 6 feet.

K. Sidewalk easement needs to be provided if the sidewalk is not in ROW.

L. If development is in two (2) of four (4) quadrants, then their responsibility for traffic signals is most likely 50% for collector and arterial intersections.

M. Bus bays at Arterial/Arterial street intersections

N. Mid-block – Desired design:

1. Shelter bus pad at arterial/collector street intersections
2. Keep collectors at ½ mile location.
3. Entire intersection should be shown including existing and proposed improvements to check compatibility.
4. Speed limit to one (1) for transitions
5. A phasing schedule must include interim pavement design between phases.

[END OF SECTION]